International Journal of Economics, Commerce and Management
United Kingdom ISSN 2348 0386 Vol. 11, Issue 9, Sep 2023

https://ijecm.co.uk/

EFFECT OF FINTECH AND FINANCIAL INCLUSION ON ECONOMIC GROWTH IN NIGERIA

Ephraim Victor Okon
Institute of Strategic and Development Communication,
Nasarawa State University, Nigeria
ndiche77@yahoo.com

Etima David Umoh
Department of Economics, Faculty of Social and Management Science,
Nasarawa State University, Nigeria
etimau80@gmail.com

Udo Emmanuel Samuel
Emma-Kenrick Consult, Nigeria
emmanuelkenrickconsult@gmail.com

Abstract

Studies exploring the nexus between FinTech and financial inclusion in Nigeria employed the indirect measures of FinTech. Previous studies in this area also adopted a bundle indicator of financial inclusion ignoring the individual indicators effect. This study contributes to the extant literature by expanding the generic FinTech frontier to capture the direct measures (automated teller machine, web pay, mobile banking, and point of sale) and also test the model on Nigeria by unbundling financial inclusion indicators individual index to examine the degree of contribution. The autoregressive distributed lag (ARDL) bounds test cointegration approach was used to estimate the respective equations and find evidence of a long-run nexus between FinTech, financial inclusion, and economic growth. The direct measures of FinTech positively and significantly impact financial inclusion and economic growth. The negative nexus between automated teller machines, financial inclusion, and economic growth can be attributed to the

closure of most automated teller machine galleries in bank branches and outside the branches due to, high maintenance costs and insecurity around galleries. This is evident in the long waiting time to use the automated teller machine and the growing number of bank customers further suggests that the current 22,500 automated teller machines are insufficient to enhance inclusive growth in Nigeria. Individual financial inclusion indicators positively impact economic growth while the usage dimension of financial inclusion improves economic growth but not significantly. Also, bank branches had a positive and significant impact on economic growth, and credit to private had a non-significant effect.

Keywords: Financial inclusion; economic growth; FinTech; ARDL; Nigeria

INTRODUCTION

The 21st-century economic and financial policy objectives include the realization of inclusive economic and financial development through FinTech resourceful mobilisation and allocation of economic and financial resources to economic agents particularly the active poor. Largely comprising of the rural dwellers most commonly referred to as the "*Base of the Pyramid*" (BoP) living in extreme poverty on an income of less than $2.00 per day (Udoh, Udo, Abner, Ike, Tingir, & Ibekwe, 2016). According to the United Nations Secretary-General's Special Advocate (2013) for inclusive financial development, more than 200 million small- and medium-sized businesses in emerging economies are financially and data excluded, thus limiting their competitiveness and ability to thrive. Despite extensive progress made by banks, microfinance, savings and loans institutions, credit unions, and cooperative societies in extending financial services to marginalized groups, about 2.5 billion of the world's adult population, are excluded from the formal financial services (Udo, et, al 2023; Udo, et, al 2019; Hannig & Jansen, 2010).

In Nigeria, about 38.3 million adults are data and financially excluded out of which 21.3 million are adult women representing 20% and 17 million men (Udo, et, al 2023). The World Bank (2014) report disaggregated financial exclusion into; voluntary and involuntary exclusion. Voluntary exclusion arises from economic agents' decision not to use financial services either because they have no immediate need for them or due to cultural and religious beliefs. Others also cite inadequate household incomes, commuter distances from financial service providers, cumbersome documentation, market failures, and imperfections associated with the free market as reasons for their involuntary exclusion (Park & Mercado, 2015).

FinTech involves the integration of information and communication technology into the operational and business activities of classical financial systems for financial transactions,

payment, insurance, and peer-to-peer lending. The incorporation of financial technology (FinTech) into the mainstream operational and business activities of the classical financial systems has successfully reshaped, restyled, and eliminated some of these barriers (Udo, et, al 2023). Financial inclusion is the integration of the various FinTech platforms to make formal financial services available, accessible, and affordable to all households and enterprises, regardless of their level of income (Diniz, Birochi, & Pozzebon, 2018; Demir, Pesque-Cela, Yener Altunbas, & Murinde, 2020).

Formal financial inclusion begins with operating a deposit or transaction account with any financial institution or other financial service providers (Demirguc-Kunt, Klapper, & Singer, 2017; Udo, et, al 2023). In the UN 2030 agenda for sustainable development, policymakers, economists, and governments globally recognise the indispensable role of FinTech in economic growth, financial inclusion, and achieving the Sustainable Development Goals (SDGs). They are also preoccupied with the formulation of fit-for-all-purpose financial inclusive policies to integrate the unbanked and underbanked population into the mainstream financial system.

To address the upshot of widespread involuntary exclusion, exposure of the active poor to usurious moneylenders, the inability of the poor to improve earnings, protect themselves in times of crisis, and build for the future (Udo, et, al 2023, Sahay, Čihak, N'Diaye, Barajas, Mitra, Kyobe, Mooi, & Yousefi, 2015; World Bank, 2014; IMF, 2014; Demirguc-Kunt, Asli, Leora, Klapper, Dorothe, Saniya, & Jakes, 2018). Also, in a bid to address the upshot of widespread involuntary exclusion, in Nigeria the Central Bank of Nigeria (CBN) in 2012, reintroduced the financial inclusion strategy to improve adult access to financial products and services from the 21.6% reported in 2010 to 70% in 2020, access to savings from 24.0% to 60%, credit from 2% to 40%, insurance from 1% to 40%, and pension from 5% to 40% (Udo, et. al 2023; Mckinsey Global Institute, 2014; Ayinde, Ganiyu, & Yinusa, 2016; Madichie, Maduka, Oguanobi, & Ekesiobi, 2014; Cyn-Young & Ragelio, 2015). The rapid evolution in development communication, internet services, availability of mobile and smartphones, and the availability of information technology infrastructure, to the rural dwellers, has enormously transformed and provided secure, low-cost, and contactless financial instruments across ecosystems, enhanced cashless financial systems and limited traditional branch-based banking (Dahiya & Kumar, 2020; Udo, et. 2019; Inoue & Hamori, 2016; Kim et al., 2017; Sethi & Acharya, 2018; Sharma, 2016; Lenka & Sharma, 2017 and others).

This is evidenced in the Nigerian Inter-Bank Settlement System (NIBSS) report (2022) on active accounts with a bank, credit union, microfinance institution, and mobile money service providers increasing by 14.41% from 97.485million to 111.54million in 2022 (Udo, et, al 2023). Total savings increased by 13.8% from N114.13 million in 2019 to N 138.91 million in May 2022.

The geometric increase could be attributed to the Covid-19 safety measures of social and economic lockdown (Udo, et, al 2023; Udo, et,al 2019). To curtail the spread of the virus. The lockdown period reinforced the importance of cost-effective, affordable, available, and flexible, agency banking channels as a vital part of the financial ecosystem. On an operational basis, most agents rebalance through the ATM to meet liquidity needs (Udo, et, al, 2019).

