



Effect of FinTech on Financial Deepening and Financial Inclusion in Nigeria

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Abstract

This study was done to determine the effect of FinTech on financial deepening and financial inclusion in Nigeria. The study used annual data obtained from the statistical bulletin of the Central Bank of Nigeria for the period 2009-2021. The study adopted five (5) models, with two model depicting measures of financial deepening and three models measuring financial inclusion. The values of ATM, POS, Web pay (WP) and Mobile pay (MP) transactions were adopted as FinTech (Independent) variables in all 5 models. While, ratio of private sector credit to GDP (PSC/GDP) and ratio of total savings to GDP (SAV/GDP) were the adopted dependent variables to measure financial deepening in models 1 and 2. Small and Medium Enterprises Credit (SMEcr), Rural Deposits (RD) and Rural Loan and Advances (RL) were typified as measures of financial inclusion in models 3, 4 and 5. Employing the Ordinary Least Square (OLS) regression techniques. Findings of the study showed that; FinTech has no significant effect on the ratio of Private sector credit as a measure of financial deepening in Nigeria, FinTech has marginal significant effect on ratio of savings to GDP as a measure of financial deepening in Nigeria via POS. FinTech has significant effect on SME credit as a measure of financial inclusion in Nigeria, especially via ATM and Web pay. FinTech has significant effect on Rural Deposit as a measure of financial inclusion in Nigeria, specifically through POS transactions. FinTech has no significant effect on Rural Loan and Advances in Nigeria. Thus, the study recommended amongst other that: The government to provide, upgrade facilities and infrastructure that support FinTech in urban, sub-urban and rural communities in Nigeria, government and corporate organization as well as NGOs to provide technical support in the areas of digital/IT literacy to citizens and SME owners and operators in Nigeria.

Keywords: *Financial Technology, Financial deepening, Financial Inclusion, Rural deposit, Small and Medium Enterprises, Rural Loan*

Introduction

Financial technology (FinTech) is the description given to the use of technology in the process of delivering financial services to clients. It is the use of automated devices

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domiciled in computer electronics, internet services, a network of debit, credit cards and electronic machines as well as cloud computing technology, broadband and/or a combination of the aforementioned to deliver financial services to citizens and residents of nations globally. According to PWC (2020), on a worldwide scale the financial service industry has come under intense competition from FinTech firms as “agile” and innovative companies are taking advantage of technology to deliver suitable financial products to corporate and individual clients/consumers.

Zeidy (2021) Fintech is used to aid companies, business owners and consumers as they improve and manage their financial operations, procedures, processes, and living through the adoptions of tailored made software and algorithms applications on computers and, smartphones. There is now possibility that, entities leveraging on by Fintech may soon become competitive alternatives to traditional financial intermediaries, markets, and infrastructures. The widespread adoption of modern technologies seems to offer more opportunities for inclusiveness and the advantages derivable therefrom, but also poses risks. Fintech have the potential to create efficiency benefits in the financial sector, offer enhanced and more targeted products and services, and deepen financial inclusion emerging economies. Though, it may also create risks, if its deployment undermines monetary policy transmission, trust, competition, and financial stability.

Financial technology (FinTech) stimulates the development of the financial sector of an economy. It makes it easier to collect and analyze data in the financial markets thereby reducing information asymmetry. Business deals and investment plans based on artificial intelligence and data can recreate and redirect price discovery mechanism of the financial markets and increase transaction promptness, promote liquidity in financial markets and enhance the efficiency and stability of financial markets. It can also assist regulators to monitor types and volume of financial market transactions. Moreover, smart FinTech helps reduce labour costs and abolish staff duplication by combining data with artificial intelligence. Furthermore, the development deployment and usage of FinTech aid more persons, including the unbanked and poor to obtain financial services at relatively reduced cost and convenience (Li & Xu, 2021).

There is need for financial inclusion in Nigeria, as the banking system in particular, financial system and associated markets in general are less inclusive compared to some African countries such as South Africa. Several policies have been introduced by various government agencies in contemporary times, to enhance the level of financial inclusion in Nigeria. Accordingly, Ozili (2021) posited that, the relevance of financial inclusion in Nigeria is connected to three major contemporary issues of; poverty reduction, the need to reduce the level of inflation and the need to control the shadow banking sector. Fintech seems to be facilitating financial inclusion in Nigeria via the introduction of new ways of performing financial transactions through electronic and internet enabled devices. Nigeria witnessed an increase of Fintech business in 2015, which was made possible by increased number of smartphones users across the country. Fintech, powered via smartphones of individuals in Nigeria, made it possible for individuals to make bank transfers using mobile apps, manage their personal finance etc. Thereby, bridging the gap between a large number of citizens and the financial sector and markets and ultimately



causing financial inclusion in Nigeria. Also, new businesses were able to set-up new business models that require business owners to work from home aided by financial technology and to save the cost of renting a physical office space. Additionally, payments made via FinTech enabled platforms and processes, enable financial regulators to monitor all financial transactions for transparency, fairness and to detect suspicious activities related to fraud and other crimes. Volz and Cheng (2021) mentioned that, digital finance and blockchain-based financial solutions can increase information flows and finance sector efficiency by birthing better systems and data, encouraging inclusion and inventions in the real economy, widening choices that are sustainable, and by creating new sources of funding

