CENTRAL BANK OF NIGERIA

Impact of Oil Price Volatility on Selected Macroeconomic Indicators in Nigeria

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Information on manuscript submission is provided on the last and inside back cover of the Review.

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Impact of Oil Price Volatility on Selected Macroeconomic Indicators in Nigeria

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Abstract

This paper investigated the impact of oil price volatility on GDP, inflation, exchange rate and interest rate in Nigeria, using monthly time-series data from January 2000 to April 2015. It utilised the Autoregressive Conditional Heteroskedasticity (ARCH), Generalised Autoregressive Conditional Heteroskedasticity (GARCH) and Autoregressive Distributed Lag-Error Correction Model (ARDL-ECM) frameworks, to estimate the magnitude of the impact. The results showed that oil price volatility exacerbated exchange rate depreciation, significantly. In contrast, it was also interesting to find that oil price volatility had a significant positive impact on real GDP. This could be explained by a possible shift of effort to boost economic activity in non-oil-growth-enhancing sectors, as a result of uncertainties associated with volatile oil prices. Overall, the results showed that the exchange rate channel was a dominant channel through which oil price fluctuations affect the economy, thus, reaffirming the need for exports diversification.

I.   Introduction

Oil has been a dominant factor in Nigeria's fiscal space since the mid-1970s. Over the years, the various episodes of oil price boom had resulted in substantial revenue accretion, which enabled the government to embark on financing huge capital projects in pursuance of its macroeconomic objectives of sustainable growth and development. Thus, oil windfall has led to huge expansion in government activities and the complete reliance on earnings from oil, over the years, has made the country extremely vulnerable to the volatility in international crude oil prices. As a result, the World Bank (2003) observed that the Nigerian economy was among the most volatile economies in the world between 1961 and 2000. These observations were attributed, largely, to both oil price volatility and the pro-cyclicality in government expenditure. Available evidence show that Nigeria has maintained a pro-cyclical fiscal policy with government expenditures increasing rapidly in eras of oil price increase and declining minimally in periods of reduced oil prices since the discovery of oil. For instance, when oil price increased from US$4.24 in 1970 to US$12.85 in 1975, government expenditure also increased significantly from ₦1.44 billion to ₦9.00 billion. However, the drastic drop of 62.0 per cent in crude oil prices between 1980 and 1986 only led to 1.8 per cent reduction in government expenditure.

Despite the huge contribution of oil to government revenue, its contribution to GDP has remained insignificant. This may be an indication that oil price volatility may not necessarily lead to higher output volatility and lower GDP growth in the long-run in Nigeria as opined in the literature (Sachs and Warner, 1995; Rodriguez and Sachs, 1999). Major episodes of oil price shocks have, however, continued to have attendant implications for interest rate, exchange rate, and inflation rate because of the predominating nature of oil in the country's fiscal space. Moreover, the pro-cyclical nature of government fiscal policy has made it extremely difficult, in the past, to minimise expenditure in periods of low oil prices,

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thereby bringing about huge fiscal deficits that were financed through ways and means advances from the CBN, with undue pressures on interest, exchange and inflation rates.

The Nigerian government, in recent years, appreciated the need to shield the domestic economy from the overall impact of oil price volatility. In line with this, the government adopted the fiscal rule, in its budgetary process in 2004. The framework allows for the setting of a volatility-absorbing reference oil price, through which oil revenues enters the budget. Most importantly, with this framework, government expenditure can be smoothened by ensuring that it is driven by medium-term objectives, rather than by short-run revenue availability (Fasano, 2003). Furthermore, apart from making government fiscal policy sustainable, in times of oil price shocks, through its accrued savings element, which was later backed by the Sovereign Investment Authority Act, 2011, it was also meant to de-link government expenditure from oil revenue and mitigate the internal vulnerability, arising from oil price volatility.

The outcome of de-linking government expenditure and the macro economy from oil price volatility however, remained a tall order, especially in the midst of the declining current crude oil price. The crash in the price of the Bonny light from US$111.9/barrel in May 2014 to US$56.69/barrel in March 2015, had resulted in vast distortions in government revenue. Government revenue fell to an extent that some state governments found it extremely difficult to meet their financial obligations, particularly the payment of salaries. Monthly total statutory allocations, to the three tiers of government, dropped from ₦660 billion in January 2014 to ₦404.05 by April 2015.

Also, there has been profound pressure on the exchange rate with attendant consequences on the external reserves. From an average of ₦171.71/USD in January 2014, at the Bureau de Change (BDC), the naira depreciated to ₦222.93/USD in March 2015. Furthermore, inflation went up from 7.8 per cent in January 2014 to 8.5 per cent in March 2015, while interest rates rose substantially as government had resorted to borrowing extensively from both the money and capital markets to meet its immediate expenditure needs. To worsen the already gloomy outlook, GDP growth rate showed a significant downward trend, from the third quarter of 2014, following the negative oil price shocks. From 6.54 per cent in 2014Q2, GDP growth rate fell to 3.96 per cent in 2015Q1. The implications of the foregoing are grave for the economy in the long-run, if the current downward trend in oil prices persists.

Unlike previous studies on the impact of oil price shocks on the macroeconomic performance in Nigeria (Olomola and Adejumo, 2006; Akinyele and Ekpo, 2013; Oriakhi and Osaze, 2013; Alley et al., 2014), the current study is necessitated by the 2014 oil price shocks that worsened major macroeconomic indicators. The basic question, which this study, therefore, addresses, is whether or not oil price volatility, or other factors, is responsible for the behaviour of these indicators. In line with this objective, the study employed high frequency monthly data with the GARCH model to empirically estimate the impact of oil price volatility on selected macroeconomic variables.

The rest of the paper was structured as follows. Section 2 reviewed related theoretical and empirical literature. Section 3 provided the trend analysis of oil price and some selected macroeconomic variables in Nigeria, while Section 4 outlined the methodology of the study. Section 5 focused on the results and the policy implications; and conclusion was presented in Section 6.

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II.   Literature Review

II.1   Theoretical Issues
II.1.1   The Effects Of Oil Price Volatility On Oil-Importing Countries

Given the importance of energy in driving most economies, the stability of oil prices, particularly for oil-importing and oil-dependent countries, remains crucial, as their volatility is likely to hinder economic development. Oil price rises are usually expected to impact negatively on oil-importing countries; since energy is a factor of production, a rise in oil price would ultimately result in an increase in production cost, leading to cost-push inflation, low economic growth, and possibly economic recession. The reverse is the case when oil price falls for an oil-importing economy.

According to Kilian (2008 and 2010), an exogenous rise in the price of imported crude oil is a terms-of-trade shocks for the oil-importing country. Hamilton (2000) revealed a strong relationship between oil price volatilities and economic growth, particularly in the US. He opined that, oil price shocks caused economic slowdown in oil-importing countries, like the US, as they disrupt spending by consumers and firms. On the demand side, oil shocks could also affect the economy since the short-run elasticity of oil demand is very low. If consumers want to keep up their real purchases of energy notwithstanding rising prices, their savings and/or spending on other goods must fall in the same proportion (Hamilton, 2011). Thus, there is a general believe that increase in oil prices would slow economic growth through a reduction in consumer spending (Bernanke, 2006). According to Kilian (2009), the reduction in consumer spending is due to four major reasons. First, higher energy prices reduce discretionary income, since consumers have less money at their disposal after paying energy bills. Second, volatile energy prices could create uncertainty about future prices, thus, making consumers postpone irreversible purchases of consumer durable goods. Third, even when the decisions to purchase are reversible, consumption levels may decline due to energy price shocks arising from the increase in consumers' precautionary savings. Finally, consumption of durable goods that are energy complements would fall as households may delay or forego the purchase of such energy-intensive durable goods.

According to Roubini and Setser (2004), the volatility of oil price also has a stagflationary effect on the macroeconomy of oil-importing countries, because it slows down the rate of growth or even results in decreases in output levels, thereby causing economic recession. Oil price surges are similar to consumption taxes and, for net oil-importers; the benefits of the tax are accrued to the oil-exporting country. They emphasised, however, that the impact of oil price volatility on growth and prices depends on the size of the shocks (both in terms of new real prices of oil and the percentage increase in the prices of oil), the persistence of the volatility, the dependency of the economy on oil and energy, and the policy response of the monetary and fiscal authorities.

II.1.2   The Effects of Oil Price Volatility on Oil-Exporting Countries

The stability of oil prices is important for oil-exporting countries, particularly since most of them rely on receipts from oil as major sources of revenue and foreign exchange earnings. This makes them susceptible to oil volatilities. High oil prices, however, are beneficial as they provide additional revenue to finance government expenditures and meet their import demand. Declines in oil prices, on the other hand, reduce revenue and affect negatively fiscal sustainability.

According to Moshiri and Banihashem (2012), many oil-exporting countries are heavily dependent on revenue from oil exports. As a result, when oil prices fall, their economies suffer, and when oil prices rise, economic activities boom. Oil price increases translate to higher earnings for oil-exporting countries, which could help in implementing new projects and investments. However, when an unexpected decrease in oil price occurs, most government-based projects and investments are abandoned or the government is forced to borrow to implement the fiscal deficit. In order to shield the economy from oil price volatility, some governments in oil-exporting countries have, over the years, been able to utilise efficiently the extra revenue, resulting from rises in oil prices to diversify their economies, through the establishment of the Sovereign Wealth Funds (SWFs).

The SWFs have served as useful buffers against low oil prices by helping such countries preserve capital and channel excess reserves to development. This will ensure the diversification of the revenue base and protect the domestic economy from volatility, arising from oil price shocks. The SWFs also provide opportunities to finance productive investments and smoothen consumption over time through the stabilisation of public spending. Several oil-exporting countries currently have well-established SWFs. For instance, Norway, the Government Pension Fund Global with an estimated fund of US$882.0 billion; the United Arab Emirates, the Abu Dhabi Investment Authority with an estimated fund of US$773.0 billion; and Saudi Arabia, the SAMA Foreign Holdings, with an estimated fund of US$757.2 billion, amongst others (SWFI, 2015).

Notwithstanding the positive impact of oil price increases, oil-exporting countries are not insulated from some of the harmful effects of oil price volatility. Some of them suffer the Dutch Disease Syndrome (DDS), which makes other sectors of their economies less-competitive, especially in the export market, due to neglect in form of developments in other sectors of the economy, as a result of oil boom.

II.2   Empirical Literature

A number of empirical studies on the relationship between oil price fluctuations and macroeconomic stability have been undertaken, employing different estimation procedures. By examining the channel of transmission of such shocks to the economy, studies have argued that fluctuations in oil prices are related to macroeconomic performance.

Jiménez-Rodríguez and Sánchez (2005) applied quarterly data from 1972Q3 to 2001Q4 to study the effects of oil price shocks on real economic activity of major industrialised Organisation of Economic Cooperation and Development (OECD) countries by employing a multivariate vector auto-regression (VAR), using both linear and non-linear models. They discovered that an increase in oil price impacted more on GDP growth than a decrease. Furthermore, for oil-importing countries, oil price increases had a negative impact on economic activity, except for Japan. However, the impact of oil price volatility on oil-exporting countries was inconclusive. On the contrary, Aparna (2013) used quarterly data spanning 1995 to 2008 and employed the vector autoregression (VAR) methodology to investigate the impact of crude oil prices on the Indian economy. The results showed that an increase in crude oil price had a negative impact on GDP and index of industrial production (IIP), but a positive impact on the wholesale price index (WPI). Gronwald et al. (2009) had similar findings, while analysing the effect of oil price decline on key macroeconomic variables (real GDP, inflation and real exchange rates) in Kazakhstan,

using VAR methodology with quarterly data spanning 1994 to 2007. Rafiq and Salim (2014) employed quarterly data covering 1986 to 2013 to examine the impact of oil price volatility on China, India, Indonesia, Malaysia, the Philippines and Thailand. They employed a panel data estimation, which revealed that oil price volatility was detrimental to the economies of these countries in the short-run. The volatility however, had varying effects on the economies of these countries, as it negatively influenced only output growth in China, Malaysia, and Thailand. It, however, had a negative effect on GDP growth, and a positive impact on inflation in India and Indonesia, while in the Philippines, oil price volatility impacted negatively only inflation.

Rafiq et al., (2009) investigated the impact of oil price volatility on key macroeconomic variables in Thailand, using quarterly data spanning 1993 to 2006. Employing the VAR technique, they found a unidirectional causality from oil price volatility to investment, unemployment, interest rate and trade balance. Furthermore, the findings showed that oil price volatility had significant (positive or negative) impact on macroeconomic indicators, such as growth, employment and investment and that the volatility was transmitted through a budget deficit. Ito (2010) examined the impact of oil prices on some macroeconomic variables in Russia, using the VAR methodology with quarterly data spanning 1994:Q1 to 2009:Q3. He found that a 1.0 per cent increase (decrease) in oil prices led to the depreciation (appreciation) of the ruble by 0.17 per cent in the long-run and a 0.46 per cent decline in GDP growth. Furthermore, he found that, in the short-run, increase in oil prices did not only cause GDP growth and ruble depreciation, but also led to increase in the inflation rate. Taghizadeh-Hesary and Yoshino (2015) examined the impact of crude oil price fluctuations on GDP growth rate and inflation rate in China, Japan and the US adopting a structural VAR model with annual data spanning 2000 to 2013 and found that the impact of oil price fluctuations on the GDP of oil-dependent economies was less, compared with that of emerging economies. However, the impact of oil price fluctuations on inflation in China was less, compared with that of the US and Japan.

