

Financial Deepening, Financial System Fragility and Economic Growth in Nigeria

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Abstract

Since the 2007/2008 Global Financial Crisis, there has been renewed interest in re-assessing the implications of financial development, specifically, financial deepening, on the financial system and the overall economy. Given that financial inclusion is a major crux of the Central Bank of Nigeria's (CBN) policies targeted at the financial sector, it became imperative to investigate this nexus for Nigeria. Utilising quarterly data from 2007Q1-2018Q4, this study employed a non-linear co-integrating ARDL model in assessing the relationship between financial deepening, financial fragility and economic growth in Nigeria. Findings suggest the existence of a positive relationship between financial deepening and growth, but a non-linear relationship between financial system fragility and economic growth. The study recommends that the CBN should identify high-risk sectors, with the aim of encouraging banks to reduce lending to them, while working with the Securities and Exchange Commission (SEC) to provide sector-product-backed securities to enhance funding to those sectors.

Keywords: Economic Growth, Financial Deepening, Financial System Fragility, Non-Linear Autoregressive Distributive Lag Model

JEL Classification: E5, G0, G1

I. Introduction

A well-developed financial system is an important driver of economic growth due to its role in mobilising savings, promoting information sharing, boosting the efficiency of resource allocation, and facilitating the management and diversification of risk, thereby spurring real sector growth (Levine, 1997). The general belief is that a more developed financial system is more stable, and therefore, "less fragile". This is based on the fact that deep and liquid financial systems, with varied instruments tend to absorb more shocks than a shallow one (Sahay et al., 2015). The effects of the 2007/2008 Global Financial Crisis (GFC), motivated interest in re-assessing the implications of financial development, and by consequence, financial deepening for financial stability and economic growth. This is because the crisis originated from developed economies which have large and robust financial sectors. Whereas one strand of the literature

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suggests a positive relationship between financial deepening and economic growth, some schools of thought argue that financial deepening is intrinsically associated with financial instability, which may pose a threat to economic growth and development (Batuo, Mlambo, & Asongu, 2017).

Financial deepening presents a myriad of positive outcomes in developed and developing nations alike, due largely to its role in boosting the rate of capital accumulation. Although this is undoubtedly important for long-run economic growth, some studies (Demetriades, Rousseau, & Rewilak, 2016; Loayza & Ranciere, 2006; and Sahay et al., 2015) have shown that economic growth in the short-run could be affected by the fragility that characterises maturing financial systems. This is because as an economy develops, financial development could make the sector more prone to systemic risk, cycles of booms and busts, and overall financial volatility. More so, high level of financial depth could be an indication of the degree to which the impact of a potential financial crisis may be assessed (Loayza & Ranciere, 2006). Sahay et al. (2015) further argued that the rate at which a deepening in the financial system occurs may have implications for economic growth. According to the study, if too fast, deepening has the potential to cause financial instability as it would lead to a higher rate of risk-taking among sector operators, especially in the absence of effective supervision and regulation. This study is, therefore, very relevant for developing countries like Nigeria, where financial sector reforms are most often targeted at promoting financial deepening and inclusion, with little consideration of the implications it holds for financial system stability.

Against the backdrop of highly uncertain, and at times, worsening financial and economic conditions, the Central Bank of Nigeria has implemented several financial sector reforms over the years, aimed at boosting the sector's operational efficiency, and its ability to effectively deliver financial intermediation, among others. The banking sector has significantly evolved over the years, from an era of free banking (1892-1951) to a period of strict regulation (1959-1986), subsequent liberalisation between 1986 to 2003, and more recently, the period of bank consolidation from 2004 to 2006 (Okafor & Nwosu, 2018). A notable effort made towards financial deepening is the National Financial Inclusion Strategy that was launched in October 2012. The Strategy aimed at reducing the percentage of adult Nigerians who are unable to access financial services and products, from 46.3 per cent recorded in 2010 to 20 per cent by the year 2020. Although empirical literature on Nigeria largely supports the presence of a positive link between financial deepening and economic growth (Nwanna & Chinwudu, 2016; Nwaolisa & Cyril, 2018; and Karimo & Ogbonna, 2017), little attention has been paid to the analysis of the relationship between financial deepening and fragility in the country, as well as the effect of financial system

fragility on growth in the country. Considering the above, this paper assesses the relationship between financial deepening, financial system fragility and economic growth in Nigeria.

Following this introduction, section two focuses on the conceptual framework, review of theoretical and empirical literature, and the trend analyses. Section three focuses on the methodology, covering the sources and nature of data, as well as the techniques of analysis. The results are analysed in section four, while section five offers recommendations for policy and concludes the study.

II. Literature Review

II.1 Conceptual Review

II.1.1 Financial System Fragility

Various studies have adopted different definitions and proxies for the term "fragile" financial system. Whereas some studies define fragility as the propensity of financial problems to generate crises (Tymoigne, 2011) or the degree of vulnerability of a financial system (Andrianova et al., 2015), some others view fragility as being synonymous with financial instability/volatility (Ajogbeje, 2016; Adebiji, 2002; and Loayza & Ranciere, 2005). Giordani and Kwan (2019), however, noted that despite these divergences, a financial system could be said to be more fragile when high levels of debt (high leverage) are linked with high valuations in the assets used as collateral. There is also a counter-argument that financial fragility should not focus on the probability of a crisis to occur, but on the costs that could accrue from such a crisis.

There is also no generally agreed methodology for measuring financial fragility. Andrianova et al. (2015) proposed seven bank-level variables of financial fragility, chosen to mirror the "CAMELS" bank rating system (i.e. Capitalisation, Asset Quality, Managerial Efficiency, Earnings, Liquidity and Systemic Risk) to enable policymakers to understand the initial mechanisms via which crises are generated. The ratios utilised include: equities to total assets; impaired loans to gross total loans; cost to income; returns on average assets; net loans to total assets; liquid assets to total assets; and net charge-offs to average gross loans. These variables were summarised into a "Z-score" to provide a single indicator of financial fragility, where a lower "Z-score" is indicative of financial fragility, while a higher "Z-score" score indicates financial soundness.

