OPEN ACCESS
Finance & Accounting Research Journal
P-ISSN: 2708-633X, E-ISSN: 2708-6348
Volume 5, Issue 5, P. No. 100-115, May 2023
DOI:10.51594/farj.v5i5.488
Fair East Publishers
Journal Homepage: www.fepbl.com/index.php/farj

DIGITAL FINANCE AND FINANCIAL INCLUSION IN NIGERIA: ARE THEY SIAMESE TWINS?

Bernhard O. ISHIORO, Ph.D[1]

[1]Department of Economics
Delta State University
Abraka, Nigeria

*Corresponding Author: Bernhard O. ISHIORO
Corresponding Author Email:ben_ishioro@yahoo.co.uk

Article Received: 15-02-23 **Accepted:** 25-03-23 **Published:** 15-05-23

ABSTRACT

The link between Financial inclusion (FIN) and digital finance(DF) is the primary subject of this research. Digital finance and inclusive financial though have been adjudged to be related; there are quite a plethora of issues that are still unclear concerning the nature and type of their relationship. Why are they related and at what point are they related? Short or long-run relationship? To clarify these issues, the study applied the Auto regressive Distributed Lag (ARDL) long-run cointegrating technique to explicate our econometric models. Our data is time series in nature and is for Nigeria. The study established that, internet-powered electronic device users, a proxy for digital finance has a positive long-run relationship with FIN while Automated Teller machine (ATM) ownership and usage has a negative long-run relationship with FIN. The study recommended that internet service providers (ISPs) be integrated into the Nigerian FIN paradigm to enhance the accuracy and viability of financial service provision, leading to a decline in the unbanked population.

Keywords: Digital finance, FIN, financial services, ARDL Bounds Test, Nigeria.

INTRODUCTION

Financial inclusion (henceforth FIN) is concerned with the application and utilization of functional financial assistance to assist those who are underserved and disadvantaged in

breaking free from the "financial exclusion trap" (as implied by Zins and Weill, 2016; and Ngoma, 2019). Considering this important goal of FIN, its subject matter has gained sustained public attention and research interest from all economies whether rich or poor; developed or underdeveloped; technologically advanced or technologically backward; core or periphery; small open or closed economy; industrialized or weakly industrialized countries around the world. This is the belief of most studies including Babajide, Adegboye, & Omankhanlen (2015).

After the G20 and World Bank Summit held in Seoul, South Korea few years ago, Zins & Weill (2016) emphasized the importance of FIN as one of the 9 principal pillars of the global development and global policy-making agenda (GPFI, 2011; Ouma, Odongo, and Were, 2017) and as a panacea to the problem of deepening poverty caused by financial exclusion (Zins & Weill, 2016). It's worth mentioning that, in response to the World Bank-G20 global development initiative, most developing countries formulated and began to adopt FIN policies that have been considered critical to their growth processes. But, as the FIN policies were just being executed, these countries realized that in order for FIN to be effective, all previously financially excluded adults needed unconstrained access to a wide range of financial services (FS), depending on the nature and type of services they needed.

A corollary debate was born out of the question of what actually constituted unrestricted access to FS (OECD,2015; AFI,2016; FinCoNet, 2016, 2017, and 2018).Some studies have agreed that, unhindered access to FS can be fostered by owning and operating an account with a bank or any other financial institution. But other studies have argued that unrestricted access to FS is beyond ownership of account with a bank as it depends on the type of account (whether it is a high use, medium use, low use or dormant account). In a bid to untie the knot in this debate; Le, Chuc & Taghizadeh-Hesay (2019) reminded others that, the formal FIN process usually start with the financially excluded proportion of the population having a functional transaction account at a bank or suitable financial institution but does not amount to unrestricted access to FS (Diniz, Birochi, & Pozzebon, 2012). Accounts with banks are to facilitate either saving and credit penetration or payments spread in case of monetary/financial transactions (Kendall, Mylenko & Ponce, 2010; Jack and Suri,2011).

But with a large proportion of the population dwelling in the rural and unbanked areas; lack of access to FS becomes a serious hindrance to the achievement of each economy's FIN program. Some studies strongly believed that reforms strictly targeting the consolidation of the banking sector is the only way out. Meanwhile, it has been universally accepted in the literature that reforms specifically aimed at consolidation in the banking industry have increased the distance between both the banking system and the remote communities targeted by FIN (Alessandrini *et al.* 2009; Ishioro, 2020b). It has been observed that in Nigeria, as banks consolidate, they become less interested in the establishment of their branches in the rural and unbanked areas and, eventually, they become urban centres and cities entities due to high rate of concentration (Uchendu,1998). Therefore, the program of banks branch network has not proffered solution to the problem of financial de-inclusion in Nigeria since the first commercial bank was established in 1892.For instance, the actual achievement of Commercial Bank branches per 100, 000 customers reached 4.8 (but was 2.7 less than the expected target of 7.5).Besides, Zins and Weill (2016) affirmed that African banks are

weakly financially inclusive and as a result, Africa is in dire need of FIN even amidst many city-based banks (Mlachila et al.,2013a; 2013b; Christen, Rosenberg and Jayadeva,2004).

The way out of this financial exclusion morass is to adopt digital FS that can reach the unbanked public without the establishment of bank branches in financially excluded areas. More so, it has been argued in the literature that having a commercial bank account does not equate to FIN if access to the bank is hampered by a number of obstacles. Digital FS can adequately remove these obstacles and FS would become accessible, always available and of course, affordable to the financially disenfranchised population. The purpose and objective of this study therefore is to evaluate the relationship between digital FS and FIN in Nigeria because although there are banks in all the cities, the extent to which FS have been delivered to the poor is worth evaluating. The rest of the paper is structured as follows:

Financial Inclusion and Digital Financial Services in Nigeria

The Central Bank of Nigeria (CBN, 2019) stated that the Nigerian National FIN Strategy (NFIS) commenced operations officially in 2012 with the mandate to considerably reduce the percentage of adults who are financially disadvantaged and unbanked from 46.3 percent (as at 2010) to 20 percent in 2020.