Castillo et al., (2010), using a fully micro-founded new Keynesian framework, studied the interaction between oil price volatility, pricing behaviour of firms and monetary policy for the period, covering 1970-2008. The findings showed a positive relationship between oil price volatility and inflation rate. Thus, they concluded that higher oil price volatility would lead to higher level of inflation. El Anshasy (2009) employed the Generalised-Method-of-Moment (GMM) methodology with annual data from 1970 to 2004 on a panel of 15 oil-exporting countries (Bahrain, Cameroon, Colombia, Egypt, Indonesia, Iran, Kuwait, Malaysia, Mexico, Nigeria, Norway, Oman, Syria, UAE and Venezuela). He found that oil price volatility was not detrimental to long-run growth. Furthermore, after controlling for fiscal policy, higher oil prices had a positive but fairly small effect on growth, as fiscal policy was the major channel through which oil price shocks passed through to the economy. This explained the difference in growth performance, across the countries. In another study, El Anshasy & Bradley (2012) used the same methodology on annual data from 1972 to 2007 and included Algeria to the panel of 15 oil-exporting countries. They investigated the role of oil prices in determining fiscal policy and found that fiscal policy in oil-producing countries was pro-cyclical in nature. A rise in oil prices led to growth in both GDP and government expenditure.

Alley et al. (2014) applied the GMM methodology to examine the impact of oil price shocks on the Nigerian economy. Employing annual data from 1981 to 2012, they found that oil price shocks did not significantly slow down economic growth, which reinforced the view

that an increase in oil price was beneficial to oil-exporting countries. They also observed that these shocks, however, created uncertainty, thereby undermining effective fiscal management of crude oil revenue; hence, the negative effect of oil price shocks.

ThankGod and Maxwell (2013) investigated the impact of oil price volatility on macroeconomic activity in Nigeria, using annual data from 1970 to 2009. Employing the Exponential Generalised Autoregressive Conditional Heteroskedasticity (EGARCH) and Lag-Augmented VAR (LA-VAR) methodologies, the empirical results showed that oil price volatility had no significant effect on government spending, output and inflation in Nigeria. However, oil price fluctuations affected substantially the real exchange and interest rates in the long-run. Umar & Kilishi (2010), using the VAR methodology and data covering 1970 to 1980, posited that crude oil prices influenced GDP, money supply and unemployment significantly, but had an insignificant impact on consumer price index. Hence, the economy is vulnerable to external shocks.

Oriakhi and Osaze (2013) examined the effect of oil price volatility on the growth of the Nigerian economy, using quarterly data covering 1970 to 2010. Using the VAR methodology on real government expenditure, real exchange rate, real import, real GDP, real money supply and inflation, the authors found that oil price volatility had a direct impact on real government expenditure, real exchange rate and real import. It, however, impacted indirectly on real GDP, real money supply and inflation through real government expenditure. This implied that oil price volatility determined the level of government expenditure, which, in turn, affected growth in Nigeria. Akinyele and Ekpo (2012) examined the macroeconomic implications of oil price and oil revenue shocks in Nigeria by employing the VAR methodology on quarterly data for the period, spanning 1970:1 to 2010:4. The results indicated that oil revenue shocks could inhibit economic growth only in the long-run, while inducing inflation marginally in the short-run, following the initial shocks. Furthermore, positive shocks to oil revenue stimulated fiscal expansion, thereby causing inflationary pressure and depreciating the naira.

Olomola and Adejumo (2006) investigated the impact of oil price shocks on output, inflation, the real exchange rate and money supply in Nigeria, using quarterly data from 1970 to 2003. Adopting the VAR methodology, they discovered that oil price shocks did not significantly affect output and inflation. However, it influenced exchange rate significantly. Similarly, Ebele (2015) investigated the impact of crude oil price volatility on economic growth in Nigeria from 1970 to 2014. Adopting the engel-granger co-integration methodology, the empirical results revealed that oil price volatility had negative impact on the economic growth in Nigeria. In the same vein, Okoro (2014) examined oil price volatility and economic growth in Nigeria using quarterly data spanning 1980-2010. He estimated a non-linear model using the VAR technique. The study revealed that oil price volatility had a significant negative impact on economic growth in Nigeria.

Omojolaibi & Egwaikhide (2014) used quarterly data, covering 1990 to 2010 and a panel vector autoregressive technique (PVAR) to examine the impact of oil price volatility on the economic performance of five oil-exporting African countries (Algeria, Angola, Egypt, Libya and Nigeria). The variables of interest were oil prices, real GDP, fiscal deficits, gross investment and money supply. The results on impulse response functions showed that gross investment responded more to oil price volatility, than other variables. Demachi (2012) investigated the impact of changes in international oil price and price volatility on the Nigerian economy using structural vector autoregression (SVAR) and monthly data,

covering January 1970 to May 2011. The results revealed that exchange rate was affected by both the changes in the international oil price and its price volatility with a 1.0 per cent change in oil price explaining 18.0 per cent of the variation in exchange rate.

Omisakin et al., (2009) examined the short-run implications of oil price shocks on macroeconomic performance in Nigeria by employing the vector error correction methodology (VECM) on data spanning 1970-2006. The results revealed that a 10.0 per cent increase in the international price of oil would lead to an increase of about 79.0, 45.0, 17.0 and 31.0 per cent in oil revenue, government expenditure, money supply and GDP, respectively. However, a 10.0 per cent increase in oil prices leads to an 11.0 per cent decrease in CPI, implying that the Nigerian economy was vulnerable to oil price volatility. Aliyu (2009) assessed the impact of oil price shocks and real exchange rate volatility on economic growth in Nigeria, using quarterly data from 1986 to 2007. He applied VECM to examine the sensitivity of real economic growth to changes in oil prices and real exchange rate volatility in the long-run and found that oil price shocks and appreciation of the naira exerted positive impact on real economic growth. Englama et al., (2010), examined the relationship between oil price volatility and exchange rate volatility in Nigeria, using monthly data from 1999 to 2009. The study employed the co-integration technique and VECM, and found that a 1.0 per cent increase in oil price, increased exchange rate volatility by 0.54 per cent in the long-run and by 0.02 per cent in the short-run. Ogundipe et al., (2014) used the same methodology to examine the effects of oil price, external reserves and interest rate on exchange rate volatility in Nigeria. Employing annual data, covering the period 1970 to 2011, they found that a proportionate change in oil price led to a more than proportionate change in exchange rate volatility.

Oyeyemi (2013) investigated the impact of oil price shocks on growth in Nigeria by applying ordinary least squares (OLS) on annual data covering 1979 to 2010. The results showed a positive relationship between oil price and the real exchange rate. The study further showed a direct relationship between crude oil price and GDP, as a unit increase in crude oil price caused real GDP to rise by 15.0 per cent. Wilson et al., (2014) investigated the relationship between oil prices and inflation, interest rate, exchange rate and real GDP in Nigeria, using annual data from 1980 to 2010. They adopted the Granger causality and OLS techniques and found that, in the short-run, oil price volatility did not affect any of the variables. While Onoja (2015) examined the relationship between oil price volatility and the real exchange rate in Nigeria. using the error correction methodology (ECM) on quarterly data for the period 1981:1 to 2009:4. The results revealed that the dynamic impact of oil price volatility on exchange rate did not hold in the short-run.

It is apparent that the literature on the impact of oil price volatility on macroeconomic stability is mixed. This study, however, differs from previous studies in scope and the analytical technique employed.

III.   Trend Analysis of Oil Price and Selected Macroeconomic Variables in Nigeria

The oil boom of the mid-1970s gave government the necessary impetus to embark on economic reconstruction after the civil war. This led to the construction of gigantic and unsustainable white elephant projects and the inability to make any meaningful savings for the country. The government was, therefore, ill-prepared for the 1980s oil price glut that drastically reduced prices in the international oil market from US$38.0/pbl in 1980 to

US$14.5/pbl in 1986. Consequently, government revenue dropped from ₦15.23 billion (30.7% of GDP) to ₦12.60 billion (6.2% of GDP); expenditure, however, increased from ₦14.97 billion (30.2% of GDP) to ₦16.22 billion (8.0% of GDP) because of the pro-cyclical pattern of government spending. The price of crude rebounded in 1987, trended upward all through the 1990s and ranged between US$13.2/pbl and US$24.2/pbl. In line with the movement in oil prices, government revenue increased astronomically from ₦25.38 billion (10.2% of GDP) in 1987 to ₦98.10 billion (19.6% of GDP) in 1990 and ₦949.19 billion (17.9% of GDP) in 1999. Similarly, government expenditure increased from ₦22.02 billion (8.8% of GDP) to ₦60.27 billion (12.1% of GDP) and ₦947.69 billion (17.9% of GDP), respectively, in the period. The aftermath of the late 1980s crude oil price crash, however, continued to linger on the country's fiscal landscape, as prices remained substantially below the pre-crisis level in the international oil market in the 1990s.

Figure 1: Movements in Oil Price, Government Revenue and Expenditure (₦ Billion)
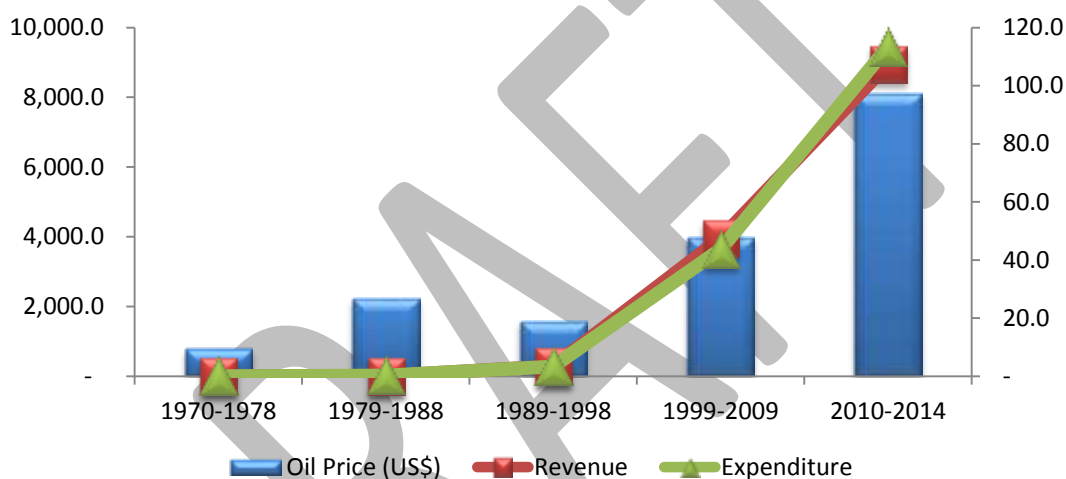

Apart from the periods of global financial crisis in 2009 and the discovery of the Shale oil and excess supply of inventories in 2014, prices of crude oil in the international oil market increased considerably in 2000-2014, with substantial impact on government's budgetary operations. The colossal spending patterns of the three-tiers of government, which necessitated incessant drawdown of crude oil savings, however, made it impossible to have a substantial fiscal buffer for the country during the period. Available data showed that oil prices rose from US$28.58/pbl in 2000 to US$113.40/pbl in 2012, but dropped to US$100.70/pbl in 2014. Also, government revenue and expenditure increased from ₦1,906.16 billion (41.6% of GDP) and ₦1,786.38 billion (26.5% of GDP) in 2000 to ₦10,654.90 billion (20.1% of GDP) and ₦9,622.91billion (13.5% of GDP) in 2012, respectively. Government revenue, however, dropped to ₦10,068.85 (11.3% of GDP), while the expenditure increased to ₦9,896.78 (6.2% of GDP) in 2014.

The sporadic spiral adjustment in oil prices, coupled with the pro-cyclical nature of government expenditure, led to persistent fiscal deficits financed from the Central Bank of Nigeria from the late 1980s through the 1990s. This resulted in massive macroeconomic distortions with inflation, increasing colossally from 9.7 per cent in 1987 to 76.8 per cent in 1994, but declined considerably to 0.2 per cent in 1999. Interest rates, however, increased and maintained an upward trend with the maximum lending rate rising from 15.7 per cent in 1987, to 21.1 and 25.3 per cent in 1994 and 1999, respectively; while the exchange rate

depreciated from ₦4.17/US$ to ₦21.89/US$ and ₦98.20/US$ during the period. Also, real GDP grew from 0.6 per cent to 0.2 and 0.4 per cent in 1987, 1994 and 1999, respectively.

