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Digital Financial Inclusion and Economic Growth: Evidence from Sub-Saharan Africa (2011-2017)

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Abstract:
This paper examined the long run causal effect of digital financial inclusion on economic growth in sub-Saharan Africa. The study employs a sample of 22 sub-Sahara African countries using quarterly data from 2011-2017. The dependent variable was economic growth measured by GDP per capita with the indicators of digital financial inclusion being automated teller machine (ATM), number of commercial bank branches (CBB), Loan Outstanding (LOS), Mobile agent outlets (MOAO) and Mobile money transactions (MOMO). The long run causal effect of digital financial inclusion was analyzed using the vector error correction model and the granger causality test for causality and direction. The estimated results indicate that a long run causal relationship exists between digital financial inclusion and economic growth in sub-Sahara Africa and the direction of causality is unidirectional running from economic growth to digital financial inclusion. The study observed that digital financial inclusion strongly associated with the progress and development of the sub-Saharan economic growth. In spite of this, there is need for proper digital financial inclusion education, customer awareness, E-banking training and digital financial inclusion literacy programmes to all citizens alongside regulation in the continent to access financial services. Thus, digital financial inclusion is a long road which sub-Sahara Africa needs to travel to make it completely successful.

Keywords: GDP, digital financial inclusion, ATM, MOMO, CBB, LOS, MOAO

1. Introduction

Digital financial inclusion for the poor is becoming a reality. While traditional microfinance and banks remain important, the potential of using new technology-based platforms to serve the poor is huge. In particular, digital finance network coverage and the use of a variety of indirect channels (e.g., agents) reduce the costs compared to more customary full service branches owned by banks.

Cash is the main barrier to financial inclusion. In as much as poor people rely on cash or barter, it remains too costly for financial institutions to serve them. Once the poor have access to cost-effective digital means of payments, they exit this trap and could in principle be profitably supplied by a range of financial institutions. Providers can offer not only mobile money, but also savings, credit, insurance, and other digital financial products to the poor at low cost. Digital Financial inclusion is usually defined as the percentage of individuals and firms that have access to or use financial services (World Bank, 2014). Burkett and Sheehan (2009) define financial exclusion as:

A situation where a person, group or organization lacks or is deprived of access to affordable, appropriate and fair financial products and services, with the result that their capability to participate fully in social and economic activities is reduced, financial adversity is increased, and poverty (measured by income, debt and assets) is exacerbated.

Digital Financial inclusion, therefore, is beyond access to finance, usage and quality are also important. Many people may have access to digitalfinancial services at affordable prices, but decide not to use certain financial services for reasons such as religion or culture. Statistics show disparities due to factors such as income, age and gender (Demirgüc-Kunt et al, 2015). Others may lack access due to exorbitant costs of the services, unavailability of services because of regulatory barriers, or a variety of other market and cultural factors.

Fuhrmann, (2017) postulated that the business of banks involves taking deposits and using the same deposits to make loans. It could be complicated, but this is the basic model used in banking. In the past banks in Asia have been accused of not reaching out in areas where the transaction or deposit size is very low. In places with low deposits, the volumes are usually low, and the costs of serving are high. The banks did not see any sense to open up branches in areas with low volumes and the high cost of operation. The revolution of information technology (IT) has changed every aspect

of human being's life including banking. IT works as a mechanism for growth in the banking sector; mainly because it supports banking services, productivity growth, and risk management

The above situation has changed though, and most banks have embraced the concept of digital financial inclusion where they strive to open up to the new areas by biometric devices and mobile money. This practice has opened up access to financial services even in the remotest areas of most countries. Digital Financial inclusion is a broad concept which can be defined as the process that ensures the ease of access, availability, and usage of formal financial system for all members in an economy using digital technologies.

Digital Financial inclusion is becoming an essential concern for many developed and developing countries worldwide. Digital Financial inclusion is the usage and accessibility of the affordable financial services and products via M-banking, POS,1 E- banking, ATMs etc. to the deprived, low income and disadvantage sector of the population. Digital Financial inclusion enhances the accessibility of prescribed financial inclusion services for instance taking a bank account, consuming credit and saving services of Bank. Countries are initiating to establish the strategies to enhance persons' access to financial digital inclusion for attainment of benefits through financial inclusion

About three-quarters of the adult population in Sub-Saharan Africa (henceforth SSA) do not hold a bank account with a formal financial institution (World Bank, 2014). Low financial inclusion (FI) in SSA has been a major obstacle to stellar economic growth. Recent empirical evidence using household data indicates that access to basic financial services such as savings, payments and credit can make a substantial positive difference in improving the lives of the poor (Dupas and Jonathan, 2013a; Sarma and Pais, 2011). An inclusive digital financial system allows broad access to financial services, without price or non-price barriers. In the absence of inclusive financial systems, the less privileged rely on their own limited savings to invest in their education or become entrepreneurs. Financial exclusion to a certain extent contributes to persistent income inequality and low growth (Ravallion, 2014).

Digital financial inclusion does have a multiplier effect on the economy as a whole, achieved via higher savings pooled from the massive segment of the population at the bottom of the pyramid (Koku, 2015). Deeper engagement of the under banked population in the economy through the formal financial system could lead to the improvement of their financial conditions and living standards, hence enable them to create financial assets, generate income and build flexibility to meet macroeconomic and livelihood shocks (Chibba, 2009). Government also immensely benefits from increased local economic activities and consequently that decreases economic inequality at the macroeconomic level and increased growth (Levine, 1997).

Ozili (2018) provides a discussion on some issues associated with digital financial inclusion an area which has not been critically addressed in the body of literature. There many advantages of Digital financial inclusion to financial services users, digital finance providers, governments and the economy; in spite of the advantages, a number of issues still persist which if addressed can make digital financial inclusion work better for individuals, businesses and governments. The digital aspect of financial inclusion discussed in this article are relevant for the on-going debate in developing and emerging economies (Ozili, 2018).Our study will look at how digital financial inclusion has contributed to the growth of sub-Saharan Africa.

