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Financial Innovation And Economic Growth Nexus In Nigeria: Evidence From Autoregressive Distributed Lag (ARDL) Bound Test And Granger Causality Approach

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Abstract: ***This paper aims at investigating the long –run relationship and direction of causality between Financial Innovation and Economic Growth in Nigeria, using quarterly time series data from 2009-2018. The Autoregressive Distributed Lag (ARDL) bound testing; Augmented Dickey Fuller (ADF) unit root test and Pair-Wise Granger Causality were applied on the sampled data. Empirical findings from the bound test confirm the existence of long-run co-integration relationship between the variables. The result of the Long-run ARDL estimates revealed that the Value of Transaction on POS and Mobile Payment exert positive and significant impact on Economic growth in Nigeria in the long-run. Results from granger causality show a unidirectional causality which runs from financial innovation elements to economic growth. The implication of these findings is that financial innovation supports the growth of Nigerian economy in the long-run. On the basis of these findings, it was recommended that government should formulate policies to promote the development of innovative products to improve the operational efficiency within banks and the growth of Nigerian economy at large. There is need for government to formulate financial policies to promote the installation of ATM outlets in rural areas where they are scarce to spur economic activities in the country. It was also recommended that Central Bank of Nigeria should encourage banks to promote financial literacy education to sensitize the public on the significance of innovative products in driving trade and the growth of Nigerian economy at large.***

Keywords: Financial innovation, economic growth, financial literacy, ARDL, Granger Causality.

I. INTRODUCTION

Banks as the backbone of the financial system and growth of every economy needs continuous innovation to remain in operation, hence, an assessment of the relationship of financial innovation on economic growth has become a subject of significant research interest in recent times**.** Slogan (2003) defined financial innovation as technological advances which assist in trading ,access to information, means of payment and the emergence of new financial instruments and services, new forms of organization and more developed and complete financial markets. Ignazio (2007) sees financial innovation as the development of new financial products, new ways of delivering already financial services or new financial services with new processes. According to Tufano (2003) as well as Lerner & Tufano (2011) financial innovation is defined as the act of creating and then popularizing new financial instrument as well as new financial technologies, institutions and market.

Over the past decades, banks globally witnessed the development and introduction of cost effective and efficient Fin-Tech innovative products such as Electronic Funds Transfers at Point of Sale (EFTPOS), Automated Teller Machines (ATM Cash dispenser), Web/Internet Banking, Mobile Banking, Society for Worldwide Interbank Financial Telecommunication (SWIFT), Electronic Data Interchange (EDI), Block chain banking, Bitcoin Wallet , Crowd funding (Jarunne, 2018), development of peer-to-peer lending services websites, usage-based insurance, longevity bonds and swaps, money management such as google pay and improved payment services like Apple pay and Android Pay (Nejad, 2016),hence brought substantial changes in their operations as well as contribution to the economy as a whole (Boot & Marinc, 2010; Michalopoulous, et.al,2011; Gudimetla & Sekhar ,2013). In the recent past decade, Nigerian banks shifted from traditional banking methods to fast innovative service delivery technological channels such as the NIBSS Electronic Transfer, Automated Teller Machines (ATMs), Point of Sale (POS) terminals, Electronic Funds Transfer, Internet/Web Banking, Mobile banking among others which structurally transformed the landscape and quality of financial services given to customers in the country. Agboola (2013) argued that the development and adoption of ICT devices facilitated accuracy of accounts, provided home and office banking services, ensured convenient business hours, promoted fair attention and enhanced service delivery, improved bank image, competitiveness and relationship with customers, solve operational planning problems as well as facilitates faster and efficient market.

Empirical studies on the Nexus between financial innovation and economic growth suggests that there is positive and significant relationship between financial innovation and economic growth (Lumpkin, 2010; Sekhar, 2013; Qamruzzaman & Wei, 2017, 2018a, 2018b & 2019; Schrieder & Heidheus, 1995; Laeven, etal.2014 and 2015; and Michalopoulos, et.al 2009 and 2011 among others). Adu-Asare Idun & Aboagye, (2014) document that there is significant bidirectional granger causality between financial innovation and economic growth. Michalopolous et.al (2009) argues that financial innovation allows for the expansion of financial services through the development of new financial institution, financial instruments, financial reporting technology and market knowledge. Frame & White (2004) suggest that successful financial innovation reduces cost and risk or provides improved services to end users. Qamruzzaman (2017) added that financial innovation serves as a major driver of technological progress, business success and main key for the growth and development of nations.