In Nigeria, the financial exclusion rate of *bankable* adults has relatively improved from about 46.3 percentage points in 2010 to about 41.6 percentage points in 2016 and, it increased from almost 37 per cent in 2018.This is close to the NFIS target of 20.0 per cent financial exclusion (that is, 80 percent FIN) by the ending of 2020 (CBN, 2019).

Strides in Financial Services and Inclusion in Nigeria

From table 1, FIN in Nigeria experienced reasonable progress in 2018. Financial services to the unbanked, financially underserved and under-banked population was relatively enhanced between 2016 and 2018 respectively.

Table 1

Progress Made in Financial Services in Nigeria (2016/2018).

S/No	Financial Service Indicator	Years		
		2016	2018	Percentage Change 2016 / 2018
1	Banked Population	38.3 %	39.6%	+1.3%
2	Financially Excluded Population	41.6%	36.8%	-4.8%
3	Female Exclusion Rate	46.6%	40.9%	-5.7%
4	Male Exclusion Rate	36.8%	32.5%	-4.3%

Source: Central Bank of Nigeria (CBN, 2019)

The proportion of population that is banked increased from about 38.3 per cent to 39.6 per cent (representing an increase of about 1.3 percentage points). Also, the proportion of the population who are financially excluded reduced from about 41.6 per cent in 2016 to 36.8 per cent in 2018 (that is, about 4.81 percentage point positive change). Financial-service-induced gender gap shows that female financial exclusion rate decreased from 46.6 per cent in 2016 to about 40.9 per cent in 2018(representing about 5.7 percentage points reduction in two years) while male financial exclusion rate also declined from 36.8 per cent in 2016 to about 32.5 per cent in 2018 (representing about 4.3 percentage points decrease in two years).

FIN measure showed an enhanced performance in 2018 as the biannual FIN rate indicated a marginal increase from 58.4 per cent in 2016 to about 63.2 per cent in 2018 (CBN, 2019).Furthermore, the state-by-state disaggregated FIN measures showed an enhanced

significant performance in the North West and North East geo-political zones. These zones are the most disproportionately excluded zones in Nigeria with about 62 per cent and 55 per cent financial exclusion rates as at 2018 (CBN, 2019). The Southwest geo-political zone recorded about 19 per cent financial exclusion rate in 2018 , and has been the only region to have exceeded the targeted 20 per cent financial exclusion rate (80 percent FIN rate) by the Year 2020.

The Central Bank of Nigeria (CBN,2018 and 2019) has made it clear that, the attainment of the 80 per cent FIN rate (by implication 20 per cent exclusion rate) is an herculean task. To attain the financial inclusion target of 80 per cent by 2020, the Nigeria FIN agenda needs about 62 digital FS providers / Agents per 100,000 underserved adults of which as at 2017 ending only 28.2 digital financial service providers / agents per 100,000 adults were engaged.

Also, the apex bank noted that due to insufficient fixed location FS agents, the programme of digital service penetration to the rural areas has suffered serious setbacks. To solve this problem, the CBN licensed a National Microfinance Bank (NIRSAL) that is expected to maximize the current locations of NIPOST in all the 774 Local Government Areas (LGAs) in Nigeria . To strengthen the instrument of FIN, the CBN also initiated the followings: Conditional Cash Transfer Programme (CCTP), the *TraderMoni* initiatives, and the Anchor Borrower Programme (ABP).

Credit penetration is has been very low in Nigeria (as it is still at 3 per cent as at 2018).However, the CBN has earmarked a target of 40 per cent credit penetration by the end of Year 2020 (CBN, 2019).

LITERATURE REVIEW

The literature review is categorized into three main areas: theoretical, empirical and methodological review.

Theoretical Review: Conceptual Issues of Financial Inclusion

The search for a commonly accepted definition of FIN is still on (Hajille, Stringer & Metghalchi, 2017). However, most definitions given by recent studies including Hajille, Stringer & Metghalchi (2017) straddle between two key conceptual perspectives: Policy-based perspective, and resources-targeting (financial tools) perspective.

The policy-based definition of FIN sees it as either " supply-side policy" or " demand-side policy " instrument adopted by developing and less developed countries in fast-tracking the growth process of their various economies. According to Hannig and Jansen (2010), and Agyekum, Stuart and Hewa-Wellalage (2016), the demand-side proponents see FIN as a medium of providing opportunity-facilitating financial services such as saving, variety of payments, funds transfer and other services to the *financial-services-denied* population. OECD (2017) identified the demand-side boosters to include : demand for and current application of DF services among the financial-service-repressed population; the digital literacy of the unbanked population as a gradient for FIN, etc.

The supply-side policy definition of FIN described it as the supply of affordable, widely accessible and appropriate quality FS to the financially-marginalized segment of the population (Triki and Faye, 2013; Agyekum, Stuart and Hewa-Wellalage, 2016).The supply-side variables include: digital and financial products/ services available and accessible to

users; the identified channels used by service providers, and the digital service-enabling technology required for quality service provision.

On the other hand, the resources-targeting definition also known as ' financial tools ' definition describes FIN as the mechanism used to harness redundant resources that have been hitherto unaccounted for, thereby redirecting and repositioning them for growth-enhancing investments. The mechanism referred to in the resources-targeting or financial tools definition include: Mobile phone and other internet-enabled electronic devices such as POS terminal, tablets, phablets, etc (medium used for making FS accessible, available and affordable (AFI ,2016). Ozili (2018) gave a good example of resources-targeting or financial tools definition of FIN to imply that all adult members of the society are granted access to a range of proper FS, designed based on their needs and provided at affordable costs.