Since 2010, the G-20 and the World Bank have led the initiative for increased financial inclusion in developing countries to help reduce poverty levels in developing and emerging economies (GPFI, 2010). Today, the importance of digital financial inclusion for poverty reduction and economic growth is attracting the attention of policy makers and academics, largely because of the number of issues that persist which if addressed can make digital financial inclusion work better for individuals, businesses, governments and the economy. One key achievement of the G20's *Global Partnership for Financial Inclusion* (**GPFI**) has been to establish a consensus that digital financial inclusion is desirable and a priority because it can boost productivity and growth, improve transparency, increase tax revenues and enhance the efficiency of public expenditure and transfers (Better Than Cash Alliance, 2016). The four Principles for Digital Financial Inclusion are: (1) promoting a digital approach to financial inclusion, (2) balancing risk and innovation to achieve financial inclusion, (3) creating an enabling legal and regulatory framework, and (4) expanding the digital financial services infrastructure ecosystem (GPFI, 2016).

Industry experts, academics and NGOs agree that the use of digital technologies will be vital in order to achieve the World Bank's ambitious goal of full financial inclusion by 2020. One of the largest supporters is the Bill and Melinda Gates Foundation; they firmly believe that providing access to digitalfinancial inclusion services through digital-based tools is extremely important to help people in the world's poorest regions improve their lives and build sustainable futures. The Advancement in mobile phone technology, cloud computing, big data analytics and blockchain / distributed ledger technology are transforming the digital financial inclusion services industry, allowing people to access financial products and services at anytime and anywhere in the world in a cost efficient and fast manner

Today Governments and financial institutions have approached Digital financial inclusion initiatives by designing tailor fitting products and services suitable for the previously excluded and underserved customers. This is with the premise that digital financial inclusion has positive economic growth effects (Chibba, 2009) and in turn can lead to improved stability of the institutions and enhanced financial performance. The subprime lending and resultant Global Financial crises (GFC) which was accused to be a result of financial inclusion (Carneiro, 2011; Ghosh, 2008) put to test the justification of financial inclusion and its effect on the economy. This was further supported by discoveries of multiple lending and suicide instances that have been associated with MFIs lending (Gokhale, 2009). Allen *et. al.* (2012) contributes to this by bringing to light the success of microfinance institutions (MFIs), such as Grameen Bank, which has captured the attention of many economists and policy makers, but new evidence reveals that some MFIs are now beset by non-repayment problems and high cost of financing.

Financial institutions in response to the government initiative have opened doors and developed products and services for the previously unbanked population. In order to fully recognize the concept of Digital financial inclusion there is need to understand its effect on the institutions that engage in it. This is because financial inclusion customers are considered opaque, numerous and characterized by frequent small value transaction with high operating costs (Hannig & Jansen, 2010) and can pose threat to economic stability. Previously financial inclusion in Africa and other developing nations was spearheaded by MFI's (Kipesha & Zhang, 2013) and government owned banks. Currently commercial banks which are mainly profit seeking have shown growing interest in digital financial inclusion. This change in the digital financial inclusion landscape has elicited a lot of attention from researchers, policy makers and financial institutions.

There is limited literature devoted to investigating the determinants of digital financial inclusion in SSA. A couple of available empirical studies in the domain have mainly looked at financial inclusion in specific countries. For example, Johnson et al. (2011) examine financial access and exclusion using data from a Financial Access Survey carried out in 2006 in Kenya and Uganda, and Akudugu (2013) investigates the determinants of FI in Ghana only. These two empirical studies are country specific and the results of their empirical findings are mixed. Moreover, Akudugu (2013) and Johnson et al. (2011) used household data in their analysis. It is fair to opine that to date; studies related to the digital Financial Inclusion and economic growth in the SSA region is limited. It is this gap in the research that this paper would like to exploit. Thus, the contribution of this paper to the body of literature. It also investigates the long run causal effect of digital financial inclusion in the SSA region as a whole. Second, it uses country-level data from the new World Bank data set of global FI.

Therefore objective of this article is to contribute into the debate on digital financial inclusion and the long run causal effect on economic growth in sub-Saharan Africa countries and to also check if sub-Saharan Africa countries have embrace digital financial services as the way of life while documenting the state of digital financial inclusion and informing policymakers, financial sector stakeholders and development actors about existing opportunities and specific challenges that need attention and action.

The significance of paper finding to societies especially in Africa is to help national governments and international organizations on how to use digital Financial Inclusion to strengthen and accelerate their strategies to enhanced growth.

2. Literature Review

2.1. Theoretical Review
This section analyzes theories advanced to explain the relationship that exists between digital financial inclusion and the economic growth in sub-Saharan Africa. The main theories explored in this area include the Financial Intermediation Theory, Theory of financial innovations, Bank Led Theories, and.

2.1.1. Financial Intermediation Theory
Financial intermediation refers to the process by which financial institutions bring deficit spending units and surplus spending units together. Financial intermediation theories try to explain why surplus funds are first lent to banks who then lend to deficit units, instead of lending directly. The work of Raymond Goldsmith (1969) is the basis of the financial intermediation theory. In his work, Goldsmith gave wide-ranging facts related to the financial structure and the economic development. It was determined that in the course of economic development of a nation, the financial system develops faster than the wealth of the nation. Determining the size of the financial system in a country is the division of the role of saving and investment among the various units in the economy (Goldsmith, 1969). The remark made in the 1960s is very much relevant to the modern-day format of financial intermediation. The modern society has continued to be grateful for the role played by financial intermediation in development of the economy (Scholtens & Van Wensveen, 2003). Theoretical and empirical researchers have shown that financial intermediation plays an important role in the growth of the economy.

