EFFICACY OF DIGITAL FINANCE ON FINANCIAL INCLUSION: EVIDENCE FROM THE NIGERIAN BANKING INDUSTRY

Abstract

Globally, the number of adult population who do not have access to financial services continues to pose a challenge to economic development. The problem of financial exclusion is more acute in developing countries where more than half the adult population is unbanked. In 2021, 55 percent of the population of adults in Nigeria were unbanked, which created gaps in financial access for typically excluded and underserved adults, especially the vulnerable groups – the women, the poor, the less educated, the rural dwellers, the young, and those outside the labour force. The motivation for this study arose from a concern of how to use digital finance to bring those who are unbanked and financially excluded into the formal financial system. The study employed the quantitative research method using an ex-post facto research design. Annual time series data spanning from 2004 to 2020 was analysed using the ARDL estimator. The results reveal that commercial bank branches and internet access are the strongest drivers of financial inclusion in Nigeria in the short run. On the contrary, digital credit to the private sector and a period lag in interest rate hinder financial inclusion. In the long run, commercial bank branches, internet access, and exchange rates significantly affect financial inclusion. Conversely, digital credit to the private sector and lending rate are the critical factors contributing to financial exclusion. Based on the findings, the study suggests the need for a holistic financial framework that aims at incorporating the informal financial market into the mainstream financial system with the capacity to integrate majority of the financially excluded Nigerian adults. Such a robust framework should be digitally sensitive, politically neutral, financially inclusive, economically viable and spatially distributed for sustainability purposes.

UNDER PEER REVIEW

Keywords

Banking Sector, Financial inclusion; Digital finance; Digital Credit; Nigeria

1. Introduction

Financial inclusion has continued to receive global attention among policymakers, researchers, and development-oriented agencies as a tool for economic development with particular evidence in poverty alleviation, reduction in inequality, wealth creation, and employment generation, improving welfare, social harmony and general standard of living (Ade' Soyemi, Olowofela, & Yunusa, 2020; Igwemeka , Eje, Okonkwo, Onoselogu, 2020).

Technically, the World Bank (2022) conceptualised financial inclusion as individual and business accesses to affordable financial products that have the ability to satisfy their needs in terms transactions, credit, payments and insurance, which must be delivered in a responsive and sustainable manner. Inclusive financial services enables people who were unbanked and lacked access to financial products and services to carry on investment in education, health, found businesses, which helps to alleviate poverty and promote growth (Beck, Demirgüç-Kunt, & Levine, 2007; Bruhn & Love, 2014).

Globally, the number of adult populations without access to financial services continues to pose a challenge to economic development, despite the recorded progress on financial inclusion. This menace of financial exclusion is worse in developing countries where over 50 percent of the adult population is unbanked, with Sub-Saharan Africa as the least banked region (Igwemeka , Eje , Okonkwo, Onoselogu, 2020). In Nigeria, 44% of population of adults is still unbanked. Therefore, increasing the availability and accessibility of financial services for the marginalized or the vulnerable groups becomes necessary for people to enjoy a better life and economic growth (Agyekum, Locke, & Hewa Wellalage, 2016). The motivation for this study stems from a concern for the adult population that is unbanked and financially excluded, especially the vulnerable groups - the women, the poor, the less educated, the rural dwellers, the young, and those outside the labor force, who may miss opportunities to improve their wellbeing.

Digital finance may offer ways to overcome challenges of non-availability of financial institutions, inadequate facilities, and high banking costs that impede the ability of adult population and vulnerable groups to access and use financial services. Digital finance entails technology, facilities, products, services, and infrastructure that provides people and firms access to payments, insurance, credit, and savings through the internet without interfacing with the banking industry in an innovative way.

UNDER PEER REVIEW

Innovation in finance is the engine that propels digital transformation of the financial system, as it leads to financial inclusion, promotes convenience, reduces cost of banking, and guarantees the security transactions. In the opinion of Asian Development Bank (2016), digital financial services help nations to actualise financial inclusion and economic growth by providing swift, secured and affordable alternative platforms to the banking halls. Furthermore, the lessons from the COVID-19 pandemic have shown the need for individuals and businesses to rely on digitalization to continue accessing and using financial products and services beyond the barriers of physical infrastructure, high cost, or distance to the financial institution and safety.

However, digital finance is not without its disadvantages. Providers of digital financial services (Financial and non-financial institutions) are in business for profit maximization. Thus, there is a high tendency to employ different marketing strategies to persuade customers across the strata of income level. For instance, high-income and middle-income level customers would be aggressively persuaded to use innovative and digital finance platforms, while the low-income classes, who may not afford the associated cost, are discouraged. Thereby excluding the lower income classes as the net monetary pay-off to digital finance providers is higher with high-and-middle income customers than with low-income clients. Also, the attitude of customers to use these platforms can pose a threat to the process of financial inclusion.

This paper investigates the role of digital finance in driving financial inclusion in Nigeria. It checked for the short-run and long-run effects of digital financial services on financial inclusion and the determinants of financial inclusion in Nigeria.

The study employed annual time series data spanning from 2004 – 2020. The quantitative research method was adopted using an ex-post facto research design. Financial inclusion, the dependent variable, is measured using the number of depositors with commercial banks per 1,000 adult population. Internet access, commercial bank branches- per 100,000 population, and digital credit to the private sector- as a proportion of gross domestic product (GDP) are proxies for digital finance, the key independent variable of the study.

The study reveals that commercial bank branches and internet access are the strongest drivers of financial inclusion in Nigeria in the short run. On the contrary, digital credit to the private sector, current internet access, and a period lag in interest rate hinder financial inclusion in Nigeria.

