



Does Financial Innovation Drive Growth? Empirical Analysis of the Nigerian Case

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Authors' contributions

This work was carried out in collaboration between all authors. Author IGO designed the study and performed the statistical analysis. Author EHC wrote the first draft of the manuscript and managed the analyses of the study. Author AKC managed the literature searches and wrote the protocol. All authors read and approved the final manuscript.

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ABSTRACT

The goal of this study is to examine the effectiveness of financial innovation in driving growth in Nigeria using quarterly data from 2009:Q1-2014:Q4. The Least Squares (Gauss-Newton/Marquardt steps) based on vector autoregressive (VAR) system was used to estimate our system model whereas Johansen cointegration test was utilized to test for long-run relationship among our series. The Augmented Dickey-Fuller unit root test, descriptive statistics and diagnostic tests were also employed. The results showed that there is a long-run relationship between growth and financial innovation. The findings indicate that financial technological innovations (ATM transactions, Web/internet transactions, POS services and Mobile payments) do not jointly have positive effect on growth. However, the responsiveness of growth to the individual innovation channels varied. Value of transactions via ATM, the internet and mobile payments all have relative positive effect on growth, with the exception of POS channel which exerted a negative influence on growth. We therefore conclude that financial technological innovation has not had the desired effect on the Nigerian economy. This may be due to the fact that these innovative channels are yet to have

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significant depth required to drive growth. However, we recommend that investment in financial innovation be intensified, and must be accompanied with mass literacy which will aim at educating the citizenry on the need and benefits of effecting financial transactions through the various financial innovation channels. Effective regulations and adequate monitoring are very critical in ensuring security and healthy competitiveness in this area. Going forward, the positive effect of financial innovation will begin to be felt in real terms.

Keywords: Financial innovation; growth; electronic and internet banking channels; VAR.

1. INTRODUCTION

Financial sectors across the globe are fast growing in relevance and competitiveness. But to be competitive entails flexibility and adaptability to change. Breaking the ornaments of rigidity cannot come in better ways than embracing innovation. The swift rate at which innovation drives the financial sector has endeared researchers to examining financial innovation and its dynamism across different jurisdictions. Financial innovation in essence constitutes the introduction of new financial instruments, provision of new practices and improved services delivery within a financial system. We have been gripped with technology-driven financial system which not only introduces new techniques or practices of doing things, but provides solutions to hitherto difficult financial problems world over. [1] explains that financial innovation has a long history of success, with potentials of providing benefits that are extensively felt in the industries and across the broader economies. [2] argue that financial innovation has enhanced financial system deepening, structural diversification and sophistication of the financial system.

The main function of the financial system is the facilitation of efficient allocation and deployment of economic resources at all times. This very role comprises various payment systems, savings mobilisation and transfer of funds from net savers to investors of funds. The growing desire to satisfy the needs of diverse financial system participants can be said to be causal for emergence of new financial products, services and instruments. In the context of financial innovation, these competitive products, techniques and instruments often enhance the efficiency of the financial system by reducing cost of transacting, minimizing risk, improving information sharing and promoting dynamism in financial intermediation. New products (e.g. mobile and internet banking), new techniques or production process (e.g. credit scoring and electronic data management) and new institution

(e.g. internet-based financial institutions) all form the very spectrum of financial innovation [3]. These innovations have broadened both credit products and funding techniques in financial intermediation. Basically, financial innovations have improved the accessibility of credit by households and increased the availability of finances for the private sector [4].

Considering huge investment in financial technology, technological changes creates uncertainties for both investors and the respective target niches expected to benefit from it. It does not however mean that such efforts amount to mere gamble, but that its benefits may not be determined with certainty or calculated through probabilities. [5] suggests a shift from a development model based on technology absorption to one that promotes innovation, specialized finance, which would allow innovative firms to conduct research, adopt technologies necessary for inventions, and in due course commercialize innovations. [6] opines that though investment in innovation is simply a bet for the future, and not all attempts turn out successful, only a long-term strategic commitment determines how successful it would be. And such commitments require either internal or external finance. Technological advances has facilitated the banking system to invest hugely in electronic and internet banking facilities; Automated Teller Machines (ATM), Point of Sale (POS), Mobile banking software and applications, digital database et cetera. These facilities are meant to aid financial accessibility and positively impact on the lives of users and bank customers. In most developing countries and Nigeria in particular, the welfare impact of financial innovations have been understudied and the need to examine its effect on growth cannot come at a better time. The need to fill this gap in knowledge motivated this empirical study which is aimed at assessing the effect of financial innovation on economic growth in Nigeria spanning the period 2009 to 2014.