As asserted by Okoduwa and Odibo (2021) that, to attain economic development, enhance the economic wellbeing of the country and reduce inequality, developing countries like Nigeria set out to reduce the financial inclusion gap. But, are the obtainable FinTech business platforms, services, infrastructure and products suitable, accessible and convenient for the unbanked? Wayne, Soetan, Bajepade and Mogaji (2020) mentioned that, Nigeria is a major economic player in the West African region with about 202 million people: amongst countries with the largest populations of youth globally. This is a huge market for services. But, the level of financial inclusion is low. A higher percentage of the Nigerian population still live in areas, with no access to enough financial services like credit, savings and micro insurance opportunities, thus, they are financially weak. Moreover, are the existing FinTech opportunities delivering novel advantages to the micro, small and medium scale enterprises (MSMEs)? Especially, as the AFI (2018) report, mentioned that Nigeria is amongst the seven nations that host about 50% of the unbanked population globally, others are Pakistan, China, Mexico India, Bangladesh and Indonesia. However, the report posited that major progress has been made in India and China while, similar stratagems for digital financial inclusion have been developed in Pakistan, Indonesia, Mexico, and Bangladesh. Expectedly, Nigeria and many other countries are developing similar stratagems to support the change offered by digital finance. This study is to examine the capacity of financial technology (FinTech) to influence financial deepening and close the financial inclusion gap via efficient credit delivery, encouraging savings and giving leverage to SMEs to grow in Nigeria and thereby creating advantages for the financially weak.

Literature Review

Financial Technology (FinTech)

FinTech is a cross-disciplinary subject that combines finance, technology management and innovation management (Leong & Sung, 2018). Fintech is a business and banking company that translates to financial technology. It is the technology used and applied in the financial services sector including its involvement in mobile payments, money transfer, loans, fundraising and asset and property management. Fintech investment has grown exponentially recently in the world and is likely to continue to increase, given that Fintech is not only related to the financial services sector, but all companies that deal with the financial services industry and Fintech startups are usually smart and capable of causing disruption. Fintech is described as those products and services that rely on technology to improve the quality of traditional financial services. They are



quick and easy. In most cases, these services and products are developed by startup companies, which seek to improve retail and corporate banking in cooperation or competition with existing financial service providers. Banks and financial technology companies benefit from the existing cooperation between them for the benefit of both parties (Almomani & Alomari, 2021).

Broadly, the term "financial technology" can apply to any innovation in how people transact business, from the invention of digital money to double-entry bookkeeping. Since the internet revolution and the mobile internet/smartphone revolution, however, financial technology has grown explosively, and FinTech, which originally referred to computer technology applied to the back office of banks or trading firms, now describes a broad variety of technological interventions into personal and commercial finance. It primarily works by unbundling offerings by such firms and creating new markets for them. Startups disrupt incumbents in the finance industry by expanding financial inclusion and using technology to cut down on operational costs (Investopedia, 2021).

Financial Deepening

Chakraborti (2018) cited that financial deepening, was first articulated by Gurley and Shaw (1955, 1967) to mean "a wide array of changes in financial structure accompanying economic development". These changes include loosening credit constraints, more intensive use of external finance, fewer distortions in the credit market and a general increase in financial activity. It is the increased provision of financial services by financial intermediaries with wider choice of services geared to all levels of society. It is measured by an increased ratio of money GDP like the degree of financial intermediation/development ($M2/GDP$ and the ratio of private sector credit to GDP). It helps to improve the efficiency of credit allocation.

Financial Inclusion

The World Bank as cited by Okoduwa and Odibo (2021) described financial inclusion as the "provision of useful, relevant, and affordable financial services such as payments, credit, and insurance to the financially excluded including individuals and SMEs." Financial exclusion is very much a symptom of poverty. Sahay et al (2015) defined financial inclusion as "a combination of depth (size and liquidity of markets), access (ability of individuals to access financial services), and efficiency (ability of institutions to provide financial services at low cost and with sustainable revenues, and the level of activity of capital markets)".

Durai and Stella (2019) Financial inclusion may be defined as the process of ensuring access to financial services and adequate credit where needed by vulnerable groups such as weaker sections and low income at an affordable cost. Financial inclusion includes access to financial products and services like banks accounts, insurance, remittance & payment services, financial advisory services etc. It provides individuals with the possibility to save for future stability, a high level of bank deposit would enable a stable deposit base, opportunities to build savings, make investments and access credit. Now a day, there is an inclusive growth focused on financial inclusion. Collectively, these are achieved with the enabling of new banking technology. Many banks have arrived with new



banking technology that took place in the new scenario of banking customers that is called “Digital finance”. Thus, digital finance has given a new shape to the banking industry. Digital finance is a financial service delivered through mobile phones, personal computers, the internet or cards linked to a reliable digital payment system. Digital finance has the potential to provide affordable, convenient and secure banking service. Digital finance provides greater control of customer personal finance, quick financial decision making, and the ability to make and receive payments. Financial inclusion is a win-win situation that is achieved through digital finance.

The financial services landscape is fundamentally changing. Today’s organizations need to shift in order to accommodate the opportunities and challenges created by new technologies and evolving customer needs. Part of that shift is a change in mindset: financial institutions need to accept that technology has become and will remain an integral part of financial services delivery. As such, financial institutions are increasingly becoming technology firms (Ruddenklau, 2018).

Theoretical Review

Technology Acceptance Theory (TAT)

Davis, Bagozzi, and Warshaw (1989) used the TAT to explain users’ degree of acceptance of information system or new technology. The model is premised on the fundamentals of perceived advantages that comes the use of information technology. The theory posit that the deployment of ICT in the operations of businesses could cut cost and enhance service delivery. However, perceived advantages are hinged on ICT literacy.