The study assumes that one of the reasons for financial exclusion is low income and assets among some people in the society. Because of financial intermediation, there is an efficient allocation of capital within the economy with the aim of ensuring that economic growth. Another mentioned factor that contributes to financial exclusion is limited information related to certain financial aspects. Financial intermediation provides information to the owners of capital and the borrowers of capital. The financial intermediation process brings together the deficit and surplus units in an environment not known to them (Mandell, 2008).

The banks through financial intermediation ensure that there is digital financial inclusion. In the process of ensuring that there is access to information, financial literacy and efficient allocation of the resources in the country, there is a risk that the banks take on behalf of the different players in the economy (Scholtens & Wensveen, 2003). The risk taken during the financial intermediation process has to cover the financial institution through the charging of the interest rate. The elements of financial intermediation have proven critical in ensuring financial.

2.1.2. Theory of Financial Innovations
The theory of financial innovations was proposed by Silber (1983) premised on the idea that benefit expansion of money related foundations is the key reason of financial inclusion (Li and Zeng, 2010). The theory demonstrates that the primary thoughts behind the new innovations are the defects of the money related business sector, mostly the deviated data, office expenses and exchange costs (Błach, 2011). According to the theory, financial related innovations can be very new resolutions or simply customary means whereby latest component of development has been offered, enhancing firms' liquidity as well as expanding quantity new applicants, due to their qualifications on the situation (Ionescu, 2012).Digital financial innovations create more access and use of finance tools.

According to the theory, financial innovation is a critical motivating force of the financial system, which leads to better economic competence and enhanced economic advantage derived from the new and frequent changes (Sekhar, 2013). Financial innovations define financial developments by coming up with new ways of production, technological solutions, creating better return rates hence boosting the country's economy in general. The theory posits that the innovativeness improves the firms' competitive edge of a corporate and generates more earnings to the investors (Błach, 2011). Innovation is a tool used to solve, manage and transfer the entire extra burden. The application of innovations promotes growth of financial entities through improved allocation, efficiency and a reduction of financial and administration costs (Sekhar, 2013).

2.1.3 Bank Led Theory

The bank led theory began under various efforts by banks to come up with new models of reaching their customers through agents. Many researchers have studied the theory (Kiburi, 2016; Kendall, 2012). According to this theory, licensed financial institution that operate in a country, in most cases a bank, uses retail agents to deliver financial services to clients. Banks create the financial products and services and then distribute them to the retail agents who handle all the interactions with the clients. The ultimate providers of the financial services are the banks, and the customers have to maintain an account with the primary bank.

Under this arrangement, the retail agent maintains a face-to-face contact with the customer in the same manner as a teller at a branch. They handle cash functions through taking deposits and processing of withdrawals. The use of retail agents is at an advanced level in many countries where they open accounts, identify clients and service them with loans (Kiburi, 2016). The outlets that provide cash services are close to the customers and at the same time perform as retail agents. The agent has a direct electronic communication with the bank that they serve for any updates concerning customers.

The bank led theory is critical in this paper as it forms the basis of agency banking which is an important element of digital financial inclusion. While looking at the use of agents and proliferation of ATMs and mobile banking services, what comes to mind is the bank led theory (Kendell, 2016). The analysis of the theory explains why banks have continued to use the elements prescribed under the variables as modes of enhancing digital financial inclusion. Even though the theory forms the backbone of the element of agency banking, it has not established the outcome of the practice regarding the returns to the banks and the customers. In a simple form, the theory has highlighted the manner in which the process of agency banking occurs within business environment.

3. Conceptual Reviews

3.1. Concept and Definitions of Digital Finance

From a practitioner's viewpoint, digital finance is financial services delivered through mobile phones, personal computers, the internet or cards linked to a reliable digital payment system.

Some of the definitions are reviewed and analysed here. Digital Finance is a suite of financial services rendered via mobile phones, personal computers, the internet or cards linked to a reliable digital payment system (Consultative Group to Assist the Poor [CGAP], 2015; Durai& Stella, 2019). This definition basically emphasizes two basic dimensions of DF, the product dimension, and digital platform dimension. In addition, DF as defined by Shofawati, (2019), means all products, services, technology and/or infrastructure which facilitate easy access to payments, savings, and credit facilities via the internet by individuals and companies, without the need to visit a bank branch or without dealing directly with the financial service provider. Shofawati(2019)'s definition goes beyond the description of DF as a mere product, but encompasses technology and infrastructure.

In the same vein, Mckee, et al. (2015) observe that digital financial services (DFS) include the full range of products (such as digital transfers, payments, stored value, savings, insurance, credit, and more), channels (like mobile phones and ATMs), and providers including mobile network operators (MNOs), banks, nonbank financial institutions, and e-money issuers, retailers, post offices, etc. This implies that DF includes products, channels as well as providers (agents) of digital finance. Furthermore, Alliance for Financial Inclusion Global Policy Forum[AFI], (2016) and Kambale (n.d) also define DFS as the broad range of financial services accessed and delivered through digital channels, including payments, credit, savings, remittances and insurance. The authors defined digital channels to mean internet, mobile phones (both smart phones and digital feature phones), ATMs, POS terminals, biometric devices, tablets, phablets and any other digital system. Furthermore, Asian Development Bank [ADB], (2016), defined DF as the far-reaching technologies available to perform financial services from a widespread range of providers to an extensive category of recipients. To ADB (2016), DF basically connotes technology. Dara (2018) also submits that DF basically means financial services delivered over digital infrastructure including mobile and internet with low use of cash and traditional bank branches. Holtman(n.d.) simply refers to DFS as the provision of financial services utilizing technology. The Holtman(n.d.)'s definition though but encompasses the trio of the process, product as well technology dimensions of DF.