UNDER PEER REVIEW

However, the highest hindrance is a period lag in interest rates. In the long run, commercial bank branches, internet access, and exchange rates significantly affect financial inclusion. Conversely, digital credit to the private sector and lending rate are the critical factors contributing to financial exclusion in the long run by retarding financial inclusion in Nigeria. The paper concludes that digital finance is a driver for financial inclusion in Nigeria.

The study contributes to the broader literature on financial inclusion by discussing the relevance of digital and non-digital variables as enablers and hinders of financial inclusion in Nigeria.

The rest of the study is organized as follows: the next sub-section discusses the problem statement. Section 2 shows the theoretical relationship between financial inclusion and digital finance, review of previous studies on the topic, and empirical gaps. Section 3 provides the theoretical framework and the methodology; section 4 specifies the data description and sources. Section 5 dwells on empirical analysis. Section 6 recommends the policy implications of the findings, while section 7 summarizes and concludes the paper.

1.1 *Statement of the Problem*

The clamour for financial inclusion is fundamental based on the assumption that those who are financially excluded are owners of formal bank account(s). That is to say that account ownership is the gateway to financial access. Likewise, to use digital financial services, the financially underserved or excluded persons must have an existing bank account that they own. Although emphasis should also be made on the usage, account ownership remains the necessary but not sufficient condition for financial inclusion.

Account ownership entails either individual account ownership or joint ownership of account at financial and non-financial institutions (Global Findex Database, 2021). It is a channel that equips the adult population (men and women) to use financial services in a manner that drives inclusive development. (Global Findex Database, 2021) revealed a global growth in account ownership, which may indicate opportunity for financial inclusion. From a global perspective, the proportion of adults with bank accounts increased by 7 percent between 2017 and 2021 from 69 percent to 76 percent respectively. Over the past decade, there has been a 50 percent increase

UNDER PEER REVIEW

in account ownership worldwide. In developing economies, account ownership increased from 63 percent in 2017 to 71 percent in 2021, which is 1 percent point higher than the global rate.

This recent progress in the growth of account ownership is far-reaching across the developing economies as against when China and India were solely at the top of the game for most of the newly banked adults from 2011 to 2017. Nigeria has also made impressive progress in account ownership such that the share of adults who own a bank account rose from 30 percent in 2011 to 45 percent in 2021 (Global Findex Database, 2021).

Although this progress, there continue to be gaps in financial access for typically excluded and underserved adults, especially the vulnerable groups – the women, the poor, the less educated, the rural dwellers, the young, and those outside the labor force. These groups make up most people excluded from the formal financial sector. Thus, the motivation for the study arose from a concern for those who are unbanked and financially excluded, especially the vulnerable who may miss opportunities to improve their standard of living.

The World Bank reports that 1.4 billion adults or 24% of adults globally are unbanked. The majority of unbanked adults worldwide are women. Among the 24% of unbanked adults, 13% are women, while 11% are men, because they lack documentation requirements, do not own a mobile phone or other forms of technology, and have a lower financial capability. Globally, the poorest 40 percent of households make up nearly half of all the unbanked, and 64 percent of unbanked adults have primary education or less.

Unfortunately, Nigeria fell among the seven economies in the world that accounted for over 50 percent of the unbanked adults and accommodates 5 percent of unbanked people globally. This situation is evidently backed by the 38 million adults, that is, 49 percent of Nigerian adults who are financially excluded (Global Findex Database, 2021). The Enhancing Financial Innovation and Access (EFInA) survey 2020 revealed that although 51 percent of Nigerian adults have access to financial services; the national financial inclusion strategy targets of 70 percent were still not met. The strategy also set targets for overall financial inclusion, which counts Nigerians that use either formal financial services or informal financial services that are not nationally regulated, such as savings groups. The overall financial inclusion target was 80% by 2020;

UNDER PEER REVIEW

EFInA data shows that only 64% of Nigerian adults were financially included by the end of 2020 (EFInA, 2021).

Worse still, the vulnerable groups experience a persistent gap in financial access. The vulnerable group includes women, who continue to be less favourable to financial inclusion, with just 39 percent inclusion rate compared to the 51 percent for their men counterpart. Also, regional disparities exist in financial inclusion drives in Nigeria. Financial exclusion among adults is more acute in the North than Southern Nigeria, with most financially excluded adults' dwellers in rural settings. Furthermore, young adults and those with higher education level between the ages of 18-25 years are likely to be financial excluded than older adults. (EFInA, 2021). Thus, as stated earlier, the motivation for this study becomes more convincing to examine the roles of digital finance in improving financial access for these groups.

2.0 Review of Related Literature

Bayero (2015) conducted a study to ascertain the influence of financial service providers' business models, awareness, enhanced customer value proposition, and accessibility of payment infrastructure on financial inclusion. The sample for the study comprised 230 adults of working age. Multiple Linear Regression (MLR) analysis for the study revealed that awareness, customer value, and infrastructure were significantly associated with the financial inclusion of working-age adults. Infrastructure had the greatest impact among these variables, followed by customer value and awareness, in that specific order. However, the business model did not demonstrate a uniquely significant contribution to the model.

Evans (2018) conducted a study that explored the relationship and causality between the internet, mobile phones, and financial inclusion in Africa. The study analyzed data from 2000 to 2016. The three outcomes of panel FMOLS approach and Granger causality tests revealed a significant positive correlation between internet and mobile phones and financial inclusion, suggesting that higher internet levels and mobile phone usage impacted the increased financial inclusion. Moreover, the study identified a unidirectional causality from internet and mobile phones to financial inclusion. The findings also emphasized the significance of macroeconomic factors, including capital formation, primary enrolment, bank credit, broad money, population growth,

UNDER PEER REVIEW

remittances, agriculture and interest rates, and institutional factors as regulatory quality in influencing financial inclusion in Africa.