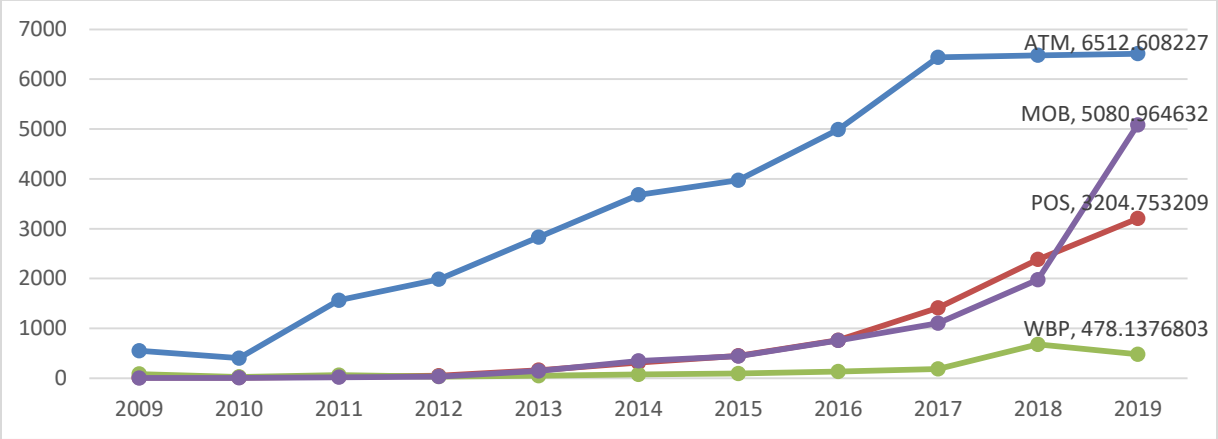
The positive influence of FinTech on economic growth, extreme poverty, and income inequality gap reduction through financial inclusion is acknowledged in the theoretical and empirical literature. This significance and the contribution as observed can be explained under three key aspects: (a) boosting financial inclusion, improving international trade finance transactions, enabling remittances, and enhancing financial efficiency, (b) in response to the innovation-growth hypothesis, FinTech improves investment and allocation procedures (Allen 2011), accelerates the financial development process (Ozcan 2008), contributes to financial institutions efficiency level (Shaughnessy 2015), and builds the quality of financial products and services, (c) with greater accessibility to formal financial services through FinTech platforms (Raffaelli and Glynn 2013). By including the data and financially excluded individuals, households, and small-medium businesses in the mainstream economic and financial systems. The outcome of FinTech integration into the economic and financial climate is financial inclusion.

This study contributes to the literature by expanding the generic FinTech to include direct measures, due to the upsurge in FinTech in Nigeria. However, most of the proxies within the literature restrict FinTech to traditional banks and obscure the current evolution of FinTech outside the mainstream financial boundaries. In Nigeria mobile banking, internet banking, point of sale, and web pay among other digital products (that control a substantial portion of access, usage, and penetration of financial services are innovations initiated, owned, and championed by telecommunication companies).

To capture the essence of “out of mainstream banking and financial FinTech. This study broadened the definition of a direct measure of FinTech as the total value of transactions on retail digital platforms which include ATMs, point of sales, internet banking, mobile payment, Nigerian Interbank Settlement System Instant Payment (NIP), Nigerian Interbank Settlement System Electronic Fund Transfer (NEFT), and E-billsPay transactions. The FinTech platforms considered in this study are mobile banking [MOB], point of sales [POSs], web pay [WBP], and automated teller machines [ATM]. This study contributed by unbundling the financial inclusion indicators to access individual contributions to financial inclusion and economics in Nigeria and also help tailor specific policies to each of the individual indicators of financial inclusion.

This study also contributes to the literature by testing the linear influence of FinTech on financial inclusion and economic growth using the autoregressive distributed lag (ARDL) bounds testing model. Figure 1 reveals that the values of ATM, MOB, POS, and WBP transactions increase trajectory from January 2009 to December 2019 in Nigeria within the period under review. The possible explanation for the geometric increase could be the ease, availability, and affordability features associated with these digital products. Between 2009 and 2019, the value of ATM transactions increased from naira N548.6 billion to N 6512.60 billion, representing above 1,415% change. Similarly, the values of MOB, POS, and WBP transactions also increased geometrically respectively. Figure 1 also revealed ATM to be the most popular digital platform in Nigeria, followed by MOB and POS, while WEP witness the lowest growth rate within the period under review. The results show that ATM, POS, and MOB account for the fastest channels to access and use financial products, while poor internet services and coverage affect access and usage of financial products by individuals.

Figure 1: Monetary value of digital platform transactions in (N Billions) Nigeria



LITERATURE REVIEW

Financial Inclusion

Financial inclusion is a process by which all households, individuals, and businesses regardless of income level have access to affordable, flexible, eco-friendly, and appropriate financial services that meet their daily financial and economic needs to improve their lives. The maxim of financial inclusion fundamentally inferred connecting the unbanked and underbanked individuals, businesses, and households to far-reaching economic benefits and financial services (Sarma, 2015; Siddik et al., 2019; Udo, et, al 2023). Financial development and financial inclusion are broadly two inseparable concepts (financial inclusion is a basic determining element of financial development), it is imperative to establish that a country may

be financially developed with several individuals, businesses, and households and data excluded from the mainstream financial system (Lenka, 2021). Both promote economic growth with divergent magnitudes (Chauvet & Jacolin, 2015; Li & Wong, 2018).

Patrick (1966) argued that a nation's level of development influences its level of technological advancement, economic growth, and financial development. The development of communication technology has greatly improved digital financing. As such digital financing is considered a better solution for financial inclusion (GSMA, 2017). Financial inclusion-exclusion is a result of numerous factors such as the absence of literacy and awareness, unfavourable demographic and geographical conditions, self-exclusion, income per capita, internet access, inflation, and bank concentration (Thathsarani et al., 2021; Asuming et al., 2018; Ajide, 2017; Karlan et al., 2016; Oyelami et al., 2017; Evans & Adeoye, 2016; Soumaré et al., 2016; Sotomayor et al., 2018; Pazarbasioglu et al., 2020). Financial exclusion arises principally from social exclusion and poverty (Barboni et al., 2017).

Indicators of Financial Inclusion

The lack of consensus on the definition of financial inclusion is also evidenced in the lack of appropriate indicators of financial inclusion. In a bid to zero down and developed an all-inclusive indicator of financial inclusion. Beck et al. (2007) measured financial inclusion under access (credit facility; deposit) and usage (payment system). Similarly, Honohan (2008) adopted a percentage of households with an active account in the formal financial sector. Demirguc-Kunt et al., (2018) among others adopted a set of specific indicators to include savings, credit, and payment. Park and Mercado (2015) and Nguyen, (2020); Sarma, (2016) argued that the adoption of individual metrics can only offer a hazy picture of an economy's financial system's inclusiveness and degree of coverage. The findings of Neaime, and Gaysset (2018); Khan, Khan, Sayal, and Khan, (2021); Park and Mercado (2018) collaborated these findings. Over the decades diverse theoretical and empirical studies by Gupte et al., (2012); Li, (2011); Sarma, (2008) among others have tried to develop and construct a suitable indicator for financial inclusiveness. In developing an all-inclusive indicator of financial inclusion, Gupte et al. (2012) used the average of four dimensions usage, outreach, cost of transactions, and ease of transactions.

The adopted dimension index followed the United Nations Development Program (UNDP) model in constructing the human development index (HDI). The major methodological limitation of these studies according to Amidžic et al., (2014); Singh and Stakic, (2020) is the arbitrary allocation of equal weights or weights to the selected elements. Amidžic et al., (2014); Singh and Stakic, (2020) posit that such weights are assigned based on academic intuition, the

author's experience, and the assumption that all indicators have the same impact on financial inclusiveness. To determine the appropriate weights, Amidžic et al. (2014) and Clamara and Tuesta (2014) proposed a factor analysis and principal component analysis (PCA) approach respectively, as a less arbitrary weights-assigning model that relies on available data for the various dimensions and indicators of financial inclusion. However, diverse studies, in developing financial inclusion index, adopted either the PCA or individual approach (Ahamed & Mallick, 2019; Anarfo et al., 2019; Elsherif, 2019; Nguyen, 2020; Park & Mercado, 2018; Dahiya & Kumar, 2020; Huang & Zhang, 2019; Sethi & Sethy, 2019). Each of these methods has merits and demerits which has allowed for non-consensus among scholars (Mialou & Amidžic, 2017; Park & Mercado, 2015). The construction of the financial inclusion index is not only divergent in method, but it also varies in the choice of indicators among studies (Nguyen, 2020).

