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Financial Innovation and Economic Growth: Empirical Evidence from Nigeria

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Abstract: The study examines the impact of financial innovation on the Nigerian economy using both quarterly and monthly series ranging from 2010 to 2020. Most of the previous studies did not disaggregate the financial innovative channels in Nigeria using a value-based approach and also fail to capture the full data information as they annualized both the quarterly financial innovation data and quarterly GDP time series. The study adopted the autoregressive distributed lag model (ARDL) and the polynomial distributed lag mixed data sampling (PDL MIDAS) model as it is effective when combining low frequency and high-frequency data. The outcome of the ARDL showed that mobile payment platform in Nigeria had a positive significant effect both in the long run and short run while internet web transactions and POS transactions have a negative insignificant effect on the Nigerian economy in the short run and long run. The PDL MIDAS equation result, also confirms mobile payment transactions is positively related to Nigeria's economic growth while POS transactions were negatively related to the Nigerian economy. The results of the study suggest that financial innovation in the Nigerian financial system has a crucial role to play in the nation's economy which validates the finance-growth theory. The study, therefore, recommends that there is need to strengthen policies towards improving the performance of the financial innovative channels in Nigeria and improve the financial security of existing payment platforms.

Keywords: Financial transactions; Online payment; Economic growth; Mixed data sampling; ARDL

JEL Classification: C22; C51; G20; O30; O41

1. Introduction

Financial innovation has continued to shape many business activities all over the world. It creates new businesses and provides better medium of exchange for goods and services. It also leads to the invention of new financial technologies which accelerate the productivity of capital, reduce transaction costs and hence stimulate economic growth. Financial innovation refers to the process of creating new financial or investment products, services or processes. According to Tahir et.al (2018) financial innovation refers to the introduction of new financial instruments in financial intuitions and markets through new technologies. It includes process, product and institutional innovation. In modern economy, the mode of payments plays a key role in the smooth functioning of economic activities. There is no doubt to the fact that financial innovations have created an efficient system of payments which provides instantaneous settlement of financial transactions and expedites the exchange of goods and services in a prompt, protected, and reliable manner. According to Qamruzzaman and Jianguo (2017), financial innovation promotes economic growth through financial inclusion and the facilitation of international exchange of goods and services.

Recently, Nigeria experiences financial innovations especially in the banking sector which move the

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country from being an analogue nation to a technology hub. Payments platforms such as Automated Teller Machines (ATMs), Point of Sales (P.O.S) Machines, electronic payment system, mobile banking have emerged from the technological development of the finance sector. These payments systems have resulted in reduction of transaction costs and created more employment opportunities for many youths in the country. It has also led to the emergence of new enterprises that provides a financial technology platform that allows individuals and businesses to make and receive payments from anywhere. There is an increase in the number of financial technology innovations enterprises that are driving banking services in Nigeria. This has made life and economic activities easier for Nigerians. However, despite the importance of these financial innovations, the process of making payments online in Nigeria have been marred with many challenges.

Enormous empirical studies carried out in Nigeria shows that financial innovations via most electronic channels was found to contribute positively to the economic growth while some others conclude that it does not have a desired effect on the economic growth of Nigeria. Ozurumba and Charles (2019) examined the effect of financial innovation on the economic growth of Nigeria and concluded that the volume of financial transactions via NIBSS and Agent Banking platforms have positive but insignificant effect on economic growth of Nigeria, while the volume of transactions carried out through the Automated Teller Machine (ATM) have negative effect on economic growth. Meanwhile, John (2019) adopted Autoregressive Distributed Lag (ARDL) technique to explore relationship between the adoption of electronic payment system and the growth of the Nigerian economy and concluded that automated teller machine, mobile payment and web-based transactions have negative impact on the real GDP growth of Nigeria while POS transaction have positive impact on economic growth. Ogedebe and Jacob (2012) attributed the problems associated with financial innovation channels in Nigeria to unreliable network connectivity and cyber insecurity. BCBS (2017), Ahmed and Monir (2019) also identified challenges such as data security, high operational risk, vendor management risk, money laundering, liquidity risk hampering the effectiveness of financial innovation channels. These challenges had led many people to abandon the use of financial technology and innovation platforms offered by vendors and banks, preferring to withdraw and deposits money in the banking hall. Therefore, there is need to investigate the impact of financial innovation on the Nigerian economy to contribute to existing literatures in this line of knowledge.

This study therefore aims to fill the knowledge gap in existing literature in the following ways. Firstly, this paper employs a value-based approach (as it captures both the local currency value and volume of financial transactions through financial innovation channels) by disaggregating financial innovation into five important financial innovation channels which are values of POS, internet web, cheques, mobile payments and ATM transactions to determine the relationship between financial innovation and the Nigerian economy. Secondly, the study employs an high frequency data (monthly and quarterly) to capture the objective of this paper as against annualizing the time series as used by most studies in this line of knowledge. Thirdly, this paper adopts a dynamic approach to explore the relationship between financial innovation and economic growth by employing a dynamic mixed data sampling (MIDAS) and the ARDL model. Lastly, the study uses the MIDAS model to capture the full time and data information of both the GDP variable (which is a quarterly series from first quarter 2010 to first quarter 2020) and financial innovation indicators (which is a monthly series from January 2010 to April 2020).

It is against this background that this study adds to the body of knowledge. This paper will help the policy makers to understand the role of financial innovation on the economy. Also, the empirical result of this paper will help identify the financial innovation channels that are important and that needs to be improved in order to aid the development of the financial sector and economic growth in Nigeria. In addition, this paper will help policy makers understand the trend of financial innovation in Nigeria so far with a view to identifying challenges facing by financial innovation system users in Nigeria and proffering possible solutions to the problems identified.

The broad objective of this paper is to examine the impact of financial innovations on the Nigerian economy. The primary objectives of this paper are to examine the impact of financial innovation through five indicators such as value of internet web transactions (VAIW), value of mobile payment transactions (VAMP), value of ATM transactions (VATM), value of POS transactions (VAPOS) and value of cheque transactions (VACT) on the Nigerian economy as well as to examine the trend of these financial innovation indicators in Nigeria.

In order to achieve this objective, the paper is structured as follows: Section 1 is the introduction, while section 2 provides an overview of the related literature reviews on the financial innovations as well as its impact on an emerging economy. In section 3 and 4, the methodology and results are respectively presented. The conclusion and recommendations from the study are presented in section 5.

2. Literature Review

Although evidence from literature have shown that financial innovation has played a vital role on the growth of any economy whether developed or developing. Moreso, there are quite a number of empirical studies on the impact of financial innovation on economic growth. However, the results obtained from many of these studies on various financial innovation variables have not being conclusive.

Okafor et al. (2017) emphasized the effects of online payment channels on the growth of the Nigerian economy. The study employed the Least Square (Gauss-Newton/Marquardt steps) based on vector autoregressive (VAR) system and Johansen cointegration test to explain the relationship among the variables. The study made use of data covering the period from 2009 to 2014 sourced from Central Bank database on financial innovation. The study used variables such as total volume of transactions via internet banking, volume of transactions through automated teller machine (ATM), and the total volume of Point of Sale (POS) transactions, while gross domestic product is proxied for economic growth. The results obtained from the Johansen cointegration test revealed the existence of long run relationship between economic growth and financial technology innovation in Nigeria, that is, both variables move together over a long period of time. The regression results revealed that financial technological innovation via automated teller machine (ATM) and internet banking have significant positive impact on economic growth in Nigeria, while financial technological innovation through point of sale (POS) payment channels have negative impact on economic growth in Nigeria. In other words, financial transactions or payments through automated teller machine (ATM) and Internet banking platforms influence economic growth in Nigeria while financial transactions or payment through the point of sale (POS) machine worsened the economic growth prospects of the country.

Qamruzzaman and Jianguo (2017) applied Autoregressive Distributed Lag (ARDL) bound test and the Granger-Causality based Error Correction Model (ECM) to investigate the existence of long run relationship among the variables used and also to find the direction of causality among the variables. The study used real GDP per capita as a measure of economic growth which is widely used by economic researchers. On the part of financial innovation, the study used two indicators as a measure, the first is the ratio of domestic credit to private sector and the second is the ratio of Broad-to-Narrow Money (M2/M1). The results from the cointegration test revealed the existence of long run relationship between financial innovation and economic growth in Bangladesh. The results further revealed that financial innovation relating to both the ratio of domestic credit to private sector as well as the ratio of Broad-to-Narrow Money have positive and significant effect on economic growth of Bangladesh. This implies that the Performance of the banking sector through financial innovation have significant influence on the economic growth in Bangladesh. The causality test revealed that there is evidence of causality from financial innovation to economic growth. This implies that any shock in financial innovation will bring about a positive impact on economic growth of Bangladesh.