Shofawati (2019) explored the effect of digital finance on financial inclusion and the growth of small and medium-sized enterprises (SMEs) in Indonesia. The study utilized qualitative techniques and a comprehensive literature review to develop a model that elucidated the importance of digital finance in strengthening financial inclusion and facilitating SME growth. The findings highlighted the significant role of digital finance in promoting financial inclusion, particularly for SMEs with limited access to traditional banking services. Digital finance provided SMEs with the opportunity to secure capital and financing for operational expenses, investments, and growth. This emphasized the transformative potential of digital finance in driving financial inclusion and enabling the growth of SMEs in Indonesia.

Mushtaq and Bruneau (2019) looked at the effect of Information and Communication Technologies (ICT) on poverty reduction and financial inclusion. The research used data from 62 countries between 2001 and 2012. The findings indicated a positive relationship between ICT diffusion and financial inclusion, suggesting that increased ICT usage improves access to financial services. Additionally, a negative correlation was observed between ICT diffusion and poverty levels, indicating that greater ICT adoption contributed to poverty and inequality reduction. The study highlighted the importance of leveraging various ICT dimensions, such as mobile phones and internet access, to promote financial inclusion and accelerate economic growth. Collaboration between the ICT and financial sectors was recommended to enhance mobile banking and e-finance services, bridging the financial infrastructure gap and reaching underserved populations.

In their study, Melubo & Musau (2020) investigated the impact of digital banking on the financial inclusion of women-owned enterprises in Narok County, Kenya. The research involved a census sampling method with 184 targeted respondents. They found that digital banking services, including agency banking, mobile banking, online banking, and ATM services had a significant and positive influence on the financial inclusion of women-owned enterprises in Narok County. These services played a crucial role in facilitating access to and utilization of banking services by local women entrepreneurs. However, the study also revealed limitations in

UNDER PEER REVIEW

the use of online banking among women-owned enterprises. Factors such as low levels of literacy, limited computer proficiency, and restricted internet availability hindered their full utilization of online banking services.

Contrarily, some researchers investigating digital financial inclusion have contended that utilizing digital platforms to access financial services does not impact financial inclusion.

Agufa (2016) conducted a study to investigate the impact of digital finance on financial inclusion within the banking industry of Kenya. The study employed purposive sampling, focusing on 13 banking institutions in the country. The study revealed that digital finance did not significantly impact financial inclusion in the Kenyan banking sector. The rationale behind this observation was that the banking institutions in Kenya primarily adopted digital financial services to reduce operational costs related to physical branches and enhance their productivity and financial performance rather than explicitly promoting financial inclusion.

Akinwunmi (2018) examined the influence of financial services and policies on financial inclusion. The research utilized the Ordinary Least Square (OLS) Regression and Error Correction Model (ECM) to analyze the data. The findings indicated that adopting digital financial services and implementing cost-reducing innovations did not necessarily lead to increased access to financial services among the unbanked population. However, the study revealed that a free-market environment played a crucial role in translating technological advancements, such as providing digital financial services and cost savings resulting from innovation into improved access to financial services. Consequently, the study advocated for policy targets to liberalise the financial market for non-bank financial service providers, enabling their active participation. These policies have a significant and positive correlation with access to finance for previously excluded adults.

The global issue of financial inclusion continues to be a matter of concern, despite concerted efforts to address it. It is alarming that more than half of the world's adult population still lacks access to vital financial services. Moreover, this problem is exacerbated by a significant disparity in financial inclusion, particularly among vulnerable groups in society.

UNDER PEER REVIEW

Igwemeka, Eje, Okonkwo, & Onoselogu (2020) conducted a comprehensive case study analysis on digital finance and financial inclusion, encompassing countries such as India, South Africa, Kenya, Brazil, and Nigeria. The study's findings revealed that financial inclusion is not solely a Nigerian concern, as other developing nations face similar challenges. Furthermore, the research highlighted inadequate utilization of banking agents in Nigeria and emphasized the restrictive regulatory environment that hampers innovation and flexibility for service providers.

In their study, Tay, Tai, & Tan (2022) conducted a comprehensive literature review to investigate the status of digital financial inclusion in different countries. The findings highlighted the notable progress made by developing countries, particularly in Asia, in adopting and improving digital financial inclusion to address poverty. However, the study also revealed persistent inequalities in accessing and utilizing digital financial services within these developing countries. These disparities were observed across various dimensions, including gender, socioeconomic status (wealthy vs. poor), and geographical areas (urban vs. rural).

Abiola, Adedoyin, Umoren, & Areghan (2019) conducted a comprehensive review of past and current initiatives aimed at enhancing financial inclusion in Nigeria. While some progress has been observed in this regard, the study identified several significant challenges that hinder the achievement of substantial expansion in financial inclusion levels in Nigeria. These challenges include low levels of financial literacy, inadequate infrastructural facilities, and insufficient and inefficient technology-based services provided by financial institutions.

Nur, Siddik, Sun, Yanjuan, & Kabiraj (2014) conducted a study to analyze the factors that influence the behavioral intention of individuals in Bangladesh to adopt or continue using mobile banking. Utilizing Structural Equation Modeling (SEM), the research findings revealed that perceived financial cost, perceived risk, and subjective norm were the most significant factors influencing people's behavioral intention to adopt or continue using mobile banking services.