Thus far empirical evidence from existing literatures showed that studies on the nexus between financial innovation and economic growth were concentrated on developed countries. To the best of the researchers' knowledge, studies carried out by Ajide (2016), Okafar, Chijendu & Anyalechi (2017), Chukwunulu (2019) and Ozurumba & Onyeiwu (2019) suggest that little research have been conducted in Nigeria. Hence, the objective of this present study is to empirically examine the nature of relationship and direction of causality between financial innovation and the growth of Nigerian economy using quarterly time series data over the period 2009-2018 within the framework of Autoregressive Distributed Lag (ARDL) bound testing and Pair-Wise granger causality approach. This paper specifically aims to:

- ✓ Examine the long run equilibrium relationship between financial innovation and economic growth in Nigeria.
- ✓ Investigate the direction of causality between the proxies of financial innovation and economic growth in Nigeria.

The rest of this paper is structured as follows: Section 2 presents a review of related literature. Section 3 describes the data and methodology used for the study. Section 4 presents the empirical analysis and discussion of findings while Section 5 concludes the study and offers some policy implication.

II. LITERATURE REVIEW

A. CONCEPTUAL CLARIFICATION

Financial innovation has become a major area of significant research interest among scholars and policy makers in recent times. Debrowski (2017) defines financial innovation as creating new financial instruments, technologies, institutions and market. For Frame & White (2014), financial innovation is defined as something new that reduces costs, reduces risks or provides an improved product /service/ instrument that better satisfies financial system participant demands. Batis-Lazo & Woldesenbet (2006) conceptualized financial innovation as an idea, product, process, service, hardware or software application that is perceived as new by an adopting organization or unit. Financial innovation can be categorized into process innovation, product innovation and organizational innovation (Tsuma, Musiega & Odhiambo, 2015; Debrowski, 2017; Vargas, 2008; Frame & White, 2014; Allen & Gale, 1994). Scholars argue that process innovation relates to new or significantly improved production methods or elements introduced in the organization's service operation to render services which has the potential to increase operational efficiency and market size (e.g. Credit scoring and electronic recording for tracking security). Production innovation refers to new products or services such as subprime and adjustable rate mortgages, internet banking, mobile banking, on-line security trading, exchange traded index fund, electronic fund transfer at point of sale, bill payment, derivatives, default swaps, securitized asset created to meet user or market needs of customers .Product innovation help banks to differentiate themselves from each other by providing solution to unattended needs of their customers. On the other hand, organizational innovation encompasses new types of financial institutions or organizational structure within institution where the production process is held. This form of innovation aims at influencing the financial system.

The pace of financial innovation in Nigerian banks has grown over the recent decade following the globalization and deregulation of the nation's financial system, technological advancement in information and communication, changing nature of consumers need, excessive competition in the banking industry and the desire of banks to make profit as well as hedge against economic risk such as inflation and interest rate (Adu-Akare Idun & Aboagye, 2014; Frame & White, 2009). In Nigeria, financial innovation was incorporated into

the banking industry through the introduction of Electronic Funds Transfer, Automated Teller Machine, Mobile banking, Internet banking, Point of sales (POS) among others. The National Electronic Fund Transfer is a nationwide payment system that facilitates an irrevocable one to one fund transfer between individuals or entities from one bank to individuals or entities having account with any other branch in the country participating in the scheme. NEFT makes real time transfer of funds possible in a secured and convenient manner. The Automated Teller Machine (ATMs) is the most commonly form of electronic funds transfer in retail banking in Nigeria that allows a bank customer or cardholder to use his/her magnetically encoded plastic card containing his/her personal identification number (PIN) to interact with the machine to make payment or receive cash as well as perform other banking transactions without the help of a teller. ATMs offer convenience to customers as well as provide banking services beyond the traditional banking hours.

Mobile Banking is a recent banking service which was developed following the introduction of the Global System for Mobile Communication (GSM). This method of banking allows bank customers to carry out wide range of financial transactions through the use of mobile devices such as smart phones and wireless tablets. It provides convenience to customers as well as support person to person transfer of funds for the beneficiary. Internet banking is a fast innovative system of banking that allows bank customers to conduct wide range of financial transactions on the internet or bank's website using electronic devices like computers, laptops, tablets or smart phones without visiting the banking hall. Internet banking provides customers with banking services at any place with access to the internet. Internet banking can be secured through a login pin and a onetime password (OTP) which is personal to the holder of the account. Point of sale (POS) terminals is however an electronic retail payment facility in the stores that permits a bank customer to pay for purchases of goods and services electronically at the point of purchase through the use of a debit or credit card by deducting the cost of the transaction directly from his/her bank account instantly.