Ravikumar et.al (2019) assess the impact of digital payments on the growth of Indian economy. The study used the Ordinary Least Square (OLS), Autoregressive Distributive Lag (ARDL) cointegration approach and ARDL bound test techniques for the analysis. Digital payments were measured using Real Time Gross Settlement (RTGS), Clearing Corporation of India Ltd (CCIL) operated system, paper clearing, retail electronic clearing, card payments, and Prepaid Payment Instruments (PPIs). While real GDP is used as a measure for economic growth during the periods of 2011 to 2019. The OLS results show that only retail electronic payments as a measure of digital payments influences the real GDP significantly. All other variables used as measures of digital payments do not have significant impact on the real GDP in India. Moreover, the results obtained from the ARDL bound test revealed that digital payments do not have significant impact on the economic growth of India in the long run.

Ozurumba and Charles (2019) employed Ordinary Least Square (OLS) technique to examine the effect of financial innovation on the economic growth of Nigeria. The study used data on Nigeria Interbank Settlement System (NIBSS) transactions, Amount of Automated Teller Machine (ATM) transactions and the transactions of the Agent Banking function over the period 2012 to 2018. The results from the regression analysis revealed that the volume of financial transactions via NIBSS and Agent Banking platforms have positive but insignificant effect on economic growth of Nigeria, while the volume of transactions carried out through the Automated Teller Machine (ATM) have negative effect on economic growth and statistically significant at 5% level.

John (2019) adopted Autoregressive Distributed Lag (ARDL) technique to estimate the relationship between the adoption of electronic payment system and the growth of the Nigerian economy. The study used data on the volume of transactions carried out on web-based transactions (WBT); point of sales (POS); automated teller machine (ATM); Mobile payment (MOP); interbank money transfer transactions (INTERBANK) covering the period 2012-2017. The results from the empirical findings revealed that automated teller machine, mobile payment and web-based transactions have negative impact on the real GDP growth of Nigeria. This means that ATM, MOP, WBT transactions contribute negatively to economic growth in Nigeria. The results further revealed that POS transaction has positive impact on economic growth, while interbank transaction has an insignificant impact on the growth of Nigeria.

Moreover, Chukwunulu (2019) investigated the effect of financial innovation on the growth of the Nigerian economy. The study used data on GDP growth and the four major e-money transactions used in Nigeria as proxies for financial innovation, namely: amount of automated teller machine (ATM) transactions, amount of web transactions, amount of point-of-sale (POS) transactions, and the amount of mobile payments transactions for the period of 2008-2017. The research employed the Generalized Methods of Moments (GMM) since the time frame is short. The results obtained from the data analysed show that all the four major e-money transactions used in Nigeria (i.e amount of ATM transactions, amount of internet transactions, amount of POS transactions, and the amount of mobile payments transactions) have significant positive effect on the GDP growth in Nigeria. This indicates that financial innovation has impacted positively on the economic growh of Nigeria over the period 2008-2017 which contradicts the results obtained by (John, 2019) which show that automated teller machine, mobile payment and web-based transactions have negative impact on the real GDP growth of Nigeria.

From the empirical studies reviewed, most of the findings showed that various channels of online financial transactions give mixed results in different countries. For instance, some studies carried out in Nigeria revealed that financial innovations via most electronic channels were found to contribute positively to the economic growth while some other studies conclude that it does not have the desired effect on the economic growth of the Nigerian economy. The results from this study will serve as an empirical evidence showing the impact of financial innovation on Nigeria economy and will be useful to policymakers in formulating policies for the realisation of all-important inclusive growth necessary for sustainable development

3. Research Methodology

3.1. Theoretical Framework

This paper was anchored on the finance-growth theory, theory of Task Technology Fit (TTF) which was developed by Goodhue and Thompson in 1995 and the Romer endogenous growth theory.

The Task Technology Fit (TTF) theory states that information technology mostly has a positive relationship with individual performance especially if the task to be performed with the technology matches the individual's skills. This indirectly indicates that the efficiency of financial innovation depends on the capability of the user. This theory is relevant to this paper because diverse range of financial innovation systems such as POS, internet web and mobile payment channel and its effectiveness on financial sector development and economic development generally. In short, applying the TTF concept to financial innovation concludes that for financial innovative systems such as the e-payment channels to have significant impact on individuals and the aggregate economy, the users must be capable of using the system and it must match their need.

Secondly, the finance-growth theory posits that financial development contributes to productivity through 'demand following' and 'supply leading' effect. This theory can be traced back to Bagehot work in the 1870s. Accessibility and affordability of funds is a pre-condition for boosting economic growth under this theory. Bagehot emphasized the role of the financial institutions and systems in pooling and allocating financial resources to the most profitable enterprises or sectors. Efficient allocation of this financial resources will have a multiplier and positive spillover effect on economic growth. On the demand side, aggregate demand will increase due to accessibility to more finance which is expected to increase investment expenditure. From the supply side, boost in accessibility to finance by various sectors and investors will enhance output of firms and different sectors of the economy. This is expected to positively contribute to employment, human welfare, firm's profitability and overall aggregate demand.

Finally, from a macroeconomics-based approach, the relationship between finance and economic growth can be explained with the aid of Lucas and Romer endogenous growth theory.

Assume production function,

Equation one is an endogenous production function which shows that output is determined by capital and augmented labour. K is assumed to represent financial capital while Y is proxy to real gross domestic product (RGDP).

A----- Technology constant

N-----Population which is assumed to be exogenous such that output is a function of only financial capital.

$$Y = (AN)^{1-\alpha} K^{\alpha} \qquad (1)$$

Rearranging (1) to separate the constants

$$Y = A^{1-\alpha} N^{1-\alpha} K^{\alpha} \qquad (2)$$

$$Y = A.A^{-\alpha} N^{1-\alpha} K^{\alpha} \qquad (3)$$

Divide both sides of equation (3) by A,

$$\frac{Y}{A} = A^{-\alpha} N^{1-\alpha} K^{\alpha} \qquad (4)$$

$\frac{Y}{A}$ ---Output manufactured (growth) with the aid of technology

$$\frac{Y}{A} = N^{1-\alpha}\left(A^{-\alpha}K^{\alpha}\right) \qquad (5)$$

$$\frac{Y}{A} = N^{1-\alpha}\left(A^{-1}K\right)^{\alpha} \qquad (6)$$

Equation (6) represents the transformed output function of equation (1) which now indicates that technological augmented output is a function of constant population growth (N) and technological augmented financial capital (AK).

$$\frac{Y}{A} = N^{1-\alpha}\left(\frac{K}{A}\right)^{\alpha} \qquad (7)$$

Let $\frac{Y}{A} = y, \frac{K}{A} = k$

$$y = N^{1-\alpha}k^{\alpha} \qquad (8)$$

$\frac{K}{A}$ ----Financial capital innovation

Equation 8 shows that output (RGDP) is determined by population which is assumed to be exogenous to the model and technological augmented financial capital (financial capital innovation.

Taking the natural logarithm of the LHS (left hand side) and RHS (right hand side) of equation (8) to linearise the equation.

$$\ln(y) = \ln\left(N^{1-\alpha}\right) + \ln(k) \qquad (9)$$

Population is exogenous: $N^{1-\alpha} = \varphi$

$$\ln(y) = \ln(\varphi) + \ln(k) \qquad (10)$$

Let, $\ln(\varphi) = \eta$

$$\ln(y) = \eta + \ln(k) \qquad (11)$$

Equation (11) is the final equation that shows the relationship between output (y) and financial innovation (k). According to the equation, there is a positive relationship between financial innovation and economic growth.