Figure 2: Oil Prices, Government Expenditure and Selected Macroeconomic Variables (Per cent)
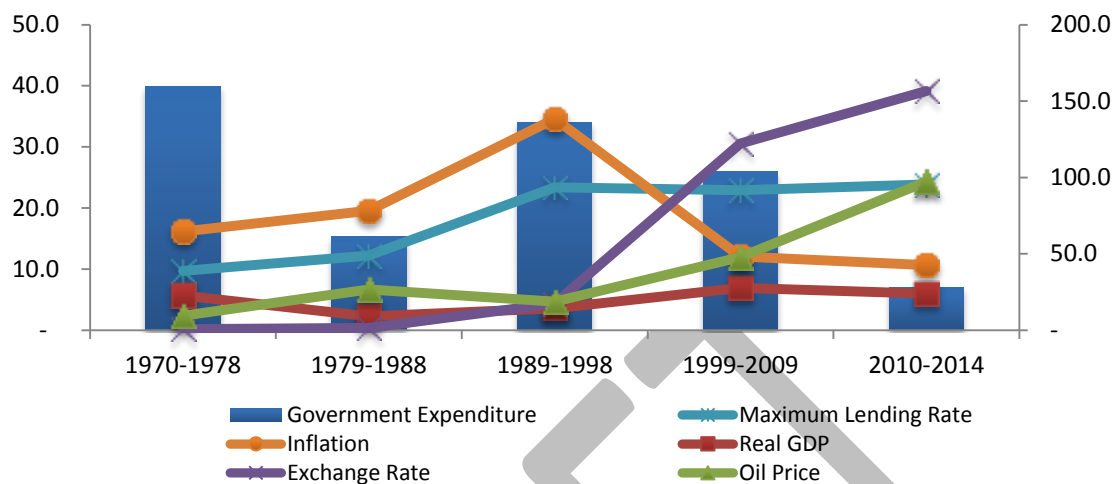
The huge spending patterns of the three-tiers of government made it difficult for the CBN to achieve the objective of maintaining a single-digit inflation rate in the period 2000-2014. Thus, apart from 2006, 2007, 2013 and 2014, inflation rate remained above 10.0 per cent and averaged 12.2 per cent for the period. Also, there was undue pressure on the naira which depreciated from ₦102.11/US$ in 2000 to ₦169.68/US$ in 2014. Growth rate of GDP between 2000 and 2014 was above 5.0 per cent, averaging 7.0 per cent, apart from the 4.2 per cent growth rate recorded in 2012. The growth performance was driven mostly by the non-oil sector, which contributed more than 70.0 per cent of the entire GDP, during this period. Furthermore, the interest rate recorded relative stability, as the maximum lending rate ranged between 18.4 per cent and 20.6 per cent from the period 2000-2008. This trend was later reversed with a range of 21.9 and 25.9 per cent, for the period 2009-2014.

Further analysis, using correlation coefficients, showed strong correlation among oil price, government revenue, government expenditure and exchange rate at 0.98, 0.98 and 0.91, respectively. Also, the correlation between oil price and maximum lending rate was strong and positive (0.61), while that of inflation was strong, but negative (0.58). The correlation between oil price and real GDP was, however, weak at 0.44. Although, there seemed to be strong relationship between oil price and most of the selected macroeconomic aggregates during the review period, there is need for a more rigorous empirical analysis to further investigate this conclusion.

Table 1: Correlation Coefficients: Oil Price vis-à-vis Selected Macroeconomic Aggregates

Exchange Rate	Inflation	Maximum Lending Rate	Expenditure	Revenue	Real GDP
0.9164	-0.5829	0.6126	0.9846	0.9825	0.4412

IV.   Methodology

The methodology was presented in two parts. In the first part, the GARCH methodology was used to generate the volatility of crude oil price, while the second part investigated

empirically the impact of the oil price volatility generated on inflation rate, interest rate, exchange rate and gross domestic product.

IV.1   Data

The study employed time-series data on selected macroeconomic variables - inflation rate, exchange rate, interest rate and gross domestic product and crude oil price volatility. The data spanned January 2000 to April 2015, representing one hundred and eighty four (184) observations. The series for inflation was proxied by the consumer price index and was sourced from various editions of the Statistical News of the National Bureau of Statistics (NBS). For crude oil price (COP), the price of the "Bonny light" – Nigeria's reference crude oil price – was used and was sourced from the CBN *Statistical Bulletin* (various editions). Exchange rate (EXRT) and maximum lending rate (MLR) were sourced from the CBN *Statistical Bulletin* (various editions). The real GDP (RY) was also sourced from the CBN Annual Report and converted to monthly series using the quadratic polynomial option on E-views. The method was adopted in order to avoid the trap of losing the original information and trend contained in the annual GDP, as mentioned in the guide provided in E-views manual. The manual stated that "the quadratic polynomial is formed by taking sets of three adjacent points from the source series and fitting a quadratic so that either the average or the sum of the high frequency points matches the low frequency data actually observed".

Oil price volatility series was generated, using the GARCH model. The GARCH model was used to produce the GARCH variance series, which was found most appropriate to represent volatility in price. However, the limitation of the method arises from its assumption of the symmetric effect of shocks. The interest in using a volatility series for oil price necessitated the collection of high frequency data. The same reason justified the disaggregation of the GDP series to monthly.

IV.2   Model Specification and Methods of Estimation

To capture volatility of crude oil price, Engle's (1982) Autoregressive Conditional Heteroskedasticity (ARCH) model was adopted. Second, oil price volatility series was generated from the best determined GARCH model. This is because the ARCH-type family of models seems to be the most widely accepted and have been described as the best model to capture volatility persistence (Salisu and Fasanya, 2013; Salisu and Mobolaji, 2013; Narayan and Narayan, 2007; and Morelli 2002). Third, the volatility series was utilised along with selected macroeconomic variables within an ARDL-ECM model framework of the Pesaran et al., (2001) to capture the impact of oil price volatility on inflation, exchange rate, interest rate and GDP. The advantage of this method over others is its non-restrictive assumption on the variables integration, which allows testing for co-integration among series of different orders of integrations.

IV.2.1   Model of Crude Oil Price Returns

We specified crude oil price (COP) returns as adapted from Salisu and Mobolaji (2013) as follows:

$$COPR = Log (COP_t / COP_{t-1}) \tag{1}$$

Where: COPR= Crude Oil Price Returns;
   COP_t = *Current Crude Oil Price; and*
   COP_{t-1} = *Crude Oil Price Lagged one period*

This served as the first stage of variable transformation and an input into the volatility process. Crude oil price is expected to exhibit volatility properties *a-priori*. This is because volatility is associated with rational expectations of variables that are susceptible to daily spikes dictated by market fundamentals.

IV.2.2   Existence and Persistence of Shocks

To determine the existence (impact of shocks) and extent of volatility (persistence of shocks) on the variable of interest, the following steps were taken: (1) modeling AR(k) with the generated returns series in equation 1; (2) testing for ARCH/GARCH effect (existence of volatility); and (3) modeling for the extent of volatility and generating crude oil volatility series (GARCH variance series).

IV.2.2.1   Modeling AR(k) (Conditional Mean Model)

In order to specify a model that captures the impact of shocks to volatility in crude oil price, the simplest version of autoregressive (AR(k)) (k=1) model was formulated. Thus:

$$CO\,PR_t = \alpha_0 + \alpha_1 CO\,PR_{t-1} + \varphi_t \tag{2}$$

Equation 2 represented the mean equation and provided the basis for which the ARCH/GARCH effect test was conducted. The model with ordinary least squares (OLS) method was estimated and followed the necessary process to check for the existence of volatility in crude oil price (tested for ARCH/GARCH effect).

IV.2.2.2   Testing for ARCH Effects (Variance Models)

To test for the existence of volatility, the ARCH test was conducted as suggested by Engle (1982) and applied in Narayan and Narayan (2007). The test was carried out to ascertain whether or not ARCH/GARCH effect existed in Equation 2 and this enabled us to either retain the OLS model or proceed to an ARCH-type model.

The ARCH-type model followed the framework of a moving average (MA) process. More specifically, the square of the contemporaneous residual in Equation 2 on the squares of their lagged residuals was regressed. Algebraically, the ARCH-type model was specified in general form as follows:

$$\hat{\varphi}^2_t = \eta_0 + \sum_{i=1}^{p} \eta_i \hat{\varphi}^2_{t-1} \tag{3}$$

Where: $\hat{\varphi}^2_t$ =squared error term of the mean equation;

   p = length of ARCH lags;

   $i = 1$ =starting from lag1 to p

   $\eta_i = \eta_1 ... \eta_p$ = Coefficients of lagged squared error term of the mean equation

The hypothesis of the ARCH effect (H_0) is stated as: "no ARCH effect" thus:

$$H_0 : \eta_0 = \eta_1 = ... = \eta_P = 0$$

In confirming this, the probability values of the F- tests and the observed R-squared (nR^2) were expected to fall within the conventional levels of significance (1, 5 and 10 per cent). However, for this study, five per cent (5%);($p<0.05$) significance level (95 per cent

confidence level) was adopted. Where there is significance, we reject the H_0 and *vice versa*.

And in a more explicit form, it follows the ARCH (P) as thus:

$$\varphi^2{}_t = \eta_0 + \eta_1\varphi^2{}_{t-1} + \eta_2\varphi^2{}_{t-2} + \eta_3\varphi^2{}_{t-3} + \ldots + \eta_P\varphi^2{}_{t-p} + \iota_t \quad (4)$$

IV.2.2.3   Modeling the Extent of Volatility

The extent of volatility was modelled by formulating a GARCH (p, q) model. This became necessary when the outcome of the ARCH-effect test on crude oil price (COP) showed volatilities. The model for measuring the extent of volatility is a system model that combines both the mean equation and the variance equation. Thus, we simultaneously estimated Equations 2 and 3 as follows:

$$\begin{bmatrix} CO\,PR_t = \alpha_0 + \alpha_1 CO\,PR_{t-1} + \varphi_t \\ \varphi^2{}_t = \eta_0 + \eta_1\varphi^2{}_{t-1} + \eta_2\varphi^2{}_{t-2} + \eta_3\varphi^2{}_{t-3} + \ldots + \eta_n\varphi^2{}_{t-n} + \iota_t \end{bmatrix} \quad (5)$$

Here, the focus was on the parameter estimate of the variance equation. If its mean reverts towards 1, it implies slower return to equilibrium or initial level, while the reverse would be the case when it tends towards zero. The estimated model was used to make the GARCH variance series (oil price volatility).

IV.2.3   Pre-Estimation Diagnostics

Before modeling the relationship between oil price volatility and the identified macroeconomic variables, the unit root property of each variable was tested. The summary statistics of data utilised pre and post unit root test was conducted in order to reveal the salient properties of the series and to lend credence to the methodology adopted.

IV.2.4   Model of the Impact of Crude oil Price Volatility on the Macroeconomy of Nigeria using Unrestricted ARDL Models

To capture the relationship between oil price volatility and the selected macroeconomic variables, several ARDL model equations were specified with the inclusion of control variables to minimise the size of the error term. The control variables included trade openness (*TOPN*) and real investment (*INV*).

Thus, the following ARDL equations were specified:

i.   **Impact of Oil price volatility on Exchange Rate (EXRT)**

$$DLEXRT_t = \alpha_0 + \sum_{i=1}^{n}\alpha_1 DLEXRT_{t-1} + \sum_{i=1}^{n}\alpha_2 DCOPR\_VOL_{t-1} + \sum_{i=1}^{n}\alpha_3 DLRY_{t-1} + \sum_{i=1}^{n}\alpha_1 DLTOPN_{t-1} + Z_t$$

$$(6)$$

ii.   **Impact of Oil price volatility on Interest Rate (MLR)**

$$DMLR_t = \beta_0 + \sum_{i=1}^{n}\beta_1 DMLR_{t-1} + \sum_{i=1}^{n}\beta_2 DCOPR\_VOL_{t-1} + \sum_{i=1}^{n}\beta_3 DLRY_{t-1} + \sum_{i=1}^{n}\beta_4 DLEXRT_{t-1} + \sum_{i=1}^{n}\beta_5 DLRINV_{t-1} + \sum_{i=1}^{n}\beta_6 DLM2_{t-1} + v_t$$

$$(7)$$

iii.   **Impact of Oil price volatility on Inflation Rate (HCPI)**

$$DLHCPI_t = \delta_0 + \sum_{i=1}^{n} \delta_1 DLHCPI_{t-1} + \delta_2 \sum_{i=1}^{n} DCOPR\_VOL_{t-1} + \delta_3 \sum_{i=1}^{n} DLRY_{t-1} + \delta_4 \sum_{i=1}^{n} DMLR_{t-1} + \delta_5 \sum_{i=1}^{n} DLRINV_{t-1} + \delta_6 \sum_{i=1}^{n} DLM2_{t-1} + \sigma_t$$

(8)

iv.   **Impact of Oil Price Volatility on Real GDP (RY)**

$$DLRY_t = \partial_0 + \sum_{i=1}^{n} \partial_1 DLRY_{t-1} + \sum_{i=1}^{n} \partial_2 DCOPR\_VOL_{t-1} + \sum_{i=1}^{n} \partial_3 DLM2_{t-1} + \sum_{i=1}^{n} \partial_4 DLTOPN_{t-1} + \sum_{i=1}^{n} \partial_5 DLEXRT_{t-1} + \partial_6 \sum_{i=1}^{n} DMLR_{t-1} + \sum_{i=1}^{n} \partial_7 DLRINV_{t-1} + \varphi_t$$

(9)

Where:
COPR_VOL = Crude Oil Price Volatility
RY = Real Gross Domestic Product
HCPI = Headline Consumer Price Index
LHCPI=Inflation Rate
M2 = Broad Money Supply
EXRT = Exchange Rate
TOPN = Degree of Trade Openness
RINV = Real Investment
MLR = Maximum Lending Rate
α , β , δ , and ∂ are parameters

IV.2.5   **Co-Integration Analysis**

The bound testing approach was used to test for possible long-run linear relationships (co-integration) between oil price volatility and the selected macroeconomic variables in Equations 6-9. The critical values of the Pesaran et al., (2001) tables on co-integration were employed to confirm the significance or otherwise of the estimates from the bound test.