The relationship between digital finance and macroeconomic concepts has shown a positive impact, as evidenced by the study conducted by Obinne, Efanga, & Clifford (2020). Their research examined the influence of digital finance on the money supply in Nigeria. Using the Autoregressive Distributed Lag (ARDL) model, the findings indicated a positive association between digital finance and money supply in Nigeria during the period analyzed (2009-2018).

UNDER PEER REVIEW

2.1 *Observed Gaps in the literature.*

The aforementioned studies present conflicting evidence, with (Bayero, 2015; Evans, 2018; Melubo & Musau, 2020; Mushtaq & Bruneau, 2019; Shofawati, 2019) finding positive effects of digital finance on financial inclusion, whereas (Agufa, 2016; Akinwunmi, 2018) finding negative effects of digital finance on financial inclusion. Our study re-examines the empirical evidence and contributes to this on-going debate by assessing the roles of digital finance in driving financial inclusion in Nigeria, a country-level projects directed at greater financial inclusion via digital finance.

3. Theoretical Framework and Empirical Methodology

3.1 Theoretical Framework

Theoretical lenses from which financial inclusion has been addressed are in three strands of financial inclusion beneficiary, delivery, and funding. Our study is underpinned by the Dissatisfaction theory of financial inclusion, which is one of the beneficiary theories.

The theory posits that financial inclusion programs are targeted at those on-boarded into the formal financial system but left because of dissatisfaction and unfavorable experiences in their engagements with operators in the formal financial system. The theory suggests those who left the formal financial settings could have been dissatisfied following issues around financial fraud resulting from debit or credit card fraud, theft, high transaction costs and exorbitant bank charges, and should be persuaded by guaranteeing safe, secured and efficient financial services. One of the ways through which safe, secured and efficient services could be guaranteed is by adopting digital financial management system in financial inclusion policies (Adetunji & David- West, 2019; Bansal, 2014; Bazarbash, Beaton, & Eriksson, 2020; Gupta, 2011; Ndassi Teutio, Kala Kamdjoug, & Gueyie, 2021)

The strength of this theory is that it offers solutions to the problem of voluntary financial exclusion that other theories do not address. Also, from the dissatisfaction theoretical lenses, identification of the voluntary financially excluded is made possible by viewing the personal data of those who exited the formal financial sector. More so, the theory established that financial inclusion programs and activities should be extended to those who have never been in the formal financial system after the voluntary (Ozili, 2020).

UNDER PEER REVIEW

3.2 Methodology

Our study explores the roles of digital finance in achieving financial inclusion in Nigeria. Following the dissatisfaction theory, a quantitative research method is adopted using an ex-post facto research design. The ex-post facto research design ensures clarity in data presentation and minimizes bias in data analysis (Eze & Markjackson, 2020).

The analytical model of the study emerged by adapting an earlier model by (Eze & Markjackson, 2020) on the determinants of financial inclusion in Nigeria. The adaptation is by incorporating digital finance and non-digital financial variables in the financial inclusion model. The inclusion of these key explanatory variables is in justified by the dissatisfaction theory of financial inclusion which provides the framework for our study. More so, the study included other explanatory variables in the model in line with shred of empirical literature(Abdu & Adem, 2021; Akileng, Lawino, & Nzibonera, 2018; Akudugu, 2013; Chithra & Selvam, 2013; David, Oluseyi, & Emmanuel, 2018; Desalegn, 2021; Ndanshau & Njau, 2021; Zins & Weill, 2016).

$$fin = f(dcps, net, cbb, int, exr) \quad 1$$

$$fin = \beta_0 + \beta_1 dcps + \beta_2 net + + \beta_3 cbb + \beta_4 int + \beta_5 exr + e_t \quad 2$$

fin - depicts the natural rate of financial inclusion

$dcps$- denotes digital credit to private sector

net - represents access to internet

cbb - represents bank branches

int - stands for interest rate (lending rate)

exr - denotes exchange rate

e_t - is the error term

β_0 - is the model intercept, which depicts the natural rate of financial inclusion

$\beta_1 - \beta_5$ - are the coefficients of the model

Theoretical expectation

$\beta_0 > 0;\ \beta_1 > 0; \beta_2 > 0;\ \beta_3 > 0;\ \beta_4 < 0;\ \beta_5 > 0$

To estimate the stochastic model above, we use multiple regression estimators.

4. Data description and Sources

UNDER PEER REVIEW

The study employed annual time series data that spanning 2004 – 2020 (17 years). The period affords us the opportunity to collect more recent and complete data set on financial inclusion and management information systems for Nigeria. The dependent variable, financial inclusion is measured using the number of depositors with commercial banks per 1,000 adult populations. We capture our key independent variable digital finance using proportion of population with access to internet and digital credit to the private sector as a proportion of gross domestic product (GDP). Commercial bank branches per 100,000 population, lending rate and exchange rate are incorporated as control variables (see eqn 2).

Table 1 Description of variables

Variable	***Description***	***Apriori***	***Source***
FIN	Financial inclusion proxy by depositors with commercial banks per 1,000 adults	Nil	World Bank's WDI, 2022 https://databank.worldbank.org/home.aspx
DCPS	Digital credit to private sector	>0	World Bank's WDI, 2022 https://databank.worldbank.org/home.aspx
NET	Internet Access	>0	World Bank's WDI, 2022 https://databank.worldbank.org/home.aspx
CBB	Commercial bank branches per 100,000 population	>0	World Bank's WDI, 2022 https://databank.worldbank.org/home.aspx
INT	Lending rate	<0	World Bank's WDI, 2022 https://databank.worldbank.org/home.aspx
EXR	Exchange rate	>0	World Bank's WDI, 2022 https://databank.worldbank.org/home.aspx

Source: Authors' compilation

Following the methodological exposition and the description of data, the study proceeded to data presentation and empirical analysis to determine if management information system fosters financial inclusion in Nigeria.