Economic growth can be defined as a sustained increase in a country's level of output of goods and services or per capita national income over a significant period of time say one year. Ohale & Onyema (2001) see economic growth as sustained increase in the productive capacity of an economy which leads to increase availability of goods and services in the economy over some given period of time. A country's economic growth is determined by the quantity and use of its natural resources, quality and size of human resources, level of physical capital and technological development, size of entrepreneurial stamina , economic policy, social and political climate of the country. Economic growth serves as an indicator for assessing the prestige and performance of an economy at a given financial period. In this paper, economic growth is measured using real gross domestic product which is the inflation adjusted value of all final goods and services produced in an economy over a period of one year.

B. THEORETICAL UNDERPINNINGS

The theoretical underpinnings for this study anchors on Innovation diffusion theory, technology acceptance model and unified theory of acceptance and use of technology. The Innovation Diffusion Theory proposed by Rogers (1962) explicates that innovation is communicated over time among members of a social system through certain elements like innovation, communication channels, time and social system. The theory states that the decision to adopt an innovation process follow five progressive stages which begins with initial knowledge and awareness of the existence of an innovation followed by the individuals' persuasion of the value of the new practice and the decision to either accept or reject the innovation as well as the implementation and confirmation of the decision. Rogers (2003) re-iterates that innovation- diffusion process is influenced by five attributes among which are relative advantage, compatibility, complexity, triability and observability. For Roger adopters are based on the measure of innovativeness such as innovators, early majority, late majority and laggard.

The technology acceptance model was developed by Davis (1989) as an extension of Ajzen & Fishbeins theory of Reasoned Action to provide explanation for the general determinants of users' acceptance of modern technology. This theory postulates that an individual's intension to use new technology is essentially determined by user's perceived usefulness (that is the prospective user's subjective believe that a new technology will enhance his/her job performance) and perceived ease of use which is the degree to which a prospective user expects a given technology to be easier or free from effort. According to Davis (1989) these two factors are influenced by external variables such as social factors (language, skills and facilitating conditions), cultural and political factors. Venkatesh & Davis (1996) assert that external variables such as system characteristics training, user involvement in design and the nature of implementation process directly influence perceived usefulness and perceived ease of use of new technology. Teo (2013) sees individual differences, social influences, beliefs, attitudes and situational influences as primary factors that determine individual's intension to use new technology as well as to accept or reject it.

The Unified Theory of Acceptance and Use of Technology (UTAUT) is one of the latest theoretical framework developed by Venkatesh, Morris, Davis & Davis (2003) to explain the behavioral determinants for the adoption of new technology. This theory proposes that users' behavioral intention to use new technology is explained by four constructs namely performance expectancy (PE), social influence (SI), effort expectancy (EE) and facilitating condition. The theory postulates that the effect of core constructs is influenced by four moderators among which are gender, age, experience of a potential user and the voluntariness of use of the innovation while self-efficacy, anxiety and attitude towards the use of new technology acts as mediators and not direct determinants of behavioral intention to the use of technology.

C. EMPIRICAL REVIEW

Literature is replete on the nexus of financial innovation and economic growth. Using Bank industry and country level data for 32 high income countries over the period 1996 - 2006, Beck, Chen, Lin & Song (2012) investigated the relationship between financial innovation in the banking sector and (i) real sector growth (ii) real sector volatility and bank fragility. The findings of the study revealed that higher level of financial innovation is associated with stronger relationship between a country's growth opportunities and capital and GDP per capita growth and with higher growth rate in industries that depend more on external financing and innovation. It was also confirmed that financial innovation is associated with higher growth volatility among industries that depends on external financing and on innovation and with higher idiosyncratic bank fragility, higher bank profitability and higher bank losses. Domeher, Frimpong & Appiah (2014) examined the determinants of the adoption of financial innovation in Ghana's banking industry. Using a logistical regression, the study concludes that innovation characteristics such as lack of complexity, compatibility and perceived usefulness increase the likelihood of the adoption of electronic banking.