Organization for Economic Co-operation and Development [OECD] (2017) (as cited in OECD, 2018), posit that DFS is the financial operations using digital technology such as electronic money, mobile financial services (MFS), online financial services and branchless banking, whether through bank or non-bank financial institutions. Furthermore, United States Agency for International Development [USAID] (2016) describes DFS as a broad category that encompasses MFS and all branchless banking services that are enabled via electronic channels. Here, only products and channels (platform) definition are emphasized by USAID (2016). Again, Digital Financial Service refers to the wide range of existing

technologies to deliver financial services from a broad range of providers to a wide range of recipients using digital remote means such as e-money, mobile money, card payments, and electronic funds transfers (ADB, 2016).

A more comprehensive definition of DF, was given to include a broad range of new financial products, financial businesses, finance-related software, and new forms of digitally enabled customer communication and interaction rendered by innovative financial service providers and fintech companies (Gomber, Koch, &Siering, 2017; UNEI, 2018). In addition, Gomber et al. (2017) refers to DF as the digitalization of the financial industry generally. From this definition, it is clear that DF entails digital financial products, digital financial business operations and process, digital technologies, as well human interface involved that ensures a successful process of meeting the requirements of financial products customers.

3.2. Digital Financial Services

DFS are the wide range of technological tools use for financial services accessed and delivered through digital channels, including payments, credit, savings, remittances, insurance and financial information. The term 'digital channels' refers to the internet, mobile phones (both smart phones and digital feature phones), ATMs, POS terminals, NFC-enabled devices, chips, electronically enabled cards, biometric devices, tablets and any other digital system (AFI, 2016).

DFS have the capacity to spread out the delivery of basic financial services via affordable, convenient and secure environment to the general public especially tothe poor through innovative technologies like electronic money models and digital payment platforms. Financial Institutions (Banks, Microfinance institutions) and non-Financial firms (mobile network operators) and third party providers (agent network managers, payment aggregators, and others) are leveraging digital channels to offer basic financial services at greater convenience, scale and lower cost than traditional banking allow. The digital arena brings new improvement to financial inclusion, offering the public new ways of increasing the inclusion of the 'legible' and global finance new forms of 'profiling' they have not households into mechanisms of financial assets (Gabor and Brooks, 2016).

Mobile telephoneas one of the digital financial service exerts a significant and non-negligible impact on economic growth (Saibal, 2016).The wide use of digital finance could increase annual GDP of all emerging economies by $3.7 trillion by 2025 (6% increase). Roughly 65% of this increase would come from raised productivity of financial and non-financial businesses and governments as a result of digital payments. Furthermore GDP could lead to the creation of approximately 95 million jobs across all sectors (James et al., 2016).

3.3. Linkage between Digital finance and financial inclusion

The relationship between digital finance and financial inclusion seems inseparable this is because the world of technology had brought the closeness of bank customers from far and near. It is virtual impossible to a bank account owner today without an ATM card or an internet bank app where transfer are made. To enable closeness, banks and governments today encourage all citizens to own a bank and use a bank card where remittances can be easily done. The following subheading will show but the positive and negative relationship that exists between digital finance and financial inclusion.

3.3.1. Positive Relationship between Digital Finance and Financial Inclusion

Theoretically the relationship between digital finance and financial inclusion is the basis that a huge amount of those excluded owns (or have) a mobile phone, and that the provision of financial services through mobile phones and related devices can increase access to finance for the excluded population (World Bank, 2014).If the excluded population have a mobile phone and affordable internet connectivity, greater supply of digital finance can be predicted to have positive effects for financial inclusion, all other things being equal; implying a positive relationship between digital finance and access to formal financial services.

The positive effects of digital finance for financial inclusion and economic growth are many. Greater digital finance when applied to the lives of low-income and poor people can improve their access to basic services, thereby leading to greater financial inclusion in rural areas. Again, greater digital financial services channeled to rural and poor communities can improve access to finance for bank customers in rural and poor communities who cannot conveniently access banks located in the formal sector due to poor transportation networks and long queuing hours in banking halls, and will reduce bank customers' presence in bank branches and reduce cost because bank would spent less to maintain fewer branches, and the lower costs would have positive effects for bank profitability and financial inclusion in rural and poor communities. Furthermore, easy-to-use digital finance can provide a more convenient platform for individuals to carry out basic financial transactions including payments for electricity, water supply, money transfer to family and friends etc. If digital finance platforms are easy-touse, users of digital financial services can help inform and persuade their peers in the formal and informal (rural) sector to take advantage of DFS hence leading many people using digital finance thereby leading to greater financial inclusion. One caveat worth-noting here is that while there may be a positive relationship between easy-to-use digital finance and financial inclusion, it is needful to stress that the implied positive relationship is stronger for high-and-middle income users of digital finance while the relationship may be non-linear or negative for low-income and poor users of digital finance because digital finance users in indigenous and poor communities despite persuasion can refuse to use digital finance services due to (i) superstitious and religious beliefs they have about technological advancements and innovation, or (ii) unaffordable fees charged by digital financial services providers, or (iii) financial illiteracy and (iv) other reasons.

3.3.2. Negative Effect between Digital Finance and Financial Inclusion

Digital finance can also be destructive and hence affects financial inclusion negatively. Providers of digital finance services are profit-seeking corporations that use digital finance to maximize their profitability or to maximize the profitable opportunities of businesses affiliated with digital finance providers namely banks, financial and non-financial institutions. Providers of digital finance services can discriminately use a more aggressive marketing techniques to persuade high-and-middle income customers to use a new or existing digital finance platform or infrastructure and use a less-aggressive marketing tactic to persuade low-income and poor customers to use new or existing digital platforms or infrastructure if they believe the latter cannot afford the associated fees, thereby leading to lower financial inclusion for poor and low-income customers since the net monetary pay-off to digital finance providers is higher with high-and middle income customers than with low-income and poor customers.

