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Financial Innovation and Industrial Growth Volatility: Evidence from the Nigerian Banking Industry

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Abstract

Traditional innovation-growth view posits that financial innovations help reduce agency costs, facilitate risk sharing, and ultimately improve efficiency and economic growth. The study examines the effects of financial innovation in the banking sector on industrial growth volatility. It used causal research design to analyse data obtained from Central Bank of Nigeria (CBN) Statistical Bulletin for the period 1981 to 2016 and tested for causality with the Toda-Yamamoto causality test. Our findings show that financial innovation, bank branch network and growth of banks' credit to private sector significantly reduced industrial growth volatility while the quasi-money in the circulation exacerbated it.

Keywords: Financial Innovation, Banking Sector, Toda-Yamamoto causality, Industrial Growth Volatility

1.0 Introduction

Financial development is one of the major requirements for rapid and sustainable economic growth and development because the financial superstructure in form of both primary and secondary securities accelerates economic growth and improves economic performance (Goldsmith, 1969). This conforms to the view of Chernykh and Theodossiou (2011) that the economic strength of a nation and the ability of such nation to gain the most from its accumulated human and material resources require a well-developed financial market to power the industrial sector in particular and the economy as a whole. Ojo (2010) asserts that sustainable industrial development cannot be achieved without efficient and well-functioning financial institutions to channel funds to the industrial sector for productive uses. The industrial sector is the driving force of any economy because it combines the raw materials and other production inputs to produce goods and services. Industrialization is one of the most reliable means of raising a country's standard of living. The sector is very important to the growth and development of the entire economy because it produces goods and services for the increasing population, generates employment opportunities, enhances government revenue through taxes, and foreign earnings through exports (Osinubi & Akinyele, 2006).

Akingunola (2011), documents that the ability of industrial sector to enhance economic growth of the country rest on the accessibility of the operators to relatively low interest rate finances. This corroborates the view of Obitayo (2001) who identifies poor access to institutional finance as one of the major impediments to the growth and development of the industrial sector in Nigeria. Thus, banks have been considered to be more effective

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in financing industrial expansion than any other form of financing in developing economies, especially in Nigeria where banks constitute the largest financial intermediaries (Gershenknon, 1962). In view of this, funds mobilized from numerous customers are aggregated and disbursed as credit facilities to the deficit sector in form of loans and advances which facilitate the exploration and expansion of productive investment by small, medium and large scale industries. Also, Ogujiuba, Ohuche and Adenuga (2004) in their study confirm that about 79 percent of industries surveyed in 2001 identified lack of financial resources as their critical constraint. Thus, it can be deduced that inadequate access to finance hinders industrial growth and this can be attributed to inefficiency of the banking sector. The efficiency of the banking sector can be enhanced by innovation which signifies the emergence of new financial instruments, services, and re-organization of existing financial institutions and channels.

In the light of the above, financial innovation means introduction of new financial instruments and emergence of new markets through technological revolutions (Tahir, Shah, Arif, Ahmad, Aziz, & Ullah, 2018). These authors classified financial innovation into process, product and institutional innovation. Process innovation is new ways of operating business and implementing information technology, such as the Automated Teller Machine (ATM), mobile banking, and online banking, among others. Product innovation includes new financial products such as securitized assets, derivatives, weather derivatives, foreign currency mortgages, hedge funds, exchange-traded funds, private equity and retail structured products, among others. An institutional innovation is the process of introducing new types of financial firms such as discount broking firms, internet banking, and specialist credit card firms, among others. All these types of innovation improve bank efficiency in the borrowing and lending of funds, which ultimately opens up a quick way of dealing with customers. This is in line with the findings of Nkem and Akujinma (2017) that the banking sector in the developing economy is strengthened by financial innovations in various payment methods such as the use of automated teller machines, mobile banking, and electronic banking and in the area of technological progress, resulting in increased competition in the sector.

In consonance with the above points, vast numbers of studies such as Domeher, Frimpong and Appiah (2014) confirm that innovation attributes such as lack of complexity, compatibility and perceived usefulness provided by financial innovation increase the likelihood of e-banking adoption. Similarly, Anthony and Aboagye (2014) document bidirectional Granger causality between financial innovation and economic growth. Also, Dunne and Kasekende (2016) stress that financial innovation plays a crucial role in explaining money demand in sub-Saharan Africa and can have important implications for future policy design. Ajide (2016) stresses that policies which would drive competition and efficiency in the banking industry as well as financial innovation should be introduced to ensure effective functioning of the financial system.

None of these studies however examined the effects of financial innovation on industrial growth volatility and therefore leave a gap in the literature which this study intends to fill. In addition, Toda-Yamamoto causality test has not been employed to test for causality in this nexus. Thus, this study is different from the previous ones in these ways. To fill

this gap, this study examined the effect of financial innovation in banking sector on industrial growth volatility using the Toda-Yamamoto causality test.

The rest of this paper is organised as follows: section 2 reviews the theoretical and empirical literature; section 3 presents stylised facts in Nigeria while section 4 outlines the methodology and model specification adopted. Data analysis and discussions are presented in section 5 and section 6 concludes the paper with relevant recommendations.