While Ajogbeje (2016) and Loayza and Ranciere (2006) defined financial fragility to mean financial volatility, and thus adopted exchange rate volatility and interest rate volatility as proxies, Giordani and Kwan (2019) used financial fragility

indicator which consists of two-key variables – the ratio of private credit to GDP (to measure of credit leverage), and the ratio of house price to house rent (to capture asset prices). To them, the concept is a non-linear and non-Gaussian phenomenon, which made its precise timing difficult. As such, they put less emphasis on the use of fragility indicators in ascertaining the probability of a crisis to occur, but rather argued that it might be more worthwhile to apply the concept in showing the losses that could accrue from a given crisis. They further argued that a financial crisis could range from mild to severe and that this nuance is lost when a system is classified as either “fragile” or “non-fragile”.

Important to note is that a state of financial stability is difficult to measure due to the interdependence and complex interactions of different elements of any given financial system between themselves and the real economy. This already complex relationship is made more complex by the time and cross-border dimensions of such interactions. This has spurred debate in the literature about how financial fragility should be defined, and what its measure should or should not incorporate. Furthermore, financial system fragility has both macroeconomic and microeconomic aspects. Whereas the macro angle is as discussed above, micro-level financial fragility refers to a situation whereby elements on the asset and/or liability side of the balance sheet (on- and off-balance) are highly sensitive to variations in income, interest rate, amortisation rate, and other elements which influence the liquidity and solvency of a balance sheet (Tymoigne, 2011).

Atoi (2018), on the other hand, rather than measure financial system fragility, constructed an index of financial system stability, as the ratio of the sum of returns on asset (ROA) and capital-asset ratio (C/A), to the standard deviation of ROA. However, since financial system stability and fragility are only but two-sides of the same coin, inverting the stability ratio would indicate a measurement of financial system fragility. This study adopts this approach, and therefore measures financial system fragility as the ratio of the standard deviation of returns on assets (ROA), to the sum of ROA and capital-asset ratio (C/A).

II.1.2 Financial Deepening

Financial deepening could be defined as increased provision of financial services, with a wider choice of services channeled to all levels of the society. It generally implies more liquidity. This is based on the premise that the more liquid money is accessible in an economy, the more is the financial deepening and opportunities for continuous growth and expansion (Shaw, 1973 and Deema & Buthiena, 2016). Financial deepening is most often a key objective of financial sector reforms adopted by developing countries (Odhiambo, 2005).

Indicators of financial depth are used to estimate the size of the financial sector relative to the economy. Proxies utilised in empirical literature have been either bank-based (e.g. ratio of broad money to GDP, ratio of private sector credit to GDP and the ratio of bank assets to GDP) or stock market-based (e.g. ratio of stock market capitalisation to GDP). A proxy variable, which has received substantial attention in the literature is the ratio of private credit to GDP, which captures domestic private credit to the real sector by deposit money banks as a percentage of GDP in local currency. It has been argued that this is more indicative of the level of financial access/inclusion (World Bank, 2012).

II.2 Theoretical Review

In their seminal works, Mckinnon (1973) and Shaw (1973) provided models of economic growth, in which the growth and liberalisation of the financial system were shown to boost the rate of economic expansion. This has largely formed the theoretical basis for the policy decisions and financial reforms adopted by many developing countries aimed at improving the mobilisation of capital and efficiency of financial intermediation (Maxwell, 1989). Fundamentally, the argument linking financial sector development to growth is that a well-developed financial system, by minimising information and transactional costs, would help enhance the efficiency of financial intermediation, through which funds are transferred from surplus units (savers) to deficit units (investors) (Chukwu & Agu, 2009).

Theoretically, a divide could be said to exist on the relationship between financial deepening and economic growth. In the endogenous growth literature, financial deepening is viewed largely as a necessary pathway to improving the efficient allocation of savings to growth-spurring investment activities. Most often referred to as the **“supply-leading” hypothesis**, this strand of thought asserts that financial development, a key feature of which is financial deepening, is positively related to economic growth. In contrast, the **“demand-following” view** is aligned with the Keynesian view of financial deepening, which states that financial development moves in tandem with changes in the real sector and is the result of increased government expenditure. In this case, an increase in government expenditure is expected to translate to increased demand and income, thereby raising the demand for money, and subsequently, promoting financial development. As such, causality is seen to run from economic growth to financial development, wherein increasing rate of economic expansion is expected to boost demand for financial services, thereby causing the financial sector to develop.

With respect to the direction of causality, Patrick (1966) showed that the causal relationship between financial development and economic growth may be dependent on the stage of economic development. This link is such that during the early stages of development, precepts of the supply-leading view apply, as financial development plays a role in stimulating real capital formation, but with economic progress, this role becomes less visible as the precepts of demand-following view begin to materialise. There is also the “feedback” hypothesis, which suggests that the relationship between financial deepening and economic growth is a mutually reinforcing one. On the other hand, the “neutral” hypothesis states that no causal relationship exists between financial deepening and economic growth (Karimo & Ogbonna, 2017).

Empirical research on financial instability also highlights the destabilising role of financial liberalisation (or excess financial deepening) in spurring a rapid expansion of credit. According to this school of thought, this excessive growth in credit could occur due to a number of factors, such as limited monitoring capacity of financial sector regulators, the inability of banks to appropriately screen good projects during investment booms, and the moral hazard associated with the presence of insurance backing to guard against banking system failures (Loayza & Ranciere, 2006). In the aftermath of the 2007/2008 GFC, further investigation into the finance-growth nexus showed that the relationship between financial development and growth may become negative after a certain threshold of financial development has been attained. Proponents of this view opined that the negation of the finance-growth nexus can be attributed to the effects of systemic banking risks on growth, the probability of which is expected to become higher as financial development advances. Demetriades, Rousseau, and Rewilak (2016) also noted that financial development, especially when preempted by financial liberalisation or deregulation could potentially re-focus human capital away from more productive economic activities by artificially inflating reward structures in finance. The study also states that financial fragility is likely to reduce the amount of credit available for long-term investment as banks would strive to reduce their proportion of risk-weighted assets and de-leverage their balance sheets, implying that fragility has the potential to erode banks' ability to effectively carry out their primary role of financial intermediation.