Theoretical Framework

FinTech, Financial Inclusion, and Economic Growth

In establishing the financial sector-economic growth nexus, the pioneering studies of Schumpeter (1912), Shaw (1973), and McKinnon (1973) laid the foundation. The underlying evidence is that financial development is fundamental in explaining economic growth patterns through efficient mobilization and allocation of limited economic-financial resources to active economic agents in developed and emerging economies (Chen et al., 2021). An efficient financial system drives the processes of creating wealth, trade, and, most importantly, capital formation (Ahmed 2006). In accounting for cross-country variations in economic growth, exogenous and endogenous growth models were developed. The exogenous growth model emphasises the significance of technological advancement (Solow, 1956) and labour productivity (Domar, 1946) in growth disparities globally. Contemporary, studies criticised exogenous growth for disregarding efficiency variables such as macroeconomic conditions, appropriate regulatory framework, and institutions that convert savings into investments (Chirwa & Odhiambo (2018).

Modern economic development is largely influenced by the exogenous growth assumption of, innovation through the diffusion of technological advancement, new organisational structures, production processes, and management styles in transforming a static economy into a dynamic economy. Contemporary, innovation has evolved from the creation of new products to provide solutions to ongoing problems in an economy (Kotsemir and Abroskin 2013). Financial innovation is considered the "engine" driving a financial system toward its goal of improving the performance of the real economy (Merton 1992).

The theoretical nexus between FinTech, financial inclusion, and economic growth are underpinned in, two major channels; (a) the provision of affordable, flexible, and cost-effective financial services to the "*Base of the Pyramid*" (BoP) to encourage economic activities and increase national output and improve welfare (Udo, et, al 2023; Adedokun & Ağa, 2021; Nanda & Kaur, 2016; Sahay et al., 2015 Udoh, Udo, Abner, Ike, Tingir, and Ibekwe, 2016); (b) including the excluded individuals, households and small-business into the mainstream financial systems to boost saving, funds mobilization and allocation for investment, poverty reduction among others (Ramkumar, 2017). Mobile technology and development communication are the springboards for digital financial inclusion (Chu 2018). Aside from the adoption of financial digital technology, the extension of development telecommunications services to rural areas for digital communication completes the digital inclusion of the economy (Peru 2018; Ghosh, 2016; Gosavi, 2018; Tchamyou, Erreyger, & Cassimon 2019).

Empirical Literature

The FinTech-financial inclusion nexus has been extensively examined, these studies report diverse and contradictory results as presented in Table 1. Most of these studies focused on measuring the degree of financial inclusion (Abdulmumin et al., 2019; Lenka & Barik, 2018; Nguyen, 2020). Evans and Adeoye, (2016); Soumaré et al., (2016); Oyelami et al., (2017); Sotomayor et al., (2018); Chinoda et al., (2019) focused on the micro-macro level determinants of financial inclusion. The studies of Inoue and Hamori, (2016); Chatterjee, (2020); Nizam et al., (2020), and others opined that FinTech through financial inclusion promotes economic prosperity.

Table 1: Summary of Empirical Literature

Authors	Objective	Scope	Methodology	Findings
Inoue and Hamori (2016)	Effect of financial access on economic growth	37 sub-Saharan African countries (2004– 2012)	Panel dynamic GMM	Positive nexus between several commercial bank branches and real GDP per capita.
Thomas et al. (2017)	Financial Accessibility and economic growth nexus	8 South Asian countries (2007-2015)	Panel dynamic GMM	Positive nexus
Kim et al. (2017)	financial inclusion and economic growth nexus	55 Organization of Islamic Cooperation (OIC) countries	Dynamic panel vector autoregressive (VAR); impulse-response functions (IRFs) and panel Granger causality tests	Positive nexus

Malinda and Maya (2018)	Linkages between financial inclusion and economic growth	11 countries (2007-2016)	The pooled regression model, vector error correction model, and Granger causality tests	Long-run nexus between financial inclusion and economic growth.
Sethi and Acharya (2018)	financial inclusion on economic growth nexus	31 developed and developing countries from 2004 to 2010	Panel model (country-fixed effect, random effect and time-fixed effect regressions, panel cointegration, and panel causality tests)	Positive long-run nexus between financial inclusion and economic. A bi-directional causality between financial inclusion and economic growth
Van and Linh (2019)	financial inclusion on economic development nexus	23 Asian countries (2010-2015)	The pooled regression model, vector error correction model, and Granger causality tests	Positive nexus between numbers of bank branches, ATMs, domestic credit in the private sector, and economic development
Singh and Stakic (2020)	Nexus between financial inclusion index and economic growth	8 South Asian Association for Regional Cooperation (SAARC) countries for the period (2004-2017)	Fully Modified Ordinary Least Square (FMOLS) and Dynamic Ordinary Least Square (DOLS).	Positive nexus
Huang et al. (2021)	Financial inclusion and economic development nexus,	Comparing the old and new EU (27) countries (1995-2015)	FMOLS and panel autoregressive distributed lag (ARDL)	Positive and significant in the low—income and new EU countries than for high-income and old EU countries
Dahiya and Kumar (2020)	The Link between economic growth and Financial Inclusion	India (2007-2015)	Bayesian autoregression	Mixed results

Despite the about 35.5% internet and 47.36 broadband penetration (% of the population) for the use of mobile phones and internet access, this study empirically examined the FinTech-financial inclusion nexus on economic growth due to the upsurge in digital retail financial services platforms (that control a substantial portion of deposits innovations initiated, owned, and championed by telecommunication companies, when developing the index of financial inclusion in Nigeria also close the literature gaps.

METHODOLOGY

Data and Econometric Model

The dataset was collated from the CBN statistical database and World Bank Development Index for the period 2009Q1–2019Q4. For this study, FinTech is measured as the sum of financial transactions on retail digital platforms evaluated at a constant price. Transactions on these platforms are expected to increase financial inclusion and boost

economic growth. According to Adil et al. (2020), retail digital financial products are the most potent measure of FinTech.

The dependent variable for this study is the GDP per capita as a measure of economic growth (Inoue & Hamori, 2016; Kim et al., 2017). The value of the is expressed in US dollars and natural logarithm. Financial inclusion was proxied by the bundle indicators taking on three dimensions (availability, penetration, and usage). Availability is unbundled as (number of bank branches); Sarma (2016) argued that transaction points are fundamental to financial inclusion and should be easily available and convenient to users.

Penetration as (banks depositors per 1,000 adults). An all-inclusive financial system requires numerous users, implying that it needs to penetrate deeply (Nguyen, 2020). Usage as (credit to the private sector (% of GDP). This is a reflection of the extent to which the private sector contracts loans from financial institutions for various projects. A more comprehensive financial system guarantees that financial services are wholly utilized (Nguyen, 2020; Sarma, 2016). Control variables: financial deepening index (Domestic credit to the private sector and M3 (% of GDP) and development communication index (the internet access (% of the population) and Mobile cellular subscriptions (per 100 people) were adopted for their influence on financial inclusion and the economy.