IV.2.6   **ARDL-ECM Model**

The lags of the residuals from equations 1 to 4 were incorporated as explanatory variables with an error correction mechanism parameter as coefficients in each of the equations.
The general functional form of the ARDL-ECM model is given as:

$$Y_t = \beta_0 + \sum_{i=1}^{n} \beta_1 Y_{t-1} + \sum_{i=1}^{n} \delta_i X_{t-1} + \omega_t ecm_{t-1}$$

The ecm parameter ω_t helps to determine the speed of adjustment and reversion to the long-run equilibrium.

V.   **Discussion of Empirical Results**
V.1   **Oil Price Volatility Series**

The following results summarised the steps adopted to arrive at oil price volatility series.

V.1.1   **Testing for ARCH Effect**
Table 1 presents the ARCH test parameters for crude oil price. For robustness, the mean model in Equation 2 was extended to AR(3); hence, K=1,…,3.

TABLE 1: ARCH TEST

Dependent variable: COPR

Model	p=1		p=3		p=5	
	F-test	**nR²**	**F-test**	**nR²**	**F-test**	**nR²**
	COPR	**COPR**	**COPR**	**COPR**	**COPR**	**COPR**
k = 1	7.147*	6.949*	2.651**	7.782**	1.897	9.301
k = 2	6.929*	6.744*	2.664**	7.817**	1.762	8.675
k = 3	6.098*	5.961*	2.779**	8.137**	1.841	9.042

Note: The model follows the autoregressive process of k = 1, 2, 3 respectively, and p is the lag length for the test statistics. * = 1% level of significance; ** = 5% level of significance;

The results confirmed the presence of ARCH effect at the lag length of p=1 and p=3 at 5 per cent level of significance. Thus, the null hypothesis (H_0) of no ARCH effect was rejected. Consequently, the extent of crude oil price volatility was estimated, using the ARCH-type model.

V.1.2   Estimating GARCH (1, 1)

With the presence of ARCH, the extent of volatility, using a GARCH (1, 1) model was modeled. Table 2 below summarised the coefficient of variance equation, which was used in generating GARCH variance series, named oil price volatility series. It could be observed that the results captured the volatility revealed in Table 1, based on the ARCH-LM test, as the F-statistic and observed R^2 (nR²) were insignificant at 5 per cent level of significance. Thus, the null hypothesis (H0) of no ARCH effect was rejected. Based on the above results, GARCH variance series was generated and used as the oil price volatility series in the study.

Table 2: GARCH (1, 1)

	Mean equation		Variance equation			Diagnostics:			ARCH LM test on Models	
Variable	α_0	α_1	η_0	η_1	η_2	AIC	SIC	HQC	F-Statistics	nR²
GARCH (1,1)	0.006	0.149***	0.0004	0.161**	0.803*	-2.065	-1.959	-2.022	0.030	0.031

Note: * = 1% level of significance; ** = 5% level of significance;

V.2   Descriptive Statistics

The descriptive statistics are shown in Table 3. On average, the exchange rate was ₦136.35/US$ with positive spread to ₦197.07/US$ and negative spread to minimum rate of ₦98.78/US$. The minimum trend occurred in January 2000 and followed a partially steady trend till March 2015, when it rose to highest observed rate. The highest rate could not be unconnected to the recent persistent crude oil price crash in the international market, which led to a continuous dwindling foreign exchange earnings and depletion of external reserves.

Crude oil price during the period averaged US$68.29pbl with unstable positive trend of US$138.7pbl in June 2008, which coincided with the global financial crisis. The all-time minimum oil price of US$18.65pbl was recorded in December 2001. Maximum lending rate and inflation rate reached their peak in July 2002 and April 2015, respectively, while the lowest rates were recorded in July 2007 and January 2000, respectively.

Table 3: Descriptive Statistics

	EXRT	LHCPI	COP	M2	MLR	RY	RINV	TOPN
Maximum	197.07	5.13	138.74	17,713,597.00	32.27	97,679.83	15,779.69	14.41
Mean	136.34	4.36	68.29	7,271,905.00	23.13	56,683.75	6,082.69	5.50
Minimum	98.78	3.38	18.65	648,506.60	17.17	34,003.99	61.21	(1.12)
Std. Dev.	18.97	0.50	34.21	5,597,248.00	3.62	18,735.74	3,815.02	2.63
Skewness	0.1524	(0.1861)	0.1891	0.3924	0.4418	0.6847	0.2070	0.1153
Kurtosis	2.7105	1.9036	1.6864	1.6437	2.5842	2.3094	2.3418	3.2783
Jarque-Bera (JB)	1.3550	10.2786	14.3264	18.8250	7.3110	18.0318	4.6346	1.0015
Prob. of JB	0.51	0.01*	0.00*	0.00*	0.03**	0.00*	0.09***	0.61
Observations	184	184	184	184	184	184	184	184

Note: * = 1% level of significance; ** = 5% level of significance; Source: Computed by the Authors

Furthermore, both exchange rate and trade openness appeared to be leptokurtic, while the remaining variables are platokurtic. Also, all the series appeared to be positively skewed with the exception of inflation rate series. The Jarque-Bera statistics showed that the variables were normally distributed at the 5 per cent level of significance.
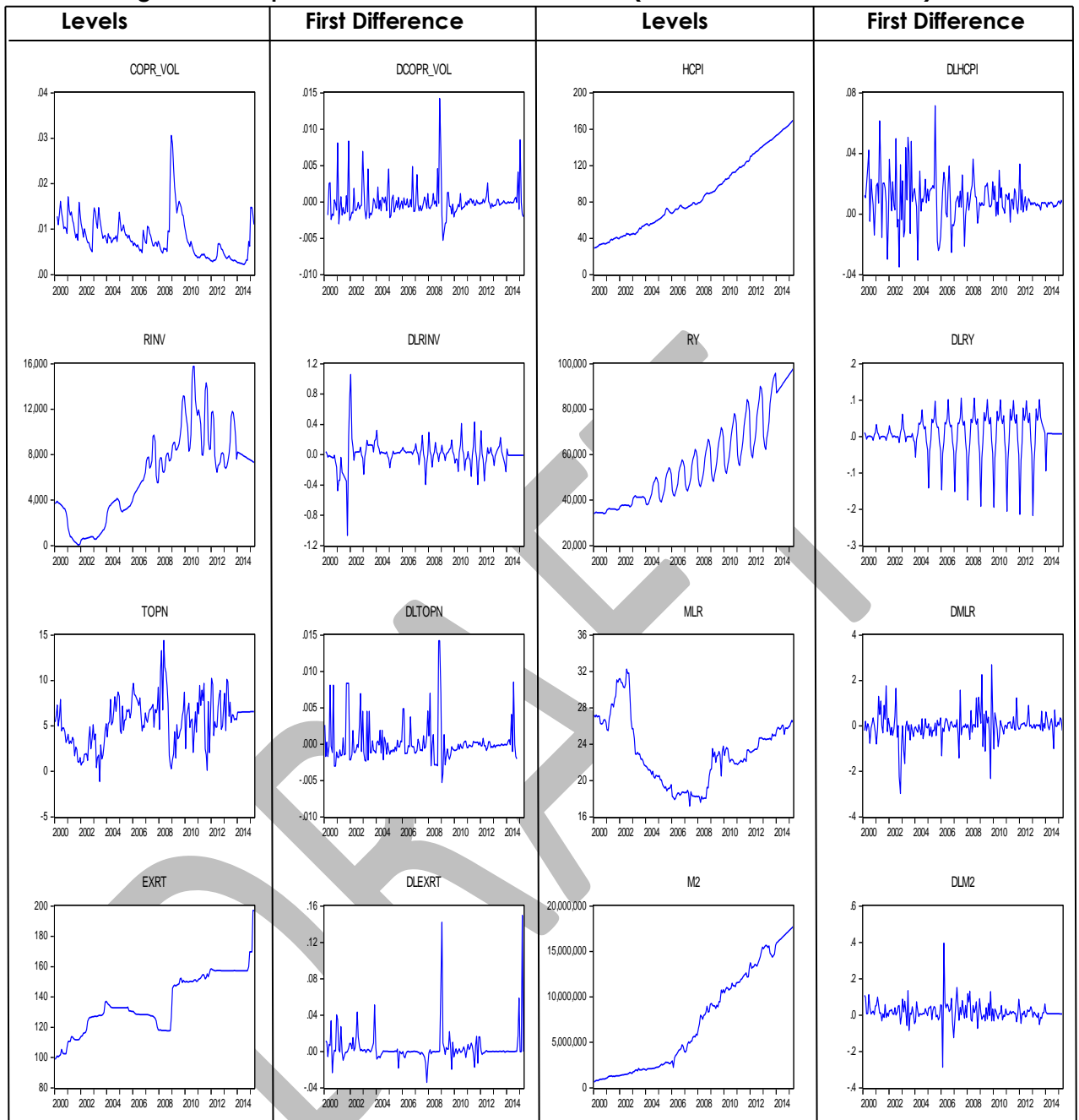
V.3   Unit Root Tests

The results of the unit root tests were shown in Table 4. The Augmented Dickey Fuller (ADF) test for stationarity was selected by the SIC criterion and showed that LHCPI, LEXRT, MLR, LRY, LRINV and LM_2 were integrated of order one (I(1)), while COPR-VOL and LTOPN are integrated of order (I(0)). The Philip Perron (PP) test confirmed the same results. These results further justified the use of ARDL-bound test approach (*Pesaran et. al., 2001)*. In addition, the results suggested that the variables need to be transformed to be consistent with the basic axioms of the OLS methodology.

Table 4: Unit Root Test using the SIC and Newey-West Bandwidth Criterion

Variables	ADF Test Statistic	Longest Lag	Order of Integration	PP Test Statistic	Longest Bandwidth	Order of Integration
LHCPI	-11.68*	0	I(1)	-11.66*	10	I(1)
LEXRT	-5.47*	2	I(1)	-10.68*	3	I(1)
MLR	-13.17*	0	I(1)	-13.22*	4	I(1)
COPR_VOL	-3.66*	1	I(0)	-3.45*	5	I(0)
LRY	-6.24*	12	I(1)	-5.80*	9	I(1)
LRINV	-5.35*	3	I(1)	-7.11*	18	I(1)
LTOPN	-4.20*	1	I(0)	-6.65*	8	I(0)
LM2	-16.35*	0	I(1)	-16.66*	3	I(1)

Note: * = 1% level of significance; ** = 5% level of significance;
Source: Computed by the Authors

Figure 2: Comparative Trend of Selected Series (Levels and First Difference)

Source: Computed by the Authors

V.4   Co-Integration Tests and Model Estimation

Following the outcome of the unit root test, an unrestricted ECM (ARDL Model) was estimated to test for possible long-run linear co-integration between oil price volatility and the selected variables.

The result in Table 5 below showed that the variables in two of the four models exhibited long-run relationships. The F-statistic values for Model 1 and 4 (exchange rate and real GDP model) were above the upper bound critical values at 4.92 and 10.54, respectively, of all the three at the 1 per cent level of significance. Therefore, only Equations 1 and 4 were

modeled for long-run relationships as their Null Hypothesis (H_0) of no joint co-integration were rejected.