2. REVIEW OF RELATED LITERATURE

[7] expounded a compelling argument on the theoretical backing for innovation and growth linkages. He buttressed that financial innovation increases the efficiency of financial intermediation by broadening the variety of financial products and services, thereby enhancing matching of the needs of individual savers with those of firms raising funds for expanding future products. The resulting capital accumulation therefore leads to economic growth, and improved standard of living. There are various growth theories in economics and innovation as a driver of growth plays a major role in each of the theory. Innovation and technological advances influence long term growth process. Creativity in financial engineering has improved the quality of inputs and the way they are integrated into the production process. The Schumpeterian approach to growth identified innovation as key disturbance in the economic system. Schumpeter therefore argues that awakening in innovation is driven by competition, new technology, competition for new supply sources and competition for cost and quality which are determinant of profit margin and output level [2]. Innovation thus promotes growth by introducing new and most efficient ways of doing things without sacrificing quality, at minimum possible cost and time.

The rate of usage of alternative banking outlets like mobile and internet banking, ATMs and point of sale (POS) in Nigeria has continued to rise. These are financial technological innovations designed to address the needs of businesses and households. Individuals and corporations who are financially included in the system have easier access to finances and may execute day-to-day deals with minimal barriers of time or place. Hence, it is theoretically argued that such facilities would promote economic activities and the well being of people by enhancing promptness in completion of transactions and promoting financial literacy. Financial innovation may affect the marginal propensity to spend out of income or savings by household and businesses and, in response to shock, a larger marginal propensity to spend out of income, instinctively, generate larger multiplier effects. On the other hand, the change in the response of households and businesses to variation in income and cash flow may have some moderation effects on the economy [8]. Thus, at a macro level, unraveling the effects of financial

innovation on growth remains an empirical question.

[9] analysed the Schumpeterian models and asserted that while technological and financial innovation may be positively correlated, economic growth will eventually be stagnant unless financiers innovate. The growing importance of the financial sector to growth and sustainable development, and the rapid rate of innovation in the sector have awakened research interests in financial innovation [3]. Markedly, the financial services industry has taken advantage of technological innovation thereby making financial services delivery as well as consumption easier and convenient. [10] posit that the innovations are basically driven by developments in information technology which may have induced excessive 'changeability' in the economy. One can now access one's financial statements and pay bills online [11]. Some studies on this subject focus on the effect of innovation on economic growth and development [12], and welfare impacts of financial innovation [13], whereas others evaluated the potential implication of financial innovation on demand for money [14], and the banking industry and financial sector performance [15,7]. [16] maintains that financial innovations have been acknowledged to have potentials of inducing more efficient allocation of resources, and also provide for a higher level of capital productivity and economic growth. In addition, [8] suggest that financial innovation is indeed vital for long-term decline in economic volatility, and is strongly associated with rapid economic growth [17]. According to [18] a positive and robust correlation exists between financial depth and economic growth in economies with small and intermediate financial sectors.

[19] examined the relationship between financial innovation and economic growth and volatility. The results revealed that a higher level of financial innovation exerts strong positive influence on a country's growth opportunities and capital and GDP per capita growth. Financial innovation was linked with higher growth rates in industries that are innovation reliant, and depend more on external financing. On the other hand, the study found that financial innovation is associated with higher growth volatility among industries more dependent on external financing and on innovation and with higher fragility, higher fragility in the banking industry - higher bank profit volatility and higher bank losses during financial distress.

[20] argue that innovation is highly correlated with entrepreneurship. In the case of relative effect of innovation on the financial sector, [21] examined the relationship between financial innovation and financial performance of commercial banks in Kenya and found that innovations in the context of mobile banking and credit cards have impacted positively on the financial performance of the banks. Similarly, while assessing the implication of innovation on the financial services sector, [2] contend that financial innovation has significant effect on both profitability and asset growth, and also revealed that there was no significant correlation between selected transaction channels and market size. [22] made a similar assertion in the Indian case and explained that such financial technologies like NIBBS Electronic Fund Transfer (NEFT), Mobile-Banking, Online share trading, E-banking have played a vital role in steering the Indian economy on the growth path.