Idun & Aboagye (2014) used quarterly data from 1990 to 2009 to estimate the relationship between bank competition, financial innovation and economic growth. Employing the ARDL approach, the authors found that bank competition positively relates with economic growth in the long run while financial innovation is negatively related to economic growth. The result of the granger causality test confirms that unidirectional granger causality run from bank competition to economic growth while bidirectional granger causality prevails between financial innovation and economic growth.

Johane (2016) studied the contribution of financial sector innovation on economic growth of Botswana using quarterly time series data from 2006 – 2014.The study used Real GDP as the dependent variable and proxy for economic growth and the values of the transactions on ATM and EFTPOS, ratio of credit to private sector to nominal GDP, ratio of total deposits to nominal GDP, trade ratio, 3 months deposit interest rate and inflation ratio as the independent variables. The study reveals that technological innovation (ATM and EFTPOS) and business innovation variables (bank deposits and credit to private sector) have significant positive impact on economic growth of Botswana during the study period. Bara & Mudzingiri (2016) in their study of the causal relationship between financial innovation and economic growth in Zimbabwe for the period 1980 – 2013 found that significant long run relationship exist between financial innovation and economic growth with bi-directional causality running from economic growth to financial innovation. Usman (2016) examined the impact of financial innovation on bank performance, risk and economic growth of Pakistan using time series data from 2000 – 2013. The result of the study established that positive and significant relationship exists between financial innovation and economic growth over the study period. Qamruzzaman (2017) explored the relationship between financial institutional innovation and economic growth of Bangladesh from 1991 to 2015 and utilizing Johansen co-integration test and Pair-wise Granger causality test established that significant long run relationship prevailed between financial innovation in the financial system and economic growth in Bangladesh. The results of the Granger causality test reveal that bi-directional relationship exist among GDP, capital flow and CPI while unidirectional relationship exist between GDP and market capitalization, thus suggesting that market capitalization and GDP granger cause each other in either direction in the long run.

Qamruzzaman & Wei (2017) by applying Autoregressive Distributed Lag (ARDL) bound testing and Granger causality-based Error correction model (ECM) examined the influence of financial innovation on economic growth in Bangladesh for the period 1980 – 2016. The study reveals that credit circulation to the private sector and monetary management play important roles in economic growth. It was also discovered that the coefficients of financial innovation proxy variables are positive and statistically significant both in the short run and long run while trade openness and gross capital formation contributes to the growth of Bangladesh economy. Okafor, Chijendu & Anyalechi (2017) examined the extent to which financial innovation influence the growth of Nigerian economy using quarterly time series data spanning 2009Q1 – 2010Q4. Employing the Vector Autoregressive (VAR) approach and Johansen co-integration, the study reveals that long run relationships exist between financial innovation and growth. The findings of the study further indicate that the proxies of financial innovation as measured by the value of ATM transaction, Web/Internet transactions and mobile payment transaction exert positive effect on economic growth in Nigeria with the exception of the value of point of sale (POS) transaction which exerted a negative influence on economic growth. Zabairu & Oyedeko (2018) analyzed the effect of financial innovation on industrial growth volatility in Nigeria using annual data sourced for the period 1981 to 2016. Employing the Toda-Yamamoto causality test found that financial innovation; bank branch network and growth of banks credit to private sector significantly reduce industrial growth volatility while quasi money exacerbated it.

Nazir, Tan & Nazir (2018) investigates the causal relationship between financial innovation and economic growth in China, India and Pakistan for the period 1970 – 2016. By employing the Autoregressive Distributed Lag (ARDL) bounds testing and Granger causality-based Error correction model found that financial innovation has a positive and statistically significant influence on economic growth in both short run and long-run. The result of the study further shows that monetary management and credit flow to the private sector play a significant effect on economic growth in the long run. By applying the Autoregressive Distributed Lag (ARDL) bound test and non linear ARDL (NARDL) test, Qamruzzaman & Wei (2018) explored on the nexus between financial innovation and economic growth in South Asia countries such as Bangladesh, India, Pakistan and Sri Lanka for the period Q1 1975 – Q4 2016. The finding of the bounds tests confirms that significant long-run relationship prevails between financial innovation and economic growth in the sampled countries while the findings of the non-linear Autoregressive Distributed Lag (NARDL) test confirms that positive changes in financial innovation is positively associated with economic growth and vice versa in the long

run. The result of the Granger causality test indicates that feedback relationship prevails in both long run and short run. Qamruzzaman & Wei (2018) explored the relationship between financial innovation, stock market development and economic growth of Bangladesh for the period 1980 - 2016. The result of the Autoregressive Distributed lags (ARDL) bound test confirms that long-run relationship exists between financial innovations, stock market development and economic growth. The Granger causality test suggests bidirectional causality between financial innovation and stock market development and economic growth both in the long run and short run.