Secondly, bias in the provision of digital finance can be geographical because digital finance providers, based on their own internal risk assessment which may change from time to time, can choose to withdraw or discontinue the provision of specific digital finance services to high-risk rural areas or communities that do not have the supporting infrastructure to sustain specific digital finance services, thereby leading to lower financial inclusion. Some supporting infrastructure is needed to make DFS work efficiently such as mobile phones that have modern (and up-to-date) operating software systems and applications that support digital finance services. Finally, educational bias can be introduced in the provision of digital financial services. If the net value of making digital finance to poor communities is very low, digital finance providers, based on their profitability assessment, can choose to focus less on the delivery of digital finance to the poor masses and those who are uneducated in the communities because of the lack of basic financial literacy to use and understand digital finance.

4. Digital Financial Inclusion in Africa

Digital Financial systems in Africa generally poor as compared to those in other developing economies, despite the very fact that significant improvements were implemented within the past decades. According to Demirgüç-Kunt and Klapper (2012), overall, 23% of adults within the Africa region have an account. Within Africa, there's an outsized variation in account ownership: 24% of adults in Sub-Saharan Africa report having an account at a proper financial organization, though this ranges ranging from 51% in Southern Africa to 11% in Central African Republic (Figure 1). The low level of monetary inclusion in Africa is reflected in constraints on both the demand and therefore the supply side of the economy. Existing financial systems are underdeveloped, credit reporting from financial institutions is lacking and therefore the level of monetary literacy is usually poor. Financial inclusion is further limited by low-quality financial infrastructure and therefore the small size of the many African economies (Triki and Faye, 2013). Banksstill dominate financial services in most developing countries with deposits being more common than loans. However, the rise in mobile accounts may turn this around.
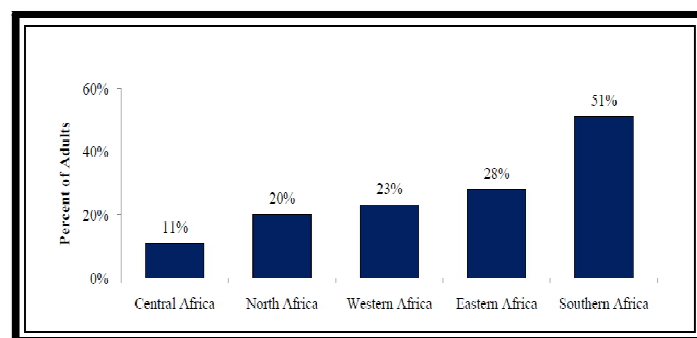

Figure 1: Financial Inclusion in Africa as at 2011
Demirgüç-Kunt & Klapper, 2012

4.1. Factors Associated with Digital Financial Exclusion in SSA

There are plenty of factors that affect DFI in SSA (Akudugu, 2013 andDemirgüç-Kunt et al., 2015). The following paragraphs outline important factors that have a negative influence on FI in the SSA region.

4.1.1. High Transaction Costs

Empirical evidence opined that providing less financial products do not yield a better financial return than the operating and finance costs of providing it (Moore and Craigwell, 2003; Natamba et al., 2013). More so, it costs more to tailor and provide undersized financial services for the poor (Bag, 2013). It is because of this reason that the banking network in SSA is predominantly concentrated in populated commercial areas. Also, the bank services are skewed towards serving its wealthy customers (Beck and Samuel Munzele, 2012). Macro-prudential policies and the costs of managing a rural branch network exacerbate the high costs of financial intermediation in the region (Beck and Samuel Munzele, 2012; Brown et al., 2005).

4.1.2. Poor Infrastructure

Africa is ranked the lowermost among the developing economies in terms of access to infrastructure, far behind Latin America and East Asia. Essential infrastructure such as security services, telecommunication facilities and proper

road network are still underdeveloped: the situation is much worse in rural areas (World Bank, 2014). Batuo (2015) notes that telephone lines are predominantly served in urban areas, and the average tele-density in the region is roughly 1 and 13 per cent for fixed and mobile lines, respectively (Wilson et al., 2014). There is a growing mountain of evidence indicating that providing adequate infrastructure is an important step towards alleviating poverty and accelerating economic growth. Finally, the dismal infrastructure in SSA has been poignantly found to contribute to the negative effect of slow economic growths in the past decades (Kessides, 2012).

4.1.3. High Poverty Levels and Banking Charges

Lacking sufficient means (poverty) is one of the main causes why the poor fail to maintain a vanilla bank account. According to a World Bank (2013) survey, 81 per cent of respondents cited lack of funds as the main reason for not opening a formal bank account. In addition, the difficulties of securing proper documentation needed to open a bank account are commonly cited as the barrier for not accessing formal financial services (Akudugu, 2013; Hendricks and Chidiac, 2011). Almost all the countries in SSA require consumers to hold a minimum book balance. In most cases the balance can be as high as 50 per cent of gross national income (henceforth GNI) per capita (Fosu, 2013). This traditional bank practice of maintaining a minimum book balance with the bank is also a major deterrent for many to access formal financial services. Furthermore, the exorbitant bank charges such as medical levy, withdrawal fee and bank monthly maintenance fee further aggravates the situation (Tchouassi, 2012). Lastly, the average annual bank charges in SSA account for about 20 per cent of the country's GNI per capita and for some commercial banks, the bank service charges account for a quarter of their revenue (Beck and Samuel Munzele, 2012).

4.1.4 Sparse Population

SSA is the least populated region of the world with the average people per square kilometer standing at 40 overall and 14 for rural areas (Collins, 2014; World Bank, 2014). Therefore, providing financial services to the dispersed rural population costs more than the yield on capital employed. In addition, the high fixed costs associated with operating branches in sparsely populated peripherals aggravate the endemic situation of high financial exclusion in the region. It is for this reason that the bank branch network is highly concentrated in the economically viable towns (World Bank, 2014).