3. DATA AND METHODOLOGY

This study basically examines a historical event and therefore is an *ex-post-facto* design. As a result we made exclusive use of secondary data. Financial technological innovations namely; total value of transactions/payments through the electronic and internet banking channels (FI), values of automated teller (ATM) transaction, Mobile Banking, Point of Sale (POS), and Web-based (or internet) Banking are our independent variables while productivity as proxied by the gross domestic product growth rate is our dependent variable. All data are collated on quarterly basis from the Central Bank of Nigeria Statistical Bulletin for the period 2009:Q1 – 2014:Q4. Choice of the chosen period is based on data availability particularly on innovation. Least Squares (Gauss-Newton / Marquardt steps) based on vector autoregressive (VAR) system will be used to estimate our system model whereas Johansen cointegration test will be utilized to test for long-run relationship among our series while the Augmented Dickey-Fuller unit root test will be employed to determine the stationarity of our series. Other diagnostic tests will however be applied to confirm the stability and reliability of our model.

3.1 Model Specification

This study adopted and modified the model in [19] which examined the bright and dark sides of financial innovation. The model is of the form;

$$Growth_{i,t} = \beta_1 GGO_MA_{i,t} + \beta_2 FI_{i,t} + \beta_3 GGO_MA_{i,t} * FI_{i,t} + \gamma X_{i,t} + \varepsilon_{i,t} \quad (1)$$

Where Growth is real capital growth, i and t represents country and period, GGO_MA is a measure of growth opportunities, FI denotes indicator of financial innovation and ε is error term.

Equation (1) is modified to reflect our variable proxies. The baseline model for this study is therefore presented thus:

$$GROWTH_t = \beta_0 + \beta_1 LogFI_t + \beta_2 LogATMV_t + \beta_3 LogWEBV_t + \beta_4 LogMOBV_t + \beta_5 POSV_t + \varepsilon_t \quad (2)$$

Where t denotes time, GROWTH is quarterly real GDP growth rate, β_0 is constant, $\beta_1 - \beta_5$ are coefficients, Log stands for logarithm operator for respective variables, FI is the independent variable and proxy for financial technological innovation and include the total value of transaction via electronic and internet channels. ATMV is the value of financial transactions through automated teller machines (ATMs), WEBV is value of transactions through web-based channels, MOBV is value of mobile banking transactions, POSV is value of financial transactions via Point of Sale channels, and ε = white noise process.

In the course of our estimation, we will first determine the stationarity of our variables using the Augmented Dickey Fuller unit root test. A series is said to be stationary if its mean and variance are constant over time. The ADF model is expressed thus:

$$\Delta y_t = \mu + \alpha_{t-1}t + \sum_{i=1}^n \gamma_i \Delta y_{t-1} + \varepsilon_t \quad (3)$$

where t = linear time trend, μ = constant, the differencing operator is denoted by Δ , and ε is the stochastic error term. Secondly, if all our variables are found to be stationary after first differencing, we may have test for a long-run relationship among the variables using the Johansen cointegration test.

The nature of relationship which Johansen cointegration test is bound to determine was modeled in [23] but modified and expressed for our purpose thus,

$$\Delta y_t = \lambda y_t - 1 + \sum_i^k \delta_i y_t - i + \mu_t \quad (4)$$

y_t = vector of variables whose dynamics will be studied.

λ = a matrix number

δ = A matrix whose rank explains the number of cointegrating equations.

4. RESULTS AND ANALYSIS

Table 1 explains the statistical positions of the series. The results revealed that growth averaged 6.97% while the total value of transactions necessitated by financial technological innovation averaged 518.7 billion between 2009:Q1-2014Q4. All the channels put together highest value in transaction in 2014:4 at 1.255 trillion, and lowest in 2010:Q1 at 69.6 billion. In particular, ATM transaction recorded the highest value compared to other financial innovation options. ATM value averaged 458.48 billion, Web payments 13.41 billion, mobile payments 22.82 billion, and POS 23.99billion. Behind ATM is point of sale (POS) services which recorded second highest in transaction value while mobile payments came slightly behind the POS. Web-based (internet) transaction recorded lowest transaction value even though it has relatively higher volume of transaction compared to other innovation channels.

Fig. 1 explains the relative trends of the natural logarithm of our series over the period covered by the study. The trends reveal that there are no significant signs of stability in the movement of the series within the coverage period.

Results of unit root test in Table 2 indicate our series are stationary but the stationarity so attained are of different orders. While GROWTH, MOBV and POSV are stationary after first differencing, FI, ATMV and WEBV are stationary at level. P values less than 5% equally indicate stationarity at each point. This outcome therefore means that we are going to apply a VAR-based estimate in processing our model. However, the Johansen cointegration test may still be run to determine if the series have any cointegrating equations.