II.3 Empirical Review

Of the numerous studies that seek to analyse the finance-growth nexus, the relationship between financial depth and economic growth could be said to have received the most attention over the years (Pasali, 2013). Studies in this direction have utilised a range of methods in arriving at varied conclusions, with the empirical debate being mostly centered on the direction of causality

between financial deepening and economic growth, as well as the most appropriate measure for financial deepening.

In Nigeria, findings from empirical studies have been mixed, although largely aligned with the supply-leading and/or demand-following views (Karimo & Ogbonna, 2017). For instance, applying the OLS regression technique Nwanna and Chinwudu (2016) and Nwaolisa and Cyril (2018) analysed annual data for Nigeria for the periods 1985 to 2014, and 1990 to 2016, respectively. Both studies utilised bank-based, and stock market-based proxies for financial deepening, i.e. ratio of M_2 to GDP, the ratio of private sector credit to GDP, and the ratio of stock market capitalisation to GDP and found a positive and significant relationship between financial deepening and economic growth.

Also employing indicators of banking sector and stock market developments to assess the impact of financial deepening on growth on Nigeria between 1981 and 2010, Iyoboyi (2013) applied the ARDL Bounds testing approach to cointegration. The study, however, showed that while a bi-directional causal relationship exists between financial deepening and economic growth, causality also runs from economic growth to (non-bank) financial deepening.

Chukwu and Agu (2009) adopted a multivariate Vector Error Correction Model (VECM) in ascertaining the direction of causality between four indicators of financial depth and economic growth in Nigeria from 1971 to 2008. Financial deepening proxies utilised included the ratio of broad money supply (M_2) to GDP, the ratio of private sector credit to GDP, loan to deposits ratio and the ratio of bank deposit liabilities to GDP. Findings from this study showed that, using private sector credit and real broad money supply as proxies, the demand-following hypothesis was supported. Also, supply-leading hypothesis was supported when the ratio of loan to total deposits, and bank deposit liabilities, were used. The study, therefore, underscored that the choice of financial depth indicator/proxy determines the direction of causality with economic growth.

Igwe, Edeh, and Ukpere (2014) also investigated the effect of financial deepening on economic growth in Nigeria using the ratio of broad money supply (M_2) to GDP and the ratio of credit to the private sector to GDP as proxies for financial deepening. Applying the Engle-Granger Cointegration technique and Error Correction Model, they found that a positive and significant relationship exists between broad money supply/GDP and economic growth, but a negative although insignificant relationship to be the case for the link between private sector credit/GDP and economic growth, reinforcing the findings of Chukwu and Agu (2009).

Karimo and Ogbonna (2017) utilised the Toda Yamamoto Augmented Granger Causality Test to analyse the direction of causality between financial deepening and economic growth in Nigeria for the period 1970 to 2013. Their findings were in favour of the supply-leading hypothesis, as a uni-directional causal relationship from financial deepening to economic growth was confirmed. This was similar to the findings of Pasali (2013), who synthesised over 100 studies that analysed the finance-growth nexus in developing countries. On the relationship between financial deepening and economic growth, the study found financial sector deepening to have a “statistically significant and economically meaningful positive” effect on economic growth.

The empirical literature has shown the relationship between financial fragility and growth to be significantly negative (Pasali, 2013). This is especially true where fragility is loosely defined or, seen as synonymous with financial crises or volatility. For instance, Ajogbeje (2016) adopted the Barro Growth model in investigating the effects of financial fragility and financial development on economic growth in Nigeria between 1982 and 2012. The study used the Johansen approach to cointegration, and the result showed that financial development, proxied by credit to private sector as a percentage of GDP was positively related with economic growth, whereas financial fragility, measured as financial volatility, was inversely linked with economic growth. Empirical studies on financial fragility and growth are lacking, especially for Nigeria. This study, therefore, attempts to fill this gap by utilising the methodology for measuring financial fragility proposed by Andrianova et al. (2015).

In recognition of the potential for financial development exerting dual effects on economic growth, Loayza and Ranciere (2006) applied the Generalised Method of Moments (GMM) for dynamic models of panel data developed by Arellano and Bond (1991) in estimating a model of short and long-run effects on a panel data for 82 countries over the period 1960 to 2000. The study found that while a positive long-run relationship exists between financial intermediation and output growth, there is a negative short-run relationship between financial intermediation and short-run growth. The study further showed that whereas financial deepening leads to higher growth, financial fragility (measured as financial volatility and banking crises) has negative implications for economic growth. Misati and Nyamongo (2012) also analysed the dual role of financial liberalisation on growth by utilising a bank crisis model and a growth model. The authors applied panel econometric techniques on data for 34 countries in Sub-Saharan Africa over the period 1983 to 2008. Their findings revealed that the growth-retarding effects of financial liberalisation were more dominant than its growth enhancing effects.

Sahay et al. (2015) constructed a composite measure of financial development, which included proxies for markets, banking and non-banking institutions across the three dimensions of depth, access and efficiency. Applying the dynamic system GMM estimator in analysing data for 64 countries, the paper examined the threshold beyond which the benefits of financial development for Emerging Markets (EMs) would decline, and costs would increase. The study found the relationship between financial development and growth to be bell-shaped and statistically significant, wherein there is a point at which the costs of financial development would begin to outweigh the benefits. The study, however, showed that most EMs were still at the point where financial development would enhance the stability of the financial system and promote economic growth. Results from the analysis further showed that of the three dimensions of financial development explored, the weakening effect on growth at higher levels of financial development was found to emanate from financial deepening, and that when the pace of financial deepening is "too fast", this could lead to instability in the financial system.

Demetriades, Rousseau and Rewilak (2016) utilised the international database on financial fragility for 124 countries, covering the period 1998-2012, which was developed by Andrianova et al. (2015), in analysing the effects of fragility on the finance-growth nexus. Employing a Barro Growth Regression model, the study found that financial fragility has significant negative implications for economic growth, and that these effects are distinct from the effects that accrue from a financial crises. The findings also revealed that financial deepening, proxied as private sector credit, exhibited a negative relationship with growth, and that the effects observed could be mitigated by very low levels of financial fragility.