2.0 Empirical and Theoretical Review

Mention (2011) posits that financial innovation constitutes the introduction and promotion of financial products and services, the development of new processes, as well as the interaction with customers and the development of new structures for financial institutions. Among the financial innovations that have taken place in Nigeria is mobile financial service. This service includes sending money, paying bills, receiving bulk payments and purchasing airtime with the high reduction in the cost of hardware and other supporting infrastructures, the new trend shows that the number of ATMs and POS has been growing at a fast pace in Nigeria. Somoye (2005) views industrial sector as contributing the highest multiplier effects of all sectors in the economy and therefore holds the key to broadening both the productive base of the economy and the revenue base of the government. Hence, the industrial growth volatility is the variance in the industrial growth. In view of this, similar studies have been conducted on financial innovation and industrial growth. For instance, Adegbite and Oke (2008) employed time series econometric techniques to examine the nexus between financial development and economic growth in Nigeria from 1975 to 2005. Their findings show a high positive and significant correlation between credits to private enterprises and the Gross Domestic Product (GDP) which indicates that the extent of credit to private sector is a great mover of economic growth. They further recommended an increase in the total credit to Small and Medium Scale Enterprises (SME) subsector as it controls a greater portion of output and employment.

Claessens and Laeven (2003) related a competition measure to industrial growth for 29 banking systems using the model developed by Rajan and Zingales (1998). They found that the effects of competition on access to finance (and growth) depend on the level of development of the financial system. Soedarmono (2010) investigated the link between bank competition and economic development from a sample of Asian countries over the period 1999-2007. The study found that, banking market power has a non-linear relationship with economic growth; banking market power tends to improve economic growth. However, the positive impact of banking market power on economic growth only occurs in the agricultural sector, but not in the industrial sector. The study concluded that when economic freedom increases and financial service investments come into a country, any policy to boost banking competition becomes necessary and this make industrial sector more important than the agricultural sector.

Asante, Agyapong and Adam (2011) investigated the relationship between bank competition, stock market and economic growth in Ghana for the period 1992 to 2009. The short and long run relationships were established within the frameworks of Granger causality and the Autoregressive Distributed Lag (ARDL)/ Dynamic Ordinary Least Square

(OLS) approach respectively. The study found that bank competition and stock market development granger caused economic growth in Ghana. Also, in the long run, banking competition is good for economic growth. However, there is a disproportionate response of economic growth to stock market development. Gakure and Ngumi (2013) conducted a study on bank innovation and profitability of commercial banks in Kenya. The study found that the financial performance of banks was moderately influenced by financial innovation products. The study concluded that positive relationship exists between the bank innovation profitability of commercial banks in Kenya. Also, Simiyu, Ndiang'ui and Ngugi (2014) estimated the impact of financial innovations on the market size of firms, focusing precisely on the return on equity. The study found that there was significant impact of financial innovations on the profitability of the banks. The study concluded that there was also a significant relationship between various market needs and the products developed. The study recommended that more financial innovations must be employed to enhance customer satisfaction and value, and eventually to expand the size of the market. In a similar study conducted by Jegede (2014), on effect of Automated Teller Machine on the performance of Nigerian banks. The study measured the influence of ATMs on the performance of banks, using convenience sampling design; data were collected from 125 employees of five randomly selected banks. The study confirmed that the financial performance of banks was moderately improved due to the deployment of ATMs. Ilo, Wilson and Nnanyelugo (2014) investigated the impact of technological innovation on the delivery of banking services. The results revealed that there is a positive connection between financial innovation and banks' performance. The study concluded that customer retention rate and the level of satisfaction were improved by the use of information and communication technology innovations.

In a study conducted by Domeher, etal. (2014) on the factors influencing the adoption of financial innovation in Ghana's banking industry, surveys were conducted involving 405 clients of the six major banks in the country. Using logistic regression, the results showed that innovation attributes such as lack of complexity, compatibility and perceived usefulness provided by financial innovation, increase the likelihood of e-banking adoption. Malak (2014) conducted a study on effect of financial innovation on the performance of commercial Banks in South Sudan. The study concluded that financial innovation products significantly influenced the financial performance of commercial banks operating in South Sudan. Anthony and Aboagye (2014) examined the relationship between bank competition, financial innovations and economic growth in Ghana using quarterly data from 1990 to 2009. They employed the ARDL co-integration procedures. The results showed that, in the long run, bank competition is positively related to economic growth while financial innovation is negatively related to economic growth. In the short run, bank competition and financial innovation are negatively related to economic growth. Also, the study revealed bidirectional Granger causality between financial innovation and economic growth.

A recent study conducted by Dunne and Kasekende (2016) investigated the development of financial innovation and its impact on money demand in sub-Saharan Africa using panel data estimation techniques for 34 countries between 1980 and 2013. The results indicated that there was a negative relationship between financial innovation and money demand.