Results of cointegration test results in Table 3 indicate the presence of cointegrating of equations among our variables. Both the trace statistics and the Max-Eingen Statistic indicated 3cointegrating equations. Summary of the results is that there exist a long-run relationship between growth and financial innovation. This entails that both set of series move along together in the long-run.

Regression estimates in Table four indicate that financial technological innovations (FI) jointly have significant negative effect on growth in Nigeria within the period covered by the study. On specific terms, financial transactions through the automated teller machine (ATM) and the internet (web-based) channels have positive and significant effect on growth while Mobile payments exerted non-significant positive influence on growth. Point of sale (POS) channels was found to have negative effect of growth. The overall effect of the regressors on the dependent variable was confirmed to be highly significant while the Durbin-Watson value

Table 1. Descriptive statistics

	Growth (%)	FI (billion)	ATMV (N'billion)	WEBV (N'billion)	MOBV (N'billion)	POSV (N'billion)
Mean	6.965573	518.7001	458.4802	13.40572	22.81974	23.99443
Median	6.924217	481.9434	465.4346	10.32948	4.968344	8.689055
Maximum	7.980000	1255.739	1027.924	52.27000	119.4734	96.35052
Minimum	5.700000	69.60000	62.59000	3.370000	0.060000	1.865365
Std. Dev.	0.656912	362.7031	304.7673	10.56140	33.26296	29.01146
Observations	24	24	24	24	24	24

Source: Authors' 2016

Table 2. Augmented Dickey-Fuller (ADF) unit root test

Variable	ADF statistic	Critical value at 5%	P value	Order of integration
Growth	-4.467929	-3.632896	0.0095	I(1)
Log (FI)	-3.196897	-3.029970	0.0362	I(0)
Log (ATMV)	-3.864639	-3.029970	0.0093	I(0)
Log (WEBV)	-3.486308	-2.998064	0.0180	I(0)
Log (MOBV)	-6.040824	-3.004861	0.0001	I(1)
Log (POSV)	-6.001292	-3.004861	0.0001	I(1)