Empirical Review

Fintech and Financial Deepening

Study by Sahay e’tal (2015) on rethinking financial deepening in emerging economies of Chile, Morocco and Malaysis. The study revealed a number of issues that concern financial deepening, that would be beneficial to other developing nations. The findings of the study showed firstly; that adopting a new broad, measure of financial development including financial technology, could bring about many benefits in terms of growth and stability can still be reaped from further financial development especially FinTech innovations in most emerging economies. Secondly, the effect of financial development on economic growth is bell-shaped: it weakens at higher levels. This weakening effect stems from financial deepening, rather than from greater access or higher efficiency. The empirical evidence also suggests that this weakening effect reflects primarily the impact of financial deepening on total factor productivity growth, rather than on capital accumulation. Thirdly, the rate of financial development should be of concern to regulators. At a high speed, deepening financial institutions can lead to economic and financial instability, as it engenders greater risk-taking and high leverage, when, poorly regulated, supervised and monitored. In other words, when it comes to financial deepening, there are speed borders. This puts a premium on developing good institutional



and regulatory frameworks as financial development proceeds. Fourthly, there is very little or no conflict between promoting financial stability and financial development. Better regulation is what promotes financial stability and development and ultimately financial deepening. The fifth finding is that there is no “one-size-fits-all” in the process of developing financial institutions, instruments and markets that will ensure financial deepening, though as economies evolve the relative benefits from institutions decline and those from markets increase.

Meanwhile, in Nigeria Nkwodimmah and Ochei (2019) investigated the impact of financial technology on banking sector liquidity. Using quarterly data for the period 2009-2017. The study adopted loan to deposit ratio as dependent variable and automated teller machine, point of sales, mobile payment and automated clearing system-cheque as independent variables and employed the Auto Regressive Distributed Lag approach to determine the relationships in the model. Findings showed that electronic payment (FinTech) has a significant effect on liquidity of Deposit Money banks in Nigeria. Thus, the study recommended that, an e-system in the banking sector will bring about financial development. Deposit Money banks should therefore be encouraged (via policies and regulations) to adopt electronic payment systems so as to have a better banking experience, easy access to banking products, reduced cost and flexibility of online international transactions.

Also in Nigeria, Otuya, Ofeimun and Akpotor (2022) did a study on the effect of ICT adoption on the operational efficiency of Deposit Money Banks in Nigeria (DMBs). Using time series data from CBN Statistical bulletin for 2012 – 2021, the study revealed that ICT adoption (web payment, value of ATM and POS transactions) have positive but insignificant effect on operational efficiency of the sampled DMBs. Thus, submitted that the usage of ICT positively influences the operational efficiency of listed DMBs in Nigeria and recommends amongst others the need for DMBs to improve on their online payment systems so as to facilitate ease of payment among bank customers.

FinTech and Financial Inclusion

Tok and Heng (2022) examined the role of Fintech in financial inclusion. Making use of global findex data and emerging FinTech indicators, discovered that Fintech has a high and direct correlation with digital financial inclusion compared to traditional indicators of financial inclusion. The second stage of procedural investigation, focused key variables that correlate with the Fletcher School’s three digital divide; class (rich-poor) divide, gender divide, and rural divide. The findings indicated that more use of FinTech is significantly associated with a narrowing of the class divide and rural divide and no impact on the gender divide. Thus, the study suggests that FinTech is a necessary condition but may not be sufficient to narrow the gender gap in access to financial services. Fintech development may need to be helped by creating policies aimed at addressing the gender gap directly, and at changing attitudes and social norms across demographics.



The study of Khaerunnisa (2018) on the role of financial technology in fostering financial inclusion in Indonesia used the number of total transaction, number of financial firm, number of client using mobile banking opportunities to measure the rate at which financial technology is encouraging financial inclusion. The study showed that Indonesia is still within the catchup phase of financial inclusion. Thus, the study recommended that, more attention should be given to less costly methods of services provision such as mobile phone banking. Therefore, financial technology industry must stand –up to its responsibilities, which include product characteristic, regulation, industry competitiveness and customers.

In India, Singh (2017) posit that emphasis on financial inclusion has gained a great importance in contemporary times as, it is aimed at the provision of basic banking services to the unbanked population. The study mentioned that, the current government of India has taken a giant step to encourage financial Inclusion by introducing “Pradhan Mantri Jan DhanYojna”. Technology is a major enabler in the process of providing banking services to the needs of a larger section of society, with special emphasis on the under-privileged communities. The technological advancements need to support this initiative of government by extending banking services to the unbanked population and the available technology, along with the impetus by the government in ensuring banking system to deploy cost effective technology to transform the financial ecosystem in India.

The research of Sanga and Aziakpono (2022) done to know whether technological modernisms like information and communication technology (ICT) infrastructure, secure internet servers, the number of automated teller machines, mobile phone subscriptions, and bank branches increased financial inclusion in African countries for the period 2010–2019. The study used data collected for forty-three countries and adopted panel method of estimation, fixed effects and quantile regressions data analysis. The findings showed that technological inventions direct and significant effect on financial inclusion in Africa as it concerned banks deposits mobilization and credit allocation to firms, household and individuals. Also, the technological elements have a high positive effect the levels of bank credit to the private sector especially at the higher bracket. But, as it relate to bank deposits, only the number of branches have significant and direct sway at a high level of bank deposits compared with a low level. These results suggest that African governments and development partners can take advantage of ICT developments to reduce financial inclusion gaps and strengthen debt financing, which is the major funding source for SMEs.