Concepts of Financial Technology and Digital Finance: Theoretical Basis

Technology which is the fulcrum upon which digital finance revolves, has long been studied in relation to its role in enhancing institutional performance (in terms of even financial institutional structures, processes, and attainment of goals such as FIN). Different theoretical perspectives on the role of technology and its application in the development of institutions have emerged with respect to different scholarly views: for instance, Woodward (1965) ; Buchanan and Boddy (1983); Carter (1984); Barley (1986,1990);Burkhardt and Brass (1990); Adam and Wood (1999) and others adopted the contingency theory in evaluating how technology facilitates the processes and structures of systems and organizational activities; used transaction-cost economics perspective in exploring how technology aids institutional and organizational processes and the attainment of organizational goals (of which digital financial service penetration is implicit).Others popularized the innovative application of strategic choice models, network models, and structurational models in explaining the vital role of technology in the emergence and spread of institutional structures, processes and targets including digital spread (Chinn and Fairlie, 2007). All these form the theoretical foundation upon which the application of technology and/ or digital finance to FIN is laid (Abeywickrema , 2005; Ang , 2011).

Digital Finance and Financial Inclusion: What's the Relationship?

A mutually inclusive/direct relationship has been postulated to exist between DF and FIN; suggesting that a rise in the use of DF will lead to a rise in access to formal FS and this will in turn enhance FIN (Ozili, 2018).

Beyond the existence of a direct and mutually inclusive relationship between DF and FIN, Ozili (2018) noted that a bidirectional causality exists between digital finance and FIN. This implies that an increase in the number of DF users will lead to a greater degree of FIN while a higher degree of FIN would increase the number of DF users.

However, this relationship can also engender merits or demerits. First, DF provides a safe way of handling funds during period of insecurity because it encourages the users to operate a 'cashless economy and transactions' and to avoid keeping cash at home. This has been referred to as the principle of security. This has attracted a lot of users into DF and eventually into the FIN cycle.

Second, there is consensus that, high degree of increased DF usage when basically embraced by the proportion of the population that is poor, unbanked, under-banked, marginally banked

and/or financially disenfranchised can facilitate their access to basic goods and services which will lead to greater FIN of rural and unbanked regions.

Third, DF makes access to finance convenient and comfortable especially when the platform is used for routine utility payments for energy consumed such as electricity or gas, water supply, funds transfer to family and friends, payment for goods purchased amongst others (Agyekum, Stuart and Hewa-Wellalage, 2016).

Fourth, more importantly, is the fact that, improved digital FS directed to unbanked communities can provide stress-free access to finance without going to the banks' location. This will reduce the cost of transaction, man hour lost and the risk of travelling on *excellently bad roads* like the Nigeria's.

EMPIRICAL REVIEW

Kauffman & Riggins (2012) concertedly investigated the role of Information and communication technology (ICT) in the determination of micro-finance service provision, penetration and, as an instrument for the elimination of poverty among rural unbanked communities. The study emphasized the important and innovative role played by ' handheld digital devices' in proffering solution to the collection of information from those microfinance clients who are in the remote and financially unreached areas of most countries. Furthermore, the study observed that ICT has conveniently eliminated the problem of moral hazard, hidden action and information asymmetry by providing access to microfinance service users and clientele who reside in distant locations and somewhat unreachable terrains. Kauffman & Riggins (2012)has accepted the conclusions reached by other studies as verifiable evidences of the indispensable role played by ICT in eliminating the obstacles posed by many factors in the successful implementation of micro-finance inclusive service provision outreaches.

Chen, Hanson, and Stein (2017) find that non-bank finance companies that provide credit to small businesses grew most rapidly after the financial crisis in counties where the largest four bank holding companies had the largest presence, responding to a legitimate shortfall in the supply of small business credit (Donovan, 2012).

The problem associated with information asymmetry and moral hazard in the provision of credit and other financial services has motivated Jagtiani and Lemieux (2018) to study the link between fintech firms and the ability to address information asymmetries.

Methodological Review

Studies on the impact of DF and FIN have applied different methodological frameworks using different datasets and as such have generated different results. As an instance, applying the popular Generalized Method of Moment (GMM) as estimation technique, Kpodar and Andrianaivo (2011) established that mobile telephone (a proxy mostly used for representing digital finance in the literature as in Ozili(2018)) significantly contributed to both economic growth and FIN in Africa.

Agyekum, Stuart and Hewa-Wellalage (2016) applied the Ordinary Least Squares(OLS) to the analysis of the macroeconomic data (GDP per capita, Domestic credit to the private sector, total unemployment as percentage of total labour force); and the logistic regression estimation technique for the analysis of the micro-data from Ghana.

In a more recent analysis; Le, Chuc & Taghizadeh-Hesary (2019) examined the efficiency and stability of FIN when digital finance is applied. The study used data from 31 Asian

Countries consisting of 10 high income, 7 upper middle income and 14 low/lower middle income countries for the period 2004 to 2016.Three composite financial dimensions indicators were constructed using the common Principal Component Analysis (PCA) based on normalized series. The study applied the Feasible Generalized Least Squares (FGLS) estimation technique and re-affirmed that growing FIN is negatively related to financial efficiency while it directly affects financial sustainability.

MATERIALS AND METHODS

This section highlights the nature, description and sources of data used for this study. Beyond that, it provided a brief explanation of the estimation techniques that we applied (in terms of the unit root test, the long-run cointegration test and the Bounds long-run cointegration test).

Sources and Description of Data.