4.1.5. Pure Illiteracy

Africa is the only continent where 40 per cent of the adult populations are illiterate In addition, more than half of the parents are unable to help their children with school homework due to illiteracy (UNESCO, 2014). Sadly enough, the number of illiterate people in developing countries is rising due to high population growth rates, inadequate schooling, humanitarian crises, low schooling enrolment and general poverty. Proponents of literacy programmes argue that reading and writing skills improve individuals' chances of increasing their earnings. While it is difficult to determine causality, a growing body of evidence suggests that literacy increases the productivity and earning potential of a population (Hendricks and Chidiac, 2011; Robinson, 2014). It has been argued that illiteracy is closely tied to financial illiteracy. About two-thirds of the financially excluded see no need of opening a formal bank account due to lack of knowledge. In addition, empirical studies so far show that having financial knowledge and skills is significantly related to people having more savings and borrowing money, alongside an increased chance of starting a new business (Acemoglu et al., 2014; Hanushek, 2013; Norton, 2014).

5. Review of the Empirical Literature

As mentioned earlier, there are limited empirical studies devoted to investigating the long run causal effect of digital financial inclusion on economic growth in SSA. However, there is a growing body of literature focusing on understanding what influences access to finance in the region (see inter alia: 2010; Aterido et al., 2013; Ngalawa et al., 2013; Allen et al., 2014). On the other hand, empirical findings on digital financial inclusion are mixed. Some empirical findings on this area is mention below.

The literature on measuring digital financial inclusion is relatively new but growing rapidly (for instance, Honohan, 2008; Sarma, 2012; Demirguc-Kunt &Klapper, 2012, 2013; Sarma, 2015). Honohan (2008) measured financial inclusion by econometrically estimating the proportion of adult population/households (of an economy) that have a bank account. By so doing, the study provides a one-time measure of digital financial inclusion across countries for as many as 160 countries. These estimates might effectively quantify one aspect of digital financial inclusion, that is, financial penetration. Such a measure of digital financial inclusion, however, has many deficiencies since several crucial aspects of an inclusive financial system are ignored, including availability, affordability, quality and usage of the financial services that together form an inclusive financial system (Sarma, 2015)

Akudugu (2013) investigates the determinants of FI among the adult population across Ghana. Using the logit model, the empirical findings indicate that literacy, lack of money, lack of documentation and distance to financial institutions are the significant determinants of FI in Ghana. Sarma et al. (2011) arrived at a similar conclusion after examining the relationship between FI and development in 49 developing countries across the world. Their findings show the level of human development and that of FI to be strongly and positively related. Furthermore, they argue that the level of income measured by per capital gross domestic product (henceforth GDP) is an important factor in explaining the level of FI .They also claims that adult literacy and better infrastructure play a positive role in enhancing FI.

Onwe (2013) found that information technology facilitates financial intermediation through cost reduction and timely delivery of financial services. In another related study, Jaksic and Marinc (2015), argues that though the economics of banking have not changed but there is a need for banks to tailor its products to digitally-inclined customers'

requirements. In the same vein, Durai and Stella (2019) conclude that DF (internet banking, mobile banking, mobile wallets, credit cards, debit cards) has a significant impact on financial inclusion. Babarinde et al (2019) list some financial innovations as including ATM, phone banking, internet banking, debit cards, credit cards, agency banking, smart cards applications, POS technology; as well other technological innovations like the Internet of Things (IoT), cloud computing, big data, blockchain technology, nanotechnology, artificial intelligence, quantum computing, data analytics.

Donovan (2012) analyses the benefits and potential impact of mobile money in promoting DFI in developing countries. He notes that mobile money has the potential to contribute to DFI in developing countries, and recommends proper regulation for the industry to realize its promise. On a related note, Johnson et al. (2012) investigates the major causes of financial exclusion in Kenya between 2006 and 2009. They find that age and level of education are the obstacles in accessing the mobile money service in Kenya. On a slightly different note, Carbó et al. (2005) warns that financial exclusion is a major concern for both developed and developing countries; however, their analysis focuses on Europe.

Allen et al. (2016) also utilised the 2012 World Bank Global Findex Database to explore the individual and country characteristics associated with financial inclusion on a global scale. They find that greater digital financial inclusion is related to lower banking costs, greater proximity to financial intermediaries, and better institutions such as stronger legal rights, and more politically stable environments. Furthermore, being richer, more educated, older, urban, employed, married or separated individuals are shown to favour financial inclusion in terms of having an account at a formal financial institution. The same individual characteristics also linked with the increased probability of saving formally. Finally, the probability of borrowing formally is higher for older, educated, richer and married men.

Kim et al. (2018) examines the linkage between financial inclusion and economic growth for Organization of Islamic Cooperation (OIC) countries. Five variables were employed to measure key factors of financial inclusion, namely: (1) automated teller machines per 100,000 adults, (2) bank branches per 100,000 adults, (3) deposit accounts with commercial banks per 1000 adults, (4) borrowers from commercial banks per 1000 adults, and (5) life insurance premium volume to GDP. Based on the results of dynamic panel estimations performed on a panel data for 55 OIC countries, the study finds that financial inclusion has a crucial role in promoting economic growth and there are mutual causalities between the two variables. While the study provides some interesting results, there are several limitations. First, major differences exist among OIC countries including the level of financial inclusion. These variations might be attributable to different religion level, gender inequality, illiteracy rate, interest rate, income level, and policies. Thus, it is necessary to consider the factors that may impact the level of digital financial inclusion in Islamic countries in modeling. Second, multiple digital financial inclusions are examined separately in different models instead of a composite index for financial inclusion.

6. Data and Methodology

We collect data from the World Bank's Global Financial Development Database. In total, our country sample consists of 22 countries, table 1 show the sample countries. This study examines the effect of digital financial inclusion and economic growth in the 22 SSA member states. The list of selected variables for constructing two digital financial inclusion indicators for Economics growth aspects namely, accessibility and the actual usage of digital financial inclusion services is presented in Table 2. Our choices of variables for digital financial inclusion indicators are based on classification by the World Bank's Global Financial Development Database and subject to data availability of our study sample for a significant investigation period (2011-2017) Using Quarterly Data . The correlations of the variables are summarized in Table 3 and 4.