5. Empirical Analysis

UNDER PEER REVIEW

To establish the roles of management information system in financial inclusion in Nigeria, the empirical analyses comprise of descriptive statistic, unit root tests, correlation matrix, the F-bounds test and the Autoregressive Distributed Lag (ARDL) estimates.

	Table 2: Summary of Descriptive statistics					
	FIN	***DCPS***	***NET***	***CBB***	***INT***	***EXR***
Mean	598.8217	12.27808	17.36002	5.212353	16.82052	193.3606
Median	644.4400	11.52443	16.10000	4.980000	16.86802	157.3117
Maximum	1310.390	19.60353	35.50000	6.560000	19.18083	358.8108
Minimum	38.39290	8.111026	1.286138	3.780000	13.64202	118.5667
Std. Dev.	359.6986	3.200953	11.05598	0.895485	1.333592	79.16745
Skewness	0.276321	0.884358	0.205259	0.176070	-0.401690	0.940244
Kurtosis	2.304779	3.329331	1.739293	1.700067	3.576671	2.303204
Jarque-Bera	0.558694	2.292742	1.245185	1.284795	0.692727	2.848748
Probability	0.756277	0.317788	0.536552	0.526030	0.707255	0.240659
Sum	10179.97	208.7274	295.1203	88.61000	285.9489	3287.131
Sum Sq. Dev.	2070129.	163.9376	1955.755	12.83031	28.45548	100279.8

Source: Author's computation

Table 3: Augmented Dickey Fuller Unit Root Tests			
Variable	***ADF Statistic***	***Critical value @ 5%***	***Decision***
FIN	-3.511770	-3.081002	I(1)
DCPS	-3.952434	-3.759743	I(0)
NET	-4.319831	-3.759743	I(1)
CBB	-3.939946	-3.791172	I(1)
INT	-4.587116	-3.759743	I(1)
EXR	-4.209430	-3.791172	I(1)

Source: Author's computation

Table 2shows the summary of descriptive statistic of the variables. The mean estimate reveals that there are 598 in every 1,000 adult Nigerians are engaged with the formal financial sector within 2004 and 2020. This is rate is just above the average, which implies that a lot of Nigerians are financially excluded. Also, there about 5 commercial bank branches per 100,000 Nigerians, which is responsible for the usual long queue in banking Nigerian banking halls. More so, digital credit to private sector is on an average rate of 12% and 17% of Nigerians have access to internet

UNDER PEER REVIEW

with the period under consideration. The average lending rate for the period is 16.82% while exchange rate hovers around ₦198 to a **$USD** for the period. The standard deviation of the observation shows that financial inclusion variable has the widest degree of spread of 359.68 around the mean value, followed by exchange (79.16), internet access (11.05), digital credit to private sector (3.20), interest rate (1.33) and the variable with the lest variation is commercial bank branches with standard deviation of 0.89. The skewedness shows that the variables have positive skewness except for interest rate, which has a negative skewness. The kurtosis coefficient and the Jarque Bera probability values confirm that the variables are approximately normally distributed.

To further examine the properties of the variables, we conducted the unit root tests as presented in Table 3. The ADF result reveals that the variables are stationary in their difference except digital credit to private sector, which has unit root. Thus, unit root results established that the variables have a mixed order of integration that included ***I(0)*** and ***I(1)***, providing evidence for adopting the ARDL estimation technique.

In table 4 we present the correlation matrix to determine the nature and degree of relationship among the predictors and the effect variable. The results show that majority of the variables have weak correlation except for exchange rate and financial inclusion on one hand and between exchange rate and internet access.

	Table 4 Correlation Matrix					
	FIN	***CPS***	***NET***	***CBB***	***INT***	***EXR***
FIN	1.000	0.037	0.979	-0.154	-0.591	0.915
CBB	-0.154	0.625	-0.245	1.000	0.039	-0.446
DCPS	0.037	1.000	-0.023	0.625	-0.003	-0.125
NET	0.979	-0.023	1.000	-0.245	-0.558	0.913
INT	-0.591	-0.003	-0.558	0.039	1.000	-0.461
EXR	0.915	-0.125	0.913	-0.446	-0.461	1.000

Source: Author's computation

Table 5. presents evidence of a long run relationship between financial inclusion and management information system in Nigeria since the F-statistic of 4.496 greater than the lower and upper critical value bounds at 10%, 5% and 2.55 significance level. To determine the effect of management information on financial inclusion, the ARDL estimates for short run and long run are provided in Table 5

Table 5F-Bounds Test for Long Run Relationship

UNDER PEER REVIEW

Test Statistic	Value	k
F-statistic	4.496588	5
Critical Value Bounds		
Significance	I0 Bound	I1 Bound
10%	2.26	3.35
5%	2.62	3.79
2.5%	2.96	4.18