In the study of Kama and Adigun (2013) on the issues and challenges of financial inclusion in Nigeria, poor facilities and infrastructure to support financial technology was revealed to be a major challenge to achieving the desired level of financial inclusion. Furthermore, the nature, form and challenges of financial inclusion among jurisdictions and as such cannot be addressed by a single product or “one size fit all” approach. Countries like Nigeria should therefore implement initiatives that considers the uniqueness of their situations and most analytically beneficial to citizens and residents. Thus, the study recommended a systematic approach that aligns responsibility and institutions among all stakeholders in the financial inclusion process to guarantee sustainability.



In Nigeria, the research done by Udo, Onwumere, Abner, Inim, Izuchuwu and Akpan (2021) investigated the effect of FinTech on economic growth by closing financial inclusion gap in Nigeria using quarterly data for the 1999 to 2020. As financial technology is mentioned to have effects on economic growth directly and indirectly via financial inclusion. The study relied on the results from, Johansen cointegration test, and the Granger non-causality test, a Toda–Yamamoto procedure. Findings of the study revealed that financial technology has impact on economic growth and financial inclusion through via the reduction of income inequality and poverty rate. Also, financial technology is a necessity to incorporate the hitherto 68.1%, of the financially-unreached and micro, small and medium scale enterprises into the formal financial system and markets. Furthermore, the disequilibrium caused by demand-supply sides' barriers is corrected for in the long run. Findings also revealed a unidirectional, bidirectional and a feedback causality. Overall, the result of the study is a push to the desires of the UN-2030-ASD.

Again, the study of Babajide, Oluwaseye, Lawal, and Isibor (2020) examined developments, innovations and new financing windows engendered by Financial Technology and how it has been able to reduce financial inclusion gap in south-West Nigeria. The study adopted the binary logistic model and revealed that MSMEs financing stress has can be reduced by financial technology in the next five years after analyzing dynamics in consumer banking, payments and investment/wealth management in the financial sector. The study also posit that financial institutions must cooperate and capitalize on the Financial Technology inventions like artificial intelligence, big data, data analytics and MSMEs friendly applications to jump-start MSMEs sector. Also, the study showed that, Financial Technology has the ability to drive financial inclusion, using high internet, electricity and mobile phone penetration to achieve about 20% financial exclusion target in the south west of Nigeria by the year 2030.

In Jakarta, Wati, Ispriyahadi, Nisa, Lutfi, and Suprpta (2020) examined the ability of financial technology to increase financial inclusion by giving growth advantage to Micro, Small, and Medium Enterprises. The research used mixed-method research with sequential explanatory strategy. Firstly, 116 questionnaires were distributed to 116 MSMEs. Secondly, in-depth interviews were conducted. Findings showed that Financial Technology is positive and significantly affects financial inclusion. The study further revealed that based on interviews, fintech services such as third-party payment systems and Peer-to-Peer (P2P) type of payment systems are embraced by MSMEs. The usage of fintech services by MSME entrepreneurs have in the form of savings accounts it has the potential of closing financial inclusion gap. Thus, Government needs to conduct regular training on the use of financial technology to MSME operators, there are strong synergy and cooperation in developing a fintech system to improve the digital economic system of MSMEs.

In a survey of literature by Al-Mubaraki and Aruna (2013), on the subject of financial technology and small and medium enterprises. They noted that, globalization and technological inventions is creating novel changes around the nations of the world. Technology and entrepreneurship are dynamic element required for growth and development. Technology based enterprises are specifically smart to policy-makers



because of their higher prospective for job creation and wealth-generation through business development also they have higher rates relative analog kind of firms. After a comprehensive review of literature on the Technology innovation. The study revealed that SMEs have a lot to gain if they can leverage on the platform provided by financial technology, because in the developed countries technology push the growth of firms.

Financial services in Thailand are experiencing rapid transformation, accordingly, Moenjak, Kongprajya, and Monchaitrakul (2020) reviewed the situation using results obtained from the Thai Households Financial Access and Literacy Survey, as conducted by the National Statistical Office in collaboration with the Bank of Thailand bi- annually. The survey reflect the present level of financial inclusion and financial literacy in Thailand, with emphasis on potential areas for improvement. The study noted there is a connection between financial technology, financial attitude, financial behavior, and financial knowledge but also noted that there is a gap between these financial elements that only policies could address. The study therefore suggested three strategies that could be employed to encourage the development of financial technology for financial inclusion, and financial literacy in Thailand. The strategies include; (i) development of specialized infrastructures that are vital foundations of a digital economy; (ii) introduction of supportive laws and regulations that help foster financial technology innovations plus; (iii) promotion of financial literacy at various fronts for people at various stage of life. Finally, the study concludes that Thai experience, which could be useful for policy makers in other jurisdictions around the globe.

Another study in Egypt by Hussein (2020), focused on the influence of financial technology on financial inclusion using data obtained from World Bank financial index 2017. The Global Financial index database provides a large number of indicators on financial inclusion enabling the study to examine the amount of account penetration, the use of financial services, the purposes and motivations, the alternatives to formal finance, etc. It also provides micro-level information – gender, age, income and education that were employed for estimations. The study was focus on Egypt, Saudi Arabia, Jordan, United Arab of Emirates, Bahrain, Kuwait, Tanzania, Kenya, and Ethiopia. The study showed that financial technology indicators such as, mobile money account, Mobile Subscribers and use of Internet” have significant effect on the financial inclusion. However, as it concern high internet and mobile phone penetration Egypt still has the lowest rank of financial inclusion among other Arab and African States covered by the study.