ID	Country	ID	Country
1	Benin	2	Botswana
3	Burkina Faso	4	Cameroon
5	Côte d'Ivoire	6	Eswatini
7	Ghana	8	Guinea
9	Kenya	10	Madagascar
11	Mali	12	Mozambique
13	Namibia	14	Niger
15	Nigeria	16	Rwanda
17	Senegal	18	South Africa
19	Tanzania	20	Uganda
21	Zambia	22	Zimbabwe

Table 1: List of Country in the Study Sample
Source: Authors'(2020)

Variable	Topic	Indicator
GDP per capita growth (annual %)	Dependent variable	Annual percentage growth rate of GDP per capita based on constant local currency. Aggregates are based on constant 2010 U.S. dollars. GDP per capita is gross domestic product divided by midyear population. GDP at purchaser's prices is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products.
DF1(ATM)	Access	Automated Teller Machines (ATMs) per 100,000 adults
DFI(CBB)	Access	Commercial Bank Branches Per 100,000 Adults
DFI(LOS)	Usage	Outstanding loans per 1,000 adults
DFI(MOMO)	Usage	Mobile money transactions per 100,000 adults
DFI(MOAO)	Access	Mobile agent outlets per 100,000 adults

Table 2: SSA Digital Financial Inclusion Indicators Considered in the Study (2011-2017)
Note: Data Source: World Bank's Global Financial Development Database (2020)

7. Correlation

From table 3, it is observe that all the variables are weakly correlated to economic growth. Automated teller machine is negatively correlated to economic growth measured as per capita. From there correlation coefficient we can also infer the accept of multicollinearity among the variables under study.

	GDP	LNATM	LNCBB	LNLOS	LNMOAO	LNMOMO
GDP	1.000000					
LNATM	-0.134834	1.000000				
LNCBB	0.108020	0.792178	1.000000			
LNLOS	0.004452	-0.296130	-0.452979	1.000000		
LNMOAO	0.114011	-0.291820	-0.145658	-0.005269	1.000000	
LNMOMO	0.105795	-0.226391	-0.051209	0.063813	0.817716	1.000000

Table 3: Correlation Matrix of Coefficient of the Variables
Source: Eviews (2020)

8. Stationarity Test Results

The first step in empirical analysis is to test the unit root for stationarity. Table 5 explains the results of testing the stationarity of economic growth and digital financial inclusion from the first quarter of 2011 to the fourth quarter of 2017 using, Levin, Lin & Chu t*, Im, Pesaran and Shin W-stat, ADF - Fisher Chi-square, PP - Fisher Chi-square, PP - Fisher Chi-square. The null hypotheses was rejected at level I (0) using 1%, 5% and 10% significant respectively. The data was then difference at first level 1(1) with individual intercept to make it stationary for all the variables under study using 1%, 5% and 10% significant respectively. Looking at the table it is observed that the data at first level difference with individual intercept is significant at 1% level. This gives a signal that the variables in question have a long run relationship.

Variables	Levin, Lin & Chu t*	Im, Pesaran and Shin W-stat	ADF - Fisher Chi-square	PP - Fisher Chi-square	ORDER
GDP	-9.16269***	-6.73886***	85.2872***	168.511***	I(1)
LNATM	-13.1849***	-10.3475***	166.656***	296.458***	1(1)
LNCBB	-10.8572***	-8.61508***	117.339***	220.487***	I(1)
LNLOS	-14.4636***	-12.4431***	180.684***	353.245***	I(1)
LNMOAO	-12.7382***	-9.79479***	149.519***	262.321***	I(1)
LNMOMO	-12.6415	-10.2613***	145.947***	287.198***	1(1)

Table 4: Panel Unit Root Test for Stationarity
(***), (**), and (*) Represents 1%, 5% and 10% Respectively

9. Cointegration Test

The Johansen-Fisher panel cointegration test was carried out due to presence of non-stationarity in the variables. A cointegrating relationship is a long-term or equilibrium phenomenon since it is possible that co-integrating variables may deviate from their relationship in the short run but their relationship would return in the long run (Brooks, 2008). The results showed that the variables were co-integrated and the numbers of co integrating equations were six using the

trace statistics and three using the max-eigen test. This implies that there is a long-run relationship between the dependent and independent variables.

Hypothesized No. of CE(s)	Fisher Stat.* (from trace test)	Prob.	Fisher Stat.* (from max-eigen test)	Prob.
None	34.00	0.0000	0.231	1.0000
At most 1	48.31	0.0000	2.297	0.9705
At most 2	59.38	0.0000	9.150	0.3298
At most 3	63.06	0.0000	22.69	0.0038
At most 4	54.59	0.0000	44.59	0.0000
At most 5	24.52	0.0019	24.52	0.0019
* Probabilities are computed using asymptotic Chi square distribution.				

Table 5: Johansen Cointegration Test Results

The results of the Johansen Cointegration test as shown in Table 5 above uses both the trace statistic and maximum eigen value statistic. According to these statistics, there is cointegration between the variables as indicated by the low p-values (below the five percent level of significance). Therefore, the Vector Error Correction Model is employed to determine the relationship between Digital Financial Inclusion and Economic Growth in SSA.

10. Vector Error Correction Model

Since cointegration has been established as seen in the Johansen Cointegration test shown in Table 5, the vector error correction model was carried out to determine whether there is a short run or long run relationship between digital financial inclusion and economic growth in sub-5Saharan Africa.