This study attempts to re-examine the interlinkages between financial deepening, financial fragility and economic growth by capturing the possible non-linear relationship between fragility and economic growth. Specifically, it focuses on investigating whether there exists a "U shaped" relationship between financial system fragility and economic growth. This would be done by estimating a non-linear autoregression distributed lag (ARDL) model of economic growth, in which economic growth is expressed as a second-order polynomial function of financial system fragility. The motivation for the use of this approach is drawn from the possible "inverted U shaped" relationship between financial system development and economic growth, as captured by Sahay et al. (2015). And, considering the fact that financial system fragility reduces with the level of financial system development, it is the expectation of the study that financial system fragility would exert a U-shaped impact on economic growth.

III. Measuring and Constructing Financial System Fragility Indicator

The effect of the 2007/2008 GFC prompted the need for more robust measures to capture conditions of financial system vulnerabilities. A key effort in this direction was the creation of the “core” and “encouraged” set of Financial Soundness Indicators (FSIs) by the International Monetary Fund (IMF). These indicators, along with findings from stress test scenarios, are often carried out to assess potential risks to financial stability.

The effectiveness of macro-prudential indicators to address financial imbalances has received the attention of policymakers and regulators. Empirical studies have established that a more in-depth financial system is significantly associated with lesser growth volatility, although the relationship appears to be non-linear (Levine, 1997 and Olofin & Afangideh, 2008). They opined that as the financial system becomes larger relative to GDP, systemic risk becomes relatively more important, and acts to reduce stability. Hence, in safeguarding financial stability, there is a need to obtain accurate and relevant information about the depth and fragility of the financial system. Studies have identified measures for financial depth in the literature to include the ratio of money stock to GDP and the ratio of credit to the private sector to GDP (Nnanna & Dogo, 1998 and Nzotta, 2004).

A range of indicators and indices have been used to proxy financial fragility. In recent times, researchers have made efforts to develop a single aggregate measure of financial fragility that will enable policymakers, and financial sector participants better identify the key signals of financial system vulnerabilities, as well as understand the primary mechanisms which engender crises (Andrianova et al., 2015). Measuring financial fragility also provides financial regulators with a means of monitoring the degree of financial stability of the system, detect the sources and causes of financial stress and communicate more effectively, the potential impact of such conditions (Gadanecz & Jayaram, 2009).

In the literature, financial system fragility is a self-constructed variable, which can be measured by different approaches. Giordani and Kwan (2019) measured financial system fragility index as the extracted cycles, using Hodrick-Prescott (HP) filter, from an equal-weighted aggregated series of key performance indicators of the financial system. Tymoigne (2011), however, measured financial system fragility as the weighted aggregate of different risk indicators of banks, such as total liabilities (L); net worth (NW); debt-service ratio (DSR); monetary instruments relative to outstanding liabilities (MLR) (monetary instruments include dollar-denominated currency, demand and time deposits and money-market mutual

funds shares); proportion of cash-out refinancing mortgage loans in mortgage refinancing loans (COR); and proportion of revolving consumer debts (RC).

This study faults these approaches and opts for Equation 2 as the better measure of financial system fragility. On one hand, the HP filter approach by Giordani and Kwan (2019) is flawed on the grounds that filtered values at the end of the sample are very different from those in the middle, and are characterised by spurious dynamics (Hamilton, 2018). On the other hand, it would be difficult to determine the most appropriate weight to assign each risk indicator in the total aggregate in the approach by Tymoigne (2011).

As stated earlier, financial system fragility and financial system stability are two-sides of the same coin. That is, as financial system becomes more stable, its vulnerability to shocks, and by implication, its fragility, reduces. This notion forms the foundation for the construction of the financial system fragility index, measured as the reciprocal of the financial system stability index in Atoi (2018). Atoi measured financial system stability as the ratio of the sum of returns on asset (ROA) and capital-asset ratio (C/A), to the standard deviation of ROA.

$$Stability\ Index = \frac{ROA + \frac{Capital}{Asset}}{Standard\ Deviation\ of\ ROA} \tag{1}$$

Standard deviation is a measure of volatility (Brooks, 2014). This measure of stability, therefore, provides information on the unit of financial sector performance per unit of volatility in ROA. It would fall and rise with increases and decreases in the standard deviation of ROA, respectively.

The financial system fragility index used in this study, measures the ratio of the standard deviation of returns on assets (ROA), to the sum of ROA and capital-asset ratio (C/A). It is, therefore, the direct reciprocal of Equation 1, and given as:

$$Fragility\ Index = \frac{Standard\ Deviation\ of\ ROA}{ROA + \frac{Capital}{Asset}} \tag{2}$$

The fragility of a financial system can also be thought to reflect its degree of vulnerability, resulting from instability or volatility in its key performance indicators. This is rightly captured by the standard deviation of ROA in Equation 2. Hence, the fragility index would, therefore, increase as the standard deviation of ROA increases, and fall as the standard deviation of ROA falls.

The index comes with the double advantage of maintaining its status as the reflective image of the stability index, and, at the same time, satisfying the non-negativity constraint associated with measuring volatility. The non-negativity constraint, as captured by Brooks (2014), maintains that negative measures of

volatility do not make economic sense. An alternative derivation of the fragility index from the stability index, by subtracting the stability index from 1 or 0, would fail to maintain this important constraint.