Estimation Strategy

Given that the variables are time series (t), testing the stationary properties of the variables is extremely vital. The stationary properties of the variables were estimated using the NG-Perron, to address Augmented Dickey–Fuller (ADF) and Phillips–Perron (PP) associated weak powers (Folarin & Asongu, 2019). The autoregressive distributed lag (ARDL) bounds test framework developed by Pesaran et al. (2001) was used to examine the long-run nexus among the variables as specified in Eqn (1). The ARDL integrates variables of diverse orders of integration, we considered it the most suitable. The bound test eliminates issues of serial correlation and endogeneity of variables (Rahman & Kashem, 2017). The ARDL model is expressed as:

$$GDP\ t = \beta_0 + \beta_i\ GDPt\text{-}i + \delta_i\ ATM_{t-i} + \lambda_i\ POS_{t-i} + Y_i\ WBP_{t-i} + \phi_i\ MOB_{t-i} + \pi_i\ BB_{t-i} + \theta_i\ CP_{t-i} + \upsilon_i\ BD_{t-i} + \psi_i\ DC_{t-i} + \omega_i\ M3_{t-i} + \tau_i\ IP_{t-i} + \chi_i\ MC_{t-i} + \varepsilon_t \quad (1)$$

Where; Economic Growth (GDP); Retail Digital Products (ATM, POS, WBR and MOB) Financial Inclusion (BB, CP, BD); Financial Deepening (DC, M3) Development Communication (IP, MC).

The optimal lag for each variable was automatically determined using Schwarz information criteria (SIC). The ARDL bound test is expressed as follows in equation (2):

$$\Delta lnGDP_t = \beta_0 + \beta_i \Delta lnGDP_{t-i} + \delta_i \Delta lnATM_{t-i} + \lambda_i \Delta lnPOS_{t-i} + \Upsilon_i \Delta lnWBP_{t-i} + \phi_i \Delta lnMOB_{t-i} + \pi_i \Delta lnBB_{t-i} + \theta_i \Delta lnCP_{t-i} + \upsilon_i \Delta lnBD_{t-i} + \psi_i \Delta lnDC_{t-i} + \omega_i \Delta lnM3_{t-i} + \tau_i \Delta lnIP_{t-i} + \chi_i \Delta lnMC_{t-i} + \lambda_1 lnGDP_{t-1} + \lambda_2 lnATM_{t-1} + \lambda_3 lnPOS_{t-1} + \lambda_4 lnWBP_{t-1} + \lambda_5 lnMOB_{t-1} + \lambda_6 lnBB_{t-1} + \lambda_7 lnCP_{t-1} + \lambda_8 lnBD_{t-1} + \lambda_9 lnDC_{t-1} + \lambda_{10} lnM3_{t-1} + \lambda_{11} lnIP_{t-1} + \lambda_{12} lnMC_{t-1} + \varepsilon_t \quad (2)$$

Where; Δ = the difference operator, and *ln* is the natural log of the variables. The F-statistics value of the bound test was estimated to evaluate the presence of a long-run nexus among the variables as prescribed by Pesaran et al. (2001). The value of the estimated F-statistics is compared with the upper and lower critical values.

Decision rule: "If the calculated F-statistics is greater than the upper critical value, the null hypothesis of no cointegration is rejected, denoting the existence of a long-run nexus, if the value of the F-statistics is less than the lower critical value, a long-run nexus does not exist". There could also be an inconclusive scenario where the value of the F-statistics falls between the upper and lower critical values. From equation (2), the short-run dynamics are captured by λi; for i = 1, 2,3,4,5. . ., 11 and the long-run dynamics are captured by β_i; γ_i; δ_i; ρ_i; τ_i; υ_i; θ_i; ωi; ϕ_i; χ_i and σ_i for i = 1, 2, 3, 4, 5. . . ., p.

The error correction model, equation (2) could be expressed as:

$$\Delta lnGDP_t = \beta_0 + \beta_i \Delta lnGDP_{t-i} + \delta_i \Delta lnATM_{t-i} + \lambda_i \Delta lnPOS_{t-i} + \Upsilon_i \Delta lnWBP_{t-i} + \phi_i \Delta lnMOB_{t-i} + \pi_i \Delta lnBB_{t-i} + \theta_i \Delta lnCP_{t-i} + \upsilon_i \Delta lnBD_{t-i} + \psi_i \Delta lnDC_{t-i} + \omega_i \Delta lnM3_{t-i} + \tau_i \Delta lnIP_{t-i} + \chi_i \Delta lnMC_{t-i} + \infty ECT_{t-1} + \varepsilon_t \quad (3)$$

ECT is the error correction term that captures the long-run nexus between the variables. The coefficient, ∞, and the speed (between 0 and 1) of convergence to long-run equilibrium from short-run divergence due to shocks in the system. ∞ is expected to be negative and significant after an external shock. 0 = the absence of any adjustment, 1 = perfect or full adjustment after the occurrence of shock. The diagnostic tests of the ECM result, that is, autoregressive conditional heteroscedasticity (ARCH), the Breusch–Godfrey (BG) test for serial correlation, and the Jargue–Bera (JB) test for normality.

Table 2 Summary of Variables Description

Variable	Dimension	Description	Sources
GDP per capita	Economic Growth	GDP per capita is gross domestic product divided by midyear population. GDP is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products.	Evans (2015)
ATM, POS, WEP, and MOB	Retail digital platforms	Ease access to financial services (Automated teller machine, web pay, point of sales, and mobile banking)	Asongu and Nwachukwu (2018); Asongu and Odhiambo (2019); Demir et al. (2020)

Bank branches (BB)	Availability	Number of commercial bank branches per 100,000 adults	Adeola and Evans (2017)
Credit to the private sector (% of GDP (CP)	Usage	Reflection of the extent to which the private sector contracts loans from financial institutions for various projects. A more comprehensive financial system guarantees that financial services are wholly utilized.	Nguyen, (2020); Sarma, (2016).
Banks depositors (BD)	Penetration	Number of deposit accounts with commercial banks per 1,000 adults	Evans (2015); Adeola and Evans (2017)
Domestic credit to the private sector (% of GDP) (DC)	Financial deepening	Domestic credit to the private sector refers to financial resources provided to the private sector by financial corporations, such as through loans, purchases of nonequity securities, trade credits, and other accounts receivable, that establish a claim for repayment. For some countries, these claims include credit to public enterprises.	Qamruzzaman and Wei (2018)
M3 (% of GDP) (M3)		M3 Money Supply is an indirectly derived measure of the supply of money which includes currency with the public; current and savings deposits with the banking system; bank-issued certificates of deposit; Term deposits of residents; call/term borrowings from 'non-depository' corporations by the banking system.	
Individuals using the Internet (% of the population) (IP)	Development communication	Internet users are individuals who have used the Internet (from any location) in the last 3 months. The Internet can be used via a computer, mobile phone, personal digital assistant, games machine, digital TV, etc.	
Mobile cellular subscriptions per 100 people. (MC)		Mobile cellular telephone subscriptions are subscriptions to a public mobile telephone service that provide access to the PSTN using cellular technology. The indicator includes (and is split into) the number of postpaid subscriptions and the number of active prepaid accounts, The indicator applies to all mobile cellular subscriptions that offer voice communications.	

EMPIRICAL ESTIMATION

The descriptive statistics result is reported in Table 3. The result shows that the average value of MOB transaction for the review period is N900.376 bn, and about thrice the average value of ATM, POS and four-fold the average of WBP, which suggest that mobile money is the fastest, easiest, and most convenient retail digital platform to access financial service-product. This signals a gradual shift from ATM to a more convenient and accessible retail digital platform. WBP is the least patronized retail platform in Nigeria. The average number of deposit accounts is 823. 463 denoting penetration and usage proxy by credit to the private sector is 18.759. This is an indication that FinTech has a positive influence on financial inclusion and is evident in usage and access to financial services. The average value of N22.507 for M3 denoting financial deepening show that financial sector development has a positive influence on economic growth

with an average value of N2370.09 bn and N12.805 bn for domestic credit for the reviewed period. The average value of 75.543 for mobile cellular subscription show the importance of developing communication on financial inclusion and is evidenced in the average value of 22.497% for individuals using the internet for information. The Ng–Perron unit root test presented in Table 4 reveals that all the variables are stationary either at level or at first difference. Thus, satisfying the condition for using Pesaran et al.'s (2001) ARDL bounds test to determine the FinTech, financial inclusion, and economic growth long-run nexus.