Source: Author's computation

	Table 6 ARDL Results for Short run and Long-run Estimates Dependent variable: Financial Inclusion(FIN)				
Model	***Short-run model***		***Long-run model***		
Predictor	*Coefficient*	*P-value*	*Predictor*	*Coefficient*	*P-value*
FIN(-1)	0.579	0.0405	*CBB*	94.694	0.0118
CBB	39.796	0.1202	*CPS*	-27.405	0.0953
CPS	-11.517	0.0198	*NET*	8.375	0.4402
NET	-20.328	0.1771	*INT*	-75.642	0.0984
NET(-1)	23.848	0.0913	*EXR*	3.637	0.0646
INT	7.677	0.3644	*C*	1134.007	0.2147
INT(-1)	-39.466	0.0020			
EXR	1.528	0.0029			
C	476.572	0.0434			
ECM (-1)	-0.420	0.0910			
R-squared	0.997				
Adjusted R-squared	0.994				
F-statistic	340.299				
Prob(F-statistic)	0.0000				
Durbin Watson	2.486				

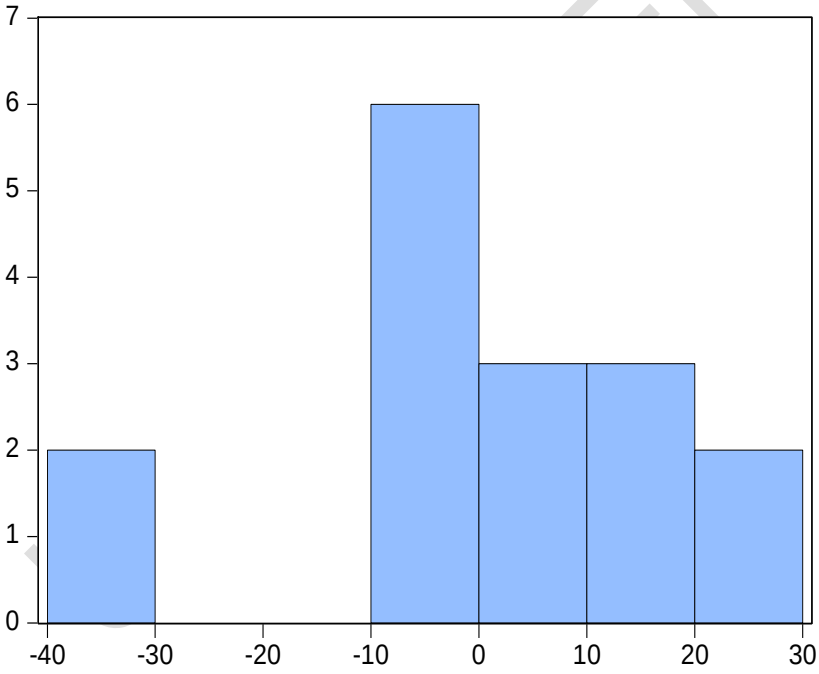
Source: Author's computation

In the short run, a period lag in financial inclusion has a significant positive effect on the current level of financial inclusion. The estimate shows that the previous year's level of financial inclusion improves the current level by 0.579%, which is statistically significant at 5%. Also, commercial bank branches, a period lag in internet access, lending rate and exchange rate are found as drivers of financial inclusion. Specifically, for every 1% increase in each of these

UNDER PEER REVIEW

enablers, financial inclusion improves by 39.796%, 23.848%, 7.677% and 1.528% respectively. Thus, in the short run commercial bank branches and access to internet are the strongest propellers of financial inclusion in Nigeria. On the contrary, digital credit to private sector, current internet access and a period lag in interest rate hinder financial inclusion in Nigeria. The strongest hinder is a period lag in interest rate. The speed of adjustment of -0.420 shows that in the short run, there is 42% of the disequilibrium in financial inclusion is restored back to equilibrium within on period.

However, in the long-run commercial bank branches, internet access and exchange rate exert significant impact on financial inclusion. In specific terms, for every 1% increase in these long-run determinants, financial inclusion increases by 94.469%, 8.375% and 3.637% respectively. Conversely, digital credit to private sector and lending rate are the critical factors contributing to financial exclusion in the long run by retarding financial inclusion in Nigeria. Specifically, for digital credit to the private sector decreases the number of depositors with commercial banks per 1,000 adults by 27 people while lending rate every percent increase in lending rate decreases the number of depositors with commercial banks by 75 people.



Series: Residuals	
Sample 2005 2020	
Observations 16	
Mean	4.97e-14
Median	-1.282475
Maximum	26.40051
Minimum	-34.27639
Std. Dev.	17.23049
Skewness	-0.427508
Kurtosis	2.757758
Jarque-Bera	0.526488
Probability	0.768554

Figure1: Normality Tests
Source: Author's computation

5.6 Heteroscedasticity Test: Breusch-Pagan-Godfrey

PEER REVIEW

F-statistic	0.726541	Prob. F(8,7)	0.6698
Obs*R-squared	7.258419	Prob. Chi-Square(8)	0.5090
Scaled explained SS	1.221033	Prob. Chi-Square(8)	0.9964

Source: Author's computation

To ascertain the predictive and explanatory power of the model, the Adjusted R-square 0.994 implies that changes in financial inclusion in Nigeria is accounted by changes in management information system and other control variables in the model to the tune of 99.4% while only 0.6% is due to chance.

Also, to test the overall significance of the model, the F-statistic of 340.229 with P-value of 0.0000<0.05 implies that the model is adequate and overall, it is statistically significant.
Post estimation tests to determine the presence or otherwise of the problems of serial correlation, asymmetricity and heteroscedasticity reveal that the Durbin Watson statistic of 2.46 is within the threshold of minimal serial correlation. The Jarque-Bera tests for normality presented in Figure 1 shows that the observations are symmetrical and the Breusch-Pagan-Godfrey test for heteroscedasticity provided evidence for a homoscedastic model. Thus, the estimates are reliable and stable for policy purposes.