The study suggested that financial innovation plays a crucial role in explaining money demand in sub-Saharan Africa and can have important implications for future policy design. A similar study was conducted by Ajide (2016), on financial innovation and Sustainable Development in Selected Countries in West Africa. The study found that an increase in banking efficiency driven by competition and financial innovation would improve economic growth and development. The study concluded that policies which would drive competition and efficiency in the banking industry as well as financial innovation should be introduced to ensure effective functioning of the financial system. Kashmari, Nejad and Nayebyazdi (2016) examined the influence of financial innovation on the share of each bank in attaining deposits as one of the most critical goals and competitive tools of a bank. The study found bilateral relation among the share of deposits and facilities provided by the bank. The study concluded that the SWIFT system, Point of Sale terminal, mobile banking, ATM machines, and personal identification number (PIN), and other banking facilities provided by each bank, showed that a causal relation in improving the share was caused by innovation.

The study carried out by Kamau and Oluoch (2016) examined the impact of internet banking, debit cards, credit cards, agency banking, mobile banking and ATMs on the financial performance of banks. The result of the study revealed that banks' financial performance was greatly influenced by ATM banking. The study concluded in aggregate on the basis of regression analysis that ATMs, debit and credit cards, mobile banking, and web banking and agency banking, all have a strong influence on commercial banks' performance. Tahir, Shah, Arif, Ahmad, Aziz, & Ullah, (2018) examined impact of innovative methods of payment used in Pakistan on the efficiency ratio (ER). The result of the study indicated a significant positive relation of transactions on the Web/Internet on ER but the results for Automated Teller Machines (ATM), Point of Sale (POS), and Mobile Banking (MOB), were found to be statistically non-significant. Furthermore, the Granger impact appraisal revealed that no innovative products had a critical effect on ER, but they did have a significant effect on the value of transactions. Thus, the study suggested that innovative methods should be redesigned in such a way that customization would enable a customer to access all banking services and reduce transaction costs.

From all these studies reviewed, it was found that most of the studies were conducted on the effect of financial innovation on the performance of banks and few studies have been conducted on the effect of financial innovation on industrial growth volatility. Also, most of these studies made use of Automated Teller Machines (ATM), Point of Sale (POS), and Mobile Banking (MOB) as proxy for financial innovation but this study made use of other indicators of financial innovation such as bank branch network, growth of banks' credit to private sector and quasi-money in circulation in order to differentiate this study from previous studies. More so, the study adopts robust statistical tool to capture the long run and the short run effect of financial innovation on industrial growth volatility. These aforementioned gaps in the literature justify the importance of carrying out this study in order to contribute to the scanty empirical literature on financial innovation and industrial growth volatility. Thus, in carrying out this study, the transaction cost innovation theory pioneered by Niehans (1983) was adopted. The theory advocates that the motive

of financial innovation is to reduce the transaction cost. However, the reduction of transaction cost can stimulate financial innovation and improvement of financial service. Consequently, reduction of operation costs through agency banking, internet banking, and mobile banking among others may influence industrial growth volatility.

3.0 Industrial Growth in Nigeria

The industrial sector of an economy refers to the segment that combines the raw materials and other production inputs such as land, labour, and capital to produce goods and services. It encompasses activities related to the aggregate supply and aggregate demand in the economy, and data on this sector cover gross domestic and national product, consumption, savings and capital formation. This sector is very important to the growth and development of the entire economy in that it produces goods and services for the ever - increasing population, generates employment opportunities, enhances government revenue through taxes and foreign earnings through exports (Somoye, 2005). It also enhances balance of payment equilibrium as well as positions the country favourably among the League of Nations (Bank of Thailand, 2008). In Nigeria, industrial sector is one of the four key economic subsectors (others include: agriculture, mining and quarrying, and building/construction) of the real sector that generates majority of a nation's wealth. Other sectors such as services and trade redistribute this wealth, and are built on the products created by wealth generators (Osoba, 1987). Industrial sector stands out in this group and it plays a unique role because ther remaining sectors are limited by one factors or the other for instance agriculture and mining are limited by natural resources; while building and construction may also be affected by international laws (Somoye, 2005).

The industrial sector has strong linkages with all other sectors of the economy and as a result, it will continue to be the fundamental base for the economic health and security of the nation. Although, it is not the only major foreign exchange earner, it is a stable and reliable source of foreign exchange earnings for major economies worldwide. It has the highest multiplier effects of all sectors in the economy and therefore holds the key to broadening both the productive base of the economy and the revenue base of the government (Somoye,2005). The performance of the industrial sector can be measured and evaluated by comparing its contribution to the overall Gross Domestic Product (GDP) of the country. Osinubi and Akinyele (2006) asserted that the industrial sector of an economy is the driving force as well as the engine of economic growth and development. An increase in the contribution of the industrial sector to the Gross Domestic Product translates to an increase in the provision of goods and services, employment level, per capita income, aggregate demand and economic growth and development. Thus, the graphical illustration shown below shows the proportion of industrial sector to the total Gross Domestic Product in Nigeria.