	Coefficient	Std. Error	t-Statistic	Prob.
(ECT)	-0.201768	0.024969	-8.080691	0.0000
*D(GDP(-1))	0.059864	0.049219	1.216288	0.2247
D(GDP(-2))	0.059864	0.049219	1.216288	0.2247
*D(LNATM(-1))	0.873804	1.578025	0.553732	0.5801
D(LNATM(-2))	0.873804	1.578025	0.553732	0.5801
*D(LNCBB(-1))	0.180529	1.162430	0.155303	0.8767
D(LNCBB(-2))	0.180529	1.162430	0.155303	0.8767
D(LNLOS(-1))	-0.098183	1.339045	-0.073323	0.9416
D(LNLOS(-2))	-0.098183	1.339045	-0.073323	0.9416
D(LNMOAO(-1))	-0.116233	0.205791	-0.564813	0.5725
D(LNMOAO(-2))	-0.116233	0.205791	-0.564813	0.5725
D(LNMOMO(-1))	0.185900	0.162987	1.140581	0.2548
D(LNMOMO(-2))	0.185900	0.162987	1.140581	0.2548
C(14)	-0.106215	0.074709	-1.421707	0.1560
R-squared	0.150545	Mean dependent var		-0.049641
Adjusted R-squared	0.120699	S.D. dependent var		1.301531
S.E. of regression	1.220459	Akaike info criterion		3.272109
Sum squared resid	551.1227	Schwarz criterion		3.416143
Log likelihood	-614.2449	Hannan-Quinn criter.		3.329239
F-statistic	5.044102	Durbin-Watson stat		2.153334
Prob(F-statistic)	0.000000			

Table 6: Vector Error Correction Model

The result of the Vector Error Correction Model estimation with two lags is presented in Table 6.The number of lags chosen is in accordance with the lag selection criterion. The results obtained after estimating the Vector Error Correction Model using an Ordinary Least Square regression with GDP per capita growth as the dependent variable. The Error Correction Term represents the speed of adjustment back to equilibrium when there is a shock and it measures the proportion of last period's equilibrium error that is corrected for in the current period. The coefficient of the Error Correction Term, *C1*, is -0.201768which implies that the speed of adjustment to long-run equilibrium is approximately 20.1768% quarterly hence the errors produced in the previous period are corrected in the current period. The sign of the Error Correction Term is negative and statistically significant at the five percent level of significance which confirms that there is a long-run causality from automated teller machine (LNATM), Commercial bank branches (LNCBB), Loan Outstanding (LNLOS), Mobile agent outlet (MOAO), Mobile money transaction (LNMOMO) andEconomic Growth Measured by GDP Per Capita Growth. it is in line with

11. Granger Causality Test

The Granger Causality test is carried out to investigate whether there is a causal relationship between digital financial inclusion and economic growth in sub-Saharan Africa. Moreover, it is important to determine the direction of causality that is to say if it is digital financial inclusion that causes economic growth or it is economic growth that causes digital financial inclusion. Therefore, this test is conducted to confirm the above conclusion.

Null Hypothesis:	Obs	F-Statistic	Prob.
LNATM does not Granger Cause GDP	524	1.40111	0.2473
GDP does not Granger Cause LNATM		2.54387	0.0795
LNCBB does not Granger Cause GDP	544	0.74885	0.4734
GDP does not Granger Cause LNCBB		4.47624	0.0118
LNLOS does not Granger Cause GDP	538	0.58189	0.5592
GDP does not Granger Cause LNLOS		3.85112	0.0218
LNMOAO does not Granger Cause GDP	464	0.74444	0.4756
GDP does not Granger Cause LNMOAO		1.72016	0.1802
LNMOMO does not Granger Cause GDP	452	0.48028	0.6189
GDP does not Granger Cause LNMOMO		4.63313	0.0102

Table 7

Based on the Granger Causality test, it is evident that digital financial inclusion granger-causes economic growth at the 5% and 10% percent level of significance. However, economic growth does granger-cause digital financial inclusion with variables such as LNATM, LNCBB, LNLOS and LNMOMO. Therefore, there exists a unidirectional causality between digital financial inclusion and economic growth of sub-Saharan Africa. This study is in line with Kim et al. (2018)examines the linkage between financial inclusion and economic growth for Organization of Islamic Cooperation (OIC) countries. Five variables were employed to measure key factors of financial inclusion, namely: (1) automated teller machines per 100,000 adults, (2) bank branches per 100,000 adults, (3) deposit accounts with commercial banks per 1000 adults, (4) borrowers from commercial banks per 1000 adults, and (5) life insurance premium volume to GDP. Based on the results of dynamic panel estimations performed on a panel data for 55 OIC countries, the study finds that financial inclusion has a crucial role in promoting economic growth and there are mutual causalities between the two variables

12. Conclusion

There is limited literature investigating the long run causal relationship between digital financial inclusion and economic growth SSA. The few available studies are country specific and, thus, in an attempt to econometrically examine what influences financial inclusion in SSA, this paper uses World Bank panel data comprising of 22 SSA countries from 2011-2014 using quarterised data. The paper's empirical findings indicate that there is a long run relationship that exists between digital financial inclusion and economic growth is sub Saharan Africa as indicated by the vector error correction model.The coefficient of the Error Correction Term, *ECT*, is -0.201768which implies that the speed of adjustment of shocks in the short to long-run equilibrium is approximately 20.1768% quarterly hence the errors produced in the previous period are corrected in the current period .The paper also observed a unidirectional causality between digital financial inclusion and economic growth of sub-Saharan Africa. The direction of causality runs from economic growth (measured by GDP per capita) to digital financial inclusion measured by automated teller machine (LNATM), Commercial bank branches (LNCBB), Loan Outstanding (LNLOS), Mobile agent outlet (MOAO) and Mobile money transaction (LNMOMO).The study observed that digital financial inclusion strongly associated with the progress and development of the sub-Saharan economic growth. In spite of this, there is need for proper digital financial inclusion education,customer awareness, E-banking training and digital financial inclusion literacy programmes to all citizensalongside regulation in the continent to access financial services. Thus, digital financial inclusion is a long road which sub-Sahara Africa needs to travel to make it completely successful.

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