Conclusively, the TTF theory posits that financial innovative system will only have an impact on individual performance and the aggregate economy only if users of these financial innovative channels are capable of using it thereby matching capability to effectiveness. Also, the finance growth theory proves to explain the role of finance on economic growth through the development of the financial system of a particular country. This finance-growth theory shows that financial development has a very important role to play in ensuring easy accessibility and availability of fund to investors which will in turn increase investment expenditure thereby boosting aggregate demand and economic growth. Lastly, from the macroeconomic growth model, the assumed output function under the assumption of exogenous population growth also concludes that there is a positive relationship between financial capital innovation and economic growth. In short, this theory helps explain the role of financial

innovation such as the POS, mobile payments, internet web transactions, mobile payments on an economy through different approach but the same conclusion.

3.2. Model Specification

The model used for this paper was developed on the assumption from the theoretical framework that financial innovation influences economic growth. This model is in line with Chukwunulu (2019) who specified that Nigeria's GDP growth is determined by financial innovation variables such as value of ATM transactions, web transactions, POS transactions and mobile payments. This paper model is however specified thus merging this assumption and Chukwunulu (2019) model:

RGDP = f (Financial innovation)

Financial innovation is proxy by variables such as the value of ATM transactions (VATM), cheque transactions (VACT), internet web transactions (VAIW), POS transactions (VAPOS) and mobile payments (VAMP)

RGDP = f (VATM, VACT, VAIW, VAPOS, VAMP)

Note: all variables were estimated in their logged forms.

The ARDL model estimated for this study is specified as follows:

$$\Delta RGDP = \alpha_0 + \sum_{i=1}^{n} \beta_1 \Delta VATM_{t-i} + \sum_{i=1}^{p} \beta_2 \Delta VACT_{t-i} + \sum_{i=1}^{q} \beta_3 \Delta VAIW_{t-i} + \sum_{i=1}^{a} \beta_4 \Delta VAPOS_{t-i} +$$

$$\sum_{i=1}^{b} \beta_5 \Delta VAMP_{t-i} + \delta ECT(-1) + \mu_t \qquad (12)$$

$\beta_1 - \beta_5$: short run coefficients

δ : coefficient of the error correction term

$$\delta ECT(-1) = \lambda_1 VATM_{t-1} + \lambda_2 VACT_{t-1} + \lambda_3 VAIW_{t-1} + \lambda_4 VAPOS_{t-1} + \lambda_5 VAMP_{t-1} + e_t \qquad (13)$$

$\lambda_1 - \lambda_5$: $Long run coefficients$

The full ARDL equation specification for this paper is as follows:

$$\Delta RGDP = \alpha_0 + \sum_{i=1}^{n} \beta_1 \Delta VATM + \sum_{i=1}^{p} \beta_2 \Delta VACT + \sum_{i=1}^{q} \beta_3 \Delta VAIW + \sum_{i=1}^{a} \beta_4 \Delta VAPOS + \sum_{i=1}^{b} \beta_5 \Delta VAMP +$$

$$\lambda_1 VATM_{t-1} + \lambda_2 VACT_{t-1} + \lambda_3 VAIW_{t-1} + \lambda_4 VAPOS_{t-1} + \lambda_5 VAMP_{t-1} + \mu_t \qquad (14)$$

The MIDAS equation is specified thus:

$$y_t = \beta_0 + X_t^I \beta_I + f\left(\left\{ X_{t/S}^H \right\}, \theta, \lambda \right) + \varepsilon_t \qquad (15)$$

y_t - dependent variable (RGDP) sampled at low frequency at time t

X_t - Vector of regressors sampled at low frequency as y_t

$X^H_{t/S}$ - Vector of regressors sampled at high frequency with

S values for each low frequency

f - function describing the effect of the higher frequency

data in the low frequency regression

β - Vectors of high frequency regression parameters

λ, θ - Vectors of low frequency regression parameters

Applying the generalized MIDAS model in (15) to the model specified for this paper,

Recall: $y = f(k)$ (16)

$y = \beta_0 + \beta_1 k$ (17)

k = financial capital

y = real gross domestic product (RGDP)

Let k proxy financial innovation

$$RGDP_t = \beta_0 + \beta_1 FI_t \quad (18)$$

$$RGDP_t = \beta_0 + X_t^1 \beta_1 + f\left(\left\{FI^H_{t/s}\right\}, \theta, \lambda\right) + \varepsilon_t \quad (19)$$

There are two approaches to estimating mixed frequency model (equation 19) which are the individual coefficient and aggregation approach. Also, the mixed data sampling (MIDAS) model offers several weighing functions which helps to reduce the number of parameters in the model by placing restrictions on the effect of high frequency on the low frequency variables at various lag periods. Equation 19 can be expressed explicitly to show the high frequency variable in relation to the low frequency variable. Financial innovation variable such as VACT, VAMP, VAIW, VAMP and VAPOS are the high frequency variables (monthly time series) while the real gross domestic product (RGDP) is the low frequency variable (quarterly time series).

$$RGDP_t = \beta_0 + X_t^1 \beta_1 + \sum_{r=0}^{S-1} FI^H_{t-r/S^1} \theta_r + \varepsilon_t \quad (20)$$

FI^H_{t-r/S^1} Monthly series on financial innovation variables with rth frequency lags

It is important to note that the Almon polynomial distributed lag weighting function was adopted in this paper to estimate the mixed data sampling (MIDAS) model for the following reasons:

(1) It helps reduces the effect of multicollinearity. (Judge et al. 1980)

(2) It reduces the number of parameters to be estimated when using a dynamic linear model (Maddala, 1977).

Applying the Almon PDL weighting function to equation (20):

$$RGDP_t = \beta_0 + X_t^1\beta_1 + \sum_{r=0}^{S-1} FI^H_{t-r/S^1}\left(\sum_{j=0}^{p} r^j\theta_j\right) + \varepsilon_t \qquad (21)$$

p – Almon polynomial order

k – chosen number of lags

$$RGDP_t = \beta_0 + X_t^1\beta_1 + \sum_{r=0}^{S-1} Z_{i,t^I}\theta_i + \varepsilon_t \qquad (22)$$

$$Z_{i,t^I} = r^i FI^H_{t-r/S} \qquad (23)$$

Z = weight

Equation 21 represents the final MIDAS model after applying the Almon polynomial distributed lag (PDL) weighing function to estimate equation 19 and equation 21 is the Almon weight applied to equation 20 to derive equation 22.

Generally, a MIDAS specification captures a very rich dynamic property of the high-frequency process in a very simple and parsimonious fashion. In this paper we will be using monthly data of financial innovation proxies such as value of POS transactions (VAPOS), value of cheque transactions (VACT), value of internet web payment transactions (VAIW), value of mobile payments transactions (VAMP) and value of ATM transactions (VATM). But, monthly data on real gross domestic product (RGDP) is not available, hence, we will use a quarterly data on RGDP. Using a high frequency data for financial innovation and low frequency data for RGDP justifies the use of mixed data sampling (MIDAS) model to examine the relationship between financial innovation and the Nigeria's economy.

3.3. Estimation Techniques

To ensure stationarity of the time series data used, Augmented Dickey Fuller and the KPSS unit root test was carried out for each of the variables both at level and first difference. Cointegration test using the ARDL bound test was carried out to verify the existence of long-run relationship between the dependent variable and explanatory variables. The parameters of the equation were then estimated using both the ARDL and polynomial distributed lag mixed data sampling (PDL MIDAS) model. The MIDAS model was used because the series on value of POS transactions (VAPOS), value of cheque transactions (VACT), value of internet web payment transactions (VAIW), value of mobile payments transactions (VAMP) and value of ATM transactions (VATM) which were used as proxies to financial innovation was available in monthly time period while the data on real gross domestic product (RGDP) is in quarterly time period from its source. Meanwhile, the financial innovation variables were also disaggregated into quarterly series by taking the sum of per three-month (say from January to March, April to June etc) data which makes up to a quarter. This disaggregated data was used alongside the quarterly series on RGDP to estimate the parameters of the ARDL model. Finally, post estimation tests such as normal distribution, serial correlation, heterosedasticity, stability and misspecification bias tests were performed on the residuals of the equations to ascertain if they conform to the normal assumptions.