III.1 Trend of Financial Deepening and Fragility in Nigeria

A trend analysis of key macroeconomic variables shows that the financial system depth measured as the ratio of private sector credit to GDP (CP/GDP), at 8.55 per cent in 2004 increased marginally to 8.77 per cent in 2005 following the Banking system reform. From 2006, the ratio of private sector credit to GDP rose from 8.82 per cent to 14.73 per cent at end-2007 and further to 20.38 per cent in 2008, reflecting the increased financing of economic activities attributable to the bank consolidation exercise, which led to the increase in the capital base of banks. The fragility index (z-score) and Return on Asset (ROA) were 0.12 and 3.26 respectively in 2006. The gain of the bank consolidation was, however, short-lived following the impact of the 2007/2008 global financial crisis. The surge in capital funds encouraged high-risk investments by banks. Consequently, when the capital market bubble burst, the balance sheets of banks were significantly eroded to the extent that many of them relied mainly on the CBN discount window. Thus, the z-score fell to 0.11 in 2008, while ROA fell to 0.07 in the same period.

Figure 1: Financial Depth and Economic Growth



Source: Authors' computation based on Data from CBN online database

Following the supportive policy measures of the Bank to tackle the effect of the global financial crisis, there was an observed increase in the financial depth and z-score to 23.76 and 0.16 in 2009, respectively, while GDP growth stood at 7.2 per cent. This was not surprising considering the view that, reviving the financial sector would translate to stimulating economic growth. The relatively higher level in the

z-score indicates a less fragile banking system. The 2009 banking crisis further threatened the stability of banks in the country as many of the banks that were exposed to the oil and gas sector suffered huge losses when oil price fell, coupled with the regulatory actions requiring banks to provide for non-performing loans (NPLs) in their portfolios. The adverse effect was evident as the ROA ratio fell from 0.03 per cent in 2010 to 0.01 per cent in 2011. The fragility index, however, increased from 0.16 per cent in 2009 to 0.23 per cent in 2010 mimicking the movement in GDP growth from 8.35 per cent to 9.54 per cent in the same period. The substantial increase in z-score could be attributed to increases in ROA, and a lower level of ROA variability reflecting lower bank risk.

Figure 2: Financial Fragility and Economic Growth



Source: Authors' computation based on data from FinA and CBN statistical Bulletin

A stress test conducted on Nigerian commercial banks in 2009 showed that only 14 banks were sound, while 10 were adjudged to be in distress, with large non-performing loans, weak capital adequacy, poor corporate governance and low liquidity (Sanusi 2011). This necessitated the establishment of the Asset Management Corporation of Nigeria (AMCON), to acquire the toxic assets from banks' balance sheets in exchange for liquidity to the banking system to avoid bank runs and systemic banking failures. The different regulatory measures put in place to return the economy to a path of stable growth yielded positive result as the financial system deepened from a ratio of 20.21 per cent in 2013 to 21.66 per cent in 2016. The financial system became less fragile, as the Fragility index increased from 0.17 per cent (ROA of 0.03 per cent) in 2013 to 0.18 per cent (ROA of 0.02 per cent) in 2016. Similarly, output growth increased from 5.31 per cent in 2011 to 6.22 per cent in 2014.

The plunge in crude oil price in 2015, alongside a decline in foreign investment, had a negative impact on Nigeria's foreign exchange reserves and government

revenue, resulting in a negative GDP growth of 1.6 per cent in 2016. The implementation of the Economic Recovery and Growth Plan (ERGP), together with the rebound in global oil prices resulted in output growth of 0.83 per cent and 1.9 per cent in 2017 and 2018, respectively. The marginal GDP growth rate represented some progress although other macroeconomic indices indicate that the system was still shallow and fragile as financial depth ratio fell from 21.66 per cent in 2016 to 17.77 per cent in 2018. The z-score on the other hand increased from 0.18 per cent (ROA ratio of 0.02 per cent) in 2017 to 0.23 per cent (ROA of 0.01 per cent) in 2018.

IV. Methodology

This section focuses on the variables used in the study, their scope, and necessary transformations. The section also discusses the technique of analysis employed, in addition to all the pre- and post-estimation tests conducted on the variables and estimated model.

IV.1 Data Sources and the Selected Variables

This study utilises quarterly data spanning 2007Q1 to 2018Q4, sourced from the statistical database of the Central Bank of Nigeria (CBN). The variables are: Real Gross Domestic Product Growth Rate (RGDPR), which was measured as the year-on-year growth rate of real GDP; Financial Deepening (FD), measured as the ratio of credit to private sector to nominal gross domestic product; Non-Performing Loans Index (NPL), which is the ratio of non-performing loans to total gross loans of commercial banks; and Index of financial system fragility (Fragility). The choice of variables was based on both theoretical and empirical considerations as well as availability of data. These variables have been carefully selected to reflect the core financial sector indicators peculiar to the Nigerian financial system.

IV.2 Estimation Technique and Model Specification

This study uses a non-linear autoregressive distributed lag (ARDL) model in measuring the relationship between financial fragility and economic growth. It is a single equation time series model, which incorporates lags of both the dependent variable, and independent variable(s). The application of this model requires all incorporated variables to be stationary. However, where the variables are not stationary, but integrated, it is still possible to estimate level relationships by determining whether the integrated variables are co-integrated or not. This can be done by evaluating the co-integrating properties of the variables using the Bounds testing approach of Pesaran et al. (2001), which is preconditioned on the order of integration of the variables. Here, if X_t is the vector of both

explanatory and dependent variables, X_t must not be integrated of order $d > 1$. It is, therefore, necessary to evaluate the unit root properties of the variables, to ensure this condition is satisfied. This was done within the frameworks of the Augmented Dickey-Fuller (1979), Phillips-Perron (1988) and Kwiatkowski, Phillips, Schmidt, and Shin (1992) tests for unit root.

This study aligns with the work of Sahay et al. (2015) and argues that there exists a non-linear relationship between financial system development and economic growth. Specifically, at initial stage of financial system development, economic growth will rise as the system develops, reaches a peak, and then starts to fall. This relationship is therefore an “inverted U” relationship. However, there is triangular relationship between economic growth, financial development (sometimes proxied by financial deepening), and financial system fragility. As financial deepening increases, the vulnerability of a financial system to systemic risks rises, leading to increase in its fragility, and invariably hurting growth. In the long-run, therefore, as financial system fragility persists, the confidence in the financial system would reduce, leading to an imminent abandonment of the system, in favour of other growth-driving determinants like consumer spending.