Table 3: Descriptive Statistics

	Mean	Median	Max	Min	Std. Dev.	Skew	Kurt	Jarque-Bera
ATM	3581.10	3679.87	6512.60	399.71	2237.27	0.024	1.6164	3.5138
POS	798.277	312.071	3204.75	11.03	1049.10	1.2943	3.2727	12.4217
MOB	900.376	346.467	5080.96	1.27	1460.20	2.1406	6.4846	55.8650
WBP	171.302	84.15	675.916	25.05	202.920	1.6451	4.21742	22.5638
BB	5.28908	4.9802	6.5643	4.2830	0.8463	0.2704	1.5028	5.48995
BD	823.463	667.464	1458.40	464.479	312.838	0.68804	2.2889	5.1981
CP	18.7595	18.667	22.7548	15.0675	1.72326	0.24431	4.12806	3.27442
DC	12.8058	12.4919	19.6256	10.2465	2.43790	1.68434	5.56140	35.8176
M3	22.5079	22.8982	24.8952	19.8205	1.39415	-0.5670	2.72619	2.94878
GDP	2370.09	2204.18	3200.95	1883.88	400.603	0.73423	2.33059	5.64306
IP	22.4975	22.75	35.5	9.3	8.50816	0.00188	1.74372	3.15648
MC	75.5349	77.4674	98.0325	47.5863	14.9815	-0.4034	2.10167	3.15902

Table 4: Ng-Perron Unit Root Test

	Mza	MZt	MSB	MPT	Decision	Lag
ATM	-17.30**	-2.92**	0.18**	0.59**	I (1)	2
POS	-33.00***	-4.06***	0.12***	0.74***	I (1)	1
WBP	-9.97**	-2.21**	0.22**	2.54**	I (0)	0
MOB	-18.86***	-2.68***	0.14***	2.63***	I (1)	0
BD	-18.95***	-3.06***	0.16***	1.34***	I (1)	0
BB	-8.70**	-2.08**	0.24**	2.84**	I (1)	3
CP	-24.93***	-8.24***	0.03***	3.05**	I (0)	2
M3	-19.26***	-3.10***	0.16***	1.28***	I (1)	1
DC	-25.82***	-21.70***	0.029***	0.42***	I (1)	0
IP	-8.81**	-2.09**	0.24**	2.82**	I (0)	2
MC	-10.68**	-2.25**	0.21**	2.54**	I (1)	2
GDP	-69.67***	-5.90***	0.08***	0.35***	I (1)	3
Critical Values						
1%	-13.8	-2.58	0.174	1.78	***Note:*** *, **, *** signify the level of significance; 10%, 5%, and 1% respectively.	
5%	-8.1	-1.98	0.233	3.17		
10%	-5.7	-1.62	0.275	4.45		

The ARDL cointegrating bound test results and other diagnostic tests are reported in Table 5. The results indicate that the various retail digital FinTech platforms of ATM, POS, MOB, and WBP cointegrated with their determinants. The ARDL results reported in Table 6 is

line with the study objectives of investigating the FinTech effect on financial inclusion and economic growth in Nigeria.

Table 5: ARDL bound cointegration test results

	Models	F-Statistics	BG LM test (1)	BPG heteroskedasticity test	ARCH test (1)
ATM	*F*(InATM,BD,BB, CP, M3, DC, IP MC	9.92	0.80	0.087	0.176
POS	*F*(InPOS,BD,BB, CP, M3, DC, IP, MC	8.05	0.09	0.04	0.86
MOB	*F*(InPOS,BD,BB, CP, M3, DC, IP, MC	7.04	0.897	0.71	0.64
WBP	*F*(InPOS,BD,BB, CP, M3, DC, IP, MC	10.50	0.51	0.85	0.59

Notes: The F-statistics upper (lower) bounds critical value at 1% and 5% are 3.77(2.62) and 3.15(2.11) respectively. The reported values for the normality test, Breusch–Godfrey serial correlation LM test (BG LM test), Breusch–Pagan–Godfrey (BPG) heteroskedasticity test, and ARCH test are the probability values of the F-statistics. ARDL is autoregressive distributive lag. ** and *** imply statistically significant at 5% and 1% respectively.

From the results reported in Table 5, it can be inferred that there is a long-run nexus between FinTech, financial inclusion, economic growth, and its determinants. To assess the degree of effect the ARDL estimation was conducted. The results are presented in Table 6.

Table 6: The ARDL results

Dependent Variable = Economic Growth (GDP per capita)				
Independent Variables	ATM	POS	WBP	MOB
Panel A				
Log(ATM)	-0.21 (3.77)**			
Log(POS)		0.62(7.72)***		
Log(WBP)			0.33(3.69)***	
Log(MOB)				0.59(4.42)***
BD	-0.065 (-3.158)*	0.34(8.06)**	0.117(2.27)**	0.69(5.50)***
BB	0.375(4.874)**	0.35(4.84)**	0.132(1.54)	0.015(4.219)***
CP	0.061(2.675)	0.09(2.82)**	0.62(5.08)****	0.40(3.053)**
M3	0.025(1.513)	-0.09(-2.25)	0.086(4.46)***	0.069(3.450)***
DC	0.063(5.325)**	-0.09(-4.91)**	0.016(4.82)***	-0.039(-2.74)
IP	0.049(0.3520)*	0.16(3.34)	0.46(3.38)***	0.024(1.14)
MC	0.013(3.096)***	0.039(0.768)	0.019(3.90)***	0.014(2.55)
C	2.75(3.384)	6.48(11.93)	5.81(6.66)	5.70(8.78)
Panel B: Error Correction Model				
CointEq(-1)*	-0.756(-11.543)**	-0.662(-8.339)**	-0.923 (-6.481)**	-0.539 (-5.921)**
R^2	0.970	0.989	0.972	0.973
Adjusted R^2	0.957	0.980	0.950	0.953
F-Stat (Prob)	76.429 (0.000)	122.019 (0.000)	43.940 (0.000)	49.436 (0.000)
Note: *, **, *** imply statistical significance levels at 10%, 5% and 1%, respectively.				

Individual financial inclusion indicators were used to estimate their respective effect in the financial inclusion–growth nexus and to avail us of the advantage of further policy implications. FinTech proxy by the retail digital platforms of ATM, POS, WBP, and MOB along with the financial inclusion index had a long-run significant influence on economic growth in Nigeria.

Specifically, a 1% increase in the value of POS, WBP, and MOB transactions increases access to convenient, affordable, and flexible financial services by 62% 33%, and 59% respectively in the long run. The results revealed that retail digital banking channels are vital in the financial ecosystem. The negative effect of ATMs on financial inclusion and economic growth can be attributed to the closure of most ATM galleries in bank branches and outside the branches due to, high maintenance costs, and insecurity around the ATM galleries among others. This is evident in the long waiting time to use the ATMs and the growing number of bank customers further suggests that the current 22,500 ATMs in bank branches are insufficient to enhance inclusive growth.

The availability index (bank branches) across the models had a positive and significant influence on financial inclusion and economic growth at 37%, 35% 13%, and 0.015% respectively in the long run. The more the financial sector provides transaction points, the more economic agents respond by increasing economic activities.

Individually a percentage increase in bank branches per 100,000 adults increase economic growth and financial inclusion by 0.37%. This impact could be attributed to increased access to financial services- products through the FinTech retail digital platforms to the banked population. Thus, collaborating the exogenous growth model argument on the significance of technology and the results of Van and Linh (2019), Inoue and Hamori (2016), and Thomas et al. (2017) on the positive and significant impact of commercial bank branches on economic growth.