3.4. Sources and Measurement of Data

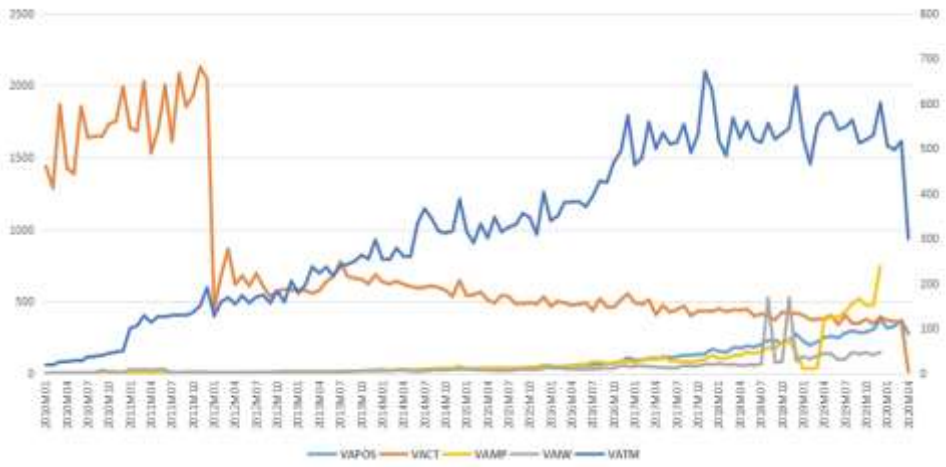
Variable Name	Description	Source	Type of Variable	Apriori Expectation
RGDP	Real gross domestic product in billion Naira used as a proxy to performance of the Nigeria economy ranging from Q1'2010 to Q1'2020.	CBN Database	Dependent (Quarterly)	
VAPOS	Value of POS transactions in billion Naira proxy to financial innovation ranging from January 2010 to April 2020.	CBN Database	Independent (Monthly)	**Positive**
VACT	Value of cheque transactions in billion Naira proxy to financial innovation ranging from January 2010 to April 2020.	CBN Database	Independent (Monthly)	**Positive**
VATM	Value of ATM transactions in billion Naira proxy to financial innovation ranging from January 2010 to April 2020.	CBN Database	Independent (Monthly)	**Positive**
VAIW	Value of internet web transactions in billion Naira proxy to financial innovation ranging from January 2010 to December 2019.	CBN Database	Independent (Monthly)	**Positive**
VAMP	Value of mobile payment transactions in billion Naira proxy to financial innovation ranging from January 2010 to December 2019.	CBN Database	Independent (Monthly)	**Positive**

4. Estimation and Interpretation of Results

4.1. Pre-Estimation Analysis

4.1.1. Trend Analysis

FIGURE 1: FINANCIAL INNOVATION INDICATORS (JANUARY 2010-APRIL 2020)



Source: Drawn by the author with the aid of WPS Spreadsheet 2020.

Figure 1 and 2 show the monthly and quarterly trend of the series for Value of Cheque Transactions

(VACT), Value of ATM Transactions (VATM), Value of POS Transactions (VAPOS), Value of Internet (Web) Transactions (VAIW) and Value of Mobile Payment Transactions (VAMP) as well as the quarterly trend of real GDP of Nigeria.

From the monthly trend, the value of cheque transactions was relatively high between January 2010 and December 2011 recording an all time high of N2129.01 billion in November 2011. Meanwhile, the value of cheque transactions fell sharply by 355.6% to N449.13 billion in January 2012 from N2046.17 billion in the previous month. Similarly, value of POS transactions, ATM transactions and Mobile payment transactions fell sharply to N400 million, N127.59 billion and N240 million respectively in January 2012. Values of internet web transactions, POS transactions, ATM transactions and Mobile payment transactions has been rising and stagnating since 2012 but value of cheque transactions has been declining since 2012, with average VACT falling to N373.47 billion in 2019 from N621.8 billion in 2012. So far, between January and March in 2020, value of POS and ATM transactions advanced 17.68% and 1.96% to N368.86 billion and N516.34 billion respectively. This is owing to increase in the use of mobile payment platforms and ATM during the government-imposed lockdown in response to the COVID-19 outbreak in Nigeria. Meanwhile, there was a sharp drop in the value of cheque transactions to N10.3 billion in April 2020 from N361.71 billion in March. In the same vein, value of POS and ATM transactions declined in April, 2020 from the previous month.

4.1.2. Descriptive Statistics

Table 1. Descriptive Statistics for Quarterly Data

	RGDP	VAPOS	VATM	VACT	VAIW	VAMP
Mean	16247474	238.4995	984.4802	2253.552	41.77375	226.237
Median	16218542	96.34	1011.48	1654.32	22.575	96.03
Maximum	19750935	1008.32	1832.55	6109.31	221.52	1687.1
Minimum	12583478	1.87	62.59	1087.96	3.37	0.87
Std. Dev.	1724008	296.3122	536.9772	1530.918	52.35771	379.0816
Skewness	-0.138808	1.258923	-0.101192	1.495748	2.172447	2.647751
Kurtosis	2.414792	3.343321	1.738025	3.54331	7.167124	9.4867
Jarque-Bera	0.716713	11.03143	2.790631	15.79223	60.40506	116.866
Probability	0.698824	0.004023	0.247755	0.000372	0.0000	0.0000
Observations	41	41	41	41	40	40

Source: Author's Computation with the aid of Eviews 10

Quarter-on-quarter, the average real GDP for Nigeria between Q1'2010 and Q1'2020 is N16.25 trillion. The lowest and the highest real GDP up till Q1'2020 is N12.58 trillion (in Q1'2010) and N19.75 trillion (in Q4'2019) respectively. The skewness statistics reveals that all the series are skewed to the right (positive skewness) except RGDP and VATM which is skewed to the left (negative skewness). Kurtosis also shows that all the quarterly series are leptokurtic (kurtosis value greater than 3) except RGDP and VATM which is platykurtic (kurtosis statistic less than 3). The Jarque bera test statistic indicates that RGDP and VATM series are normally distributed because the probability value is greater than 5%.

Table 2. Descriptive Statistics for Monthly Data

	VACT	VAIW	VAMP	VAPOS	VATM
Mean	745.209	13.92458	75.41233	81.05266	327.9258
Median	537.7700	7.5100	31.6450	33.7750	320.8100
Maximum	2129.010	168.200	743.170	372.69	670.980
Minimum	10.3000	0.8800	0.2200	0.0400	18.4800
Std. Dev.	515.0034	23.07263	127.3332	99.54974	178.4469
Skewness	1.532251	5.105949	2.861896	1.252399	-0.054845
Kurtosis	3.841142	33.59291	11.60668	3.370678	1.811809
Jarque-Bera	52.17656	5201.046	534.1832	33.12562	7.356451

Probability	0.00000	0.00000	0.00000	0.00000	0.025268
Observations	124	120	120	124	124

Source: Author's Computation with the aid of Eviews 10

On the other hand, table 2 shows the descriptive statistics for the monthly series of the financial innovation indicators such as Value of Cheque Transactions (VACT), Value of ATM Transactions (VATM), Value of POS Transactions (VAPOS), Value of Internet (Web) Transactions (VAIW) and Value of Mobile Payment Transactions (VAMP). Average value for VACT, VAPOS and VATM between January 2010 and April 2020 is N745.21 billion, N81.05 billion and N327.93 billion respectively while the average for VAIW and VAMP between January 2010 and December 2019 is N13.92 billion and N75.41 billion respectively.

Table 3. Maximum and Minimum Values of Financial Innovation Indicators with their Corresponding Dates

	Maximum	Date	Minimum	Date
VACT	2129.01	November, 2011	10.3	April, 2020
VAIW	168.2	November, 2018	0.88	January, 2010
VAMP	743.17	December, 2012	0.22	January, 2010
VAPOS	372.69	December, 2012	0.04	January, 2012
VATM	670.98	November, 2017	18.48	February, 2010

Source: Author's Computation with the aid of Eviews 10

4.1.3. Unit Root Test

H_0 - The series are stationary

H_1 - The series are not stationary

Table 4. The ADF and KPSS Unit Root Test Result

Variables	Augmented Dickey (ADF) Fuller Test Result		Kwiatkowski-Phillips-Schmidt-Shin (KPSS) Test	
	Level	First Difference	Level	First Difference
RGDP	0.2600	0.4224	0.0000 (0.8407 > 0.4630)	0.5755* (0.3246 < 0.4630)
VAPOS	0.6762	0.0000*	0.0000 (1.3029 > 0.4630)	0.2833* (0.2455 < 0.4630)
VATM	0.6297	0.0000*	0.0000 (1.1415 > 0.4630)	0.0817* (0.9169 > 0.4630)
VACT	0.9485	0.0000*	0.0000 (1.1361 > 0.4630)	0.2277* (0.2583 < 0.4630)
VAIW	0.6594	0.0000*	0.0000 (1.2362 > 0.4630)	0.4447* (0.0777 < 0.4630)
VAMP	0.6297	0.0000*	0.0000 (1.2611 > 0.4630)	0.0510* (0.2106 < 0.4630)

Source: Author's Computation with the aid of Eviews 10

**** denotes acceptance of stationarity at 5% significance level***

Values in parenthesis indicates LM stat and critical values at 5% significance level respectively

Table 4 shows the ADF and KPSS unit root test result for real GDP, value of cheque transactions (VACT), value of ATM transactions (VATM), value of POS transactions (VAPOS), value of internet (Web) transactions (VAIW) and value of mobile payment transactions (VAMP).