In India Nisha and Kavitha (2020) did a study to measure the impact of digital financial literacy on digital financial inclusion. The study focused on seven dimensions of both digital financial literacy and inclusion, using, data from 200 respondents via a structured questionnaire. The study showed that the percentage of digital financial literacy and digital financial inclusion stands at 76.42% and 62.2% respectively for the collected sample.

In Qatar the study of Darrat and Al-Sowaidi (2010) assessed the role of information technology and financial technology in the emerging economy. The study employed the



vector-error-correction model. The findings submit that real economic growth is strongly linked both financial deepening and information technology. Furthermore, the study revealed that IT is comparatively more significant, when related to financial development for pushing long-run growth. Though, the study revealed that financial development to be more critical for enhancing economic growth over the short-run horizon instead of IT.

While in Oman, Al-buraiki and Khan (2018) investigated the challenges faced by SMEs, analyzed difficulties faced by SMEs trying to adopt new technologies and coping with associated policies and procedures. The study used purposive sampling method, distributed and retrieved 257 questionnaire as samples in Oman. Employing the Chi-square tests, Kolmogorov-Smirnov tests. The findings of the study reveals that most of the respondents delayed the commencement of their business due to lack of finance. It is also revealed that the SMEs are in dire need of technical support at the time of commencement of their businesses and need support to establish IT infrastructure.

Methodology

Sources of Data

Data for the analysis were sourced from the Central Bank of Nigeria (CBN) Statistical Bulletin for the period 2009- 2021.

Model Specification

The existing banks and their operational systems have been for over one hundred years in Nigeria. Their performance has fallen short of meeting the desired goals of providing essential financial services to millions of Nigerians. A major problem faced by the traditional players is the high-cost of delivering financial services. It is economically not-viable to locate bank branches in rural areas. FinTech is seen as the solution to the financial sector challenges experienced in Nigeria for decades. The use of internet-enabled mobile technology, Unstructured Supplementary Service Data (USSD), Near Field Communication technology, etc., is a game-changer for the government to meet this social goal of providing financial services to all citizens (Moito, 2021). Therefore, based on the theories of financial development, technology acceptance theory as well as evidences from available empirical literature the models for this study are stated as follows;

- CSP/GDP = f(ATM, POS, WP, MP).....Model 1
- SAV/GDP = f(ATM, POS, WP, MP).....Model 2
- SMRCr = f(ATM, POS, WP, MP).....Model 3
- RD= f(ATM, POS, WP, MP).....Model 4
- RL= f(ATM, POS, WP, MP).....Model 5



Where;

CSP/GDP = Ratio of Credit to the Private Sector to Gross Domestic Product, SAV/GDP = Ratio of Total Savings to Gross Domestic Product, SMECr = Credit to Small Scale Enterprises, RD = Rural Bank Deposit, RL = Rural Loan and Advances, ATM = Automated Teller Machine, POS = Point of Sales, WP = Web Pay, MP = Mobile Pay

From the above models, the empirical equations for this study are specified as follows

$$\text{CSP/GDP} = \beta_0 + \beta_1\text{ATM} + \beta_2\text{POS} + \beta_3\text{WP} + \beta_4\text{MP} + U_1 \dots \dots \dots \text{Equation 1}$$

$$\text{SAV/GDP} = \alpha_0 + \alpha_1\text{ATM} + \alpha_2\text{POS} + \alpha_3\text{WP} + \alpha_4\text{MP} + U_2 \dots \dots \dots \text{Equation 2}$$

$$\text{SMECr} = \gamma_0 + \gamma_1\text{ATM} + \gamma_2\text{POS} + \gamma_3\text{WP} + \gamma_4\text{MP} + U_3 \dots \dots \dots \text{Equation 3}$$

$$\text{RD} = \kappa_0 + \kappa_1\text{ATM} + \kappa_2\text{POS} + \kappa_3\text{WP} + \kappa_4\text{MP} + U_4 \dots \dots \dots \text{Equation 4}$$

$$\text{RL} = \tau_0 + \tau_1\text{ATM} + \tau_2\text{POS} + \tau_3\text{WP} + \tau_4\text{MP} + U_5 \dots \dots \dots \text{Equation 5}$$

$U_1, U_2, U_3, U_4,$ and U_5 = Error terms

$\beta_0, \alpha_0, \gamma_0, \kappa_0$ and τ_0 = intercepts,

$\beta_1 \dots \beta_4, \alpha_1 \dots \alpha_4, \gamma_1 \dots \gamma_4, \kappa_1 \dots \kappa_4$ and $\tau_1 \dots \tau_4$ = coefficients

A priori, it is expected that

$\beta_1 \dots \beta_4 > 0, \alpha_1 \dots \alpha_4 > 0, \gamma_1 \dots \gamma_4 > 0, \kappa_1 \dots \kappa_4 > 0, \tau_1 \dots \tau_4 > 0$

Method of Estimation

The study first described the data feature by presenting the descriptive statistics. Thereafter proceeded to determine the effect of the independent variables on dependent variables of each of the five models, using Ordinary Least Square (OLS) technique. The OLS technique was adopted due to limited data availability. As the independent variables of FinTech are emerging and recent in Nigeria. Models 1 and 2 are adopted in the study as measures of financial deepening. While, models 3, 4 and 5 are used as measures of financial inclusion in Nigeria