Since financial system fragility is only but the opposite of financial stability, it is expected that financial fragility would have a “U shaped” relationship with economic growth. Where this is the case, this non-linear relationship thus established would be best captured by a non-linear co-integrating autoregressive distributed lag (ARDL), expressed as a second-order function of economic growth, in which fragility is raised to power of two. Consequently, the function is non-linear in variable and not in parameters.

In its level form, the proposed ARDL model in this study is:

$$RGDPR_t = a_0 + \sum_{i=1}^q a_{1i}RGDPR_{t-i} + \sum_{i=0}^p a_{2i}FD_{t-i} + \sum_{i=0}^q a_{3i}Fragility_{t-i} + \sum_{i=0}^r a_{4i}Fragility^2_{t-i} + \sum_{i=0}^s a_{5i}NPL_{t-i} + e_t \tag{3}$$

Where RGDPR is the growth of real gross domestic product, FD is financial deepening, fragility is the measure of financial system fragility, NPL is non-performing loans index, and e is the error term. The parameters a_1 to a_5 are the coefficients of the level relationships, respectively.

Equation 3 can be expressed in a co-integrating form to capture both the short- and long-run dynamics in the relationship between financial system fragility and economic growth, as specified in the model. Consequently, the co-integrating ARDL model estimated in this study expresses economic growth as a second order polynomial function of fragility. It is therefore of the form:

$$\Delta \text{RGDPR}_t = a_0 + \sum_{i=1}^o a_{1i} \Delta \text{RGDPR}_{t-i} + \sum_{i=0}^p a_{2i} \Delta \text{FD}_{t-i} + \sum_{i=0}^q a_{3i} \Delta \text{Fragility}_{t-i} + \sum_{i=0}^r a_{4i} \Delta \text{Fragility}^2_{t-i} + \sum_{i=0}^s a_{5i} \Delta \text{NPL}_{t-i} + \delta (\text{RGDPR}_{t-1} - c - b_1 \text{FD}_{t-1} - b_2 \text{Fragility}_{t-1} - b_3 \text{Fragility}^2_{t-1} - b_4 \text{NPL}_{t-1}) + e_t \quad (4)$$

Where RGDPR is the growth of Real Gross Domestic Product, FD is Financial Deepening, fragility is the measure of financial system fragility, NPL is non-performing loans index. Δ is a first difference operator, $a_{1 \text{ to } 5}$ and $b_{1 \text{ to } 4}$ are the coefficients of the short- and long-run relationships, respectively. The error correction term δ , also called the speed of adjustment, explains the convergence to long-run equilibrium. Finally, o, p, q, r and s are the optimum lag specifications for RGDPR, Fragility, Fragility Squared, FD and NPL, respectively, in the short-run. The respective optimum lags were determined based on the Akaike Information Criteria (AIC).

Equation 4 applies the bounds testing approach of Pesaran et al. (2001). This test is conducted under the null hypothesis of "no level relationship", using the Wald test:

$$b_1 = b_2 = b_3 \dots = b_4 = 0$$

Under the null hypothesis, when the test statistic lies above the upper bound at a chosen level of significance, the null hypothesis is rejected, and if it lies below the lower bound, it cannot be rejected. However, if it lies within the upper and lower bound at a chosen level of significance, the test is inconclusive.

The goodness of fit of the estimated ARDL model was evaluated using the residual-based tests for serial correlation, Heteroskedasticity and Normality in the distribution of its residual. This was done using the Breusch-Godfrey Serial Correlation LM Test, Breusch-Pagan-Godfrey Heteroskedasticity Test, and the Jacque-Bera Test for Normality, respectively. In addition, the study performed the Ramsey (1969) test for omitted variables and specification error, and the Brown et al. (1975) CUSUM test for stability, on the estimated model. The goal was to show that the estimated model satisfied all econometric conditions, necessary for drawing inferences from its estimated parameters.

Table 1 presents a brief description of the variables and their respective a-priori expectations within the proposed ARDL model, in terms of the direction of their impacts on the real GDP growth in Nigeria. In line with the objective of this study, the proposed ARDL model regresses financial deepening (FD), financial system fragility (Fragility), non-performing loans (NPL) on real GDP growth, to determine the impact of financial sector development and financial system fragility on economic growth in Nigeria. Based on a-priori expectation, while FD is expected

to have positive impacts on real GDP growth, the impacts of fragility and NPL on economic growth are expected to be negative. However, the second-order condition for a convexity (u-shape), requires that fragility² be positive.

Table 1: Description of the Variables and A-priori Expectations

S/N	Variable	Notation	Measurement	a-priori expectation	Data source
1	Economic growth	RGDPR	Year-on-year growth rate of real gross domestic product	Dependent Variable	NBS
2	Financial Deepening	FD	The ratio of credit to private sector to nominal Gross Domestic Product	+	CBN and NBS
3	Financial system fragility	Fragility	The Standard Deviation of Returns On Assets (ROA), to the sum of ROA and Capital-Asset Ratio (C/A).	-	CBN
4	The square financial system fragility	Fragility ²	The Square of the Standard Deviation of returns on assets (ROA), to the sum of ROA and capital-asset ratio (C/A).	+	CBN and Staff Author's estimate.
5	Non-performing loans of Banks	NPL	The ratio of non-performing loans to total gross loans of commercial banks	-	CBN

Source: Authors' computation

V. Analysis of Estimated Results

Section V discusses the results of the pre- and post-estimation procedures and the findings from the estimated model.

V.1 Preliminary Analysis

V.1.1 Unit Root Tests

Table 2 presents the results of the unit root tests on the variables. These tests were conducted on the first differences of the variables because it was only necessary to verify that each variable in the proposed ARDL model is, at most, first difference stationary processes. While the ADF and PP tests were conducted under the null hypotheses of 'unit root', the KPSS test was conducted under the null hypothesis 'no unit root'. From the result of both the ADF and PP tests, the ADF and PP statistics of the first differences of all the variables are statistically significant at 1 per cent level of significant. Similarly, the KPSS statistics is statistically insignificant for the first differences of all the variables. This further confirms that none of the variables is integrated of order $d > 1$, thereby justifying their inclusion in the proposed ARDL bound testing.