According to the ADF unit root test result, all series were only stationary at first difference except the series for real GDP which was shown by ADF not to be stationary at level (I(0)) and first difference

(I(1)). This is because the probability value for VACT, VATM, VAPOS, VAIW and VAMP was less than 5% at first difference thereby accepting the null hypothesis that the series were stationary.

On the other hand, the KPSS test result indicates that all the series used in this study such as RGDP, VACT, VATM, VAPOS, VAIW and VAMP were stationary only at first difference (I(1)) because the KPSS probability values were greater than 5%. According to the KPSS test, the null hypothesis is not rejected for all the series at first difference only thereby concluding that all series in this paper are stationary at first difference only.

4.1.4. Cointegration Test

H_0 - There is no cointegration

H_1 - There is presence of cointegration

Table 6. ARDL Bound Test Result

Test Statistic		
F-statistic	Value	k
	5.447418	5
Critical Value Bounds		
Significance	I0 Bound	I1 Bound
10%	2.26	3.35
5%	2.62	3.79
2.50%	2.96	4.18
1%	3.41	4.68

Source: Author's Computation with the aid of Eviews 10

Table 6 shows the ARDL bound test result of the ARDL model. This result indicates that there is presence of cointegration (that is long run relationship) between the dependent variable (RGDP) and financial innovation (VACT, VAMP, VAIW, VATM and VAPOS). Variables are cointegrated because the F statistic value of the ARDL bound test is greater than the upper bound value of the critical table bounds value at the significance levels indicated in the table.

Table 7. Johansen's Trace Test Result

Unrestricted Cointegration Rank Test (Trace)				
Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.835446	186.5947	95.75366	0.0000
At most 1 *	0.729291	118.0231	69.81889	0.0000
At most 2 *	0.546722	68.36799	47.85613	0.0002
At most 3 *	0.444001	38.30048	29.79707	0.0042
At most 4 *	0.279959	15.99489	15.49471	0.0420
At most 5	0.088325	3.513911	3.841466	0.0609

Source: Author's Computation with the aid of Eviews 10

Trace test indicates 5 cointegrating eqn(s) at the 0.05 level

** denotes rejection of the hypothesis at the 0.05 level*

Table 8. Johansen's Maximum Eigenvalue Test Result

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.835446	68.57161	40.07757	0.0000
At most 1 *	0.729291	49.65506	33.87687	0.0003
At most 2 *	0.546722	30.06751	27.58434	0.0235
At most 3 *	0.444001	22.30559	21.13162	0.0341
At most 4	0.279959	12.48098	14.2646	0.0939
At most 5	0.088325	3.513911	3.841466	0.0609

Source: Author's Computation with the aid of Eviews 10

Max-eigenvalue test indicates 4 cointegrating eqn(s) at the 0.05 level

** denotes rejection of the hypothesis at the 0.05 level*

Table 7 and 8 shows the Trace and Maximum Eigenvalue test statistic of the Johansen cointegration test result. The cointegration test checks for the presence of long run relationship among the variables used in this study. Since all the variables used in this study were only stationary at I(1), it is necessary to test if the variables converge in the long run. The null hypothesis is rejected if there is presence of at least one cointegrating equation in the trace and maximum eigenvalue test statistic result, otherwise the null hypothesis is accepted.

Trace test shows the presence of five (5) cointegrating equations while the maximum eigenvalue indicates the presence of four (4) cointegrating equations. We however reject the null hypothesis and conclude that there is long run relationship between the variables used in this paper.

4.1.5. Lag Selection for ARDL Model

Table 9. VAR Lag Selection Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-47.02518	NA	7.08e-07	2.866226	3.127456	2.958322
1	107.2754	250.2171	1.22e-09	-3.528397	-1.699788*	-2.883727
2	157.7536	65.48528	6.52e-10	-4.311005	-0.915016	-3.113760
3	235.9778	76.11007*	1.05e-10*	-6.593396*	-1.630028	-4.843576*

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

Source: Author's Computation with the aid of Eviews 10

The maximum lag length for the variables employed in this paper is one (1) according to the Schwarz criterion while other criterion indicates three (3) maximum lag length for the ARDL model estimated in this paper.

4.1.6. ARDL Model Selection

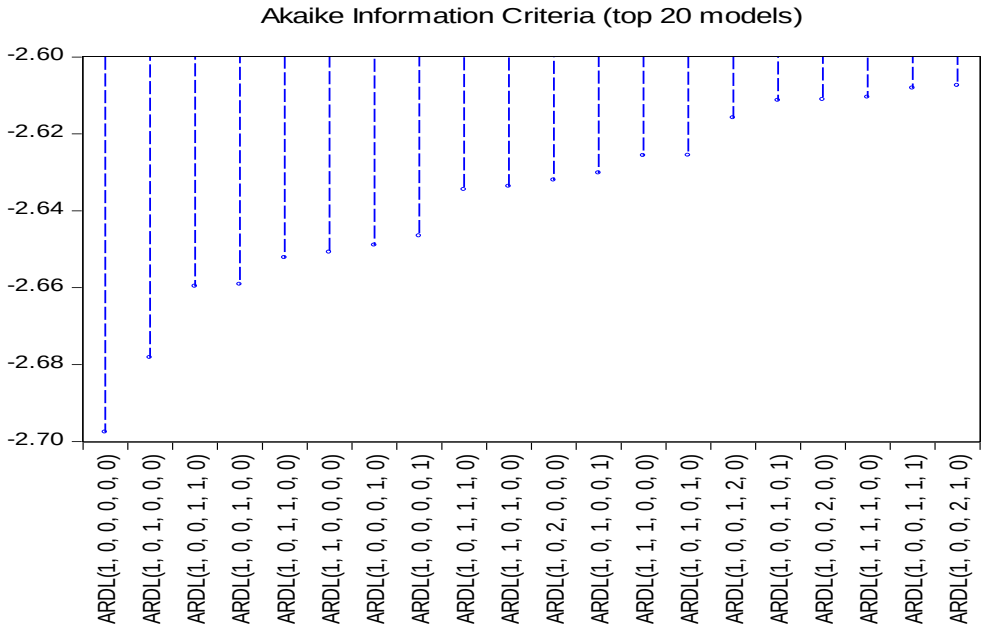


Figure 2. ARDL Model Selection Using the Akaike Information Criteria

Source: Author's Computation with the aid of Eviews 10

From the VAR lag selection criteria, the maximum lag length for the variables is 3 as concluded by majority of the information criterion including the Akaike information criterion (AIC). The RGDP ARDL model was estimated with the aid of this lag lengths and the model with the highest AIC value was selected. From about 243 models that was estimated using combinations of different lags, the ARDL model (1, 0, 0, 0, 0, 0) was selected because it has the highest AIC values of all the models estimated.