The penetration (deposit account) dimension index of financial inclusion from the various FinTech platforms showed a positive (0.34%, 11%, and 69%) and significant influence on economic growth at 10% and 5% levels. It indicates that the penetration of the financial system begins with operating a formal account with the bank or mobile money service provider to increase economic growth at every 1% increase in the country. As more people are admitted into the formal financial system, economic and financial activities increase in Nigeria. The reintroduction of the 2012 financial inclusion policy strategy has significantly facilitated banking penetration and this finding aligns with Kim et al. (2017).

The negative nexus with ATMs can also be attributed to high ATM card charges and the rigorous process of renewing or collecting new ATM cards, thus, decreasing economic activities by 0.065%. Also finding indicates that the demographic and behavioural pattern of most

Nigerians at the base of the pyramid" (BoP) indicates a lack of trust in digital financial platforms, high financial illiteracy in handling financial technology, and cash preference by most financial included. This may be due to fear of increased transparency (formal identification, collection, and recording of personal financial information), that enabled government surveillance (Koker & Jentzsch, 2013).

The usage (Credit to the private sector) dimension across the models showed a positive effect on economic growth. It means that the usage dimension influences economic growth positively through economic agent access to bank credit for economic activities. The findings of this study collaborate with Sharma (2016); Inoue and Hamori (2016) on the positive and significant nexus between GDP and credit to the private sector. The possible explanation is that a greater proportion of mobilized deposits may mostly come from the high-income groups in the economies. Schumpeterian model of growth recognized that loanable funds have a multiplicative effect on economic activity. The possible explanation of the non-significant nexus effect between bank credit and economic growth signifies that in Nigeria, bank credit is not always not utilised by micro, small, and medium-scale (MSME) businesses for the intended purpose. The unstable Nigerian business climate account for 65.9% of high default risk.

The general findings of this study support the exogenous growth model emphasis on the significance of technological advancement (FinTech) (Solow, 1956); labour productivity (Domar, 1946); new organisational structures; production processes, and management styles in transforming a static financial and economic climate into a dynamic one. As such the integration of FinTech into the operational and business activities of the classical financial system has not only created new products but has also provided solutions and eliminated barriers to financial and economic growth (Kotsemir and Abroskin 2013).

The study findings also support the endogenous growth model through financial deepening where access to financial services encourages economic growth (Ibrahim & Alagidede, 2018; Sharma, 2016). For the control variables financial deepening (M3 money supply and domestic credit) index reveals a positive (0.036) and statistically significant impact on economic growth at 10% and 5% levels. Thus, a 1% increase in financial sector efficiency increases economic growth by 0.025%, 0.086%, and 0.069% through money supply for mobilization, 0.063%, and 0.016% for allocation for investment purposes in Nigeria. Across the model’s development communication had a positive and significant effect on financial inclusion and economic growth. Thus, a 1% increase in development communication increases economic agents" access to the internet for effective information on financial inclusion for economic growth by 0. 049%; 0.16% 0.46%, and 0.24%, and for i0.013% 0.039% 0.019%, and 0.014% for mobile cellular subscriptions.

Empirically the findings of these studies collaborate with the findings of Udo, et, al (2013); Udo, et, al (2019) Peru (2018); Ghosh, (2016); Gosavi, (2018); Tchamyou, Erreyger, and Cassimon (2019) Gabor and Brooks (2017); Dorfleitner and Roble (2018), and Eton, Mwosi, Edaku, Ogwel, and Obote (2018); Na Song and Appiah-Otoo (2022) in China. From the results reported in Panel B of Table 6, the CointEq(-1)* values ranges (-0.539 to -0.756) indicates speed of convergence from short-run divergence to long-run equilibrium.

CONCLUSION AND POLICY IMPLICATIONS

The study on FinTech, financial inclusion, and economic growth nexus is still evolving and very open because of the changing and dynamic structure of technology and the global economy. Financial inclusion is vital to achieving inclusive financial and economic growth in Nigeria. Nigeria is considered an epicenter of retail digital platforms for financial inclusion. The study revealed a shift from the ATM usage to mobile device for its flexibility, convenient and accessibility. The digitalization of financial services has successfully restyled the operational and business activities of the classical financial system in Nigeria.

Access to financial services imbalances arising from voluntary and involuntary exclusion accounts for drawbacks limiting socioeconomic development and also diminishing economic growth. The reintroduction of the 2012 financial inclusion strategy in Nigeria motivated this study, and the study objective is to establish the effect of FinTech on financial inclusion and economic growth in Nigeria. The study controlled for financial deepening and development communication. For more informed policy implications, individual financial inclusion indicators were adopted.

A long-run nexus between the direct measures of FinTech on financial inclusion and economic growth was observed. The financial inclusion index positively and significantly influences economic growth. The usage indicators showed a non-significant effect. Indicating that although the development of financial infrastructure benefits the Nigerian economy, its application has not significantly influenced economic growth.

Financial inclusion positively and significantly influences economic growth, deposit accounts, and credit to the private sector promote economic growth. This study recommends that policies should not only be focused on addressing the usage of financial services but also on the availability and penetration that are key to encouraging and inculcating saving habits among the new entrance into the financial system. There is a dire need to strengthen the regulatory and supervisory frameworks for consumer protection to safeguard new entrants into the mainstream financial or mobile financial systems from predatory practices and also from usurious moneylenders in financial services. The formulation of cost-efficient and purpose-

driven fintech solutions to provide citizen-centric funding must be taken into consideration by policymakers as more countries strive to establish legislation that takes into account country-specificities. This study further recommends the adoption of a triangular model to assess fintech and financial inclusion effect on economic growth in both urban and rural areas in Nigeria.

REFERENCES

Abdulmumin, B. A., Etudiaye-Muhtar, O. F., Jimoh, A. T., & Sakariyahu, O. R. (2019). An investigation into the level of financial inclusion in Sub-Saharan Africa. *Scientific Annals of Economics and Business*, *66*(1), 41–63. https://doi.org/10.2478/saeb-2019-0004

Adedokun, M. W., & Ağa, M. (2021). Financial inclusion: A pathway to economic growth in Sub-Saharan economies. *International Journal of Finance and Economics*, 1–17. https://doi.org/10.1002/ijfe.2559

Adeola., O., & Evans, O. (2017). Financial inclusion, financial development, and economic diversification in Nigeria. *The Journal of Developing Areas, 51*(3), 1–15.

Adil, M. H., Hatekar, N., & Sahoo, P. (2020). The Impact of Financial Innovation on the Money Demand Function: An Empirical Verification in India. Margin: The Journal of Applied Economic Research, 14(1), 28–61.

Ahamed, M. M., & Mallick, S. K. (2019). Is financial inclusion good for bank stability? International evidence. *Journal of Economic Behavior and Organization*, *157*, 403–427. https://doi.org/.1016/j.jebo.2017.07.027

Ajide, K. B. (2017). Determinants of financial inclusion in Sub-Saharan Africa countries: Does institutional infrastructure matter? *CBN Journal of Applied Statistics*, *8*(2), 69–89. https://www.cbn.gov.ng

Amidžic, G., Massara, A., & Mialou, A. (2014). *Assessing countries' financial inclusion standing – A new composite index*. IMF Working Paper 14/36, International Monetary Fund, Washington. https:// www.imf.org

Asongu, S.A., Folarin, O.E. and Biekpe, N. (2019), "The long run stability of money demand in the proposed West African monetary union", Research in International Business and Finance, Vol. 48, pp. 483-495.