6. Policy implications of findings:

There is abundant evidence of low financial inclusion in developing economies, most especially Nigeria. The result of the study has shown that only 59.8% of the adult population is covered in the formal banking arrangement, while a preponderance of 40.2% is unbanked. This implies that 402 out of every 1,000 adult populations are financially excluded in Nigeria. The found that both digital and non-digital variables are responsible for the large proportion of financially excluded Nigerians. Specifically, factors such as commercial bank branches, access to internet, lending rate and exchange rate are the significant immediate enablers of financial inclusion in Nigeria, however, immediate perpetuators of financial exclusion include digital credit to private the private sector and interest rate.

The implication of this result for policy is that there is the need for all the stakeholders in the financial sector to develop a robust financial framework that seeks to mitigate the perpetuators of

UNDER PEER REVIEW

financial exclusion and promote the enablers of financial inclusion in Nigeria. Specifically, Central Bank of Nigeria should investigate the concerns of high interest rate which discourages the unbanked from wanting to be financially included. Also, the issues of unresolved complaints, especially on frauds and unjustified deductions by the commercial banks worsen financial inclusion despite the proximity of banks branches. More so, commercial and microfinance bank branches are concentrated in the urban centers, thus, limiting the opportunities of rural dwellers to be financial included, thereby creating a large informal financial market in rural settings.

The suggested holistic financial framework should aim at incorporating the informal financial market into the mainstream financial system to build synergy and develop the capacity to integrate majority of the financially excluded Nigerians into formal financial market. Such a robust financial market framework must be sustainable, digitally sensitive, politically neutral, financially inclusive, economically viable and spatially distributed.

7. Conclusion

The quest for improved financial inclusion in developing countries is premised on its ability to promote fair resources redistribution to curb poverty and to enhance standard of living. To attain financial inclusion, various studies have inquired possible routes, but less emphasis is on the roles of digital finance. Digital finance falls within the low threshold that it does not promote financial inclusion in Nigeria. With the recent clamp down on online/digital credit providers by the CBN and high default rate by online borrowers, the aim of driving financial inclusion through digital credit to the private is constrained. More so, high interest rate, poor digital penetration, or lack of access to internet is other notable factors affecting financial inclusion in Nigeria. The study further established that proximity of bank branches; improved internet access and exchange rate are long-run enablers of financial inclusion in Nigeria. It further concludes that digital credit to the private sector decreases the number of depositors with commercial banks per 1,000 adults by 27 people while every one percent increases in lending rate decreases the number of depositors with commercial banks by 75 people.

UNDER PEER REVIEW

REFERENCES

Abdelghani, E. & H. A. A. (2013). An empirical survey on the prospects of mobile money in morocco. *Studies in Business & Economics*, *8*(1).

Abdu, E., & Adem, M. (2021). Determinants of financial inclusion in Afar Region: Evidence from selected woredas. *Cogent Economics & Finance*, *9*(1), 1920149.

Abiola, B., Adedoyin, L., Umoren, G., & Areghan, I. (2019). Financial inclusion in Nigeria: Prospect, issues and challenges. *Proceedings of the 33rd International Business Information Management Association Conference, IBIMA 2019: Education Excellence and Innovation Management through Vision 2020*, (45), 6761–6778.

Ade' Soyemi, K., Olowofela, O. E., & Yunusa, L. A. (2020). Financial inclusion and sustainable development in Nigeria. *Journal of Economics and Management*, *39*(1), 105–131. https://doi.org/10.22367/jem.2020.39.06

Adetunji, O. M., & David- West, O. (2019). The relative impact of income and financial literacy on financial inclusion in Nigeria. *Journal of International Development*, *31*(4), 312–335.

Agufa, M. M. (2016). *the Effect of Digital Finance on Financial Inclusion in the Banking Industry in Kenya By a Research Project Submitted in Partial Fulfillment of the Requirements for the Award of the Degree of Master of Science in Finance , School of Business , University*.

Agyekum, F., Locke, S., & Hewa Wellalage, N. (2016). Does financial accessibility and inclusion promote economic growth in low income countries (LICs). *Financial performance analysis, measures and impact on economic growth. Nova Science Publishers Inc., New York*, 158–186.

Akileng, G., Lawino, G. M., & Nzibonera, E. (2018). Evaluation of determinants of financial inclusion in Uganda. *Journal of Applied Finance and Banking*, *8*(4), 47–66.

Akinwunmi, O. A. (2018). *Effect of innovation and policy on financial inclusion in nigeria : 1981-2015 By Olubukola Akinniyi Akinwunmi A Term Paper Submitted in the Course of my*

UNDER PEER REVIEW

Study at the Nile University of Nigeria towards the award of the Degree of Doctor of Philosophy at the.

Akudugu, M. A. (2013). The determinants of financial inclusion in Western Africa: Insights from Ghana. *Research Journal of Finance and Accounting*, *4*(8), 1–9.

Bank, A. D. (2016). Financial inclusion in the digital economy. Asian Development Bank (ADB).

Bansal, S. (2014). Perspective of technology in achieving financial inclusion in rural India. *Procedia Economics and Finance*, *11*, 472–480.

Bayero, M. A. (2015). Effects of Cashless Economy Policy on Financial Inclusion in Nigeria: An Exploratory Study. *Procedia - Social and Behavioral Sciences*, *172*, 49–56. https://doi.org/10.1016/j.sbspro.2015.01.334

Bazarbash, M., Beaton, K., & Eriksson, U. (2020). Filling the gap: Digital credit and Financial Inclusion. *IMF Working Papers*, *2020*(150).