4.2. Estimation and Interpretation of Results

Table 10. The RGDP ARDL Model (1, 0, 0, 0, 0, 0)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
SHORT-RUN EQUATION				
DLOG(VACT)	0.010437	0.038461	0.271363	0.7879
DLOG(VAIW)	-0.003676	0.021084	-0.174371	0.8627
DLOG(VAMP)	0.054141	0.02537	2.134084	0.0406*
DLOG(VAPOS)	-0.019379	0.03513	-0.551641	0.5850
DLOG(VATM)	0.013566	0.036687	0.369775	0.7140
ECT(-1)	-0.869761	0.163778	-5.310611	0.0000*
LONG-RUN EQUATION				
LOG(VACT)	0.012	0.044561	0.269283	0.7894
LOG(VAIW)	-0.004227	0.024325	-0.17377	0.8631
LOG(VAMP)	0.062248	0.032337	1.924946	0.0632**
LOG(VAPOS)	-0.022281	0.041019	-0.543196	0.5908
LOG(VATM)	0.015597	0.041371	0.377007	0.7087
C	16.265108	0.486269	33.448811	0.0000*
R-squared	0.733842	F-statistic	14.7049	
Adjusted R-squared	0.683938	Prob(F-statistic)	0.0000	
		Durbin-Watson stat	1.92122	

Source: Author's Computation with the aid of Eviews 10

* significant at 5% and 10%

** significant at 10% only

DEPENDENT VARIABLE: DLOG(RGDP)

Table 10 shows the ARDL model comprising of the long run and short run equation result with logged form of real gross domestic product (RGDP) as the dependent variable and financial innovation proxy by VACT, VAPOS, VAIW, VAMP and VATM as the explanatory variables. Variables in the long run equation are in their level form while variables in the short run equation are differenced once. The R^2 and adjusted R^2 are the coefficient of determination which signifies the proportion of dependent variable that is explained by the independent variables. While the adjusted R^2 is adjusted for the number of variables in the equation, the R^2 is not. The Adjusted R^2 in Table 10 indicates that 68.39% of the variation in real gross domestic product (RGDP) is explained by the financial innovation variables employed in this paper. On the other hand, the R^2 value shows that 73.38% of the variation in RGDP is explained by at least one of the independent variables used in this paper. The probability value of the model's F statistic is less than 5% which indicates that the overall model in Table 10 is significant. Finally, the durbin watson stat value shows that the null hypothesis of the serial correlation test is not rejected (that is there is no evidence of first-degree serial correlation) because the DW value is within 1.55 and 2.45.

4.2.1. Short Run Model Interpretation

Financial innovation proxies such as value of cheque transactions (VACT), value of ATM transactions (VATM) and value of mobile payment transactions (VAMP) are all positively related to Nigeria's economy (RGDP) while value of internet (Web) transactions (VAIW) and value of POS transactions (VAPOS) are negatively related to Nigeria's economy in the short term. Meanwhile, only VAMP has a positive significant impact on Nigeria's real gross domestic product in the short term at 5% and 10% significance level because the probability value of the coefficient is less than 5% and 10% significance level. On the other hand, VACT and VATM have a positive insignificant impact on the Nigerian economy. Ozurumba and Charles (2019) empirical result from their study on financial innovation and Nigeria's economic growth also shows that financial innovation variables such as financial transactions via NIBSS and agent banking platforms have a positive insignificant impact of Nigeria's economy. Finally, VAIW and VAPOS have a negative insignificant impact on the economy of Nigeria in the short run. It is also important to note that the error correction term conforms to the three main conditions that:

(1) The coefficient of the error correction term is negative (-0.869761).

(2) The absolute value of the error correction term (ECT) coefficient is less than 1 (0.869761 < 1).

(3) The error correction term is statistically significant because its probability value is less than the chosen level of significance (0.0000 < 5%).

The coefficient of the error correction term (ECT) also reveals the speed of adjustment and the time it takes to adjust from short-run disequilibrium to long run equilibrium. According to the error correction model, the speed of adjustment is 86.98% which signifies the rate to adjust to long run equilibrium. Furthermore, it will take approximately 13.80 months to adjust to long run equilibrium from short run disequilibrium.

4.2.2. Long Run Model Interpretation

According to the long run result, there is a positive relationship between value of cheque transactions (VACT), value of ATM transactions (VATM), value of mobile payment transactions (VAMP) and the Nigeria's economy (RGDP). Meanwhile, there is a negative relationship between value of internet (Web) transactions (VAIW), value of POS transactions (VAPOS) and Nigeria's economic performance (RGDP). It is important to note that according to Table 9, value of mobile payment transactions (VAMP) is the only financial innovation indicator that has a positive significant impact on Nigeria economy in the long run such that if there is a 1% increase in VAMP, Nigeria's economy will grow significantly by

0.062248%. VAMP has a significant impact because the probability value of its coefficient is less than 10% (0.0632 < 10%). On the other hand, value of cheque transactions (VACT) and value of ATM transactions (VATM) have a positive insignificant effect while value of internet (Web) transactions (VAIW) and value of POS transactions (VAPOS) have a negative insignificant effect on Nigeria's economy in the long run. We can however conclude that improvement in financial innovation channels such as mobile, cheque and ATM payment platforms in Nigeria will have an overall positive effect on the country's economy both in the short-run and long run. This is consistent with the empirical result of Okafor et al. (2017) which concludes that there is a positive long run relationship between financial innovation and Nigeria's economic growth.

4.2.3 PDL MIDAS Equation

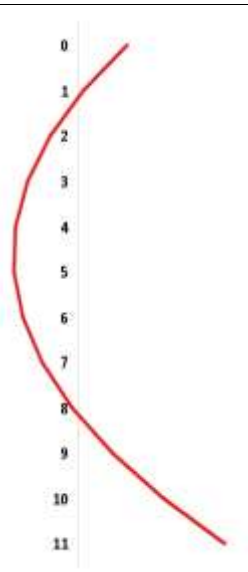
Table 11. MIDAS Polynomial Coefficients

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	17.20092	0.715758	24.03176	0.0000
Polynomial Coefficients				
LOG(VACT)				
PDL01	0.053913	0.071287	0.756291	0.4579
PDL02	-0.031145	0.028842	-1.079856	0.2925
PDL03	0.002754	0.002234	1.233057	0.2312
LOG(VATM)				
PDL01	-0.144822	0.06711	-2.157967	0.0427
PDL02	0.056157	0.025348	2.215457	0.0379
PDL03	-0.004332	0.001912	-2.266071	0.0341
Log(VAPOS)				
PDL01	0.026553	0.033822	0.785098	0.4412
PDL02	-0.004986	0.012109	-0.411791	0.6847
PDL03	9.10E-05	0.000852	0.106881	0.9159
LOG(VAMP)				
PDL01	-0.013649	0.015893	-0.858795	0.4002
PDL02	0.009261	0.005783	1.601415	0.1242
PDL03	-0.00067	0.000418	-1.603475	0.1238
LOG(VAIW)				
PDL01	0.06164	0.024629	2.502772	0.0207
PDL02	-0.033628	0.008924	-3.768242	0.0011
PDL03	0.002891	0.000676	4.273863	0.0003
R-squared		0.871865		Durbin-
Watson stat		2.199127		
Adjusted R-squared		0.871865		

Source: Author's Computation with the aid of Eviews 10

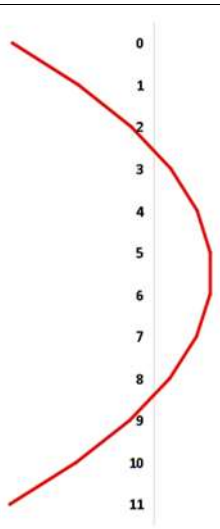
Table 12. Distribution and Lagged Coefficients of LOG(VACT)

Individual Coefficients		
LOG(VACT)		
Lag	Coefficient	Distribution
0	0.025523	
1	0.002642	
2	-0.01473	
3	-0.026593	
4	-0.032948	
5	-0.033793	

6	-0.029129	
7	-0.018956	
8	-0.003275	
9	0.017916	
10	0.044616	
11	0.076825	

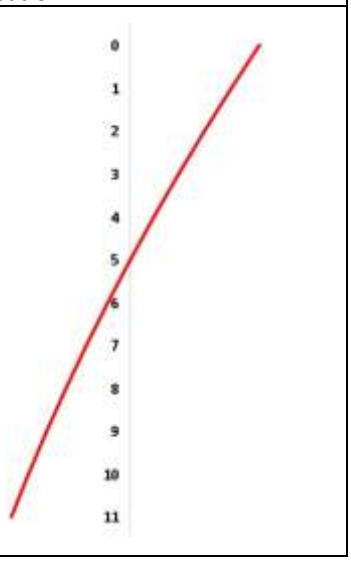
Source: Author's Computation with the aid of Eviews 10

Table 13. Distribution and Lagged Coefficients of LOG (VATM)