Okafor (2019) in his study of the impact of financial innovation on the Nigerian banking sector over the period 2009 – 2018 concluded that financial innovation is a dominant channel of financial transaction in the Nigerian banking sector with the potential of crowding out traditional banking methods in the future. Ozurumba & Onyeiwu (2019) examined the impact of financial innovation on economic growth in Nigeria over the period from 2012 – 2018. Using three proxies of financial innovation such as NIBSS instant payment, ATM and Agent Banking on real GDP found that the coefficients of the value of transactions on Nigerian Interbank Settlement System (NIBSS) and Agent banking positively relates with economic growth while the value of transaction on Automated Teller Machines (ATM) has negative relationship with economic growth.

Chukwunulu (2019) applied the Generalized Method of Moments (GMM) to evaluate the effect of financial innovation on economic growth of Nigeria using annual data from 2008-2017. The result confirms that financial transactions on ATM, mobile Banking, Internet Banking and Point of sale exert positive and significant effect on economic growth. The study concludes that financial innovations have high predictive power on the growth of Nigerian economy. Satia & Afotey (2020) estimated the impact of financial innovation on economic growth prospect of Cameroon. The economic variables used include gross domestic product per capita growth, domestic credit to private sector (DCP), ratio of broad money as a percentage of GDP (M2) and mobile banking penetration. Employing the Autoregressive Distributed Lag (ARDL) bound test, the study Show that DCP and M2 exert negative coefficients in the short run while financial innovation contributes to the growth of Cameroon economy in the long run.

From the extant literature reviewed, it is evident that empirical studies on this subject were devoted more to developing countries. Empirical work by Ajide (2016), Okafor, Chijindu & Anyalechi (2017) and Chukwunulu (2019) confirms that little research has explored the relationship of financial innovation on Nigeria's growth prospect. This therefore creates a gap in literature in which real gross domestic product (RGDP) is determined by value of transaction on ATM, value of transaction on Web/Internet banking , value of transaction on POS and value of transaction on Mobile Payment. On this premise, this present study is motivated by the need to examine the long-run relationship and direction of causality between financial innovation and economic growth using Autoregressive Distributed Lag (ARDL) bound testing approach and pair-wise granger causality over the period 2009-2018.

III. DATA AND METHODOLOGY

This study hinges on ex post facto research design since it rely on quarterly time series data gleaned from the publications of National Bureau of Statistics and Central Bank of Nigeria Statistical Bulletin to examine the long run relationship and direction of causality between financial innovation and economic growth for the period 2009 - 2018. The empirical variables used in the study include real gross domestic product (RGDP) which represents economic growth and value of transaction on Automated Teller Machine (VTATM), value of transaction on Web banking (VTWEB), value of transaction on Point of Sale (VTPOS) and value of transaction on mobile payment that represent financial innovation development. Considering the objectives of this paper, unit root test is conducted in levels and 1st difference to ascertain the time series properties and order of integration of the variables based on Augmented Dickey Fuller (ADF) test. The Autoregressive Distributed Lag (ARDL) bound testing approach by Pesaran, Shin & Smith (2001) was applied for the empirical analysis of this paper following its suitability for small sample size consisting 30-80 observations and its application for variables with mixture of 1(0), 1(1) or mutually co-integrate (Ghatak & Siddiki, 2001; Pesaran, et.al, 2001 .The causal relationship between the study variables are evaluated using the Pair -Wise Granger causality test. We also subject the sample data to heteroskedasticity test to validate the classical linear regression model assumption. All the calculation is carried out using E-Views version 10 statistical soft ware.

Based on the theoretical and empirical relationship of the study variables, our model is specified as follows:

RGDP = F (VTATM, VTWEB, VTPOS, VTMP) ----- (1)

Transforming equation 1 into a linear form, the result becomes

$RGDP=\alpha_0 + \alpha_1 VTATM_{1t} + \alpha_2 VTWEB_{2t} + \alpha_3 VTPOS_{3t} + \alpha_4 VTMP_{4t} + \mu_t$ …….. (2)

Where RGDP is real GDP, VTATM is the value of transaction on Automated Teller Machine, VTWEB is the value of transaction on Web banking, VTPOS is the value of transaction on Point of Sale (POS) terminal, VTMP is the value of transaction on Mobile Payment, t is time, α_0 is the intercept parameter; $\alpha_1 - \alpha_6$ are the slope parameters to be estimated; μ_t is the error correction term.