Figure 1: Industrial growth in Nigeria

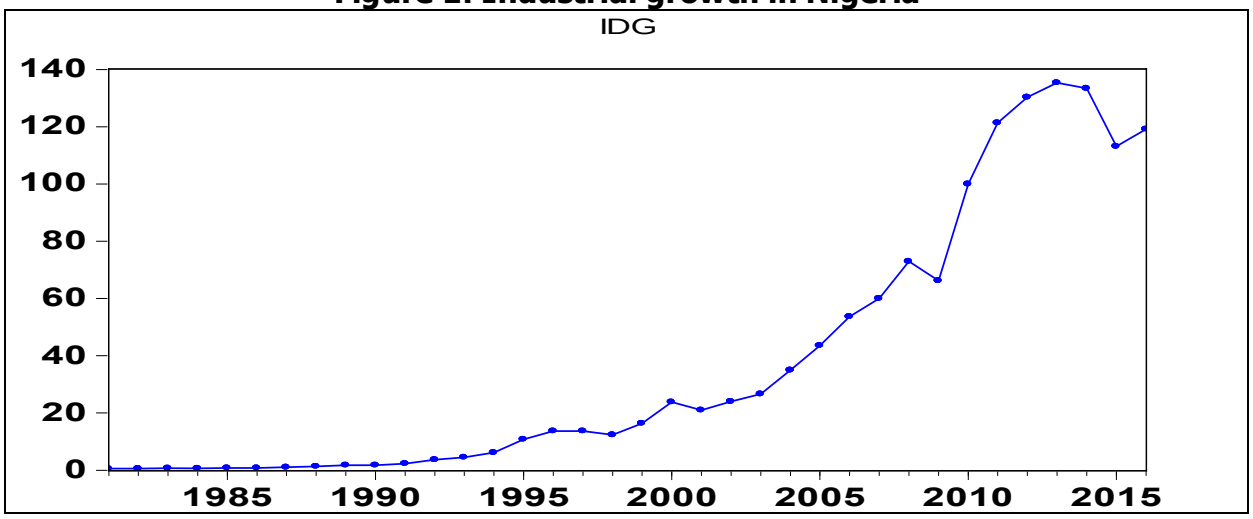

Figure 1 shows that industrial growth has been very low and stable within 1981 to 1990 but gradually increasing from 1991 to 1997. From 1988 it has been falling and increasing and reach the peak in 2013 then fall again in 2014. It can be deduced that the growth of industrial sector is not stable in Nigeria and this fluctuation may be attributed to so many factors. To this end, this study examines effect of financial innovation on the industrial growth volatility in Nigeria.

4.0 Methodology and Model Specification

Causal research design was adopted and sample size of data for the study was arrived at through purposive sampling technique. The sample size covers the period of thirty-six years which spans from 1981 to 2016. Data were obtained from Central Bank of Nigeria statistical bulletin. The study employed Toda-Yamamoto causality test. The most common way to test the causal relationship between two variables is the Granger-Causality proposed by Granger (1969). The VAR model is specified in a compacted form as follows:

$$Y_t = \Sigma^{n}_{i=1} \alpha_i Y_{t-i} + \Sigma^{n}_{j=1} \beta_j X_{t-j} + \mu_{1t} \quad \ldots\ldots 1$$

$$X_t = \Sigma^{m}_{i=1} \psi_i X_{t-i} + \Sigma^{m}_{j=1} \omega_j Y_{t-j} + \mu_{2t} \quad \ldots\ldots 2$$

where: Y represents dependent variable (measured by industrial growth volatility) and X denotes independent variable (measured by financial innovation proxies). The error term is denoted by u_{1t} and u_{2t} which follow a multivariate Gaussian distribution with zero mean and constant variance. Toda and Yamamoto (1995) proposed an augmented VAR which is robust to the integration and cointegration properties of the process. The compacted form of the model is specified as follows:

$$Y_t = \lambda + \Sigma^{m}_{i=1} \varphi_i Y_{t-i} + \Sigma_{i=1}^{m+d\max} \varphi_i Y_{t-i} + \Sigma^{m}_{i=1} \emptyset_i X_{t-i} + \Sigma_{i=1}^{m+d\max} \emptyset_i X_{t-i} + v_{1t} \quad \ldots\ldots 3$$

$$X_t = \gamma + \Sigma^{m}_{i=1} \delta_i X_{t-i} + \Sigma_{i=1}^{m+d\max} \delta_i X_{t-i} + \Sigma^{m}_{j=1} \sigma_j Y_{t-j} + \Sigma_{i=1}^{m+d\max} \sigma Y_{t-i} + v_{2t} \quad \ldots\ldots 4$$

Where λ, φ's, Ø's, γ, δ's, and σ's are parameters of the model. dmax is the maximum order of integration suspected to occur in the system; $v_{1t} \sim N(0, \Sigma v_1)$ and $v_{2t} \sim N(0, \Sigma v_2)$

are the residuals of the model and Σv_1 and Σv_2 are the covariance matrices of v_{1t} and v_{2t} , respectively.