The data used for this study were sourced from the World Bank World Development Indicators WDI) Database. The data consists of annual Time series from the Nigerian economy covering the period 1990 to 2020.The series employed in this study include: FIN (denoted as *M3*/*GDP*), digital finance variables such as : Internet electronic device ownership and usage (denoted as *INTUSRS*) and Automated Teller Machine (denoted as *ATM*) card ownership and usage for 2021.The choice of our measures of FIN and digital finance was guided by the theoretical foundations laid by Kumar and Misra, (2000); Sarma, (2004); Sarma and Pais, (2008); the World Bank, (2008 , 2009) ; Mehrotra *et al*., (2009); Arora, (2010); Gupte *et al*. (2012) ,Triki and Faye(2013) and Ishioro (2020b, 2020a).

Table 2

Nomenclature/description of Variables

Variable	***Notation***	***Definition***	***Source***
Internet Users (% of total population)	INTUSRS	Internet users refer to individuals who have used the internet (from any location) in the last 3 months, either via a computer, mobile phone, personal digital assistance, etc.	WDI
Liquid liability	M3/GDP	This is a measure of money supply that includes M2 as well as time deposits, institutional money market funds, short term repurchase agreements and large liquid assets (It is the sum of currency and deposits in the Central Bank (M0), plus transferable deposits and electronic currency (M1), plus time deposits and savings deposits, foreign currency transferable deposits, certificate of deposits and security repurchase agreements (M2), plus travelers cheques, foreign currency time deposits, commercial paper and shares of mutual funds or market funds held by individuals)	WDI
Automated Teller Machines (per 100,000 adults)	ATM	They are computerized telecommunications devices that provide clients of a financial institution access to financial transactions in a public place.	WDI

Source: Compiled by Author

Model Specification

Unit root test is conducted in this study followed the empirical path of Ishioro (2015a,2015b, 2018 ,2022a ,2022d).

Following Ishioro (2017, and 2016), we specify the unrestricted vector autoregressive (VAR) equation of order z as:

$$\psi_i = \rho + \sum_{i=1}^{z} \sigma_i \Psi_{t-i} + \varepsilon_i \quad (1)$$

Equation (1) is a general VAR model as in Ishioro(2015c; 2019; 2022c) which ψ_i is the proxy for both FIN and DF.

The functional form of the right hand side series (denoted as K_t) of the restricted equation of our VAR is expressed as in Pesaran et al,(2001) and Ishioro(2017, and 2022b) as:

$$K_t = K_t(M3/GDP_{t-1}, ATM_t, INTUSRs_t) \quad (2)$$

Equation (2) states that FIN depends on the performance of own one year lagged value (denoted as $M3/GDP_{t-1}$), current Automated Teller Machine usage per 1,000 adults (denoted as ATM_t) and internet electronic device usage by 1,000 adults (denoted as $INTUSRs_t$).

The long-run multiplier of the VAR matrix is expressed as:

$$\sigma = \begin{pmatrix} \sigma_{yy} & \sigma_{yk} \\ \sigma_{ky} & \sigma_{kk} \end{pmatrix} \quad (3)$$

The diagonal characteristics of the above matrix, are the unrestricted elements because it allows the series to be either differently integrated or integrated of the same order.

The rule of thumb for interpreting the value of the element (σ_{yy}) states that:

$\sigma_{yy} = 0$ suggests that FIN is integrated of order one [I (1)];

$\sigma_{yy} < 0$ implies that FIN is integrated of order zero [I (0)];

The ARDL Bounds test following the pragmatic practice of Pesaran *et al*., (2001) is specified as follows:

$$M3/GDP_t = \Phi_0 + \Phi_1 ATM_t + \Phi_2 INTUSRs_t + \Phi_3(M3/GDP_{t-1}) + \Phi_4(ATM_{t-1}) + \Phi_5(INTUSRs_{t-1}) + ect_{t-1} \quad (4a)$$

$$ATM_t = \Phi_0 + \Phi_1 M3/GDP_t + \Phi_2(ATM_{t-1}) + \Phi_3(M3/GDP_{t-1}) + ect_{t-1} \quad (4b)$$

$$INTUSRs_t = \Phi_0 + \Phi_1 M3/GDP_t + \Phi_2(INTUSRs_{t-1}) + \Phi_3(M3/GDP_{t-1}) + ect_{t-1} \quad (4c)$$

Results of the Unit Root Test

Table 3

Results of ADF Unit Root Test

Variables	At Level ADF (prob.)	Decision	Order of Integration	First Difference ADF (prob.)	Order of Integration	Decision
ATM	0.466 (0.806)	Not Stationary		-2.124 (0.035)**	I(1)	Stationary
INTUSRS	3.452 (1.000)	Not Stationary		-3.319 (0.026)**	I(1)	Stationary

M3/GDP	-1.685 (0.423)	Not Stationary	-2.889 (0.063)***	I(1)	Stationary

Source: Author's Computation

(N.B. **/*** significant at 5% and 10% level)
N.B: ATM = Automated Teller Machine per 100,000 users), INTUSRS = internet and mobile banking platforms (web and mobile payments),
M3/GDP = money supply-to-GDP

The results of the ADF unit root test presented in table 3 indicated that , all the series are not stationary at levels implying the presence of unit root at levels. Therefore, all the series : ATM , INTUSRS and M3/GDP are not integrated of order one (at 1, 5 and 10 percent level of significance). But they become stationary after first differencing, that is, they are integrated of order one [I(1)].Since stationary at first difference has been confirmed, we proceed to test for the long-run relationship of the variables.