All the data for this paper are stated in natural logarithm form. The a priori relationship between the dependent and independent variables is stated as: $\alpha_1\ \alpha_2, \alpha_3, \alpha_4, \alpha_5$, and $\alpha_6 > 0$.

IV. PRESENTATION AND ANALYSIS OF RESULT

A. DESCRIPTIVE STATISTICS

The descriptive statistics of the data distributions are summarized in table 1 below.

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VARIABLES	RGDP	VTATM	VTWEB	VTPOS	VTMP
Mean	20519.69	821.9903	28.39400	139.4075	116.9910
Median	20753.05	798.7050	20.97500	64.05500	61.72000
Maximum	35230.61	1832.550	221.5300	714.3500	592.9400
Minimum	5571.420	62.59000	3.370000	1.870000	0.060000
Std. Dev.	7411.050	540.4654	35.96075	190.9486	149.6355
Skewness	-0.196063	0.234506	4.029257	1.614326	1.489253
Kurtosis	2.588677	1.847507	22.01577	4.637137	4.615523
Jarque-Bera	0.538249	2.580352	710.8988	21.84069	19.13569
Probability	0.764048	0.275222	0.000000	0.000018	0.000070
Sum	820787.4	32879.61	1135.760	5576.300	4679.640
Sum Sq. Dev.	2.14E+09	11392010	50433.84	1421993.	873240.2
Observations	40	40	40	40	40

Source: E-view 10 Output on 2009 to 2018 Quarterly CBN Bulletin Data.

Table 1: Descriptive Statistics of Employed Variables

Table 1 displays the descriptive statistics of the data used in the study period. As observed, all the variables showed positive mean value which suggests increasing trend over time. Among the various proxies of financial innovative, value of transaction on ATM has the highest mean value of 821.9903 which once dipped at the lowest value of 5571.420 from a maximum value of 35230.61. This is followed by the value of transaction on POS which average around 139.4075 with a maximum and minimum value of 714.3500 and 1.870000 respectively. This signifies their relative high usage as payment channels over Value of Transaction on Mobile Payment and Value of Transaction on Web/Internet with mean values of 116.9910 and 28.39400 respectively. Similarly the value of transaction on ATM had the highest value of dispersion based on standard deviation while the value of transaction on Web/internet had the least measure of dispersion which suggests that the use of ATM is associated with the highest level of risk while the value of transaction on Web has the least standard deviation, thus exhibiting the lowest level of risk. The skewness which is a measure of the asymmetry of the probability distribution of a valued random variable about its mean is positive for all the variables while the Jarque-Bera statistics show that the sample data are normally distributed.

B. UNIT ROOT TEST

Given that time series data exhibit trending behavior which yield spurious and misleading result, the Augmented Dickey-Fuller (ADF) unit root test was conducted in levels and first difference to determine the time series properties and order of integration of the variables. This was done with constant and linear trend based on Akaike information criterion. The result of the unit root test is reported in table 2 below.

Variable	ADF stat	Critical Value at 5%	Order of Integration	P-value
LNRGDP	-4.712635	-3.544284	I(0)	0.0031
LNVTATM	-5.943682	-3.533083	I(1)	0.0001
LNVTWEB	-3.697245	-3.529758	1(0)	0.0344
LNVTPOS	-4.003298	-3.529758	1(0)	0.0168
LNVTMP	-8.162490	-3.533083	1(1)	0.0000

Source: E-view 10 Output on 2009Q1 to 2018Q4 CBN Bulletin Data.

Table 2: Summary Result of ADF Unit Root Test

The result of unit root test in table 2 showed mixed order of integration of variables. Comparing the ADF statistics for each of the variables with their associated critical values at 5 percent level of significance, the result show that Real GDP, Value of Transaction on Web Banking and Value of Transaction on Point of Sale are stationary at level , which suggests that the variables are integrated at order zero, 1(0) while the Value of Transaction on Automated teller Machine and Value of Transaction on Mobile Payment are all stationary at first difference, which suggests that the variables are integrated at order one, 1(1). These results therefore justifies the use of the Autoregressive Distributed Lag (ARDL) bound testing approach to verify the existence of long co-integration among the variables of study.

C. RESULT OF BOUND CO-INTEGRATION TEST

Sequel to the determination of the order of integration of the variables, we proceed to estimate the long-run relationship among the variables using the ARDL bound test approach to co-integration, the result which is reported in table 3 below.