LOG(VATM)		
Lag	Coefficient	Distribution
0	-0.092997	
1	-0.049835	
2	-0.015336	
3	0.0105	
4	0.027672	
5	0.03618	
6	0.036026	
7	0.027207	
8	0.009726	
9	-0.016419	
10	-0.051227	
11	-0.094698	

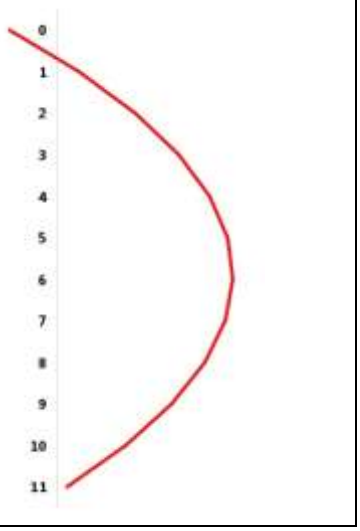
Source: Author's Computation with the aid of Eviews 10

Table 14. Distribution and Lagged Coefficients of LOG (VAPOS)

LOG(VAPOS)		
Lag	Coefficient	Distribution
0	0.021658	
1	0.016945	
2	0.012414	
3	0.008065	
4	0.003898	
5	-8.72E-05	
6	-0.00389	
7	-0.007511	
8	-0.01095	
9	-0.014207	
10	-0.017282	
11	-0.020175	

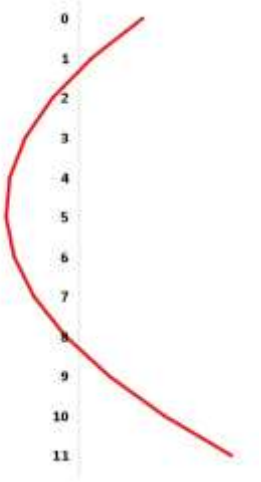
Source: Author's Computation with the aid of Eviews 10

Table 15. Distribution and Lagged Coefficients of LOG(VAMP)

LOG(VAMP)		
Lag	Coefficient	Distribution
0	-0.005058	
1	0.002192	
2	0.008102	
3	0.012671	
4	0.015899	
5	0.017787	
6	0.018334	
7	0.017541	
8	0.015407	
9	0.011932	
10	0.007117	
11	0.000961	

Source: Author's Computation with the aid of Eviews 10

Table 16. Distribution and Lagged Coefficients of LOG (VAIW)

LOG(VAIW)		
Lag	Coefficient	Distribution
0	0.030904	
1	0.00595	
2	-0.013221	
3	-0.02661	
4	-0.034217	
5	-0.036041	
6	-0.032083	
7	-0.022342	
8	-0.006818	
9	0.014487	
10	0.041576	
11	0.074446	

Source: Author's Computation with the aid of Eviews 10

Table 11 to Table 16 contains the PDL/Almon mixed data sampling (MIDAS) result with quarterly real gross domestic product (RGDP) ranging from Q1'2010 to Q'2020 as the dependent variable and the monthly series for value of cheque transactions (VACT), value of ATM transactions (VATM), value of internet (Web) transactions (VAIW), value of mobile payment transactions (VAMP) and value of POS transactions (VAPOS) ranging from January 2010 to April 2020 as the financial innovation proxies which represents the explanatory variables. The PDA/Almon MIDAS result is divided into three sections which are the quarterly coefficients (table 11), polynomial coefficients (table 11) and the individual lagged coefficients (table 12-16).

The Adjusted R^2 from the MIDAS equation indicates that 87.19% of the variation in RGDP is explained by the financial innovation variables and it shows the model has a high predictive power. The Durbin Watson stat value reveals that the residuals of the MIDAS equation are not serially correlated as it is between 1.55 and 2.45.

According to the result of the individual coefficient, at present period, value of cheque transactions (VACT), value of internet (Web) transactions (VAIW) and value of POS transactions (VAPOS) are positively related to Nigeria's economic performance while value of ATM transactions (VATM) and value of mobile payment transactions (VAMP) are negatively related to Nigeria's RGDP.

Over 12 months period, the relationship between VACT, VAMP & VAIW and Nigeria's economy changed direction from negative to positive impact in the long term (6^{th} to 11^{th} month) but VAPOS and VATM are negatively related to Nigeria's RGDP in the long term. On the other hand, VATM and VAMP is reversed to a positive relation with Nigeria's economic performance in the short term (1^{st} to 5^{th} month) while VAIW, VACT and VAPOS negatively impacts Nigeria's economic growth in the short term (1^{st} to 5^{th} month). It is however important to note that, as the number of lagged period (months) keep increasing, the relationship between financial innovation and the Nigeria's economy is mixed with a non-linear relationship.

From table 12 and table 16, an improvement in financial innovation (VACT and VAIW) is first followed by the decline in Nigeria's economy after which the economy starts recovering and improving till the 11^{th} month. Conversely, from table 13 and table 15, an improvement in VATM and VAMP will first boost the Nigeria's economy after which the positive effect begins to wane and then translate to a

declining economic performance in the short term. Lastly, the VAPOS is almost perfectly linearly and negatively related to the Nigeria's economy. Boost in the value of POS transactions in Nigeria has a positive but fading impact on Nigeria's GDP at first, after which the effect turns negative and the negative impact continues to weigh in more on Nigeria's economic performance till the 11th month. We can however conclude that financial innovation especially the mobile payment platform has both a positive short term and long-term impact on the Nigeria's economy but could also drive a negative economic performance as POS transactions negatively impacts Nigeria's economy. Specifically, VAMP has a positive short- and long-term effect on the Nigeria's economy while VAPOS has a negative impact on the Nigeria's economy both in the short and long term.

4.2.4. Robustness Check

Table 17. Robustness Check of the Relationship between Financial Innovation and the Nigerian Economy in the ARDL and MIDAS Model

Equations	ARDL	MIDAS	Comments
Short term	VACT, VAMP and VATM are positively related to RGDP while VAIW and VAPOS are negatively related to Nigeria RGDP	VAMP and VATM reversed from being negatively to positively related to RGDP between (0-5th lag periods) while VAIW, VACT and VAPOS turned from being positively to negatively related to Nigeria RGDP.	VAMP and VATM short term relation with RGDP in the MIDAS and ARDL model is consistent. Also, VACT also shows a consistent result up till the 1st lag period in the short term. VAIW and VAPOS negative relation to RGDP in the ARDL model is also consistent with the MIDAS model in the short term.
Long Term	VACT, VAMP and VATM are positively related to RGDP while VAIW and VAPOS are negatively related to Nigeria RGDP	VACT, VAMP and VAIW turned to being positively related to RGDP between (6th - 11th) period while VAPOS and VATM reversed to negative relationship.	VAMP and VACT long term relation with RGDP in the MIDAS and ARDL model is consistent. Also, VATM also shows a consistent result up till the 8th lag period in the long term. VAPOS negative relation to RGDP in the ARDL model is also consistent with the MIDAS model in the long term.

Source: Author's Computation (2020)

4.3. Post Estimation Analysis

For ARDL Model

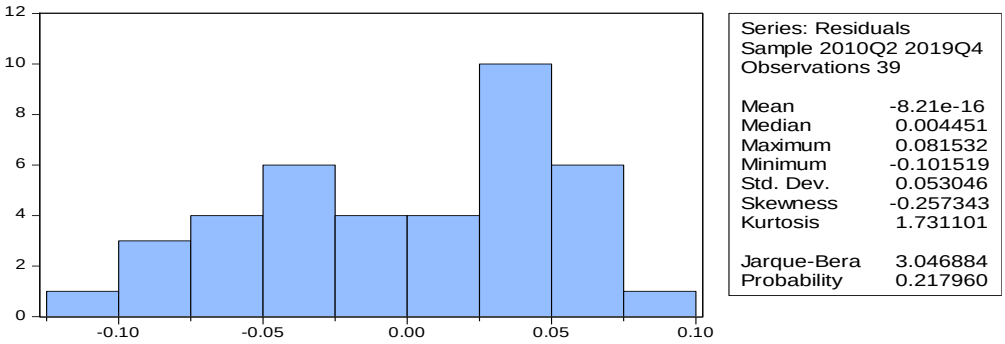


Figure 3. Jarque-bera Normal Distribution Test for the ARDL Model

Source: Author's Computation with the aid of Eviews 10

Table 18. Breusch-Godfrey Serial Correlation LM Test Result for the ARDL Model

Breusch-Godfrey Serial Correlation LM Test			
F-statistic	0.067826	Prob. F(1,31)	0.7963
Obs*R-squared	0.085144	Prob. Chi-Square(1)	0.7704