Asuming, P. O., Osei-Agyei, L. G., & Mohammed, J. I. (2018). Financial inclusion in Sub-Sahara Africa: Recent trends and determinants. *Journal of African Business*, *20*(1), 112–134. https://doi.org/10.1080/ 15228916.2018.1484209

Barboni, G., Cassar, A., & Demont, T. (2017). Financial exclusion in developed countries: A field experiment among migrants and low-income people in Italy. *Journal of Behavioral Economics for Policy*, *1* (2), 39–49.

Beck, T., Demirguc-Kunt, A., & Peria, M. S. M. (2007). Reaching out: Access to and use of banking services across countries. *Journal of Financial Economics*, *85*(1), 234–266. https://doi.org/10.1016/ j.jfineco.2006.07.002

CBN. (2012). Measuring Nigerian's financial inclusion strategy. www.cenbank.com

Chatterjee, A. (2020). Financial inclusion, information and communication technology diffusion, and economic growth: A panel data analysis. *Information Technology for Development*, 1–29. https://doi.org/10. 1080/02681102.2020.1734770

Chauvet, L., & Jacolin, L. (2015). *Financial inclusion and firms' performance*. FERDI Conference Paper, Banque de France

Chen, W., Yuan, X., & Gang, J. (2021). Financial inclusion in China: An overview. *Frontiers of Business Research in China*, *15*(4), 1–21. https://doi.org/10.1186/s11782- 021-00098-6

Chinoda, T., Kwenda, F., & McMillan, D. (2019). Do mobile phones, economic growth, bank competition, and stability matter for financial inclusion in Africa? *Cogent Economics and Finance*, *7*(1), 1–20. https:// doi.org/10.1080/23322039.2019.1622180

Chirwa, T. G., & Odhiambo, N. M. (2018). Exogenous and endogenous growth models: A critical review. *Comparative Economic Research*, 63–84. https://doi. org/10.2478/cer-2018-0027

Clamara, N., & Tuesta, D. (2014). *Measuring financial inclusion: A multidimensional index*. BBVA Working Paper 14/26, Banco Bilbao Vizcaya Argentaria, Madrid. https://www.bbvaresearch.com

Dahiya, S., & Kumar, M. (2020). The linkage between financial inclusion and economic growth: An empirical study of emerging Indian economy. *Vision: The Journal of Business Perspective*, 1–10. https://doi.org/10.1177/ 0972262920923891

Demir, A., Pesqué-Cela, V., Altunbas, Y., & Murinde, V. (2020). Fintech, financial inclusion, and income inequality: A quantile regression approach. *The European Journal of Finance*, 1–22. https://doi.org/10. 1080/1351847X.2020.1772335

Demirgüç-Kunt, A., Klapper, L., & Singer, D. (2017). *Financial inclusion and inclusive growth: A review of recent empirical evidence*. Policy Research Working Paper 8040, World Bank, Washington DC. https://www.worldbank.org

Domar, E. D. (1946). Capital Expansion, Rate of Growth, and Employment. *Econometrica*, *14*(2), 137–147. https://doi.org/10.2307/1905364

Dorfleitner, G., & Roble (2018). The financial performance of the health care industry: A global regional and industry-specific empirical investigation. European Journal of Health Economics, 19(4), 585–594. https://doi.org/10.1007/s10198-017-0904-8.

Elsherif, M. (2019, May, 21). *The relationship between financial inclusion and monetary policy transmission: The case of Egypt*. *IISES International Academic Conference*, London, United Kingdom. https://doi.10. 20472/IAC.2019.045.014

Eton M., Mwosi F., Ogwel B.P., Edaku C., & Obote D. (2018). Financial inclusion and women empowerment in Uganda. A case of Lango Sub Region, Northern Uganda. Economics, Commerce and Trade Management: An International Journal (ECTIJ) Volume 2, No.1

Evans, O., & Adeoye, B. (2016). *Determinants of financial inclusion in Africa: A dynamic panel data approach*. MPRA Paper 81326, Munich University Library, Munich. https://mpra.ub.uni-muenchen.de/81326/

Folarin, O.E. and Asongu, S.A. (2019), "Financial liberalization and long-run stability of money demand in Nigeria", Journal of Policy Modeling, Vol. 41 No. 5, pp. 963-980.

Ghosh, S. (2018). Does mobile telephony spur growth? Evidence from Indian states. *Telecommunications Policy*, *40*(10–11), 1020–1031. https://doi.org/10. 1016/j.telpol.2016.05.009

Gosavi, A. (2018). Can mobile money help firms mitigate the problem of access to finance in eastern sub-Saharan Africa? *Journal of African Business*, *19*(3), 343–360. https:// doi.org/10.1080/15228916.2017.1396791

Gupte, R., Venkataramani, B., & Gupta, D. (2012). Computation of financial inclusion index for India. *Procedia – Social and Behavioral Sciences*, *37*, 133–149. https://doi.org/10/1016/j.sbspro.2012.03.281 Honohan, P. (2008). Cross-country variation in household access to financial services. *Journal of Banking and Finance*, *32*(11), 2493–2500. https://doi.org/10.1016/j. jbankfin.2008.05.004

Huang, R., Kale, S., Paramati, S. R., & Taghizadeh-Hesary, F. (2021). The impact of financial inclusion and trade openness on economic development in the European Union.

In S. C. Park, C.-J. Kim, F. Taghizadeh-Hesary, & P. Sirivunnabood (Eds.), *Economic Integration in Asia and Europe: Lessons and Policies* (pp. 641–664). Asian Development Bank Institute. https://www.adbi.or

Ibrahim, M., & Alagidede, P. (2018). Effect of financial development on economic growth in sub-Saharan Africa. *Journal of Policy Modeling*, *40*(6), 1104–1125. https://doi.org/10.1016/j.jpolmod.2018.08.001

Inoue, T., & Hamori, S. (2016). Financial access and economic growth: Evidence from Sub-Saharan Africa. *Emerging Markets Finance and Trade*, *52*(3), 743–753. https://doi.org/10.1080/1540496X.2016. 1116282

Inoue, T., & Hamori, S. (2019). Financial inclusion and economic growth: Is banking breadth important for economic growth? In *Financial inclusion, remittance inflows, and poverty reduction in developing countries: Evidence from empirical analyses* (pp. 1–16). World Scientific Publishing.https://doi.org/10.1142/11231

Karlan, D., Kendall, J., Mann, R., Pande, R., Suri, T., & Zinman, J. (2016). *Research and impacts of digital financial services*. NBER Working Paper 22633, National Bureau of Economic Research, Cambridge. http://www.nber.org/papers/w22633

Kim, D., Yu, J., & Hassan, M. K. (2017). Financial inclusion and economic growth in OIC countries. *Research in International Business and Finance*, *43*(C), 1–14. https.//doi.101016/j.ribaf.2017.07.178

Koker, L. D., & Jentzsch, N. (2013). Financial inclusion and financial integrity: Aligned incentives? *World Development*, *44*, 267–280. https://doi.org/10.1016/j. world.2012.11.002

Lenka, S. K. (2021). Relationship between financial inclusion and financial development in India: Is there any link? *Journal of Public Affairs*, e2722. https://doi.org/ 10.1002/pa.2722

Lenka, S. K., & Bairwa, A. K. (2016). Does financial inclusion affect monetary policy in SAARC countries? *Cogent Economics and Finance*, *4*(1), 1–8. https://doi. org/10.1080/23322039.2015.1127011

Lenka, S. K., & Barik, R. (2018). A discourse analysis of financial inclusion: Post-liberalisation mapping in rural and urban India. *Journal of Financial Economic Policy*, *10*(3), 406–425. https.//doi.org/101108/JFEP- 11-2015-0065

Lenka, S. K., & Sharma, R. (2017). Does financial inclusion spur economic growth in India? *Journal of Developing Areas*, *51*(3), 215–228. https://doi.org/10.1353/jda. 2017.0069

Malinda, M. M., & Maya, D. S. (2018). Exploring the linkages between financial inclusion and economic growth in emerging countries. *Journal of Global Business and Social Entrepreneurship*, *4*(12), 63–75.