4.1 Data Presentation and Analysis

Table 4.1: Descriptive Statistics

	CSP_GD		SMECR		RL	RD	ATM	MP	POS	WP
	P	SAV_GDP								
Mean	18.75950	12.46945	33.78959	233.6295	139.242	9	2873916.	4863906	1990091.	52777713
Median	18.66727	12.51692	15.61170	107.5224	87.9309	5	3970.252	442.3538	448.5125	91.58129
Maximum	22.75484	14.56663	123.9321	988.5879	427.446	6	19121854	4823313	21135324	3.92E+0
Minimum	15.06752	10.24383	10.74789	15.59050	0.01972	3	399.7100	1.270000	11.03000	25.0500
Std. Dev.	1.776303	1.291917	35.58973	317.3270	164.769	1	7008929.	1367333	5898878.	1.30E+0
Skewness	0.244311	-0.102420	1.554654	1.432374	0.62575	4	1.921803	2.76000	2.937405	2.016231
Kurtosis	4.128061	2.275273	4.190818	3.653932	1.73316	3	4.698856	9.180167	10.03421	5.232418
Jarque-Bera	0.818606	0.307227	6.00483	3	4.676969	1.717703	9.565521	37.19351	45.49651	11.50740
Probability	0.664113	0.857603	0.04966	0.09647	0.42364	8	0.008373	0.00000	0.000000	0.003171
Sum	243.8735	162.1028	439.2646	3037.183	1810.157	1	37360906	6323078	25871182	6.86E+0
Sum Sq. Dev.	37.86303	20.02860	15199.54	1208357.	325786.	1	5.90E+14	2.24E+15	4.18E+14	2.04E+17
Observations	13	13	13	13	13	13	13	13	13	13

The descriptive statistics table above showed that the mean value of CSP/GDP is 18.76 with a standard deviation of 1.78 and maximum and minimum values of 22.75 and 15.07. While, Saving/GDP ratio has a mean value of 12.47 with a standard deviation of 1.29 and maximum and minimum values of 14.57 and 10.24 respectively. Still, Credit to SMEs, Rural Loan and Rural deposits have 33.79, 233.63 and 139.24 as mean values correspondingly. Measures of financial technology which include ATM, POS, Web Pay and Mobile Pay have their respective mean values of mean 2873916, 1990091, 52777713 and 4863906. All values in billion naira.

Results and Analysis

FinTech and Financial Deepening

FinTech and Ratio of Private Sector Credit to Gross Domestic Product (GDP)

$$\text{CSP/GDP} = 14.03 + 0.68\log\text{ATM} - 6.53\log\text{POS} - 0.76\log\text{WP} - 6.53\log\text{MP} + U_1$$

t-value (1.93) (0.217) (2.06) (-0.52) (-2.09)s



$$R^2 = 42\% \quad \text{Adjusted } R^2 = 12\% \quad F\text{-stat} = 1.42 \quad (\text{Pro.} = 0.30) \quad DW = 1.90$$

The above model showed adjusted R^2 of 12%. Thus only about 12 %of the systematic variation in CSP/GDP as a measure of financial deepening can be attributed to the independent variables (measures of financial technology in Nigeria) during the period of study. The F-statistics value of is not significant at 5%, thus, as a group there is no convincing linear relationship between the dependent and independent variables. However, the DW statistics indicate the absence of autocorrelation in the model. Looking at the individual variables in the above model, only ATM has a positive effect on the dependent variable but the effect is not significant as revealed by the probability value in parenthesis, other variables which include POS, Web pay and Mobile Pay have negative effect on CSP/GDP as a measure of financial deepening. This is against a priori expectations. This could be because these variable are mostly employed as payment and withdrawer tools and may be reducing the value of available credit in the banking sector. Furthermore, all the elements of financial technology have insignificant effect on ratio of private sector credit to GDP at 5% as shown by the probability values in parenthesis,

FinTech and Ratio of Savings to Gross Domestic Product (GDP)

$$SAV/GDP = 8.27 + 0.41\log ATM + 4.43\log POS - 0.61\log WP - 3.05\log MP + U_2$$

t-value	(2.39)	(0.27)	(2.47)	(-0.88)	(-2.05)
Prob.	(0.04)	(0.79)	(0.04)	(0.40)	(0.07)

$$R^2 = 75\% \quad \text{Adjusted } R^2 = 63\% \quad F\text{-stat} = 6.01 \quad (\text{Pro.} = 0.015) \quad DW = 1.80$$

A cursory look at the model above shows that FinTech measures adopted can explain about 63% of the systematic variation in savings/GDP ratio as a measure of financial deepening in Nigeria during the period of study. F-statistics vale indicate that the model is significant and the DW statistics indicates the absence of autocorrelation. Individual, ATM and POS has direct influence on savings/GDP ratio. While, Web pay and Mobile Pay are indirect influencers of Savings/GDP ratio as a measure of financial deepening. Furthermore, amongst all the independent variables (FinTech indicators) only POS has a significant influence on savings/GDP at 5%.

FinTech and Financial Inclusion

FinTech and Small and Medium Scale Enterprises

$$\log SMECr = 3.48 - 1.13\log ATM - 0.21\log POS + 0.46\log WP + 0.56\log MP + U_3$$

t-value	(3.41)	(-2.57)	(-0.40)	(2.27)	(1.27)
Prob.	(0.009)	(0.03)	(0.70)	(0.05)	(0.24)

$$R^2 = 73\% \quad \text{Adjusted } R^2 = 60\% \quad F\text{-stat} = 5.48 \quad (\text{Pro.} = 0.019) \quad DW = 1.73$$

The above model adopts SME credit as a measure of financial inclusion. Overall, the results shows that the elements of FinTech has the ability to explain about 60% of movement in SMEcr, and the model is significant as the value of f-statistics reveals, DW statistics reveals the absence of autocorrelation. The model shows that ATM and POS



have negative effect on SME credit. While, Web pay and Mobile pay have positive effect on the dependent variable (SMEcr). From the probabilities, ATM and Web pay has significant effect on SMEcr as a measure of financial inclusion in Nigeria during the period of study. While, POS and Mobile pay have insignificant effect of SMEcr.