4.1 Estimation Procedure

The estimation procedure includes unit root test which investigates order of integration and the properties of the series prior to the estimation of VAR model. The test is mainly a descriptive tool performed to classify series as stationary and non-stationary. It is done within the framework of Augmented-Dickey-Fuller (ADF), Philips-Perron (PP), and Kwiatkowski-Phillips-Schmidt-Shin (KPSS). The study employed these three test procedures in order to have a crosscheck and reduce level of bias. Thus, joint testing of both nulls can strengthen inferences made about the stationarity or non-stationarity of a time series especially when the outcomes of the two nulls corroborate each other. This joint testing has been known as confirmatory analysis. This occurs when the null of stationarity is accepted (rejected) and the null of non-stationarity is rejected (accepted), this implies that the series is stationary (non-stationary). Conversely, if both nulls are accepted or both are rejected, it means there is no confirmation about the series stationarity (non-stationarity). Appropriate maximum lag length for the variables in the VAR, was determined using information criteria, serial correlation in the residuals of VAR was checked among others.

5.0 Results and Discussions

This section presents the result of the analysis and the discussion of findings. The result of the analysis is presented on the basis of pre-model estimation, estimation and post estimation. The study started with the statistical description of the data collected on the variables under investigation, and then followed by analyses of estimated results to verify the objectives of the study.

5.1 Descriptive Statistics and Correlation Matrix

This section explains the descriptive statistics and the correlation matrix for each of the variables employed in the study. The descriptive statistics appear in Table 2 and the correlation matrix appears in Table 3 (see appendix). The result of the descriptive statistics provides evidence on how the data series are distributed over time. The average values of IDDGV, LBBN, LCSP and LQSM are approximately pegged at 0.000965, 3.318317, 1.069527 and 2.468247 respectively. It means that over the years, the percentage change in industrial growth volatility is found to be lower than bank branch network, growth of banks' credit to private sector and quasi-money in the circulation. Furthermore, evidence shows that percentage changes in industrial growth volatility range from 0.02% to 0.64%. The bank branch network ranges from 293% to 376%, growth of banks' credit to private sector ranges from 77% t0 156% while quasi-money in circulation ranges from 78% to 498%. Also, we found that the bank branch network is the most volatile among the variables under the study.

The correlation matrix shows some covariation between industrial growth volatility, bank branches network, growth of banks' credit to private sector and quasi-money in circulation. The study adopts the interpretation of Guilford rule of thumb on Pearson correlation which specified that a value less than 0.2 is a negligible correlation, value

between 0.2 to 0.4 is low correlation, value between 0.4 to 0.7 is a moderate correlation, value of 0.7 to 0.9 is a high correlation, value greater than 0.9 is a very high correlation. The result of the correlation matrix shows that there is negative correlation between industrial growth volatility and bank branch network to the tune of -0.016659. In addition, the result reveals negative correlation between industrial growth volatility and growth of banks' credit to private sector to the tune of -0.229671. In the same token, negative correlation exists between industrial growth volatility and quasi-money in circulation to the tune of -0.271153. However, the correlation among other independent variables such as bank branch network, growth of banks' credit to private sector and quasi-money in circulation as proxies for financial innovation are positively correlated. These weak correlation coefficients reveal that there is absence of problem of multicollinearity. The results of the correlation matrix are amazing but not sufficient to draw a meaningful conclusion about the relationship between financial innovation (measured as bank branch network, growth of banks' credit to private sector and quasi-money in circulation). Thus, the study expands the discussion to test for stationarity, optimum lag selection, VAR, Granger Causality test, impulse response test and variance decomposition test. Our results are interpreted as follows.

5.2 Stationarity Test and Optimum Lag Selection

This section presents the result of the stationarity test and optimum lag selection criteria. The stationarity test appears in Table 4a and Table 4b while the optimum lag selection criteria appear in Table 4 (see appendix). The result shows that not all the variables were stationary at level but also at first difference and second difference. Thus, there is strong indication that these variables are multi-levelled integrated and this is supported by confirmatory analysis shown in Table 4b. This analysis further confirms the decision of the joint test used to carry out the stationarity test and it reveals that two are stationary and the remaining two of the variables show mixed results. The optimum lag is given by the smallest value of the information criteria. In the Table 5 in the appendix, all the information criteria- FPE, AIC, SC and HQ have the smaller value at lag 1; implying that 1 is the optimum lag selected by these information criteria. Thus, the VAR model was estimated using 1 as the optimal lag.

5.3 VAR Estimation and Ergodicity Test

The VAR model was estimated and some diagnostic tests were conducted to confirm the stability of the model. The results from VAR model estimation show dynamic relationship among the variables but for the purpose of this study, the result of preferred equation was extracted and it reported Table 6 in the appendix. The result shows that bank branch network and credit to private sector by bank have significant negative relationship with industrial growth volatility while the quasi-money in the circulation reveals a significant positive relationship with industrial growth volatility. The test for ergodicity is carried out by computing the root of the AR polynomial and it is shown in the Table 7 and figure 2 in the appendix. From the table none of the modulus value is greater than one, it means the model is stable and meaningful interpretation can be drawn from the model. The result presented above also corroborates with the diagram below which shows that all the roots of the VAR polynomial rest on the unit cycle. This implies that the panel VAR

process is stationary or mean invertible and this strongly adheres to theoretical expectation.

The study also examines the LM statistics up to lag 3 to show the presence or absence of serial correlation in the residual of the estimated VAR model. The VAR residual serial correlation LM test was conducted and reported in the Table 8 in the appendix. From the result, LM-statistics appear to be very small and the corresponding p-values are respectively larger than 5%. In view of this, the null hypothesis of no serial correlation cannot be rejected and this implies that the residuals are independently spread.