Table 5: Combined Co-Integration Test (ARDL Bound test)
(ARDL Unrestricted ECM)

Method: Least Squares
Sample (adjusted): 2000M05 2015M04
Null Hypothesis: No Co-integration

Variable	Model 1 Exchange Rate (DLEXRT)	Model 2 Interest Rate (DMLR)	Model 3 Inflation Rate (DLHCPI)	Model 4 Real GDP (DLRY)
C	-0.0178	-7.5333	-0.0526	3.0812
COPR_VOL(-1)	0.6648**	-10.1810	0.0066	0.1403
DCOPR_VOL	0.9353***	5.9042	-0.5349	3.4516***
DCOPR_VOL(-1)	1.8043*	-5.1800	-0.4144	2.3158
LRY(-1)	0.0085	1.1368**	0.0005	-0.3023*
DLRY	-0.0420**	1.9656***	0.0094	
DLRY(-1)	0.0144	-1.9285***	0.0027	0.6854*
LEXRT(-1)	-0.0148	-2.0777*		-0.1391***
DLEXRT		0.7299		-0.9955*
DLEXRT(-1)	0.2027*	2.6249		0.0651
LTOPN(-1)	-0.0010*			-0.0035**
DLTOPN	-0.9127**			-1.0624
DLTOPN(-1)	0.5065			
DMLR(-1)		-0.0448		-0.0013
DLRINV		-0.7515**	-0.1945	-0.0160
DLRINV(-1)		0.2354		0.0221
MLR(-1)		-0.0393**		0.0033*
LHCPI(-1)			-0.0235	0.2547*
DLHCPI				0.1193
DLHCPI(-1)			0.1121	-0.0556
LM2(-1)		0.1710	0.0101	-0.0222
DLM2		-0.6443	0.0397***	-0.0415
DLM2(-1)		-0.4749	0.0077	0.0541
LRINV(-1)		-0.1945**		0.0084
Summary Statistics				
R-squared	0.4015	0.1552	0.0758	0.6060
Adjusted R-squared	0.3609	0.0666	0.0153	0.5456
S.E. of regression	0.0122	0.6226	0.0149	0.0397
Schwarz criterion	-5.6891	2.1799	-5.2928	-3.0484
Durbin-Watson stat	2.0828	1.9770	1.9866	2.4235
F-statistic	9.8837*	1.7514**	1.2528	10.0317*
ARDL Bounds Test				
Wald Test				
F-statistic	4.9181*	3.2791***	1.1414	10.542*

Pesaran and Shin Critical Bounds Value

Significance Level	I(0) Bound	I(1) Bound
10%	1.99	2.94
		3.28
5%	2.27	

Table 6: Parsimonious ECM Models

Method: Least Squares
Sample (adjusted): 2000M05 2015M04

Variable	Model 1 Exchange Rate (DLEXRT)	Model 2 Interest Rate (DMLR)	Model 3 Inflation Rate (DLHCPI)	Model 4 Real GDP (DLRY)
C	0.0001	0.0019	-0.0071	0.0019
DCOPR_VOL	1.3424*	22.4431	-0.3924	3.1318**
DCOPR_VOL(-1)	1.9671*	15.0842	-0.6343	
DLRY	-0.0556*	0.6383	0.0096	
DLRY(-1)	0.0536*	-1.0045	-0.0175	0.6895*
DLEXRT				-0.8810*
DLEXRT(-1)	0.8305*			0.1306
DLTOPN	-0.7117***			-0.7754
DLTOPN(-1)				-1.0252
DMLR(-1)		0.8359		
DLRINV		-0.6316**		
DLRINV(-1)		0.6626		
DLHCPI(-1)			1.7433	
DLM2			0.0409***	
DLM2(-1)			-0.0381	0.0759
ECM	-0.6204*	-0.8179	-1.6333	-0.2936*
Summary Statistics				
R-squared	0.3735	0.0454	0.0584	0.5902
Adjusted R-squared	0.3471	0.0008	0.0144	0.5619
S.E. of regression	0.0123	0.6442	0.0149	0.0386
Schwarz criterion	-5.7620	2.1668	1.9987	-3.4312
Durbin-Watson stat	2.0057	1.9785	1.9987	,2.4257
F-statistic	14.1432*	1.0179	1.3277	26.4130*
1%	2.88	3.99		
	Note:	Note: * = 1%	Note: * = 1% level of	Note: * = 1%	Note: * = 1%

Note: * = 1% level of significance; ** = 5% level of significance: ***=10% level of significance
Source: Computed by the Authors

Table 6 summarised the parsimonious short-run dynamic relationship between oil price volatility and the selected macroeconomic variables. As expected, only Equations 1 and 4 met the conditions of the error correction model. The error correction coefficients in these equations were found to be significant and correctly signed. The coefficients of the error correction variables for models 1 and 4 were -0.620486 and -0.293615, respectively, and were significant at the 1 per cent level of probability. For model 1, this implies that the rate of adjustment of exchange rate to equilibrium within a month in case of temporary short-run distortion (from crude oil price volatility and other control variables) would be 62 per cent. However, for model 4, real gross domestic product (RY) would revert back to equilibrium within a month by approximately 29 per cent. This is a call for concern as exchange rate took longer time to reverse from distortion, compared to real gross domestic product (RY).

The adjusted R-squared statistic showed that about 34 and 59 per cent of the variations in exchange rate and GDP are, collectively, explained by oil price and the other independent variables in model 1 and 4, respectively.

All the coefficients of the explanatory variables in Models 1 and 4 seemed to meet the *a-priori* expectations in terms of the signs of the coefficients, except DCOPR_VOL in Model 4. Also, the coefficients in Model 1 were all individually statistically significant, but in Model 4, only DLRY(-1) and DLEXRT, respectively, were significant. However, DCOPR_VOL was significant in Models 1 and 4 at the 1 per cent and 5 per cent levels, respectively.

Table 7: Model of the Long-Relationship between Oil Price Volatility and Macroeconomic Variables (Exchange Rate and Real GDP)

Variable	Model 1 Exchange Rate (LEXRT)	Model 4 Real GDP (DLRY)
COPR_VOL	19.53	10.08
LRY	- 0.012	
LEXRT		- 2.83
LTOPN	- 4.20	

See calculation in appendix 1

Given the results on Tables 6 and 7, in the short-run, persistent crude oil price volatility contributed to the continuous depreciation of the naira both at the contemporaneous and the lagged periods. This result corroborated that of Roubini and Setser (2004) who found that the impact of volatility on exchange rate depended on persistence of volatility among other factors. The positive coefficients of 1.34 and 1.96 implied that if crude oil price volatility continued unabated, naira would depreciate in that magnitude in the contemporaneous and the lagged periods. The findings were also in tandem with findings in past empirical studies on oil price volatility (Oriakhi and Osaze, 2013; ThankGod and Maxwell, 2013; Demachi, 2012, Englama et al., 2010; and Ito, 2010).

Depreciation of the naira in the past as a result of oil price volatility would lead to further depreciation of the naira in the present. Overall, this situation would worsen, if oil price volatility remains persistent into the long-run (volatility co-efficient is 19.54 per cent in the long-run model) (*see* Model 1 in Tables 6 and 7).

In addition, Model 4 revealed that the depreciation of the naira was among the factors responsible for slower economic growth in both the short- and long-run. Further depreciation of the naira led to about 0.88 per cent decline in economic growth in the short-run and 2.84 per cent in the long-run. The cycle continued as Model 1 revealed that a decline in economic growth by 1 per cent would lead to further depreciation of the naira by about 0.06 per cent. Intuitively, this implied that the persistence of oil price volatility impacted negatively on economic growth through the channel of exchange rate. This is in line with findings of El Anshasy, 2009; Alley et al., 2014; Wilson et al., 2014; Omojolaibi & Egwaikhide, 2014; and Rafiq et al., 2009.

V.5   Post Estimation Diagnostics

Figure 3 and 4 showed the actual, fitted and residual values from the regressions results. It was obvious that the fitted model mimiced the actual data quite well; thereby, giving credence to the models adopted in explaining empirical evidence of the relationship between oil price volatility and macroeconomic variables.

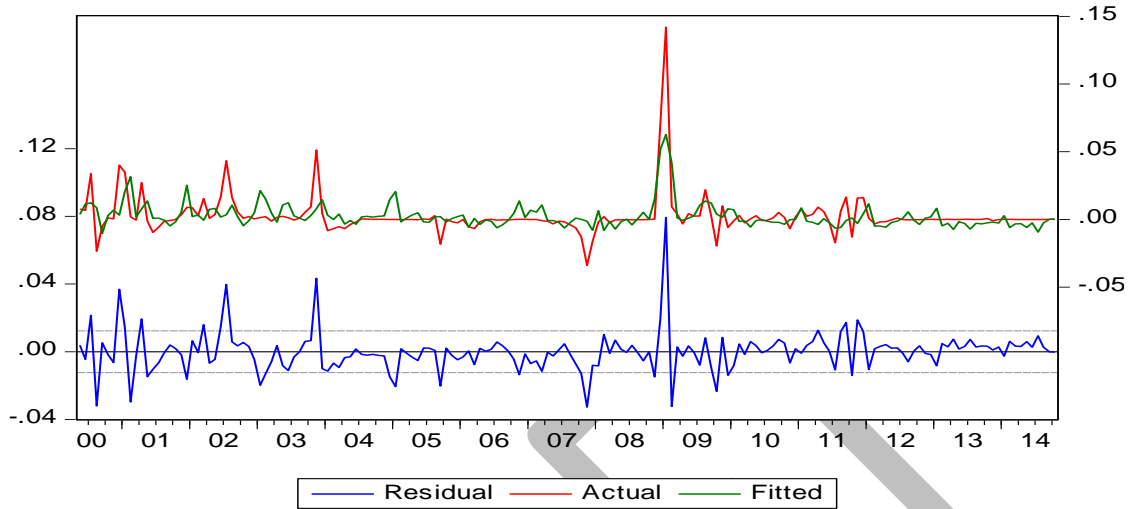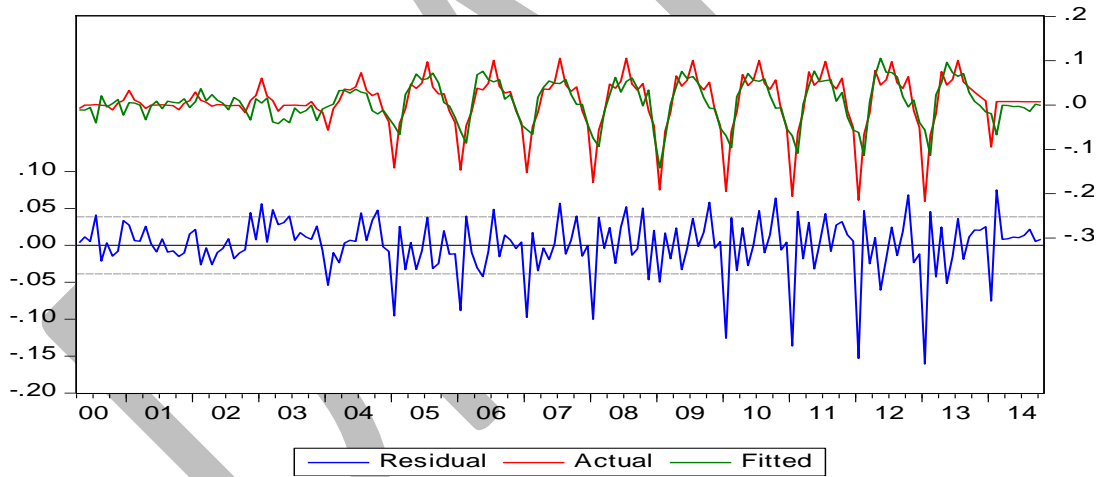**Figure 3: Actual, Fitted and Residual Test (EXRT)**

Figure 4: Actual, Fitted and Residual Test (RY)

In specific terms, the graphs indicated that the models were robust and had not violated the basic assumptions of OLS estimation. Furthermore, the results in Table 9 indicated that the exchange rate model was devoid of serial correlation problem. The F-statistic estimated by the Breusch–Godfrey serial correlation Lagrange multiplier test, showed 'no serial correlation'.

However, Table 10 revealed that there was a presence of serial correlation in the real GDP model. Therefore, the result obtained needed to be interpreted with caution. Finally, the inverse roots of autoregressive characteristics polynomial used for measuring the dynamic stability of the models, as depicted in Figure 5 and 6 showed clearly that the models were dynamically stable. It is observed that all the roots lied inside the unit circle and had modulus less than one (for modulus value, see appendix 2).