Mckinnon, R. I. (1973). *Money and capital in economic development*. Brookings Institution Press.

Mialou, A., & Amidžic, G. (2017). Assessing countries' financial inclusion standing – A new composite index. *Journal of Banking and Financial Economics*, *2*(8), 105–126. https://doi.org/10.7172/2353-6845. jbfe.2017.2.5

Nanda, K., & Kaur, M. (2016). Financial inclusion and human development: A cross-country evidence. *Management and Labour Studies*, *41*(2), 127-153

Nizam, R., Karim, Z. A., Rahman, A. A., & Sarmidi, T. (2020). Financial inclusiveness and economic growth: New evidence using a threshold regression analysis. *Economic Research-Ekonomska Istrazivanja*, *33*(1), 1465–1484. https://doi.org/10.1080/1331677X.2020.1748508

Oyelami, L. O., Saibu, O. M., & Adekunle, B. S. (2017). Determinants of financial inclusion in Sub-Sahara African countries. *Covenant Journal of Business and Social Sciences*, *8*(2), -116. https://www.journals.covenantuniversity.edu.ngOzili,

Park C-Y., & Mercado R.V. (2015). Financial inclusion, poverty, income inequality in developing Asia. Asian Development Bank Economics Working Paper 426.

Park, C., & Mercado, R. (2015). Financial inclusion, poverty and income inequality in Developing Asia. Working Paper No. 426, Asian Development Bank, Metro Manila. https://www.adb.org

Park, C., & Mercado, R. (2018). Financial inclusion, poverty, and income inequality. *The Singapore Economic Review*, *63*(1), 185–206. https://doi.org/10.1142/ S0217590818410059

Pazarbasioglu, C., Mora, A. G., Uttamchandani, M., Natarajan, H., Feyen, E., & Saal, M. (2020). *Digital Financial Services*. World Bank Group. https://www. worldbank.org

Pesaran, H.M., Shin, Y. and Smith, R.J. (2001), "Bounds testing approaches to the analysis of level relationships", Journal of Applied Econometrics, Vol. 16 No. 1, pp. 289-326.

Qamruzzaman, M., & Wei, J. (2018). Financial innovation, stock market development, and economic growth: An application of ARDL model. *International Journal of Financial Studies, 6*(3), 69.

Rahman, M.M. and Kashem, M.A. (2017), "Carbon emissions, energy consumption and industrial growth in Bangladesh: empirical evidence from ARDL cointegration and Granger causality analysis", Energy Policy, Vol. 110, pp. 600-608.

Ramkumar, G. (2017). A study on benefits of financial inclusion and cashless economy for India. *EPRA International Journal of Business and Economic Review*, *5*(8), 182–186.

Sahay, R., Cihak, M., N'Diaye, P., Barajas, A., Mitra, S., Kyobe, A., NianMooi, Y., & Reza S. Yousefi (2015). Financial inclusion: Can it meet multiple macroeconomic goals? IMF Staff Discussion Note 15/17, September

Sarma, M. (2008). *Index of financial inclusion*. Working Paper 215, Indian Council for Research on International Economic Relations, New Delhi. https://www.icrier.org

Sarma, M. (2015). Measuring financial inclusion. *Economics Bulletin*, *35*(1), 604–611.

Sarma, M. (2016). Measuring financial inclusion for Asian economies. In *Financial Inclusion in Asia*. Palgrave Macmillan.

Schumpeter, J. A. (1912). *Theory of economic development*. Routledge.

Sethi, D., & Sethy, S. K. (2019). Financial inclusion matters for economic growth in India. *International Journal of Social Economics*, *46*(1), 132–151. https://doi.org/10. 1108/IJSE-10-2017-0444

Sharma, D. (2016). Nexus between financial inclusion and economic growth: Evidence from the emerging Indian economy. *Journal of Financial Economic Policy*, *8*(1), 13–36. https://doi.org/10.1108/JFEP-01-2015-0004

Shaw, E. S. (1973). *Financial deepening in economic development*. Oxford University Press.

Siddik, M. N. A., Ahsan, T., & Kabirag, S. (2019). Does financial permeation promote economic growth? Some econometric evidence from Asian countries. *Sage Open*, *9*(3), 1–13. https://doi.org/101177/ 2158244019865811

Singh, D., & Stakic, N. (2020). Financial inclusion and economic growth nexus: Evidence from SAARC countries. *South Asia Research*, *41*(1), 1–21. https:// doi.org/10.1177/0262728020964605

Solow, R. M. (1956). A contribution to the theory of economic growth. *The Quarterly Journal of Economics*, *70* (1), 65–94. https://doi.org/10.2307/1884513

Sotomayor, N. L., Talledo, J., & Wong, S. (2018). *Determinants of financial inclusion in Peru: Recent evidence from the demand side*. SBS Working Paper, Superintendencia de Banca, Seguros y Administradoras Privadas de Fondo de Pensiones, Lima.https://www.sbs.gob.

Soumaré, I., Tchana Tchana, F., & Kengne, T. M. (2016). Analysis of the determinants of financial inclusion in Central and West Africa. *Transnational Corporations Review*, *8*(4), 231–249. https://doi.org/10.1080/ 19186444.2016.1265763

Tchamyou, V. S., Erreyger, G., & Cassimon, D. (2019). Inequality, ICT and financial access in Africa. *Technological Forecasting and Social Change*, *139*, 169–184. https://doi. org/10.1016/j.techfore.2018.11.004

Thathsarani, U. S., Wei, J., & Samaraweera, G. R. S. R. C. (2021). Financial inclusion's role in economic growth and human capital in South Asia: An econometric approach. *Sustainability*, *13*(8), 4303. https://doi.org/ 10.3390/su13084303

Thomas, A. E., Bhasi, M., & Chandramouli, R. (2017). Financial accessibility and economic growth- evidence from SAARC countries. *Contemplations on New Paradigms in Finance*, 32–52. https://www.papers.ssrn.com

Udo, E, S, Abner, I, P, Ndubuaku, V, Udoh, B, E. Okoh, J, I (2023) Effect of FinTech on cash holding: Quarterly evidence from Nigeria. *The Economics and Finance Letters 10(2), pp. 172-183 DOI: 10.18488/29.v10i2.3407*

Udo, E, S, Akpan, E, J, Abner, I, P, Idogen, K, Ndubuaku, V (2019) Finance-Led Growth and Growth-Led Finance: Evidence from Nigeria Economic and Financial Sector Development. *Humanities and Social Sciences Letters 7,(4), pp. 191-198DOI: 10.18488/journal.73.2019.74.191.198*

Udoh, E., E. Udo, P. Abner, R. Ike, T. Tingir, and U. Ibekwe, 2018. Effect of administrative capital expenditure on economic development; an emerging nation outlook. *Journal of Internet Banking and Commerce*, 23(1): 1-17.

Van, D. T. T., & Linh, N. H. (2019). The impacts of financial inclusion on economic development: Cases in Asian-Pacific countries. *Comparative Economic Research*, *22*(1), 7–16. https://doi.org/10.2478/cer- 2019-0001

World Bank (2014). Finance for all? Policies and pitfalls in expanding access. In World Bank Policy Research Report. Washington, DC: World Bank.

Zhang, Y., Zhang, G., Liu, L., De Renzis, T. and Schmiedel, H. (2019), "Retail payments and the real economy", Journal of Financial Stability, Vol. 44, p. 100690.