Test statistic	Value	K
F-statistic	14.18572	4
Critical Value Bounds		
Significance	**I(0) Bound**	**1(1) Bound**
10%	2.2	3.09
5%	2.56	3.49
2.5%	2.88	3.87
1%	3.29	4.37

Sources: E-view 10 Output from 2009Q1 to 2018Q4 CBN Bulletin Data

Table 3: Bound Test Co-Integration Result

From the result of the Wald bound test in Table 3, the computed F-statistics of 14.18572 exceeded the upper and lower bound statistics at 1%, 5% and 10% level of significance respectively. This result suggests the rejection of the null hypothesis of no co-integration and the conclusion that long run equilibrium relationship exist between the proxies of financial innovation and Economic growth in Nigeria over the study period, that is, financial innovation move together with economic growth in the long –run. This result corroborates with the study findings of Ajide (2016), Boot & Marinc (2010), Chou & Chin (2011), Bara & Mudzingiri (2016), Qamruzzaman & Wei (2017, 2018 and 2019) among others. On this premise, we proceed to estimate the long –run ARDL relationship between financial innovation and economic growth in Nigeria.

D. RESULT OF LONG RUN AUTOREGRESSIVE DISTRIBUTIVE LAG (ARDL) ESTIMATES

Having determined the bound test co-integration status f or this study, we proceed to estimate the long-run estimates of the model, the result which is represented in table 4.

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
LNRGDP(-4)	0.285146	0.080011	3.563852	0.0035
D(LNVTATM(-4))	0.100952	0.070739	1.427104	0.1771
LNVTWEB(-4)	0.040376	0.027992	1.442434	0.1728
LNVTPOS(-3)	0.108904	0.041642	2.615260	0.0214
D(LNVTMP(-2))	0.101633	0.037874	2.683470	0.0188
C	4.834595	1.698181	2.846925	0.0137

R-squared	0.995884	Mean dependent var	9.982352
Adjusted R-squared	0.989235	S.D. dependent var	0.262788
S.E. of regression	0.027265	Akaike info criterion	-4.099693
Sum squared resid	0.009664	Schwarz criterion	-3.122045
Log likelihood	93.74462	Hannan-Quinn criter.	-3.762209
F-statistic	149.7864	Durbin-Watson stat	1.706670
Prob(F-statistic)	0.000000		

**Note: p-values and any subsequent tests do not account for model selection*

Source: E-view 10 Output on 2009Q1 to 2018Q4 CBN Bulletin Data

Table 4: Autoregressive Distributive Lag (ARDL) Results

From table 4 above, it is evident that the coefficients of Real GDP and the value of transaction on ATM, value of transaction on Web/ internet , value of transaction on POS and the value of transaction on Mobile Payment assume positive values, which indicate that the various innovative products promote the growth of Nigerian economy in the long run to the extent that a 1% increase in the use of ATM, Web/Internet, POS and Mobile payment will increase the growth of Nigerian economy by 0.1, 0.04, 0.11 and 0.1 billion naira in the long -run. However, the use of POS and mobile payment tend to support significant relationship with economic growth in Nigeria, implying that they efficiently promote the growth of Nigerian economy. Although the value of transaction on ATM and Web banking presents the expected a priori sign as they reflect positive influence on economic growth, their impact are found to be insignificant during the study period. This suggests that POS and Mobile payments portray as the most convenient method of effecting transaction anytime and at anywhere in the country. These findings lends credence to the empirical work by Johane (2016),Okafor, Chijendu & Anyalechi (2017) Qamruzzaman &Wei (2018), Chukwunulu (2019), Satia & Afotey (2020) whose studies revealed that financial innovation contributes positively to the growth of the economy.

From the above, all the variables showed the expected a priori relationship with the criterion variables and the estimated model yield high adjusted R-square of 0.995884, which suggests that the predictor variable explains 99 percent of the total variation in output level of Nigerian economy while 1 percent of the variation in gross domestic product is accounted by other factors not included in the model. This result indicates that the sampled data in our model is reasonably fitted .The F- statistics of 149.7864 with p- value of 0.000000 is less than 5% level of significance. The robustness of this result is further buttressed by the Durbin-Watson statistic of 1.706670 which falls within the acceptable region of 1.5 to 2.5 confirms the absence of serial correlation among the study variables.