Table 4
Results of the Bounds Tests

Models	**AIC Lag**	**F-Statistics**	**t-statistics**	**Decision**
$F_{M3/GDP}(F_{M3/GDP} \mid ATM)$	2	4.529***	-1.076	Cointegration
$F_{ATM}(F_{ATM} \mid M3/GDP)$	1	66.682**	-2.993**	Cointegration
$F_{M3/GDP}(F_{M3/GDP} \mid INTUSRs)$	2	2.890	-2.219	No Cointegration
$F_{INTUSRs}(F_{INTUSRs} \mid M3/GDP)$	1	5.247**	-0.362	Cointegration

Source: Author's Computation

NOTE: (* 1% = 6.84 and 7.84, ** 5% = 4.94 and 5.73 *** 10% = 4.04, 4.78).

Table 5
Critical Values for Evaluating the Bounds Testing for Cointegration

Critical Values of the Bounds	**Bounds Level (Lower)**	**Bounds Level (Upper)**
1 Percent Critical Value of the Bounds	6.84	7.84
5 Percent Critical Value of the Bounds	4.94	5.73
10 Percent Critical Value of the Bounds	4.04	4.78
Optimal lag Selection (See Table 4a for Values)		

Source: Author's Compilation Using Pesaran et al., (1998) Table C1.III)

The results of the summary of the Bounds test displayed in table 6a show the long-run relationship among the three series: *M3*/*GDP*, *ATM* and *INTUSRS*. The results of the relationship between M3/GDP versus ATM ; using M3/GDP as the lead series shows that there exists a long-run relationship between them. This is because, the F-statistic of 4.529 falls within the lower bound of 4.04 and the upper bound of 4.78.This means that the F-statistics for that model is higher than the lower bound (4.04) but lower than the upper bound (4.78).

For the results of the relationship existing between M3/GDP and ATM ; using ATM card ownership and usage as the lead variable shows that the F-statistics (66.682) is significant at 1 percent level of significance with the F-statistics higher than the upper bounds at the 1 percent significance level. Therefore, we conclude that there exist a long-run relationship between FIN and, the ownership and usage of ATM.

Results of the ARDL Bounds Test

The results of the ARDL Bounds test presented in table 6 has three panels and three-two in one columns.

Table 6
Results of the ARDL Bounds Test

PANEL 1	***: Results of the ARDL Bounds Tests***				
Column One		**Column Two**		**Column Three**	
Dependent variable: $M3/GDP$		**Dependent variable:** *INTUSRS*		**Dependent variable:** *ATM*	
$(M3/GDP)_{t-1}$	0.949 (0.000)**	$(INTUSRS)_{t-1}$	0.042 (0.991)	$(ATM)_{t-1}$	0.500 (0.013)**
ATM	0.444 (0.000)**	$M3/GDP$	-1.472 (0.036)**	*INTUSRS*	-0.004 (0.983)
INTUSRS	-0.272 (0.036)**	$(M3/GDP)_{t-1}$	1.322 (0.059)***	$(INTUSRS)_{t-1}$	0.300 (0.228)
$(INTUSRS)_{t-1}$	-0.331 (0.032)**	*ATM*	0.599 (0.105)	$M3/GDP$	0.655 (0.194)
C	0.674 (0.211)	C	1.933 (0.113)	$(M3/GDP)_{t-1}$	-0.698 (0.152)
				C	0.822 (0.455)
PANEL 2: ARDL Long-run and Bounds Test (Conditional Error Correction Regression)					
Column One		**Column Two**		**Column Three**	
$(M3/GDP)_{t-1}$*	-0.050 (0.507)	$(INTUSRS)_{t-1}$*	-0.995 (0.034)**	$(ATM)_{t-1}$*	-0.499 (0.013)**
(ATM)**	0.444 (0.000)**	$(M3/GDP)_{t-1}$	-0.151 (0.393)	$(INTUSRS)_{t-1}$	0.316 (0.358)
$(INTUSRS)_{t-1}$	-0.603 (0.000)**	(ATM)**	0.599 (0.105)	$(M3/GDP)_{t-1}$	-0.043 (0.727)
$D(INTUSRS)$	-0.272 (0.036)**	$D(M3/GDP)$	-1.473 (0.036)**	$D(INTUSRS)$	-0.004 (0.983)
C	0.674 (0.211)	C	1.933 (0.113)	$D(M3/GDP)$	0.655 (0.194)
				C	0.822 (0.455)
F-Bounds Test					
F-Statistic	26.970**	F-Statistic	8.308**	F-Statistic	28.313**
PANEL 3	***: Short-run and Long-run estimates***				
Column 1A	**Column 1B**	**Column 2A**	**Column 2B**	**Column 3A**	**Column 3B**
$D(M3/GDP)_{t-1}$	2.131 (0.003)**	$D(INTUSRS)_{t-1}$	-0.533 (0.833)	$D(ATM)_{t-1}$	1.024 (0.026)**
$D(M3/GDP)_{t-2}$	-1.210 (0.014)**	$D(INTUSRS)_{t-2}$	-0.152 (0.928)	$D(ATM)_{t-2}$	-0.453 (0.059)***
$D(ATM)_{t-1}$	-0.190 (0.250)	$D(M3/GDP)_{t-1}$	-0.112 (0.942)	$D(M3/GDP)_{t-1}$	0.173 (0.652)
$D(ATM)_{t-2}$	0.053 (0.563)	$D(M3/GDP)_{t-2}$	0.229 (0.890)	$D(M3/GDP)_{t-2}$	-0.097 (0.801)
$D(INTUSRS)_{t-1}$	-0.223 (0.099)***	$D(ATM)_{t-1}$	0.312 (0.670)	$D(INTUSRS)_{t-1}$	0.187 (0.330)
$D(INTUSRS)_{t-2}$	0.192 (0.204)	$D(ATM)_{t-2}$	-0.187 (0.701)	$D(INTUSRS)_{t-2}$	0.048 (0.837)
ECM_{t-1}	-0.778 (0.013)**	ECM_{t-1}	-0.829 (0.759)	ECM_{t-1}	-0.815 (0.025)**
C	0.033 (0.478)	C	0.289 (0.720)	C	0.014 (0.841)

Source: Author's Computation (using E-views 10)

NOTE:

PANEL 1: This panel displayed the results of the ARDL test with three different dependent variables in three columns. Column 1 has FIN (denoted as *M3*/*GDP*) as dependent variable while column 2 has internet ownership and usage (*INTUSRS*) as dependent variable, and column 3 has automated teller machine (*ATM* **)** as the dependent variable.