Table 2: Result of the Unit Root Tests

ADF UNIT ROOT TEST					
First Difference		d(GDPR)	d(FRAGILITY)	d(FD)	d(NPL)
	With C	-8.37*	-7.65*	-3.17*	-3.86*
	With C & T	-8.33*	-7.57*	-3.25*	-3.80*
	Without C & T	-8.42*	-7.73*	-3.17*	-3.91*
PP UNIT ROOT TEST					
First Difference		d(GDPR)	d(FRAGILITY)	d(FD)	d(NPL)
	With C	-8.37*	-8.29*	-7.77*	-4.29*
	With C & T	-8.34*	-8.21*	-7.83*	-4.24*
	Without C & T	-8.42*	-8.38*	-7.76*	-4.33*
KPSS UNIT ROOT TEST					
First Difference		d(GDPR)	d(FRAGILITY)	d(FD)	d(NPL)
	With C	0.07^	0.12^	0.22^	0.06^
	With C & T	0.05^	0.11^	0.11^	0.06^

*Statistically significant at 1 per cent, ^statistically insignificant, C=Constant and T=Trend

Source: Authors' Estimate

V.2 The ARDL Model

To specify the most parsimonious ARDL model, the Akaike Information Criteria (AIC) was applied in determining the optimum lags of each variable in the ARDL model. The AIC selected ARDL (4, 6, 6, 4, 6) from among twenty specifications, as the most parsimonious model for capturing the relationship being investigated.

V.2.1 The Bounds Test

The result of the Bound test is presented in Table 3. This result shows that the F-statistic= 5.33, lies above the upper bound of I(1), even at 1 per cent level of significance, suggesting the variables are co-integrated. The implication is that there exists a level relationship among the variables, which can be captured in the long-run component of the estimated ARDL model.

Table 3: Result of the ARDL Bound Test

	Restricted Constant and No Trend
Test Statistic	F-Bounds Test
Selected Model	ARDL(4, 6, 6, 4, 6)
Value of test statistic	5.33
1% Lower I(0) Bound	3.29
1% Upper I(1) Bound	4.37
Conclusion	Null rejected

Source: Authors' Estimate

V.2.2 The Estimated Short- and Long-Run Relationship

The lower segment of Table 4 presents the results of the long-run relationship between real GDP growth (RGDPR) and index of financial system fragility (Fragility), financial deepening (FD), and non-performing loans index (NPL). This result reveals a U-shaped relationship between RGDPR and Fragility. This is because, the second-order derivatives of the RGDPR function, with respect to Fragility, while holding other variables constant, suggests that it is convex. The relationship between Fragility and RGDPR is, therefore, U-shaped, and statistically significant. On the other hand, financial deepening (FD) was found to have a positive impact on economic growth. Although not statistically significant, the result suggests that financial deepening is potentially growth inducing. The

impact of NPL on economic growth was found to be negative and statistically significant, reducing economic growth by about 0.49 percentage points per unit rise in NPL.

A possible reason for this development could be that, although financial deepening impacts positively on economic growth, it also comes with the disadvantage of exposing the financial system to more risks, thereby increasing financial system fragility. Increases in financial system fragility reduces the public confidence in the financial system. This may, in turn, affect financial intermediation, and, consequently investment and, then, economic growth. However, a sustained increase in the financial system fragility could lead to a total collapse of the financial system. When this happens, there would be a shift in the drivers of growth from financial sector services to fiscal sector factors such as government, and other structural factors like infrastructural development. This explains why, in the aftermath of most financial crises, fiscal injections, in the form of bailout funds, are used to boost the economic recovery or stabilise the financial system.

The long-run results are like those of the short-run relationships (upper segment of Table 3). Clearly, the relationship between economic growth and fragility is U-shaped (in both contemporaneous and lags terms of fragility), following the convexity condition of the second order derivatives. Financial deepening, however, was found to have a negative impact on economic growth, except in its third lag, where the impact is positive. Finally, the short-run impacts of non-performing loans on economic growth is negative in its contemporaneous term, third and fourth lags. The parameter $\text{Coint} = -0.31$ is error correction mechanism (the speed of adjustment), and it measures the speed at which equilibrium is restored in the long-run. This parameter is negative and statistically significant, suggesting that about 31 per cent of disequilibrium is corrected for in every quarter.

Table 4: The Short and Long-Run Estimates

Short-run: Dependent Variable= D(RGDPR)						
	D(RGDPR)	D(Fragility)	D(Fragility^2)	(FD)	D(NPL)	Coint
Lag 0		0.160 [^]	-0.159 [^]	-0.053 ^{**}	-0.107 ^{**}	
		[0.098]	[0.092]	[0.020]	[0.039]	
		(0.133)	(0.114)	(0.024)	(0.018)	
Lag 1	-0.175 [^]	1.359 [*]	-2.092 [*]	-0.134 [*]	0.057 [^]	-0.305 [*]
	[0.145]	[0.228]	[0.335]	[0.027]	[0.043]	[0.045]
	(0.254)	(0.000)	(0.000)	(0.001)	(0.213)	(0.000)
Lag 2	0.304 ^{**}	1.347 [*]	-1.972 [*]	-0.028 [^]	0.026 [^]	
	[0.123]	[0.217]	[0.308]	[0.020]	[0.060]	
	(0.032)	(0.000)	(0.000)	(0.202)	(0.677)	
Lag 3	0.470 [*]	1.604 [*]	-1.983 [*]	0.033 ^{***}	-0.09 ^{***}	
	[0.110]	[0.237]	[0.300]	[0.018]	[0.052]	
	(0.001)	(0.000)	(0.000)	(0.093)	(0.096)	
Lag 4		1.059 [*]	-1.337 [*]		-0.044 [^]	
		[0.254]	[0.291]		[0.066]	
		(0.000)	(0.001)		(0.526)	
Lag 5		0.072 [^]	-0.254 ^{**}		0.264 [*]	
		[0.064]	[0.082]		[0.058]	
		(0.287)	(0.011)		(0.001)	
Long-run: Dependent Variable= RGDP						
		Fragility	Fragility^2	FD	NPL	C
Lag 0		-3.556 [*]	5.867 [*]	0.222 [^]	-0.488 ^{**}	0.316 [^]
		[0.776]	[1.206]	[0.213]	[0.182]	[0.212]
		(0.001)	(0.001)	(0.321)	(0.022)	(0.165)