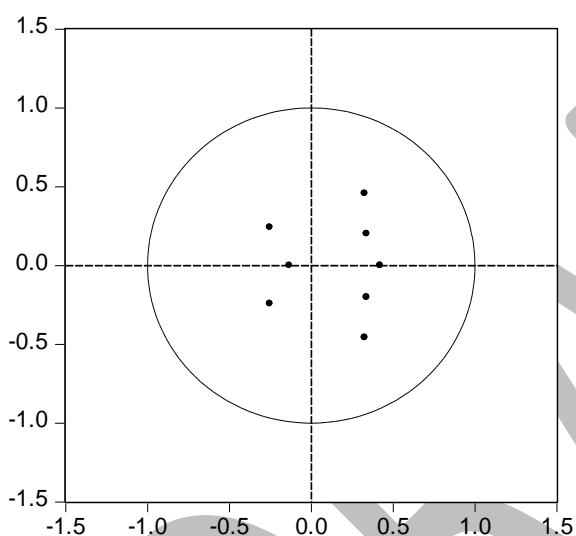**Table 9: Breusch-Godfrey Serial Correlation LM Test: EXRT Model**

F-statistic	1.19	Prob. F(2,164)	0.31
Obs*R-squared	2.49	Prob. Chi-Square(2)	0.29

Table 10: Breusch-Godfrey Serial Correlation LM Test: RY Model

F-statistic	8.0759	Prob. F(2,163)	0.0005
Obs*R-squared	15.7775	Prob. Chi-Square(2)	0.0004

Figure 5: Exchange Rate Model
Inverse Roots of AR Characteristic Polynomial

Figure 6: Real GDP Model
Inverse Roots of AR Characteristic Polynomial
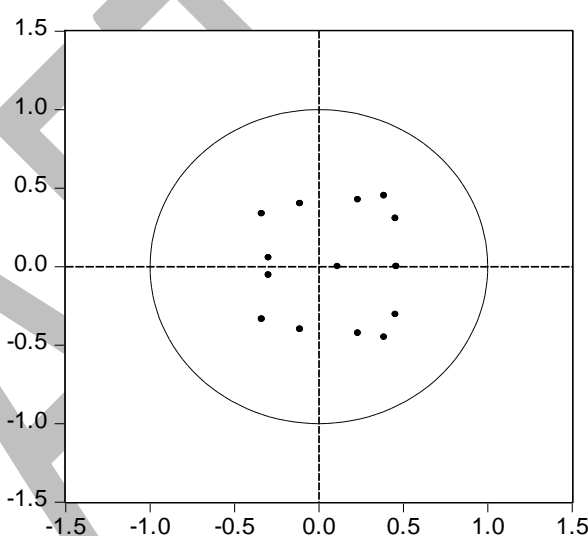
VI.   Implications and Conclusions

In summary, the results have indicated that a percentage rise in oil price volatility caused the naira to depreciate by more than a proportionate percentage. Thus, given that oil dominates Nigeria's export earnings, any volatility resulting from falling oil price would lead to a depreciation of the naira, thereby fuelling imported inflation, since Nigeria is dependent heavily on imports. Consequently, there is a need to curtail the pressure on the exchange rate by diversifying the export base and reducing dependence on imports of commodities that can be produced domestically.

The results also showed that a rise in GDP led to an appreciation of the naira. This indicates the need to stimulate growth, especially in sectors like agriculture and services that contribute substantially to GDP growth in Nigeria. All things being equal, high and stable growth would attract foreign capital, which would in turn reduce the pressure on the naira. Furthermore, the impact of oil price volatility on GDP, though positive, points to some important implication for the economy. Given the peculiarity of the Nigerian economy and its overdependence on the oil sector, volatile oil prices tend to shift attention to other sectors that engender growth and boost alternative exports commodities.

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Appendices

Appendix 1: Long-run Coefficient Calculation from the Short-run Restricted ECM Model

Appendix 2: AR Root Table for Dynamic Stability

Roots of Characteristic Polynomial for Exchange rate Model
Endogenous variables: DLEXRT DCOPR_VOL DLTOPN DLRY
Exogenous variables: C
Lag specification: 1 2
Date: 09/18/15   Time: 19:05

Root	Modulus
0.326966 - 0.457232i	0.562111
0.326966 + 0.457232i	0.562111
0.421539	0.421539
0.338412 - 0.200811i	0.393507
0.338412 + 0.200811i	0.393507
-0.252220 - 0.242606i	0.349961
-0.252220 + 0.242606i	0.349961
-0.134025	0.134025

No root lies outside the unit circle.

Roots of Characteristic Polynomial for Real GDP Model
Endogenous variables: DLRY DCOPR_VOL DLEXRT DLHCPI DLM2 DLRINV DLTOPN DMLR
Exogenous variables: C
Lag specification: 1 2
Date: 09/18/15   Time: 19:11

Root	Modulus
0.499102 - 0.318172i	0.591892
0.499102 + 0.318172i	0.591892
0.287950 - 0.515161i	0.590174
0.287950 + 0.515161i	0.590174
0.516392	0.516392
-0.481088	0.481088
0.287828 - 0.375725i	0.473302
0.287828 + 0.375725i	0.473302
-0.293118 - 0.274410i	0.401521
-0.293118 + 0.274410i	0.401521
-0.100609 - 0.358862i	0.372698
-0.100609 + 0.358862i	0.372698
-0.225439	0.225439
0.072079 - 0.169082i	0.183804
0.072079 + 0.169082i	0.183804
0.180410	0.180410

No root lies outside the unit circle.

Appendix 3: Granger Causality

Table 8: Granger Causality/Block Exogeneity

Excluded	Dependent Variable/Chi-sq.							
	DCOPR_VOL	DLRY	DLEXRT	DLTOPN	DLHCPI	DLRINV	DMLR	DLM2
DCOPR_VOL		3.601314	14.26963*	1.382849	1.969455	2.836226	0.329506	4.486463
DLRY	2.872425		0.372493	2.744512	1.268718	2.673440	1.460260	5.757076**
DLEXRT	2.733423	0.780285		9.551507*	4.910744***	1.367440	2.886842	1.585416
DLTOPN	25.20526*	0.182530	5.734175**		1.993825	10.79673*	0.484743	0.468587
DLHCPI	1.073709	4.892888***	0.705030	2.267098		3.347542	3.158155	4.158213
DLRINV	6.914916**	2.082135	2.861601	4.027322	4.688718***		2.869756	0.029546
DMLR	3.335332	6.946760**	6.291948**	2.172924	3.384245	1.575858		1.341714
DLM2	2.258538	0.674006	2.553106	0.418814	1.283388	1.094000	1.173002	
All	53.24862*	19.11224	54.65530*	20.72818	17.50985	24.36326**	12.98906	19.12758

Note: * = 1% level of significance; ** = 5% level of significance: ***=10% level of significance

The Impact of Prudential Measures on the Performance of Deposit Money Banks in Nigeria

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Abstract

The study examined the impact of prudential measures on the performance of selected deposit money banks (DMBs) in Nigeria, covering the systematically important banks (SIBs), small and foreign banks for the period 2007 - 2015. Dynamic panel and static panel models were implemented within the difference GMM developed by Arellano and Bond (1991) and the fixed and random effects model, respectively. The results showed some variabilities using different indicators of performance across the different categories of banks. It was found also that banks leverage, liquidity conditions and non-performing loans (NPLs) were the main drivers of banks' performance in Nigeria. However, the study revealed that capital adequacy did not influence significantly the profit characteristics of the Nigerian banks. Consequently, the paper highlighted the need to strengthen regulation to guide undue exposures, including under-reporting of non-performing loans (NPLs). Above all, the study recommended the need to apply categorical rules based on the sizes of banks to ensure that the smaller banks are not just viable but are able to comply with regulatory standards.

I.   Introduction

The worth of an individual and/or firm is usually captured by its financial statement, which shows the financial capability of that individual, or firm at any point in time. It determines the pace of growth and the ability to attract investments; thus, serving as a guide between borrowers and lenders. As a result, many firms direct their needs for loans and investments, accordingly. In addition, the deposit money banks (DMBs) often gauge their financial worth in making their decisions on financial commitment.

To bridge the gap and asymmetries between the lenders and borrowers, banks were established in line with acceptable guidelines (for example Basel Accord). These guidelines protect the equity of investors at all times to ensure that only certain levels of risks are permitted, amongst other considerations. This role of intermediation, however, is not without limitations, as customers can demand for their funds as at when necessary. Nevertheless, banks ensure that the limit to investment of customers' funds is established, based on classification of assets and loan portfolios, while ensuring the main aim of going concern. This necessitates the need to observe key prudential regulations to alleviate risk exposures of banks.

The Global financial crisis of 2007-2009 occurred as a result of a culmination of a number of factors, which led to asset price bubbles and the effects of the extended and unbridled borrowings of top American banks. These effects extended to other emerging markets, such as South Africa and Nigeria, highlighting contagion effect. It also stressed the extent to which the financial industry controlled the real activities of nations. These events showed the importance of the level of risk a financial institution could take to improve market quality and ensure stability of the financial system. These also underscored the

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rationale for establishing core prudential regulatory standards for financial institutions, across the globe. The universal mode of regulation that unites all nations is the Basel Accord. The Basel I, II and III have been globally utilised to set regulatory framework for banks.

The financial services industry in Nigeria has also been affected by several domestic and foreign shocks or challenges; thus necessitating a highly-regulated financial system, despite the high growth rate recorded after the consolidation exercise. The factors that led to the creation of an extremely-fragile financial system, that was further tipped into crises by the global financial crises, include: macroeconomic instability, as a result of large and sudden capital outflows; major failures in corporate governance in the banking industry, lack of investor and consumer sophistication; inadequate disclosure and transparency about financial position of banks; critical gaps in prudential guidelines and uneven supervision and enforcement (CBN, 2010). Other elements of the crisis, in the Nigerian financial services industry, can be attributed to poor operating environment, stiff competition, and lack of dependable consumer credit report from corporate bodies and prospective borrowers (Audu, 2014). The seemingly high exposure of some big and small Nigerian banks was propagated by poor risk management practices, due to excessive exposure to the stock market, petroleum industry, huge non-performing loans, inter-bank indebtedness, contravention of supervisory and regulatory provision, weak internal control, insider abuse, huge exposure to single or few obligors, and lack of adequate disclosure.

There has been serious debate in the literature regarding the impact of regulations on the performance of banks (Bougatef and Mgadmi, 2016; Salhi and Boujelbene, 2014 and Ajibike and Aremu, 2015). Some studies examined the effect of prudential guidelines on performance of banks, while others investigated the impact of prudential guidelines on the risk-taking incentives of banks. There is, however, no consensus in the literature whether or not prudential guidelines influence the performance of the deposit money banks, positively or negatively.

This paper, therefore, evaluated the impact of prudential measures on the performance of selected commercial banks in Nigeria, with emphasis on bank level information. The 2007-2009 global financial crisis and commodity price shocks underscored the need for a further review of the prudential framework. Effective implementation of prudential guidelines has proven to help banks better manage their inherent risks and provide feedback to the regulators on how to apply the micro and macro regulatory frameworks, as well as banks profit concerns. This is the main motivation for this study.

This paper is organised into six sections. Following this introduction is Section 2 focused on the review of literature, while Section 3 discussed the stylised facts on the banking industry. Sections 4 and 5 presented the methodology and findings, respectively, while Section 6 concluded the paper.

II.   Literature Review

Several theories exist to ensure banks' improve finance and return on risk (Tressel & Verdier, 2014). These are capital asset pricing model (CAPM), and other theories of bank finance. The CAPM describes the relationship between the systemic risk and expected return for assets. It is widely used for the pricing of risky securities, generating expected returns for

assets given the risk of these assets, and calculating cost of capital. Developed by nobel laureate, William Sharpe (1970), the CAPM calculates investment risk and states what return on assets an individual or business should expect.

There are other theories of bank finance that assume four types of risk neutral agents, namely: investors who supply capital elasticity; bankers who have the ability to monitor borrowers; entrepreneurs who have investment opportunities and are endowed with an aggregate capital stock normalised to one; and a banking supervisor who audits banks and enforces regulations (Tressel & Verdier, 2014). Prudential authorities enforce capital regulation in order to limit the riskiness of banks in relation to system stability, bank soundness in normal and in turbulent times and probability of minimisation in case of default. The regulation operates through the implementation of a minimum level of capital, which must be held by all banks. An increase in capital requirements gives banks the incentive to increase risks, in order to comply with the new regulation and, at the same time, keep their optimal leverage (Tanda, 2015).

In a bid to attain effectiveness and efficiency, prudential regulation of banks is intended to pursue two main goals. These include investor protection and financial stability, which indirectly highlight the direct impact of regulation on bank performance and effectiveness. To contain systemic risks, prudential regulation enhances the resilience of the whole banking system and smoothens the financial cycle (Constancio, 2015).

The theoretical justification, however, hinges essentially on three complementary arguments: the nature of the banking business; bank solvency or banking activities; and bank failures. Diamond (1984) highlighted that the nature of the banking business, making asymmetric information a severe problem in the relationship between banks and depositors. For instance, depositors' react to negative information about the solvency of a bank, which usually takes the form of deposit withdrawals, since most deposits are callable either on demand or at a small costs. Bank failures are likely to cause system risk of banking, given inter-bank lending and payment-related links among financial institutions. It can be deduced from Diamond (1984) that effective monitoring of intermediaries (that is, ensuring the implementation of effective or efficient guidelines, at the lowest possible cost), is paramount to improved bank performance.

Furthermore, the Bank for International Settlement (BIS) in the 1980s, highlighted the growing importance of systemic risks associated with financial system operations and the links with the real sector, in a world of growing financial integration (Demary, et al 2015). As a result of these systemic risks and in an attempt to guaranty customer's funds, due to the amount of asymmetric information involved in bank activity, financial institutions have been subjected to several levels of regulation. Such regulations have strengthened the stability of the banking system by imposing the choice of banks' risk taking and financial structure, which guarantees a safe environment and, by extension, increased bank performance (Salhi and Boujelbene, 2014).