In the middle two columns, only *M3*/*GDP* was statistically significant in explaining variations in *INTUSRS* . Others including own lagged value of *INTUSRS* were not significant in explaining changes in *INTUSRS* .

In the last two columns, using ATM as dependent variable; all the variables except own lagged value were not significant in explaining changes in ATM ownership and usage. This

implies that ATM ownership and usage does not depend on FIN and internet device usage to perform optimally.

PANEL 2: This panel contains the long-run conditional error correction regression of the ARDL Bounds test. This panel has three-two in one columns with FIN (*M3*/*GDP*) as dependent variable in the first two-in-one column while second two-in-one column has internet ownership and usage (*INTUSRS*) as dependent variable, and third two-in-one column has automated teller machine (*ATM* **)** as the dependent variable.

For the results of the relationship existing among M3/GDP, ATM and *INTUSRS* ; using M3/GDP as the lead variable shows that the F-statistics (26.970) is significant at 1 percent level of significance with the F-statistics higher than the upper bounds at the 1 percent significance level. Hence, we conclude that there exist a long-run relationship between FIN and, the ownership and usage of ATM and internet ownership and usage (*INTUSRS*).

The results of the F-Bounds test of the relationship existing among *INTUSRS* ,M3/GDP and ATM; using *INTUSRS* as the lead variable shows that the F-statistics (8.308) is significant at 1 percent level of significance with the F-statistics higher than the upper bounds at the 1 percent significance level. Therefore, we can conclude that there exist a long-run relationship among internet-powered-electronic device ownership and usage (*INTUSRS*), FIN and, the ownership and usage of ATM.

For the F-Bounds test results of the relationship existing among ATM, M3/GDP and *INTUSRS* ; using ATM as the dependent variable shows that the F-statistic (28.313) is significant at 1 percent level of significance (with the F-statistic greater than the upper bounds at the 1 percent significance level). This implies that, there exist a long-run relationship among FIN and, the ownership and usage of ATM and internet ownership and usage (*INTUSRS*).

PANEL 3: This panel shows the results of the short and long-run estimates of the Vector error correction mechanism as presented in the six columns denoted as column 1A,1B,2A,2B,3A and 3B respectively.

The estimates of the ECM are all correctly "signed" and statistically significant in the first two columns (1A and 1B) and the last two columns (3A and 3B). However, the coefficient of the ECM is not statistically significant in the second two columns (2A and 2B). The significance (or insignificance) of the estimates of the ECMs was determined by using their probability values as the rule of thumb. As a general rule, if the probability value of each ECM is less than 10%, it is statistically significant; if it is greater than 10%, it is statistically insignificant. The ECM coefficient indicates that the speed of correction of any prior divergence to long-run equilibrium is 0.778 (78%) for the first two columns and 0.815 (82%) for the final two columns (when past deviations will be corrected in the current period).This simply means that the present value of FIN would adjust quickly to changes in both ATM ownership and usage and internet electronic device usage for the first two columns, whereas the present value of ATM ownership and usage would adjust quickly (82 percent) to changes in both FIN and internet electronic device usage for the last two columns.

CONCLUSION, POLICY IMPLICATIONS AND RECOMMENDATIONS

Using time series data from 1990 to 2020 using the ARDL Bounds cointegration test, the study explored the nature and kind of link between DF and FIN in Nigeria. This study was inspired by observations made during the World Bank and G20 Summits on how FIN may be

utilized to decrease and/or eradicate the growing financial poverty sweeping the world, particularly in financially poor countries. During the G20 Summit, it was emphasized that DF and FIN had not reached the less-privileged and financially disadvantaged people, which comprised the "huge section and majority of the financially voiceless ones" (G20(2010) and 2016). Because of the consequences for poverty reduction, financial exclusion, FS consolidation, and the transformation of both the banking industry and the broader economy, the subject of "DF and FIN in Nigeria" merits special attention from scholars. Our findings show that the implementation of DF to FIN in Nigeria seems to have had a mixed impact. Furthermore, our findings show that DF has a substantial influence on FIN when an internet-connected technological device is adopted as a proxy (for digital finance). Surprisingly, ATM ownership and usage has a negative long-run impact on FIN in Nigeria during the period under review. Therefore, we conclude that digital finance (internet-enabled devices, mobile phones, POS terminals, NFC-powered devices, chips, tablets, phablets, i-teller, e-money) and FIN are Siamese twins only when a suitable and adequate proxy is used. Our findings have diverse array of crucial evidence-based policy implications for long-run financial and economic policy design and implementation because banks and other financial service providers increasingly rely on Internet Service Providers (ISPs) for effective digital and FS delivery, policymakers should always look beyond policies that target banks and other financial service providers and adopt comprehensive FIN policies that integrate ISPs into the paradigm of the banking and financial sector policy design(Jappelli and Pagano,2002, Jensen,2007).