Source: Author's Computation with the aid of Eviews 10

Table 19. Breusch-Pagan-Godfrey Heteroskedasticity Test for the ARDL Model

Breusch-Pagan-Godfrey Test			
F-statistic	1.772761	Prob. F(6,32)	0.1364
Obs*R-squared	9.729351	Prob. Chi-Square(6)	0.1365
Scaled explained SS	2.39443	Prob. Chi-Square(6)	0.8801

Source: Author's Computation with the aid of Eviews 10

Table 20. Ramsey RESET Test for the ARDL Model

Ramsey RESET Test			
	Value	df	Probability
t-statistic	0.190609	31	0.8501
F-statistic	0.036332	(1, 31)	0.8501

Source: Author's Computation with the aid of Eviews 10

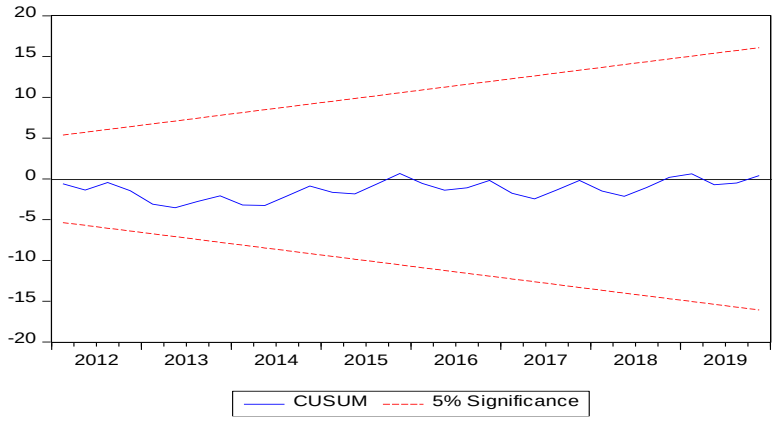


Figure 4. Cumulative Sum of Square Residual (CUSUM) Stability Test

Source: Author's Computation with the aid of Eviews 10

Table 18 to 20 as well as figure 3 and 4 shows the residuals post estimation test for the ARDL model.

From figure 4, the residuals from the long run model are normally distributed because the probability value of the Jarque-bera statistic is greater than the chosen level of significance (0.217960 > 5%).

The Breusch-Pagan-Godfrey heteroskedasticity test and Breusch-Godfrey serial correlation LM test result indicates that residuals are homoscedastic and not serially correlated because the probability values of their test statistic is greater than 5%.

Finally, the Ramsey RESET test shows that there is no misspecification bias in the long run equation as the probability value of the F statistic is greater than the level of significance (0.8501 > 5%) while the cumulative sum of squared residual (CUSUM) test reveals that the long run model is stable over the considered time period in this paper (Q1'2010-Q1'2020) as the blue line remains within the boundary of the two bounded red lines between 2010 and 2020.

For MIDAS Model

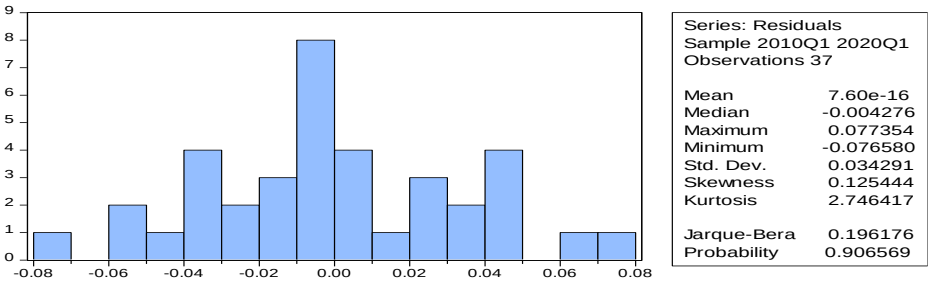


Figure 5. Jarque-bera Normal Distribution Test for the MIDAS Model

Source: Author's Computation with the aid of Eviews 10

Table 21. Correlogram of Residuals

Sample: 2010Q1 2020Q1
Included observations: 38

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob*
		1	-0.021	-0.021	0.0189	0.891
		2	-0.081	-0.081	0.2936	0.863
		3	-0.038	-0.042	0.3553	0.949
		4	0.132	0.124	1.1303	0.889
		5	-0.244	-0.251	3.8832	0.566
		6	-0.053	-0.041	4.0169	0.674
		7	-0.059	-0.095	4.1890	0.758
		8	0.204	0.174	6.2935	0.614
		9	-0.091	-0.056	6.7321	0.665
		10	-0.038	-0.068	6.8098	0.743
		11	-0.075	-0.092	7.1245	0.789
		12	0.321	0.270	13.161	0.357
		13	-0.013	0.073	13.172	0.435
		14	-0.084	-0.075	13.623	0.478
		15	-0.063	-0.065	13.882	0.535
		16	0.164	0.043	15.743	0.471

*Probabilities may not be valid for this equation specification.

Source: Author's Computation with the aid of Eviews 10

Figure 5 and table 21 shows the normal distribution and serial correlation test for the residuals of the MIDAS equation. The Jarque bera test signifies that the residuals for the MIDAS model were normally distributed as the probability value of the Jarque-bera statistics is greater than the chosen level of significance (0.906569 > 5%). On the other hand, the residuals are not serially correlated as the probability values of the autocorrelation and partial correlation test coefficients for different lag periods were greater than 5% which is the chosen level of significance. The post estimation results of this paper conclude that the residuals of the MIDAS equation are normally distributed and are not serially

correlated.

5. Conclusion and Recommendations

This paper provided empirical evidence on the impact of financial innovation on economic growth in Nigeria between January 2010 and April 2020. The study underscored the crucial role played by financial innovation in the Nigeria's economy. The financial sector is an intermediary between the deficit and surplus sector, thereby introduction of more innovative system will enhance the transfer of funds to the surplus sector. In addition, there will be easy accessibility and availability of funds to both domestic and foreign investors and this will have a positive impact on foreign portfolio investment (FPI), foreign direct investment (FDI) and domestic investment. Investment expenditure will increase and the process of money creation by the banking sector will be improved which will positively impact the aggregate economy and the financial sector development.

The ARDL Model revealed that mobile payments, ATM transactions and cheques transactions are mostly positively related to Nigeria's economic performance in the long run and short run but value of mobile payments transactions (VAMP) is positively and significantly related to Nigeria's economy in the short run and long run. Also, the ARDL bound test confirms that there is presence of long run relationship between financial innovation and Nigeria's real gross domestic product (RGDP) and the CUSUM test shows that the ARDL model is stable over the considered time period (2010-2020). The PDL MIDAS equation also confirms positive long-term relationship of value of cheque transactions (VACT) and value of mobile payment transactions (VAMP) with the performance of the Nigeria economy as well as also negative short-term relationship between value of internet web transactions (VAIW), value of POS transactions (VAPOS) and Nigeria's RGDP. The study therefore submits that the financial innovative channels in the Nigerian financial system have a pivotal role to play in fostering Nigeria's economic growth and bringing about a positive change in the welfare of citizens. Thus, the following recommendations are in line with the findings of this study:

(1) Given the positive effect of financial innovation variables such as mobile payment, cheque transactions and ATM on the Nigerian economy, the government should intensify efforts to create new forms of financial innovative structures as well as the develop existing ones especially the POS and internet web structures to ensure easy and secure accessibility to financial services and aid easy private sector access to credit & other forms of funds. This will help boost the financial sector development which will in turn have a multiplier effect on other sectors of the economy. Investment expenditure is also expected to increase which is favourable for Nigeria's economic growth and development

(2) Financial institutions and government should work with the ICT and other relevant sectors to ensure secure transactions over different platforms such as POS, internet and mobile payments. This will help improve the trust of the people on the use of these channels and indirectly aid financial and economic development of Nigeria.

(3) Financial institutions should sensitise people on the use of these various financial innovation channels in other to improve financial literacy. Improving people's knowledge on these channels will help ensure more funds are available for financial institutions such as banks for credit creation to the private sector which will improve their capital formation and aid productivity.

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