Several authors highlight the impact of prudential guidelines on bank performance, through its effect on financial statements of firms. Gardener (1983) emphasised that capital adequacy ratio (CAR) served as a protective cushion to protect depositors and other creditors against losses at the operating and liquidation stage; and against losses arising from certain kinds of uncertainties. Other scholars noted that prudential guidelines of CARs have an important effect on bank capital, profitability and costs (Bird, 1989). Jackson et al., (1999) reviewing the impact of the 1998 Basel Accord on bank

performance, emphasised that the adoption of fixed minimum capital requirements led some banks to maintain higher capital ratios, which led to higher capital or lower lending, and by implication, lower profits.

Cosimano and Hakura (2001) investigated the impact of the new capital requirements, introduced under the Basel III Framework. Using GMM, they indicated that large banks would, on average, need to increase their equity-to-asset ratio and lending rates by 1.3 and 1.6 per cent, respectively, under the Basel III framework; thus, leading to a decline in loan growth of 1.3 per cent in the long-run. These are expected to vary, considerably from one advanced country to another, depending on cross-country variations in banks' net cost of raising equity and the elasticity of loan demand, with respect to changes in loan rates.

Staikouras and Wood (2003) analysed the performance of a sample of banks operating in 13 European countries. The study found that loans-to-assets ratio and the proportion of loan loss provisions were inversely-related to banks' return on assets and that banks, with greater levels of equity, are relatively more profitable. Salhi and Boujelbene (2014) examined the impact of prudential regulation on risk-taking among the Tunisian banks and claimed that higher levels of capital and liquidity reduced risk levels; thus, increasing economic efficiency and ensuring bank stability in Tunisia.

Tanda (2015) noted that capital regulation represented the core of prudential regulation in banking and that changes in the regulatory framework could influence banks' decisions. In analysing the relationship between capital and risk changes, and the impact of regulatory pressure on a sample of European banks for the period 2006 to 2010, Uhde (2016) concluded that banks tended to adopt a different behavior, depending on the capital ratio considered, supporting the 'gamble for resurrection' hypothesis. Capital regulation aimed at ensuring that banks held a level of capital consistent with their risk exposure and their decisions to hold capital changes, as their risk position modifies by endogenous or exogenous factors.

Bougatef and Mgadmi (2016) analysed the impact of prudential regulation on bank capital and risk taking among banks in the MENA countries, using annual data. They concluded that prudential regulations neither reduced banks' risk-taking incentives nor increased capital in the region, as a result of institutional weaknesses in the region. Nonetheless, the paper did not show the relationship between prudential regulation and bank profitability.

On the African scene, Mpuga (2002) stated that the inadequacy of minimum capital was a major cause of bank failure in Uganda. While testing the impact of capital on financial performance of 19 banks, Aymen (2014) revealed that there existed a positive and significant impact of capital on return on assets (ROA), return on equity (ROE) and net-interest margin (NIM) of the Tunisian banks between 2000 and 2009.

In Nigeria, Olagunju et al., (2011) concluded that a significant relationship existed between liquidity and profitability among Nigerian banks and opined that banks profitability was determined by their level of liquidity management. One of the limitations of the paper was that it considered only one prudential indicator. Ezike and Oke (2013) employed a simple linear model, using the OLS estimation technique to investigate the impact of capital adequacy standards (CAS) on the performance of Nigerian banks. They revealed that CAS exerted a major influence on bank performance; thus, encouraging

efficient and effective bank supervision and risk management. Aside the successes recorded, CAS assisted to spread the cost of prudent business conduct, restrict the competitive ability of banks and affected banks growth capabilities. Ezike and Oke (2013) further revealed that, in Nigeria, PAT remains the most significant variable to measuring performance of banks because capital adequacy had a direct relationship with other key variables. This judgment is also strengthened by the incorporation of various variables that affect bank soundness and safety in the Basel Capital Accord, such as earnings per share and profit after tax, as measures of performance.

Ajibike and Aremu (2015), having examined the impact of liquidity on performance of banks in Nigeria, identified a significant positive relationship between one lagged difference of ROA, liquidity, leverage and ROE. They emphasised that commercial banks in Nigeria performed well at higher levels of liquidity and debt, even though they utilised one prudential variable, and considered the whole banks as one cap fits all. Ugwuanyi (2015) investigated how the regulation of bank minimum capital base in Nigerian banks interacted with the bank risk-taking behaviour of the bank operators. The study examined the impact of the regulation of bank capital on risk-taking behavior, utilising data from 2009 to 2013. Involving simultaneous linear regressions on panel data, the study concluded that increased regulatory pressure had a negative correlation with capital adequacy and risk-taking appetite but did not significantly affect the capital adequacy and risk-taking appetite of Nigerian banks. The study used bank-level data from 2009 to 2013 and found that, a negative and insignificant relationship existed between regulatory stipulations and bank risk behaviour. Applying the GLS estimator on pooled panel model for the period 2007-2015, Umoru and Osemwegie (2016) examined the degree of significance of the CAR in influencing the financial depths of Nigerian banks and found that the financial depth of Nigerian banks was enhanced by the overriding impact of capital adequacy.

As shown above, several studies have attempted to examine how prudential guidelines affect banks' performance by determining acceptable levels of commercial bank risk, profit and regulations (Salhi and Boujelbene 2014 and Ajibike and Aremu, 2015). Others studies emphasised the effectiveness of optimum capital on banks' performance such as Mpuga (2002), Tanaka (2002), Ho and Hsu (2010), Moussa and Chedia (2016) and Tanda (2015). A couple of these studies highlighted a positive relationship between: prudential guidelines and bank performance; and economic efficiency and bank stability. Others showed a negative relationship between increasing capital and liquidity levels and risk. A few, especially those covering the African region, concluded that prudential regulations neither improved performance nor reduced bank's risk-taking incentives (Bougatef and Mgadmi, 2016 and Cosimano and Hakura, 2001). Also, papers that examined the performance of Nigerian banks, especially those that utilised one prudential variable or/and those that considered the whole banks as one cap fits all, established mixed results, such as the existence of non-significant, negative and/or positive relationships between regulatory stipulations and bank risk-taking appetite.

Given the above and the recent developments in the financial system, where commercial banks are now mandated to write-off loans as a result of the present predicament of increasing losses, and their provisioning, a review of the effect of prudential measures on returns and profitability of banks becomes imperative. Also, effective implementation of prudential guidelines has proven to help banks in industrialised economies to manage efficiently their inherent risks and provide feedback to the regulators on how to apply the micro and macro regulatory frameworks. As a result, this study intends to examine the impact of such prudential guidelines on bank performance in Nigeria, having

disaggregated the banks into national, international and systematically important banks (SIBs).

III.   Trend Analysis of Indicators of Bank Performance in Nigeria

Commercial banks in Nigeria are guided by a number of guidelines issued by CBN. In addressing the challenges of bank performance in Nigeria, however, the CBN introduced a four (4) pillar reform programme in 2010 tailored towards enhancing the quality of banks, establishing financial stability, enabling healthy financial sector evolution, and ensuring the financial sector contributes to the real economy. This "Prudential Guideline for Deposit Money Banks", was revised and became effective on July 1, 2010. The operationalisation of the CBN prudential guideline was attributed to dramatic events, following the banking sector reform and consolidation exercise of 2005 and challenges associated with such huge growth, as well as the effect of the 2007/2008 Global financial crisis (GFC) on the Nigerian economy. The prudential guideline of 2010 was a review of the Banks and Other Financial Institutions guideline (BOFIA, 1991) and a part of the initiative to enhance the quality of commercial banks. This Guideline targets several regulatory requirements of commercial banks in Nigeria. It thus addresses various aspects of banks' operations, such as risk management, corporate governance, know your customer and anti-money laundering, project financing, object financing, and real estate and commercial transactions. It also covers loans and retail financing, loan loss-provisioning, financial soundness indicators and financial ratios.

This study, however, focuses on prudential guidelines as contained in risk management principles and cover liquidity ratios, statutory reserve, cash reserve ratio, CAR, and credit rating. Loan loss-provisioning entails the review of the credit portfolio, with a view to recognising any deterioration in credit quality. The criteria on the assessment of risk of default should be based on items which should include, but not limited to, repayment performance, borrower's repayment capacity, on the basis of current financial condition, and net realisable value of collateral.

The reform in the banking sector in Nigeria resulted to a total of twenty four (24) commercial banks in Nigeria as at 2017. Out of the twenty four commercial banks in operation, four (4) are foreign-owned, while, at least, five have international representation. Eight (8) are referred to as systemically important banks (SIBs), twenty (20) are major Nigerian banks (MNBs), while the others account for the balance. SIBs refer to banks that must be closely-monitored to forestall the occurrence of a distress. They include financial institutions, whose distress or failure, as a result of their size, complexity and systemic interconnectedness is capable of disrupting the wider financial system and economic activity in the economy, significantly. Prudential guidelines have had a minimal effect on the performance of banks in the Nigerian banking industry, through an analysis of the development of the prudential guidelines in the Nigerian banking industry:

a. **Capital Adequacy Ratio (CAR)** refers to a measure of a bank's capital, measured as a percentage of a bank's risk weighted credit exposures. CAR was created to manage toxic assets of banks and promote stability and efficiency of banking systems. The CAR in Nigeria is monitored or controlled by the CBN. The CAR for Nigeria's national or regional and international banks are currently held at 10.0 and 5.0 per cent, respectively. SIBs are required to maintain a minimum CAR of 15.0 per cent and a ceiling of not more than 25.0 per cent of their qualifying capital.

Before the global financial crisis (GFC), the CAR industry average of banks in Nigeria stood at 17.0 and 19.8 per cent in 2007 and 2008, respectively. The banking sector was thus, hugely, affected by the GFC as shown by the 18.2 percentage point decline in the industry average. This worsened in 2010 to -21.5 per cent. The reforms in the banking sector led to improvements in the CAR, which rose to its peak of 18.3 in 2013. As banks struggle to remain in business, despite challenges and increasing nonperforming loans, the industry average declined to 11.8 per cent in 2015. The capital adequacy of SIBs for the period 2007 to 2015 stood at 17.6 per cent; 2.6 per cent above the minimum required. On a yearly basis, however, the CAR declined consistently to 12.7 per cent in 2015.

Major Nigerian banks have maintained a relatively stable CAR and thus have left the banking industry relatively stable. The CAR of national banks have remained above the industry average of 10.0 per cent, recording 17.1, 18.9, 12.9 and 12.3 per cent in 2011, 2013, 2014 and 2015, respectively.
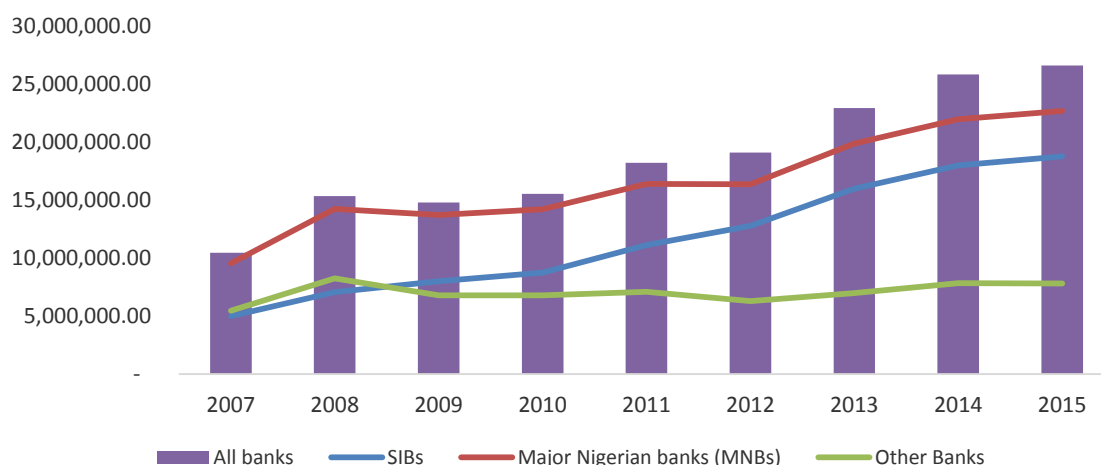
Figure 1: Capital Adequacy Ratio of Banks in Nigeria
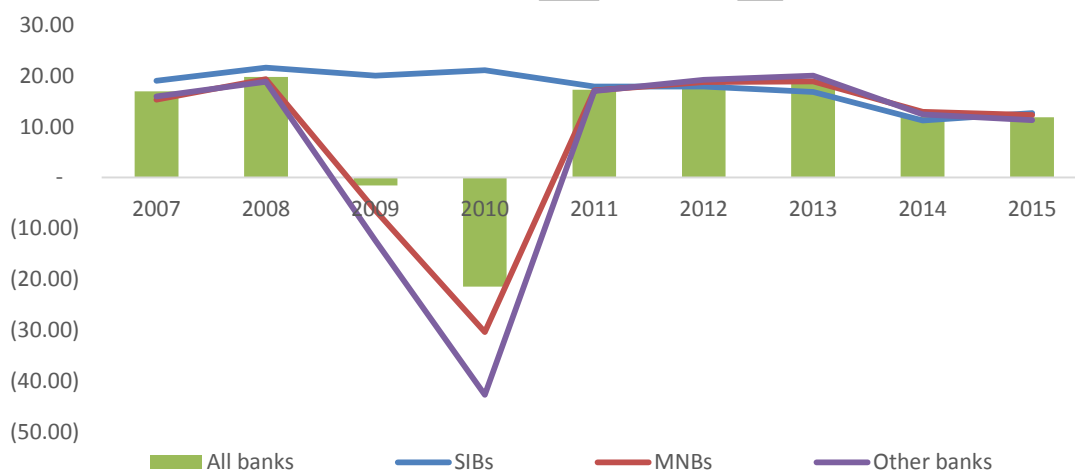
Source: Author's compilation.

b. **Total Assets (TA)** of banks in Nigeria increased in the review period, recording a growth of 153.9 per cent in 2015 over the eight year period.