References

Abeywickrema, C. P. (2005). Remittances, microfinance and technology. In S. Mathison (ed.), *Electronic Banking with the Poor: Increasing the Outreach and Sustainability of Microfinance through ICT Innovation*, Foundation for Development Cooperation,

Adam, L., & Wood, F. (1999). An investigation of the impact of information and communication technologies in sub-Saharan Africa. *Journal of information Science,25*(4), 307-318.

AFI[Alliance for FIN](2016).Digital financial services: basic terminology, guideline notes No.19, August.

Agyekum, F.L., Stuart, & Hewa-Wellalage, N. (2016). Financial inclusion and digital financial services: empirical evidences from Ghana. *Munich Personal RePEc Archive (MPRA)* Paper No.82885

Alessandrini, P., Presbitero, A.F., & Zazzaro, A. (2009). Banks, distances and firms' financing constraints. *Review of Finance*, *13*(2), 261-307

Ang, J.B. (2011). Financial development, liberalization and technological deepening. *European Economic Review*, 55(5), 688-701.

Arora, R. (2010).Measuring Financial Access. Online. http://equlla.rcs.griffith.edu.au/research

Babajide, A.A., Adegboye, F.B., & Omankhanlen, A.E.(2015) Financial inclusion and economic growth in Nigeria. *International Journal of Economics and Financial*,5(3), 629-637.

Barley, S.R. (1986).Technology as an occasion for structuring: evidence from observation of CT scanners and the social order of radiology departments. *Administrative Science Quarterly*, *31*, 78-108.

Barley, S.R. (1990).The alignment of technology and structure through roles and networks, *Administrative Science Quarterly*, *35*, 61-103.

Buchanan, D.A., & Boddy, D. (1983).*Organizations in the computer age: technological imperatives and strategic choice*, Hants (UK), Gower.

Burkhardt, E.M., & Brass, D.J. (1990).Changing patterns or patterns of change: the effects of a change in technology on social network power and structure, *Administrative Science Quarterly*, *35*, 104-127.

Carter, N.M. (1984).Computerization as a predominate technology: its influence on the structure of newspaper organizations, *Academic Management Journal*, *27*, 247-270.

CBN(2018). 2017 Annual report national financial inclusion strategy implementation, A *Publication of the Central Bank of Nigeria*.

CBN(2019). The national financial inclusion strategy. A *Publication of the Central Bank of Nigeria*.

Chinn, M. D., & Fairlie, R. W. (2007). The determinants of the global digital divide: a cross-country analysis of computer and Internet penetration. *Oxford Economic Papers*, *59*(1), 16–44.

Chen, B.S., Hansen, S.G., & Stein, J.C. (2017).The decline of big-bank lending to small businesses: dynamic impacts on local credit and labour market. *NBER Working Paper No*.w23843

Christen, R. P., Rosenberg, R., & Jayadeva, V. (2004) *Financial institutions with a ''double bottom line:'' implications for the future of microfinance*. C-GAP, Washington, DC.

Diniz, E., Birochi, R., & Pozzebon, M. (2012) Triggers and barriers to Financial inclusion: the use of ICT-based branchless banking in an Amazon county. *Electronic Commerce Research and Applications*,*11*(5), 484-494.

Donovan, K. (2012). Mobile money for financial inclusion. *Information and Communication for Development*, 61-73.

FinCoNet (2016). Online and mobile payments: Supervisory challenges to mitigate security risks,www.finconet.org/FinCoNet_Report_Online_Mobile_Payments.pdf

FinCoNet (2017). Report on the digitalization of short-term, high-cost consumer credit,www.finconet.org/Digtalisation-Short-term-High-cost-Consumer-Credit.pdf

FinCoNet (2018). Online and mobile payments: An overview of supervisory practices to mitigate security risks www.finconet.org/FinCoNet_SC3_Report_Online_Mobile_Payments_Supervisory_Practices_Security_Risks.pdf

G20 (2016). G20 high-level principles for digital financial inclusion, www.gpfi.org/sites/default/files/G20%20High%20Level%20Principles%20for%20Digital%20Financial%20Inclusion.pdf

G20 (2010). G20 principles for innovative financial inclusion www.gpfi.org/sites/default/files/documents/G20%20Principles%20for%20Innovativ%20Financial %20Inclusion%20-%20AFI%20brochure.pdf

GPFI(2011). [Global Partnership for Financial Inclusion]G20 Principles for innovative financial inclusion: Alliance for financial inclusion. Bangkok, Thailand.

Gupte, R., Venkataramani, B., & Gupta, D. (2012). Computation of financial inclusion index for India. *Procedia-Social and BehaviouralSciences, 37*, 133-149.

Hajille, M., Stringer, D.Y., & Metghalchi, M. (2017) Financial market inclusion, shadow economy and economic growth. *The Quarterly Review of Economics and Finance, 66,*149-158.

Hannig, A., & Jansen, S. (2010). Financial inclusion and financial stability: Current policy issues. *Asian Development Bank Institute Working Paper,* No. 259, 1-29.

Ishioro, B. O. (2022a). Dynamic effects of health expenditure shocks on HIV Prevalence in sub-Saharan Africa. *Journal of Academic Research in Economics***.** *14* (3),November.

Ishioro, B. O. (2022b). Deposit money bank-based financial inclusion and economic growth in Nigeria: the role of a dual folded proxy. *Gusau International Journal of Management and Social Sciences,5*(3),1-23.

Ishioro, B. O. (2022c). Unit root and stationarity tests in expenditure on health and economic growth series: maximizing the power of breakpoints. *Himalayan Journal of Community Medicine and Public Health*, *3*(6), 14-21.

Ishioro, B.O. (2022d). The long-run macroeconomic determinants of banks' performance in Nigeria. *KIU Journal of Social Sciences*, *8*(4), 25-37.