Beck, T., Demirgüç-Kunt, A., & Levine, R. (2007). Finance, inequality and the poor. *Journal of economic growth*, *12*(1), 27–49.

Błach, J. (2011). Financial innovations and their role in the modern financial system-identification and systematization of the problem. *e-Finanse: Financial Internet Quarterly*, *7*(3), 13–26.

Bruhn, M., & Love, I. (2014). The real impact of improved access to finance: Evidence from Mexico. *The Journal of Finance*, *69*(3), 1347–1376.

C.O., Igwemeka E, Eje G. C, Okonkwo M. C, Onoselogu O. C.O, O. I. P. (2020). Digital Finance and Financial Inclusion in Nigeria: Lessons from other Climes. *Nigerian Journal of Banking and Finance*, *12*(1), 97–105.

Chithra, N., & Selvam, M. (2013). Determinants of financial inclusion: An empirical study on the inter-state variations in India. *Available at SSRN 2296096*.

David, O. O., Oluseyi, A. S., & Emmanuel, A. (2018). Empirical analysis of the determinants of financial inclusion in Nigeria: 1990-2016. *Journal of Finance and Economics*, *6*(1), 19–25.

Desalegn, G. (2021). Determinants of Financial Inclusion in Small and Medium Enterprises: Evidence from Ethiopia. *International Journal of Accounting Research*, *9*(6).

EFInA (2021). *Access to Financial Services in Nigeria 2020 Survey*. https://efina.org.ng/wp-content/uploads/2021/10/A2F-2020-Final-Report.pdf

UNDER PEER REVIEW

Evans, O. (2018). Connecting the poor : the internet , mobile phones and fi nancial inclusion in Africa. https://doi.org/10.1108/DPRG-04-2018-0018

Eze, G. P., & Markjackson, D. (2020). Determinants of financial inclusion in Nigeria. *IOSR Journal of Economics and Finance*, *11*(1), 14–22.

GlobalFindexdatabase (2021). *Financial access- WB*. https://www.worldbank.org/en/publication/globalfindex/Report

Gupta, S. K. (2011). Financial Inclusion-IT as enabler. *Reserve Bank of India occasional papers*, *32*(2), 129–148.

Li, X., & Zeng, S. (2010). Finance Innovation Model Literature Review. *Beijing University of Technology*.

Melubo, K. D., & Musau, S. (2020). Digital Banking and Financial Inclusion of Women Enterprises in Narok County, Kenya. *International Journal of Current Aspects in Finance, Banking and Accounting*, *2*(1), 28–41. https://doi.org/10.35942/ijcfa.v2i1.104

Mojtahed, R., Nunes, J. M. B., & Peng, G. C. (2011). The role of the technology acceptance model in information systems research: a case study. *Proceedings of the IADIS International Workshop on Information Systems Research Trends, Approaches and Methodologies*. Sheffield.

Monyoncho, L. N. (2015). Relationship between banking technologies and financial performance of commercial banks in Kenya. *International Journal of Economics, Commerce and Management*, *3*(11), 784–815.

Mushtaq, R., & Bruneau, C. (2019). Microfinance, Financial Inclusion and ICT: Implications for Poverty and Inequality. *Technology in Society*, 101154. https://doi.org/10.1016/j.techsoc.2019.101154

Ndanshau, M. O. A., & Njau, F. E. (2021). Empirical investigation into demand-side determinants of financial inclusion in Tanzania. *African Journal of Economic Review*, *9*(1), 172–190.

Ndassi Teutio, A. O., Kala Kamdjoug, J. R., & Gueyie, J.-P. (2021). Mobile money, bank deposit and perceived financial inclusion in Cameroon. *Journal of Small Business & Entrepreneurship*, 1–19.

Nur, M., Siddik, A., Sun, G., Yanjuan, C., & Kabiraj, S. (2014). Financial Inclusion through Mobile Banking: A Case of Bangladesh. *Journal of Applied Finance & Banking*, *4*(6),

UNDER PEER REVIEW

1792–6599. www.btrc.gov.bd

Obinne, G., Efanga, U., & Clifford, E. (2020). Investigating the impact of digital finance on money supply in nigeria. *Nigerian Journal of Banking and Financing*, *12*(1), 47–55.

Ozili, P. K. (2020). Theories of Financial Inclusion. *Uncertainty and Challenges in Contemporary Economic Behaviour*, (104257), 89–115. https://doi.org/10.1108/978-1-80043-095-220201008

Rogers, E. M. (1995). Diffusion of Innovations: modifications of a model for telecommunications. *Die diffusion von innovationen in der telekommunikation* (25–38). Springer.

Shofawati, A. (2019). The Role of Digital Finance to Strengthen Financial Inclusion and the Growth of SME in Indonesia. *KnE Social Sciences*, *3*(13), 389. https://doi.org/10.18502/kss.v3i13.4218

Silber, W. L. (1983). The process of financial innovation. *The American Economic Review, 73*(2), 89–95.

Tay, L.-Y., Tai, H.-T., & Tan, G.-S. (2022). Digital financial inclusion: A gateway to sustainable development. *Heliyon*, *8*(6), e09766. https://doi.org/10.1016/j.heliyon.2022.e09766

WorldBank (2022). Financial Inclusion. https://www.worldbank.org/en/topic/financialinclusion/overview#1

Zins, A., & Weill, L. (2016). The determinants of financial inclusion in Africa. Review of Development Finance, 6 (1), 46-57. *URL: http://www. sciencedirect. com/science/article/pii*.

UNDER PEER REVIEW