5.4 Granger Causality, Impulse Response and Variance Decomposition

Further empirical investigation on the relationship between financial innovation and industrial growth volatility, involves examining the directions of "cause and effect" between the dependent and independent variable. The study employs Granger causality test for this purpose and our results are reported in Table 9 in the appendix. For brevity, the result of the first compartment is reported. In the first compartment, the p-values of all the variables are not significant and this implies that the null hypothesis that the excluded variable does Granger cause equation variable is not rejected at 95 per cent confidence in first compartment. This means bank branch network, banks' credit to private sector and quasi-money in circulation do not granger cause industrial growth volatility.

The study computes impulse-response functions (IRF) and variance decompositions, which serve as tools for evaluating the dynamic interactions and strength of causal relations among variables in the system. The IRF is a useful tool for determining the magnitude, direction, and the length of time that the variables in the system are affected by a shock to another variable and this appears in Table 10 and figure 3 in the appendix. A quick look at the first observation from the Impulse Response Factors shows that bank branch network and growth of banks' credit to private sector maintain negative relationship with industrial growth volatility, since a moderate increase in bank branch network and growth of banks' credit to private sector reduce the industrial growth volatility rise in growth and this relationship is found to be prolonged and significant as shown by the line above the horizontal axis in figure 4.2. While the second observation from the IRFs indicates that when the fluctuations in quasi-money in circulation increase, there is a net positive effect on industrial growth volatility but the effect appears to be insignificant and non-persistent as shown by the line closer to the horizontal axis in figure 3.

Moreover, the variance decomposition provided further evidence of relationship among the variables under investigation. The variance decomposition shows the proportion of the forecast error of one variable due to the other variables. Therefore, the variance decomposition makes possible to determine the relative importance of each variable in creating fluctuations in other variables (Ratanapakorn & Sharma, 2007).The results of the variance decomposition as shown in Table 11 and figure 4 in the appendix. The result reveal that about 100 per cent of the forecast error of the industrial growth volatility is explained by its own innovation in the first period of estimate-on, also, fluctuations from

its own shock gradually reduced to 94 percent after 5 years' time period. Changes in the shocks of bank branch network, growth of banks' credit to private sector and quasi-money in circulation respectively explain about 0.94, 4.7 and 0.08 per cents variation in industrial growth volatility and they all have increasing impact on industrial growth volatility but growth of banks' credit to private sector is more sensitive to industrial growth volatility.

5.5 Discussion of Result

The results show that bank branch network has a significant negative relationship with industrial growth volatility. Thus, an increase in the number of bank branches reduces the rate of fluctuation of industrial growth. These results agree with the findings by Avery and Samolyk (1999). The explanation for this is that large number of bank branches enhances customers' accessibility to higher proportion of banks' loan and this will promote industrial growth and reduce industrial growth volatility. This also corroborates the finding of Berger and Udell, (2006) who posit that bank size is as an important determinant of bank lending decision at it enhances the roles of bank as one of the financial intermediaries between the surplus unit and deficit unit. This implies that an increase in the number of bank branches induces an increase in the bank size which will facilitate customers' accessibility to banks' loan in order to promote industrial growth and reduce industrial growth volatility.

In addition, banks' credit growth to private sector has significant negative relationship with industrial growth volatility. This implies that an increase in banks' credit to private sector will promote industrial growth and reduce industrial growth volatility. This growth of banks' credit to private sector might be as a result Central Bank Nigeria's effort in 2013 whereby 200 billion Micro, Small, and Medium Enterprises Development Fund was launched with the aim of enhancing financial services accessibility to Micro, Small and Medium Enterprises, increase productivity, generate employment and engender inclusive growth. This conforms to the finding of Anthony and Aboagye, (2014). The explanation for this is that technological innovations spearheaded by the application of information and communication technology can strengthen the efficiency of the banks to mobilize savings and allocate funds to productive areas which induce industrial growth and reduce industrial growth volatility. The efficiency in the allocation of funds with the aid of information and communication technology enhances timely utilisation of the funds and this will reduce industrial growth volatility.

More so, the study found that quasi-money in circulation reveal a significant positive relationship with industrial growth volatility. This does not conform to the finding of Ajide (2016). The explanation for this could be as result of high-level financial illiteracy among Nigerian citizens which has increased demand for cash for transaction motive and this invariably increases the cost of transaction and increases industrial growth volatility. In the same token, Checkley (1980) argued that quasi-money should be included in the money supply calculation because it serves as good substitute for money in the society. Based on this argument, the supply of quasi-money has been officially accepted as substitute for cash in many developed countries but the reverse is the case in Nigeria.