Source: Authors' 2016

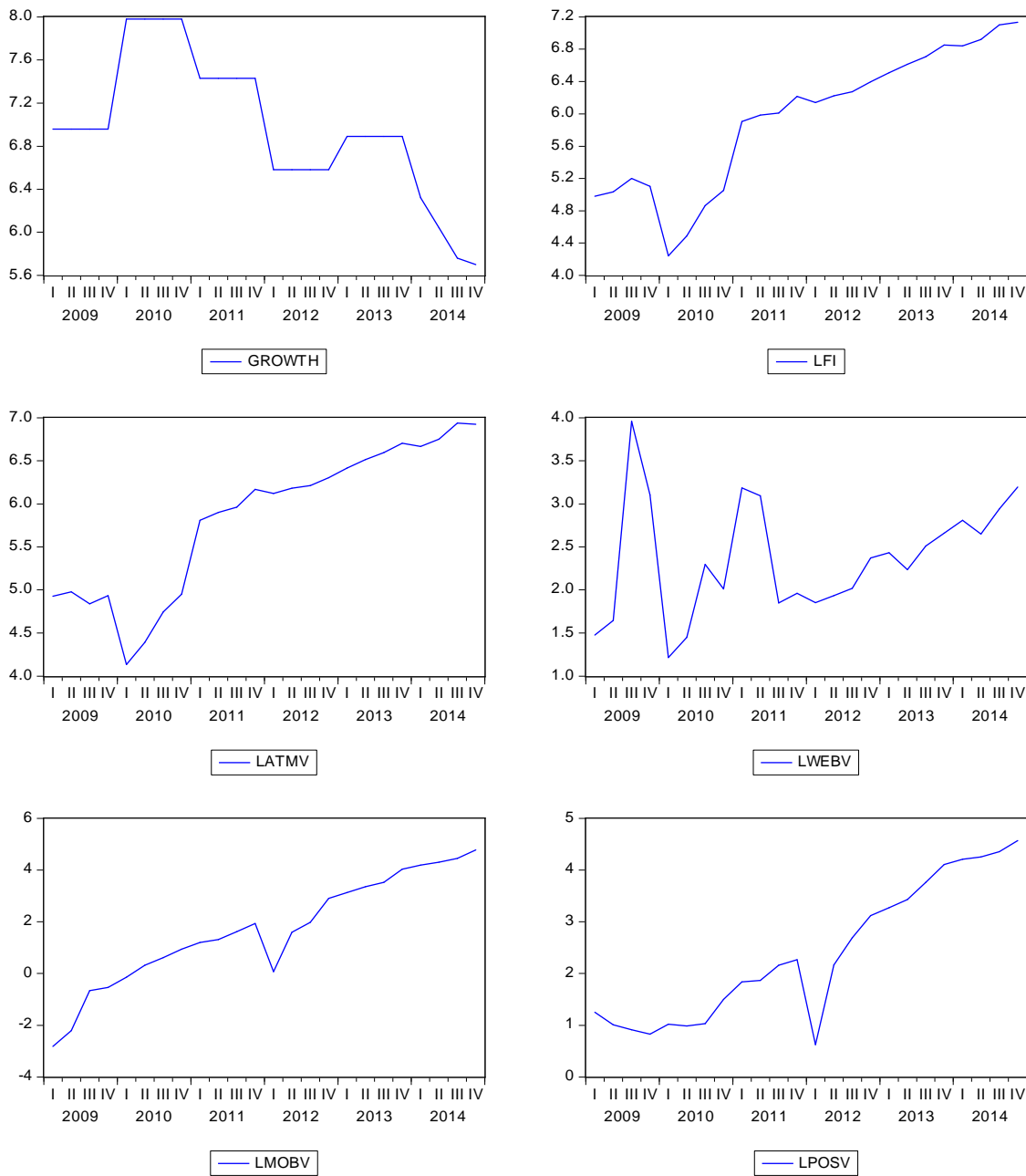


Fig. 1. Graphical representation of variable proxies

indicate that there is no autocorrelation in our model. Moreover, 88% of the variation in growth was due to changes in the regressors while the remaining 12% was caused by variables not included in the model.

Table 5 presents the Granger causality test which estimates the causal relationship between financial innovation and growth in the Nigerian case. The result indicates that there is no

causality between financial innovation and growth for the period covered by the study. In other words, causality does not run from financial innovation to growth and vice versa.

Results in the first panel in Table 6 are the serial correlation test which confirmed the Durbin-Watson test Result that our model has no serial correlation problems. The second panel showed that our series is homoskedastic which is good for our model.

Table 3. Result of Johansen cointegration test

Date: 11/28/16 Time: 07:22
 Sample (adjusted): 2009Q3 2014Q4
 Included observations: 22 after adjustments
 Trend assumption: Linear deterministic trend
 Series: GROWTH LFI LATMV LWEBV LMOBV LPOSV
 Lags interval (in first differences): 1 to 1

Unrestricted Cointegration Rank Test (Trace)

Hypothesized no. of CE(s)	Eigenvalue	Trace statistic	0.05 critical value	Prob.**
None *	0.990178	206.5669	95.75366	0.0000
At most 1 *	0.859975	104.8571	69.81889	0.0000
At most 2 *	0.782962	61.60660	47.85613	0.0015
At most 3	0.602732	27.99754	29.79707	0.0795
At most 4	0.278171	7.688351	15.49471	0.4993
At most 5	0.023229	0.517076	3.841466	0.4721

Trace test indicates 3 cointegratingeqn(s) at the 0.05 level

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

***MacKinnon-Haug-Michelis (1999) p-values*

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized no. of CE(s)	Eigenvalue	Max-eigen statistic	0.05 critical value	Prob.**
None *	0.990178	101.7098	40.07757	0.0000
At most 1 *	0.859975	43.25054	33.87687	0.0029
At most 2 *	0.782962	33.60906	27.58434	0.0074
At most 3	0.602732	20.30919	21.13162	0.0648
At most 4	0.278171	7.171276	14.26460	0.4691
At most 5	0.023229	0.517076	3.841466	0.4721

Max-eigenvalue test indicates 3 cointegratingeqn(s) at the 0.05 level

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

***MacKinnon-Haug-Michelis (1999) p-values*

Source: Authors' 2016

Table 4. Results of least squares estimate under a VAR system

Dependent Variable: GROWTH
 Method: Least Squares (Gauss-Newton / Marquardt steps)
 Date: 11/28/16 Time: 07:17
 Sample (adjusted): 2009Q2 2014Q4
 Included observations: 23 after adjustments
 GROWTH = C(1)*GROWTH(-1) + C(2)*LFI(-1) + C(3)*LATMV(-1) + C(4)
 *LWEBV(-1) + C(5)*LMOBV(-1) + C(6)*LPOSV(-1) + C(7)