E. GRANGER CAUSALITY TEST

In an attempt to evaluate the direction of causality between the study variables, Pair wise granger causality was conducted on the variables and the result is presented in table 5 below

Null Hypothesis:	Obs	F-Statistic	Prob.
VTATM does not Granger Cause RGDP	38	3.39969	0.0454
RGDP does not Granger Cause VTATM		2.14767	0.1328
VTWEB does not Granger Cause RGDP	38	7.57361	0.0020
RGDP does not Granger Cause VTWEB		2.34346	0.1118
VTPOS does not Granger Cause RGDP	38	9.27445	0.0006
RGDP does not Granger Cause VTPOS		2.79072	0.0759
VTMP does not Granger Cause RGDP	38	4.01673	0.0275
RGDP does not Granger Cause VTMP		0.06939	0.9331

Source: E-view 10 Output on 2009Q1 to 2018Q4 CBN Bulletin Data

Table 5: Summary Result of Pair Wise Granger Causality Test

A cursory examination of the result of the pair wise causality test in Table 5 above shows that there is unidirectional causality with flows from financial innovation to economic growth in Nigeria. This indicates that financial innovation in the banking sector spurs economic growth in emerging economy like Nigeria.

F. DIAGNOSTIC TEST

In attempt at ensuring that our estimated model is free from classical linear regression model assumption of heteroskedadticity, we ran a heteskedasticity test; the result is presented in table 6 below.

Heteroskedasticity test: Harvey			P-value
F-statistic	1.582463	Prob. F(21,13)	0.1985
Obs*R-squared	25.15827	Prob. Chi-Square(21)	0.2404
Scaled explained SS	33.43505	Prob. Chi-Square(21)	0.0416

Source: E-view 10 Output on 2009Q1 to 2018Q4 CBN Bulletin Data.

Table 6: Heteroskedasticity Test

The result of Harvey heteroskedasticity test reveals that the estimated model had a p-value of 0.1985 which is in excess of 0.05 level of significance level. This result leads to the acceptance of the null hypothesis that there is absence of heteroskedasticity problem in the study model, hence suggesting that the model is valid and can be used for policy formulation and prescription.

V. CONCLUSION AND POLICY IMPLICATION

Motivated by the growing interest among researchers and policy analyst in understanding how financial innovation impact the growth of economies especially emerging economy like Nigeria, this paper empirically sets out to investigate the long-run relationship and direction of causality of financial

innovation on the growth of Nigerian economy using quarterly time series data from 2009-2018 based on Autoregressive Distributed Lag (ARDL) bound testing approach and pair wise granger causality test. The Augmented Dickey Fuller (ADF) unit root test, descriptive statistics and Heteroskedasticity test were employed. Real GDP is used as a measure for economic growth while financial innovation is measured by the value of transaction on ATM, value of transaction on Web/ internet, value of transaction on POS and value of transaction on Mobile payment. The findings of the unit root test showed mixture of order of integration of variables given that some were stationary at level (Real GDP, VTWEB and VTMP) while others were stationary at first difference(VTATM and VTMP). The result of the bound test reveals that F- statistics (Wald test) of 14.18572 is higher than the upper bound and lower bound critical values of 3.49 and 2.56 at 5 % level of significance, thus suggesting the existence of long-run co-integration relationship among the variables of study.

The result of the long –run ARDL confirms that the use of POS and Mobile Payment support real GDP, implying that transaction on point of sale and mobile payment among other channels of financial innovation, stand efficiently strong in promoting the growth of Nigerian economy. These results corroborates with the findings of Johane (2016), Okafor, Chijindu & Anyalechi (2017, Qamruzzaman & Wei (2018), Chukwunulu (2019) and Sotia & Afotey (2020 in which it was discovered that financial innovation contributes positively to the growth of the economy. The result of the granger causality test evidence that a unidirectional causality flows from financial innovation to economic growth.

The findings from this study have implication for policy makers in both financial and real sector. The findings indicates that economic growth is stimulated by the use of innovative electronic channels in the long- run, hence new policies should encourage huge investment in financial innovation in the country so as to speed up the operational efficiency of banks as well as accelerate their contribution to the growth of the economy at large. It was also recommended that government should formulate financial policies to promote the installation of ATM outlets in rural areas where they are scarce to stimulate economic activities in the country. There is also need for Central bank of Nigeria and other regulatory institutions to encourage banks to promote financial literacy education to sensitize the public of the significance of financial innovative products in driving trade and the growth of the economy at large.

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