Ishioro, B.O., & Maku, O.A. (2022). Health care expenditure-GDP Nexus in Sub-Saharan Africa, *Journal of Positive School Psychology*, *6*(12), 1649-1664.

Ishioro, B. O. (2020a). Crude oil and economic growth in Nigeria: a simplified pair-wise causality test. *Journal of Academic Research in Economics***,** *12*(2), 224-246.

Ishioro, B. O. (2019). Energy consumption and economic growth in Nigeria: an augmented neoclassical growth model perspective. *Journal of Environmental Management and Tourism*, *7*(39), 1637-1657:Winter

Ishioro, B.O. (2018). Energy consumption and performance of sectoral outputs: evidence from an energy-impoverished economy. *Journal of Environmental Management and Tourism*, *7*(31), 1539-1558

Ishioro, B.O. (2016). HIV/AIDS and macroeconomic performance :empirical evidence from Kenya. *Scientific Papers of the University of Pardubice, Series D, XXIII*(36), 102-117

Ishioro, B.O. (2015a). Intertemporal optimization of the consumption of petroleum stock: empirical evidence from Nigeria. *Journal of Academic Research in Economics*, *7*(2), 232-255

Ishioro, B.O. (2015b). The long-run relationship between foreign reserves inflows and domestic credit: evidence from a small open economy, *Oeconomica*, *11*(2), 18-41.

Jack, W., & Suri, T. (2011).*Mobile money: the economics of M-PESA*. Cambridge, MA. USA. National Bureau of Economic Research.

Jagtiani, J., & Lemieux, C. (2018). Fintech lending and the roles of alternative data sources. *Federal Reserve Bank of Philadelphia working paper.*

Jappelli, T., & Pagano, M. (2002). Information sharing, lending and defaults: Cross-country evidence. *Journal of Banking & Finance*, *26*(10), 2017-2045.

Jensen, R. (2007). The digital provide: Information (technology), market performance, and welfare in the South Indian fisheries sector. *The Quarterly Journal of Economics*, 879-924.

Kauffman, R.J., & Riggins, F.J. (2012). Information and communication technology and the sustainability of microfinance. *Electronic and Commerce Research and Applications*, *11*(5), 450-468.

Kendall, J., Mylenko, N., & Ponce, A. (2010). Measuring financial access around the world. *World Bank Policy Research Working Paper Series*, 5253.

Kpodar, K., & Andrianaivo, M. (2011). *ICT,* Financial Inclusion, *and growth evidence from African countries*. USA. International Monetary Fund. 1455225010.

Kumar, C., & Mishra, S. (2000). Banking outreach and household level access: analyzing financial inclusion in India. *India Gandhi Institute of Development Research* (IGIDR), Mumbai.

Le, T.H., Chuc, A. T., &Taghizadeh-Hesary, F. (2019). Financial inclusion and its impact on financial efficiency and sustainability: Empirical evidence from Asia. *Borsa Istanbul Review*, *19*(4), 310-322.

Mehrotra, N., Puhazhendhi, V., Nair, G.G., & Sahoo, B.B. (2009). *Financial inclusion: an overview*. Mumbai, National Bank for Agricultural and Rural Development.

Mlachila, M., Dykes, D., Zajc, S., Aithnard, P.-H., Beck, T., Ncube, M., & Nelvin, O. (2013). Banking in Sub-Saharan Africa: challenges and opportunities. *Working Paper of The European Investment Bank.*

Mlachila, M., Park, S.G., Yabara, M. (2013). Banking in Sub-Saharan Africa: the macroeconomic context. *International Monetary Fund* (*IMF*).

Ngoma, G. (2019). Financial inclusion and its determinants in Zimbabwe, *International Journal of Innovative Research in Multidisciplinary Field*, *5*(3), 78-87.

OECD (2017). OECD digital economy outlook 2017, OECD Publishing, Paris http://dx.doi.org/10.1787/9789264276284-en

OECD (2015). OECD digital economy outlook 2015, OECD Publishing, Paris. DOI:http://dx.doi.org/10.1787/9789264232440-en

Ouma, S.A., Odongo, T.M., & Were, M. (2017) Mobile financial services and financial inclusion. Is it a boon for savings mobilization? *Review of Development Finance*,*7*(1), 29-35 (June).

Ozili, P.K. (2018).Impact of digital finance on financial inclusion and stability. *Borsa Instanbul Review*, *18*(4), 329-340.

Pesaran, M. H., Y., Shin, & Smith, R. (2001). Bounds testing approaches to the analysis of level Relationships. *Journal of Applied Econometrics*, *16*, 289-326.

Sarma, M., & Pais, J. (2008). *Financial Inclusion and development: A cross country analysis*. Annual conference of the Human Development and Capability Association, New Delhi. Available from: http://www.innosocial.in/services/financial-inclusion/

Sarma, M. (2004). *Index of financial inclusion.* Working paper 215, Indian Council for Research on International Economic Relations.

Triki, T., & Faye, I. (2013). *Financial inclusion in Africa*. African Development Bank: Tunis.

Uchendu, O. A. (1998).Concentration in the commercial banking industry in Nigeria. *The Nigerian Journal of Economic and Social Studies (NJESS),40*(3), 385-394.

Woodward, J. (1965). *Industrial organizations: theory and practice*, London (UK), Oxford University Press

World Bank, (2008). *Finance for all? policies and pitfalls in expanding success. a world bank policy research report*. World Bank Group. Available from: http://www.myilibrary.com?id=119146

World Bank, (2009). *Banking the poor measuring Banking access in 54 Economies*. Washington, DC, World Bank. Available from: http://public.eblib.com/choice/publicfullrecord.aspx?p=459845

Zins, A., & Weill, L. (2016). The determinants of financial inclusion in Africa. *Review of Development Finance, 6*, 46-57.