	Coefficient	Std. error	t-statistic	Prob.
Growth(-1)	0.322715	0.203380	1.586763	0.1321
LFI(-1)	-5.614827	2.157011	-2.603059	0.0192
LATMV(-1)	4.739624	1.921051	2.467203	0.0253
LWEBV(-1)	0.548706	0.201973	2.716725	0.0152
LMOBV(-1)	0.138556	0.092964	1.490419	0.1556
LPOSV(-1)	-0.026147	0.150868	-0.173312	0.8646
C	8.948780	2.757069	3.245759	0.0051
R-squared	0.878678	Mean dependent var		6.965883
Adjusted R-squared	0.833182	S.D. dependent var		0.671674
S.E. of regression	0.274334	Akaike info criterion		0.496850
Sum squared resid	1.204147	Schwarz criterion		0.842435
Log likelihood	1.286230	Hannan-Quinn criter.		0.583763
F-statistic	19.31341	Durbin-Watson stat		1.566748
Prob (F-statistic)	0.000002			

Source: Authors' 2016

Table 5. Granger causality test result

Pairwise Granger Causality Tests

Date: 12/24/16 Time: 22:29

Sample: 2009Q1 2014Q4

Lags: 2

Null hypothesis	Obs	F-statistic	Prob.
LOG (FI) does not granger cause growth	22	3.20868	0.0657
GROWTH does not granger cause LOG (FI)		1.30105	0.2980
LOG (ATMV) does not granger cause growth	22	3.68194	0.0669
GROWTH does not granger cause LOG (ATMV)		2.44628	0.1165
LOG (WEBV) does not granger cause GROWTH	22	0.99409	0.3906
GROWTH does not granger cause LOG (WEBV)		0.89804	0.4258
LOG (MOBV) does not granger cause GROWTH	22	2.72614	0.0940
GROWTH does not granger cause LOG (MOBV)		2.54228	0.1082
LOG (POSV) does not granger cause GROWTH	22	3.56546	0.0509
GROWTH does not granger cause LOG (POSV)		1.12748	0.3469

*Source: Author's 2016.***Table 6. Results of diagnostic tests**

Breusch-Godfrey serial correlation LM test:			
F-statistic	0.013661	Prob. F(2,15)	0.9864
Obs*R-squared	0.041817	Prob. Chi-square (2)	0.9793
Heteroskedasticity test: Breusch-Pagan-Godfrey			
F-statistic	0.749188	Prob. F(5,17)	0.5979
Obs*R-squared	4.152938	Prob. Chi-square (5)	0.5276
Scaled explained SS	2.276028	Prob. Chi-square (5)	0.8098

Source: Authors' 2016

5. CONCLUSION

Questions on whether growth is driven by financial technological innovation have recently begun to dominate the debate in finance circles. This has even attracted more attention since innovation through technological advances continues to shape the nature of financial transactions and products across the globe. Most studies in this regards are mainly theoretical and as result have based most arguments on non-verifiable facts or indices. The challenges in most cases are belied on data availability which has prompted some researchers to employ surveys and questionnaires in assessing link between financial innovation and productivity. Such studies based on primary data are usually viewed with contempt as their reliability as well as verifiability are often in doubt. The need to provide an empirical support to the existing plethora of literatures is the core motivation behind this study. Against this backdrop, we examined the effectiveness of financial innovation in driving growth in Nigeria. The results showed that there is a long-run relationship between growth and financial innovation. The findings indicate that financial technological innovations (ATM transactions,

Web/internet transactions, POS services and Mobile payments) do not jointly have positive effect on growth. However, the responsiveness of growth to the individual innovation channels varied. Value of transactions via ATM, the internet and mobile payments all have relative positive impact on growth, with the exception of POS channel which exerted a negative influence on growth. We therefore conclude that financial technological innovation has not had the desired effect on the Nigerian economy. This may be due to the fact that these innovative channels are yet to have significant depth required to drive growth. The period for which data became available may have also contributed to the negative influence observed in the findings. However, we recommend that investment in financial innovation be intensified, and must be accompanied with mass literacy which will aim at educating the citizenry on the need and benefits of effecting financial transactions through the various financial innovation channels. Effective regulations and adequate monitoring are very critical in ensuring security and healthy competitiveness in this area. Going forward, the positive effect of financial innovation will begin to be felt in real terms.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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