6.0 Conclusion and Recommendation

The study examined the effect of financial innovation in the banking sector on industrial growth volatility for the period 1981 to 2016. It found that bank branch network and growth of banks' credit to private sector have significant negative relationship with industrial growth volatility while the quasi-money in circulation reveals a significant negative relationship with industrial growth volatility. The study concluded that financial innovation in banking sector reduces industrial growth volatility. The implication of this study is that expansion of bank branches coupled with accessibility of credit facility and flexible repayment schedule do not only make repayment less burdensome and fairly sustainable for the industrialist but also enable them to match the gestation period with redemption period. Also, a positive significant relationship between quasi-money in circulation and industrial growth volatility implies that Nigerian financial system is underdeveloped and this necessitates intervention of the CBN to continuously pursue inclusive development. To this end, the study will assist regulatory authority such as Central Bank of Nigeria to have better understanding on how to improve on financial innovations in order to mitigate the industrial growth volatility.

In view of this, the study recommends that the Central Bank of Nigeria should promote financial literacy among the Nigerian citizens and encourage the use of quasi-money in circulation such as cheque in order to reduce demand for cash and transaction cost. This will also improve the payment system and encourage consumption which will invariably increase production and reduce industrial volatility.

One of the limitations of the study is that, it is quantitative in nature whereas the use of combination of quantitative and qualitative methods may produce more comprehensive results because qualitative method such as interviews, questionnaires among others may provide richer data on financial innovation and industrial growth volatility. Hence, further research in this area can combine both the qualitative and quantitative methods to examine the effect of financial innovation on industrial growth volatility.

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Appendix

Table 1: Measurement of Variable and A priori

S/N	Variables	Variable Type	Measurement	Source	A priori
1	Industrial Growth Volatility	Dependent	Variance of Industrial Growth	Beck, Chen, Lin and Song(2012)	
2	Bank Branch Network	Independent 1	Number of bank branches	Avery &Samolyk, (1999)	(-)
3	Growth of banks' credit to private	Independent 2	Ratio of bank credit to the private sector to GDP	Ajide(2016)	(-)
4	Quasi-money in circulation	Independent 3	Number of Financial instruments in circulation	Ajide (2016)	(-)

Researchers' compilation, (2018).

Table 2 Descriptive Statistics

Statistic	IDGV	LBBN	LCSP	LQSM
Mean	0.000965	3.318317	1.069527	2.468247
Median	0.000323	3.373463	1.040943	2.401375
Maximum	0.006396	3.764101	1.566948	4.989364
Minimum	2.04E-07	2.939020	0.772111	0.783139
Std. Dev.	0.001758	0.238012	0.187147	1.203543

Table 3 Correlation Matrix

Variables	IDGV	LBBN	LCSP	LQSM
IDGV	1.000000	-0.016659	-0.229671	-0.271153
LBBN	-0.016659	1.000000	0.224016	0.262739
LCSP	-0.229671	0.224016	1.000000	0.689513
LQSM	-0.271153	0.262739	0.689513	1.000000

Table 4A Stationarity Test

Variables	Test Statistic	1% critical value	5% critical value	10% critical value	Order of Integration
Augmented Dickey Fuller					
IDGV	-5.567849	-3.646342	-2.954021	-2.615817	I(0)
LBBN	-5.413037	-3.639407	-2.951125	-2.614300	I(0)
LCSP	-5.751552	-3.653730	-2.957110	-2.617434	I(1)
LQSM	-3.743765	-3.689194	-2.971853	-2.625121	I(2)

Philips-Perron					
IDGV	-5.573144	-3.646342	-2.954021	-2.615817	I(0)
LBBN	-5.411151	-3.639407	-2.951125	-2.614300	I(0)
LCSP	-7.540595	-3.646342	-2.954021	-2.615817	I(1)
LQSM	-6.295120	-3.646342	-2.954021	-2.615817	I(1)
Kwiatkowski-Phillips-Schmidt-Shin					
IDGV	0.281652	0.739000	0.463000	0.347000	I(0)
LBBN	0.250340	0.739000	0.463000	0.347000	I(0)
LCSP	0.270380	0.739000	0.463000	0.347000	I(2)
LQSM	0.332368	0.739000	0.463000	0.347000	I(1)

Table 4B: Confirmatory Analysis

Variables	ADF	PP	KPSS	Decision
IDGV	I(0)	I(0)	I(0)	Conclusive Decision (Stationary)
LBBN	I(0)	I(0)	I(0)	Conclusive Decision (Stationary)
LCSP	I(1)	I(1)	I(2)	Inconclusive Decision
LQSM	I(2)	I(1)	I(1)	Inconclusive Decision

Table 5: Optimum Lag Selection

Lag	LogL	LR	FPE	AIC	SC	HC
0	96.37723	NA	2.49e-08	-6.158482	-5.971656	-6.098715
1	160.8102	107.3882*	9.97e-10*	-9.387345	-8.453214*	-9.088508*
2	173.1556	17.28360	1.36e-09	-9.143707	-7.462270	-8.605801
3	188.1592	17.00403	1.72e-09	-9.077278	-6.648535	-8.300302
4	208.8478	17.93015	1.80e-09	-9.389853*	-6.213806	-8.373808

*Note that: * 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 and HQ: Hannan-Quinn information criterion.*

Table 6: VAR Estimates (Dependent Variable: Industrial Growth Volatility)

Variable	Coefficients	Standard Error	t-statistics	Level of significant @ 5%
LBBN(-1)	-0.000180	(0.00069)	[-0.26312]	significant
LCSP(-1)	-0.002790	(0.00385)	[-0.72406]	significant
LQSM(-1)	0.000188	(0.00204)	[0.09200]	significant

Table 7: Ergodicity Test

Roots	Modulus
0.819279 - 0.026742i	0.819715
0.819279 + 0.026742i	0.819715
-0.114837	0.114837
-0.001667	0.001667

Figure 2: Test of stability on financial innovation and industrial growth volatility.