FinTech and Rural Deposits

$$\log RD = 2.60 - 3.12\log ATM + 6.29\log POS - 0.13\log WP - 2.71\log MP + U_4$$

t-value	(0.57)	(-1.59)	(2.65)	(-0.15)	(-1.38)
Prob.	(0.58)	(0.15)	(0.029)	(0.88)	(0.20)

$R^2 = 80\%$ $\text{Adjusted } R^2 = 70\%$ $F\text{-stat} = 7.54$ (Pro. = 0.006) $DW = 1.75$

Rural deposit is the dependent variable and a measure of financial inclusion in the model above. The value of adjusted R^2 shows that together, all the elements representing FinTech can explain about 70% of the systematic variation in the dependent variable (Rural Deposit) and the model is significant as indicated by the value of f-statistics. However, specifically ATM, Web pay and Mobile pay have indirect effect on Rural Deposit. While POS has a direct effect on Rural Deposit as a measure of financial inclusion. Moreover, from the probabilities value, only POS has a significant effect on the dependent variable (Rural Deposit) as a measure of financial inclusion in Nigeria during the period of study.

FinTech and Rural Loan and Advances

$$\log RL = 0.43 + 0.41\log ATM + 0.67\log POS - 0.62\log WP - 0.09\log MP + U_5$$

t-value	(0.17)	(0.37)	(0.50)	(-1.21)	(-0.088)
Prob.	(0.72)	(0.72)	(0.63)	(0.26)	(0.93)

$R^2 = 44\%$ $\text{Adjusted } R^2 = 16\%$ $F\text{-stat} = 1.58$ (Pro. = 0.26) $DW = 1.9$

The above model showed adjusted R^2 of 16%. Thus about 16 % of the systematic movement in Rural Loan and Advances as a measure of financial inclusion can be attributed to the independent variables (factors of financial technology in Nigeria) during the period of study. The F-statistics value of is not significant at 5%, thus, as a group there is no convincing linear relationship between the dependent and independent variables. However, the DW statistics indicate the absence of autocorrelation in the model. Looking at the specific variables in the above model, ATM and POS has positive effect on the dependent variable, but Web pay and Mobile Pay have negative. However, all independent variables have no significant effect of the dependent variable (Rural Loan and Advance) as a measure of financial inclusion, as revealed by the probability values in parenthesis. This could be because these variable are mostly employed as payment and withdrawer tools and may be reducing the value of available Loan and Advances in rural banks.



Discussion of Results

FinTech and Financial Deepening in Nigeria

The results of the study showed that financial technology has positive and negative influences on financial deepening measures in Nigeria. However, only point of sales (POS) has a significant influence on financial deepening measure of savings/GDP ratio in Nigeria. Suggesting that POS increases the savings of Nigerians. This could be attributable to the multiplicity of POS vendors that has brought banking services close to the business locations of bank clients in contemporary times. Nevertheless, POS has a negative and insignificant effect on the ratio of private sector credit to GDP. Although ATM has a positive influence on financial deepening the effect is insignificant. This could be because most Nigerian use the tool for withdrawal often, as ATM does not engender credit increment nor generate a rise in savings. Web pay and Mobile Pay are insignificant influencers of financial deepening, possibly because they are still emerging in Nigeria and are currently been used as payment mechanisms.

This study is in partial agreement (through POS only) with the study of Sahay e'tal (2015) in Chile, which posited that financial technology pushed financial deepening. But, warned regulators to be mindful of the speed, as high speed of financial technology weakens the economy. Also, in agreement with this study (specifically the influence of POS on savings/GDP ratio), is the study of Nkwodimmah and Ochei (2019), which submitted that financial technology encouraged savings in Nigeria. However, the study of Otuya, Ofeimun and Akpotor (2022) revealed that in Nigeria, the influence of information communication technology (ICT) on the operational efficiency of DMBs is insignificant, including transaction done through POS.

FinTech and Financial Inclusion in Nigeria

The results as revealed by this study indicates that financial technology has both direct and indirect effect on the measures of financial inclusion in Nigeria. As ATM and POS have negative effect on SMEcr, while, Web pay and Mobile pay have Positive effect on SMEcr as a measure of financial inclusion. Meanwhile, only POS has a positive effect on Rural Deposit as a measure of financial inclusion. But, ATM and POS has positive effect on Rural Loan and Advances as a measure of financial Inclusion in Nigeria. As it concern the significant of these effect, ATM and Web pay have significant effect on SMEcr, POS has a significant influence on Rural Deposit, at 5%, and no FinTech variable has a significant effect on Rural Loan and Advances. Perhaps, this results places Nigeria at the same level with Indonesia according to the findings of Khaerunnisa (2018) that FinTech has the potential of closing financial inclusion gap, but, the economy is still in the catch-up phase.