[] Standard errors, () P-values. *P-Value less than 1%, **P-Value less than 5% *** P-Value less than 10%, ^ P-Value above 10%, Coint=co-integrating parameter, C=Constant, Δ=change

Source: Authors' Estimate

V.3 Diagnostic Tests

For robustness, the residual of the estimated model was tested for serial correlation, heteroskedasticity, and normal distribution. This was done within the framework of the Breusch-Godfrey Serial Correlation LM Test, Breusch-Pagan-Godfrey Heteroskedasticity Test, and the Jacque-Bera Test for Normality, respectively.

In Table 5, with a p-value of 0.82 for the F-statistic (0.20), the null hypothesis of “no serial correlation”, cannot be rejected in the Breusch-Godfrey Serial Correlation LM test. For the Breusch-Pagan-Godfrey Heteroscedasticity test, under the null hypothesis of “homoskedastic”, the F-statistic (0.83) is statistically insignificant, with a p-value of 0.68. The residual of the estimated ARDL model is, therefore, homoskedastic. Finally, the Jacque-Bera test for normality in residual, conducted under the null hypothesis of “normality” showed that, with Jacque-Bera =0.76, which is insignificant, with a p-value of 0.69, the residual of the estimated model was normally distributed.

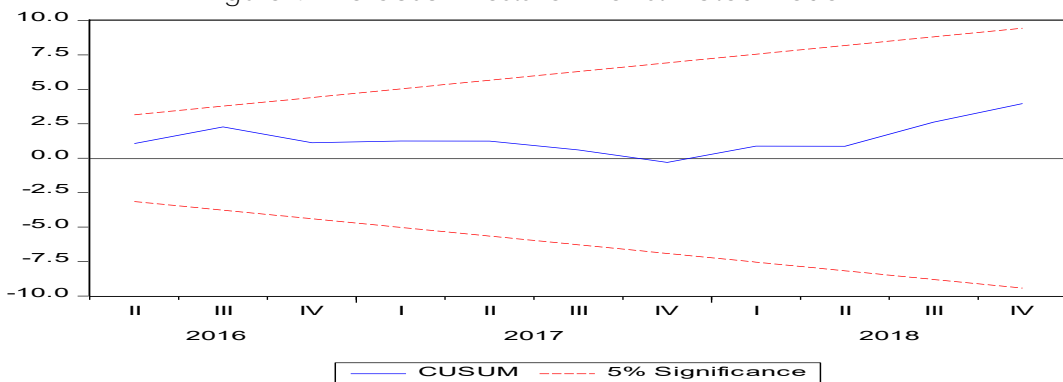
Table 5: Residual-Based Diagnostic Tests

Breusch-Godfrey Serial Correlation LM Test	
F-statistic	0.20
p-values	0.82
Heteroskedasticity Test: Breusch-Pagan-Godfrey	
F-statistic	0.83
p-values	0.68
Jacque-Bera Test for Normality of Residual	
Jacque-Bera	0.76
p-values	0.69

Source: Authors' Estimate

The coefficients of estimated model appear to be stable as the CUSUM statistic lies within the 5 per cent critical lines (Figure 4).

Figure 4: The CUSUM Tests for The Estimated Model



Source: Authors' Estimate

In addition, the Ramsey RESET test (Table 6) shows a statistically insignificant t- and F- statistics, at 5 per cent levels of significance. This suggests that the estimated model was properly specified, and that the estimated model does not suffer from omitted variable bias.

Table 6: Ramsey RESET Test

	Value	Probability
t-statistic	1.20	0.26
F-statistic	1.45	0.26

Source: Authors' Estimate

VI. Conclusion, Policy Implications and Recommendations.

The relationship between financial fragility and economic growth is vital to monetary policy. Following the 2007/2008 global financial crisis, there have been efforts to stabilise the Nigerian financial system. These efforts could be traced to the increasing credit extension to the private sector, through the promotion of financial intermediation. However, deepening the banking sector could expose the financial system to more risks, thereby increasing the fragility of the financial system. This study has employed a non-linear co-integrating ARDL model in assessing the interrelationship between financial deepening, financial fragility and economic growth in Nigeria using quarterly data spanning 2007 to 2018. The findings from the study show the existence of a non-linear relationship between financial fragility and economic growth. Also, a positive long-run relationship between financial deepening and output growth was found to coexist with a negative short-run relationship.

Over the years, the Central Bank of Nigeria (CBN) has initiated programmes aimed at deepening Nigeria's financial system, without a proportionate increase in output. This has raised doubts about the role of financial deepening in boosting economic growth in Nigeria. However, considering the systemic risk exposures of the financial system that come with increased financial liquidity, it is possible that resulting low level of economic growth, even in the face of increased CBN interventions, may be connected to the risks exposures of Nigerian Banks. This may also explain the reason for negative and statistically significant relationship between non-performing loans of Nigeria Banks and economic growth in Nigeria. This situation portends a vicious cycle, in which, efforts at increasing financial services to boost growth, leads to credit risk exposures, and this constrains growth, rather than enhancing it. Yet, a low-growth, would require even more financial resources to resuscitate.

In line with these findings, this paper argues that it is important that CBN credit expansion policies be implemented in such a way that minimises banks' exposure to credit risks. This would lower the non-performing loans of banks, and, as a result, reduce the fragility of the financial system. This may be in the form of identifying the high-risk sectors and encouraging banks to reduce their lending to those

sectors, while working with the Securities and Exchange Commission (SEC) to providing sector-product-backed securities to enhance funding to those sectors. For example, in energy sector, the Bank may collaborate with SEC and solar energy investors to establish solar energy-backed securities, in order to bridge the funding gaps in that sub-sector.

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