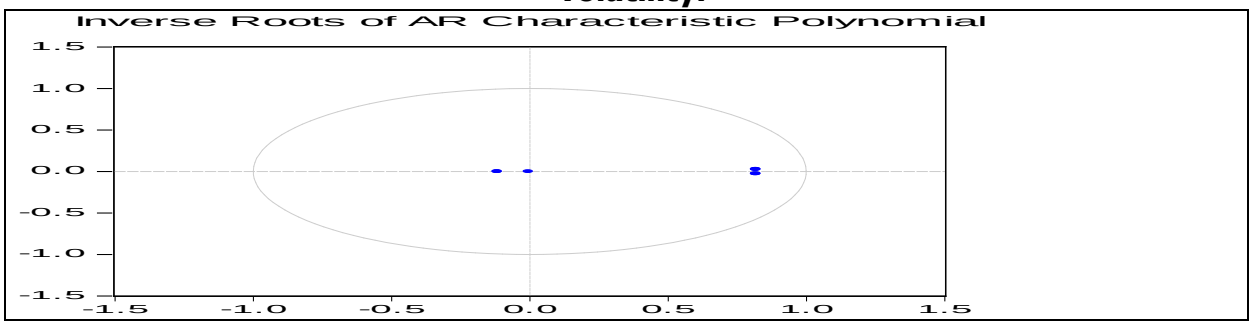

Table 8: VAR Residual Serial Correlation LM Test

Lags	LM- Stat	Prob.
1	19.43218	0.2469
2	16.80221	0.3985
3	10.26809	0.8523

Table 9: Granger Causality between Pair of IDGV, LBBN, LCSP, and LQSM

Equation/Excluded	Chi2	Df	Prob.
IDGV			
LBBN	0.069230	1	0.8844
LCSP	0.524270	1	0.3963
LQSM	0.008464	1	0.7104
ALL	0.606466	3	0.8950

Table 10: Impulse Response

Period	IDGV	LBBN	LCSP	LQSM
1	0.001889	0.000000	0.000000	0.000000
2	0.001850	-0.000104	-0.000225	4.05E-05
3	0.001824	-0.000184	-0.000418	6.04E-05
4	0.001800	-0.000256	-0.000584	6.72E-05
5	0.001780	-0.000319	-0.000725	6.47E-05

Figure 3:Impulse Response function Graph

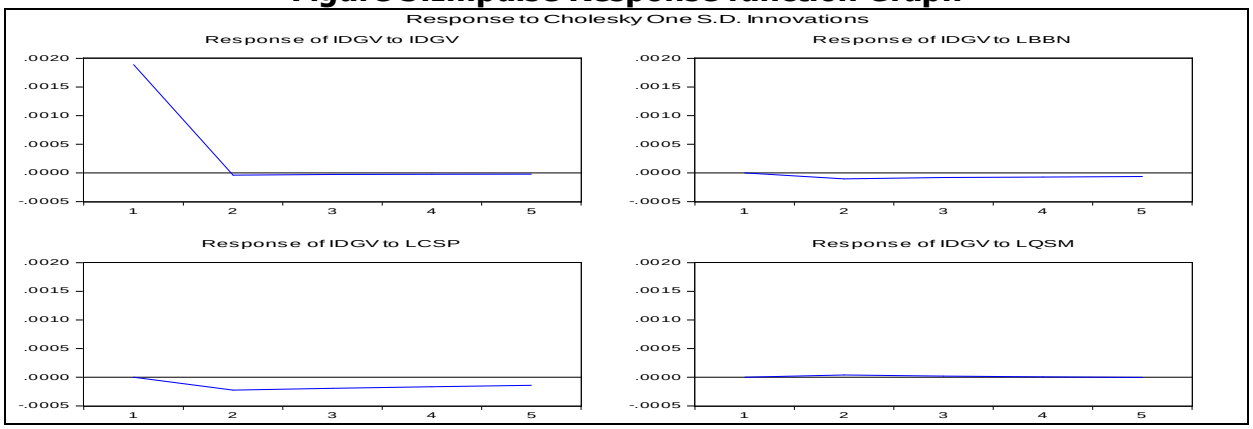

Table 11: Variance Decomposition

Period	S E	IDGV	LBBN	LCSP	LQSM
1	0.001889	100.0000	0.000000	0.000000	0.000000
2	0.001906	98.26875	0.294956	1.391256	0.045039
3	0.001918	97.08499	0.467703	2.391983	0.055327
4	0.001927	96.23067	0.603715	3.109560	0.056055
5	0.001933	95.61355	0.705892	3.624705	0.055857

Figure 4:Variance Decomposition Graph