This findings also are in agreement with the results of Onwumere, Abner, Inim, Izuchuwu and Akpan (2021) that FinTech has direct and indirect effect on economic growth via financial inclusion. The significant effect of ATM, Web pay and POS on the measures of financial inclusion as reflected in this study is in conformity with the findings of Wati, Ispriyahadi, Nisa, Lutfi, and Suprpta (2020) in Jarkata, Aziakpono (2022) on selected



Africa economies, Tok and Heng (2022), Babajide, Oluwaseye, Lawal and Isibor (2020) in Nigeria, Hussein (2020) in Egypt and Darrat and Al-Sosaisi (2010) in Qatar, although in the long-run and with a proviso that the effect is evidently pronounced when fueled by digital literacy. The position of Darrat and Al-Sosaisi (2010), was also reiterated by Al-buraikki and Khan (2018) in Oman that the significance of FinTech on financial inclusion is felt more, if technical support is available in IT literacy. Also, the study of Kama and Adigun (2013) mentioned that the bane of FinTech in emerging economies like Nigeria is poor facilities and infrastructure (Physical, Technical and Social).

Summary, Conclusion and Recommendation

Summary

The findings of this study are summarized as follows;

1. FinTech has no significant effect on Private sector credit as a measure of financial deepening in Nigeria.
2. FinTech has a significant effect on savings as a measure of financial deepening in Nigeria via POS and has insignificant effect via other FinTech variables.
3. FinTech has a significant effect on SME credit as a measure of financial inclusion in Nigeria, via ATM and Web pay. While, other FinTech variables have insignificant effect on SME's.
4. POS as a variable of FinTech has significant effect on Rural Deposit as a measure of financial inclusion in Nigeria. But, other FinTech variables have insignificant effect on rural deposit.
5. FinTech has no significant effect on Rural Loan and Advances in Nigeria.

Conclusion

Financial Technology (FinTech) has direct and indirect effect on financial deepening and financial inclusion in Nigeria. However, the effects are largely insignificant. Thus, Nigeria's government and citizen as well as business operators has a lot of "catch-up" to do in order to "catch-in" the gains of FinTech.

Recommendation

Based on the findings, the study recommends as follows.

1. The government to provide, upgrade facilities and infrastructure that support FinTech in urban, sub-urban and rural communities in Nigeria.
2. Government and corporate organization as well as NGOs to provide technical support in the areas of digital/IT literacy to citizens and SME owners and operators in Nigeria.
3. Advocacy on the use of FinTech especially as savings tools.
4. Micro-credit linked to the usage of FinTech tools should be encouraged for SME operators/owners.



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Data for Analysis

YEAR	INDEPENDENT VARIABLES				DEPENDENT VARIABLES				
	ATM	POS	WP	MP	CSP/GDP	SAV/GDP	SMECr.	RD	RL
2009	548.60	11.03	84.15	1.27	22.75	13.13	16.37	3.30	15.59
2010	399.71	12.72	25.05	6.65	18.96	10.71	12.55	0.02	16.56
2011	1,561.74	31.02	59.61	18.98	15.07	10.24	15.61	0.02	19.98
2012	1,984.66	48.01	31.57	31.51	18.31	11.05	13.86	0.02	22.58
2013	2,828.94	161.02	47.32	142.80	17.85	11.85	15.35	0.02	739.92
2014	3,679.88	312.07	74.04	346.47	18.59	12.70	16.07	0.48	988.59
2015	3,970.25	448.51	91.58	442.35	19.64	12.36	12.95	90.37	29.17
2016	4,988.13	759.00	132.36	756.90	20.50	13.68	10.75	87.93	43.78
2017	6,437.59	1,409.81	184.60	1,102.00	19.55	12.59	10.75	185.34	530.99
2018	6,480.09	2,383.11	675.92	1,974.25	17.54	12.44	44.82	308.85	200.07
2019	6,512.61	3,204.75	478.14	5,080.96	17.63	12.52	123.93	354.86	202.59
2020	18,199,660	4727077	392346247	14987739	18.82	14.26	62.51	351.50	107.52
2021	19,121,854	21,135,324	293,762,136	48,233,138	18.67	14.57	83.74	427.45	119.85

Source: CBN Statistical Bulletin, 2021

ATM = Automated Teller Machine, POS = Point of Sales, WP = Web Pay, MP = Mobile Pay, CSP/GDP = Private Sector Credit Ratio to GDP, SAV/GDP = Ratio of Total Savings to GDP, SMECr = Credit to Small Scale Enterprises, RD = Rural Deposit and RL = Rural Loan and Advances

YEAR	LOG OG DEPENDENT VARIABLES			LOG OF INDEPENDENT VARIABLES			
	Log SMECr	LOG RD	LOG RL	log ATM	Log POS	logWP	log MP
2009	1.21	0.52	1.1928601	2.74	1.04	1.93	0.10
2010	1.10	(1.68)	1.2189549	2.60	1.10	1.40	0.82
2011	1.19	(1.69)	1.3006021	3.19	1.49	1.78	1.28
2012	1.14	(1.71)	1.3537234	3.30	1.68	1.50	1.50
2013	1.19	(1.69)	2.8691867	3.45	2.21	1.68	2.15
2014	1.21	(0.32)	2.9950153	3.57	2.49	1.87	2.54
2015	1.11	1.96	1.4649238	3.60	2.65	1.96	2.65
2016	1.03	1.94	1.6412449	3.70	2.88	2.12	2.88
2017	1.03	2.27	2.7250882	3.81	3.15	2.27	3.04
2018	1.65	2.49	2.301174	3.81	3.38	2.83	3.30
2019	2.09	2.55	2.3066133	3.81	3.51	2.68	3.71
2020	1.80	2.55	2.0314989	7.26	6.67	8.59	7.18
2021	1.92	2.63	2.0786403	7.28	7.33	8.47	7.68

Source: Authors Computation

Note: CSP/GDP and SAV/GDP were not logged because figures are in ratios.