Figure 2: Total Assets

Source: Author's compilation.

c. **Non-Performing Loans (NPL)** increased, on an average, in the review period despite efforts of the regulatory authorities to reduce NPL. NPL in major Nigerian banks increased remarkably during the GFC, which affected the banking industry. The growth of NPL, however, declined for the period 2010 to 2011; thus, improving performance in the banking industry, in general. NPLs have however, increased consistently since 2013, due to the development in the global economy, the reduction in cash inflows into the economy as a result of the slump in the international price of crude oil, as most banks lent to the oil and gas sub-sector.

Figure 3: Growth of Non-Performing Loans
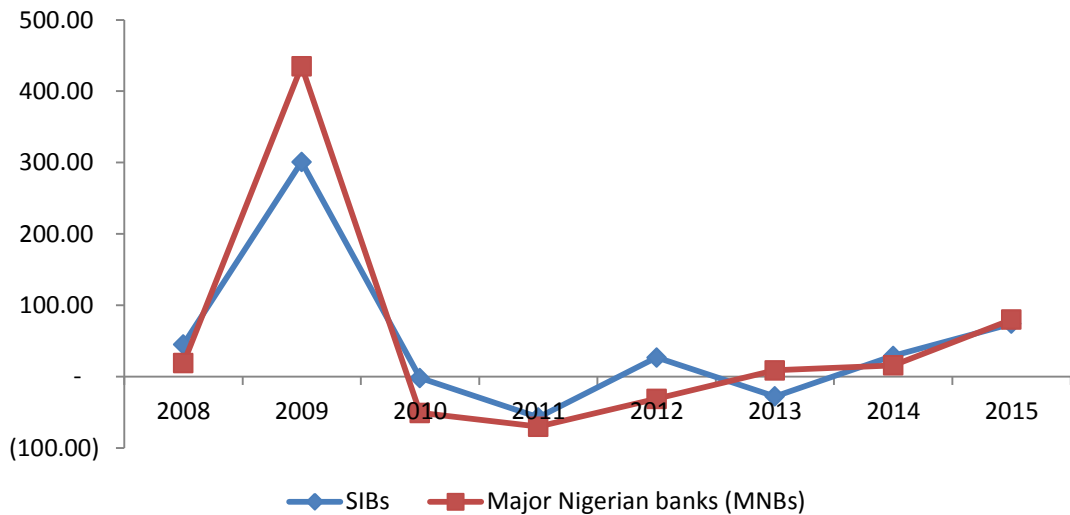
Source: Author's Compilation.

d. **The average liquidity ratio (LR)** in the Nigerian banking industry declined during the financial crisis until 2011, when it increased by 27.9 per cent. This increase was unsustainable, as liquidity declined in 2012 and again in 2014. The decline in liquidity could be attributed to the fall in the main source of revenue in the country and declining investments. Nevertheless, the LR of SIBs rose between 2014 and 2015, further supporting increased reliance on the Nigerian banking sector.

Figure 4: Liquidity Ratio
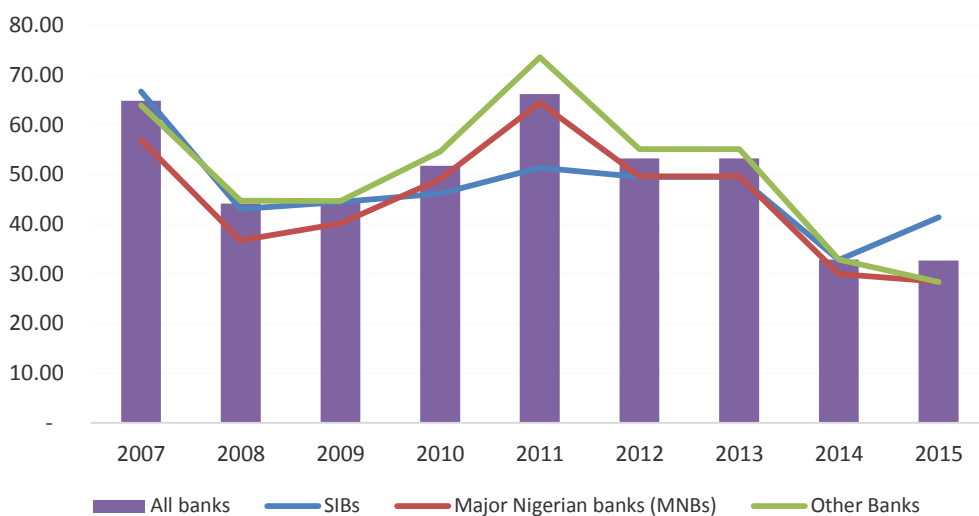
Source: Author's compilation

e. **Return on Equity (ROE)** refers to the amount the shareholders' receive from their investments. It is a measure of profitability of a business in relation to the book value of shareholder equity. It measures how well a company uses investments to generate earnings growth. They are usually paid as dividends received at the end of the banks' financial period. The higher the returns, the more profitable the institution. ROE is usually calculated, thus:

$$\frac{Total\ income\ after\ tax}{Total\ equity}$$

f. **Return on Assets (ROA)** is an indicator of how profitable an institution is, relative to its total assets. It shows the efficiency of management in the use of its assets to generate earnings. It tells how much of a banks' earnings are used to generate assets (invested capital). It shows how effectively a bank is able to convert its investments into net income. It is derived as follows:

$$\frac{Total\ income\ after\ taxes}{Total\ assets}$$

IV. Methodology
IV.1 Data

This study examined annual data from 17 selected banks[1] to cover the industry-wide analysis, as well as individual bank characteristics. These include the banks that have existed prior to consolidation, merged banks and others with international affiliates. The data were sourced from the DMBs financial statements from the Banking Supervision database of the Central Bank of Nigeria, through the EFinA platform. The variables were capital adequacy ratio, non-performing loans, return on equity, liquidity condition, board quality/non-performing loans and return on assets[2]. The study spanned the period 2007-2015. The choice of this period accounted for the recent structural changes in the industry, which transcended banking and financial system reforms, including the creation of the AMCON, the global economic and financial crisis, and the current oil price crisis that impacted the industry.

IV.2 Model Specification

The paper leaned on the dynamic panel model of Ajibike and Aremu (2015) to estimate[3] the impact of prudential measures on banks performances. However, the model is modified[4] to include other prudential[5] and performance variables, and also covers both bank specific and industry analyses. The model[6] is specified as:

$$Bpi_{it} = c + \alpha_1 Bpi_{it-1} + \alpha_2 Car_{it} + \alpha_3 Lqr_{it} + \alpha_4 Npl_{it} + \alpha_5 Lev_{it} + \varepsilon_{it} \qquad (1)$$

Where, Bpi was the Bank's performance indicators proxied by return on assets and return on equity; CAR represented the capital adequacy ratio; Lqr stood for bank liquidity levels;

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[1] Based on availability of data, particularly those that survived the banking consolidation exercise and had maintained stable and unified books of accounts.

[2] For clearer definition of these variables (see the Banking Supervision 2010 manual).

[3] The paper was founded on the hybrid of the capital asset pricing theory due to (William Sharp, 1970 and Constancio, 2015). The assumption was based on the fact that prudential regulations affect banks performance and enhance their resilience to shocks.

[4] In terms of model orientation and choice of variables for the equations.

[5] Prudential variables are those policy variables that cover capital regulations, liquidity-related issues and credit concerns of banks targeted at improving the quality and soundness of banks.

[6] The generic equation was also estimated in its static form for some other categories of banks, by removing the lag of the dependent variables.

Lev was the leverage of banks, which measured the ratio of debts to equity; and Npl measured the quality of board and the performance the bank management; ε_{it} was the error term, $i = 1,...,N$, was the cross section of banks; and $t = 1,...,T_t$ represented the time domain. Theoretically, higher capital adequacy levels, liquidity and leverage are expected to improve banks performance, while lower non-performing loans should improve banks performance variables.

In other words, the prudential measures are those policy variables that cover capital regulations, liquidity-related issues and credit concerns of banks. The choice of the variables is based on the fact that prudential regulatory measures influence these variables negatively or positively. Thus, these variables were targeted to improve the quality and soundness of banks and improve their performances.

IV.3   Model Estimation Procedure and Techniques

Following the Banking Supervision manual (2010), the study classified the selected Nigerian banks into four categories[7]: all banks, systemically-important banks, foreign Nigerian banks and other Nigerian banks to determine the impact of prudential regulations on banks performance. Moreover, the generic panel equation in Equation 1 helped to anchor the various models for the various categories, even though their estimations took care of their individual model characteristics, in terms of their uniqueness.

Given the limitations of the ordinary least squares (OLS) estimation technique in both static and dynamic panel analysis, the dynamic generalised method of moment (GMM) developed by Arellano and Bond (1991), Arellano and Bover (1995) and Blundell and Bond (1998) were applied, along-side with the fixed and random effect models for the four different models. The rationale is to determine the most appropriate model that could explain the phenomenon. However, given the shortness of the sample period (T) and the fact that previous profit could underline today's profits of firm, the Arellano and Bond's (1991) difference GMM was utilised[8] for the all the Nigerian banks and the systematically-important banks. The application of first difference helped to remove the unobserved time-invariants of firm-specific effects, as well as the inclusion of the instruments as regressors. Thus, the models were estimated within a GMM framework. Moreover, the random effect and the fixed effect models[9] were found appropriate for the other Nigerian banks and foreign Nigerian banks equations, respectively. The application of the models was based on the results of the Hausman test.

V.   Empirical Analysis
V.1   Diagnostic Tests

Prior to the estimation of the various models, pre-and post-diagnostic tests were conducted. These included the panel unit root, the Breusch-Pagan LM test, the Pasaran CDS test, the Arellano and bond test for serial correlation and Sargan test for identifying restrictions on the instrument were conducted to validate the model and analysis. The panel unit[10] results based on the Levine, Lin and Chu (2011), approach indicated that the

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[7] Comprising 17 banks for overall analysis, 8 systemically-important banks, 3 foreign Nigerian banks and 6 other Nigerian banks. Thus, two categories were estimated, using a difference GMM and the other two based on the static models.

[8] GMM provides better estimate for short samples (see Baltagi, 2011). The study has large N and few T.

[9] Given that the number of (T) was more than the (N), to capture the variations in the individual units.

[10] The result was omitted for lack of space even though the unit root test for panel was weak and often not important for short panels.

variables did not possess unit roots, highlighting the efficacy of the series to produce good estimates. Furthermore, the Hausman tests indicated that the random effect model explained better the relationship for the other Nigerian banks, while the foreign banks were justified by a fixed effect model, given the smallness of T and N (Baltagi, 2011). In addition, the Sargan tests for the validity of instruments showed that there was no over-identification of restriction in the ROE and ROA equations, for all the bank analysis, while the equation on SIBs indicated the presence of over-identified restrictions in both the ROE and ROA equations. However, Arellano and Bond (1991) argued that in first difference GMM, there was the likelihood of rejecting the null hypothesis even when it was homoscedastic, due the presence of serial correlation between the lag of the dependent variable and the instruments used. Moreover the Breusch-Pagan LM test for serial correlation also supported the RE model that there was significant difference across the banks for the equation on other Nigerian banks. However, the post estimation analysis also found the Pasaran cross-sectional dependent test significant for the FE model used to estimate the foreign Nigerian banks[11].

V.2   Empirical Analysis

The results were reported in tables 2 and 3. The results showed some variability's among the different categories of banks and the impact of the selected regulatory variables. Overall, the results revealed that the bank's leverage, non-performing loan and liquidity ratio affected the performance of banks in Nigeria, over the study period. For instance, the results indicated that a 1 per cent increase in leverage and liquidity ratios, led to 0.35 per cent and 0.03 per cent increase in banks return on equity, respectively. This corroborated the views of Ajibike and Aremu (2011) that liquidity affected the performance of DMBs. However, the results refuted the result of Ezike and Oke (2013) that capital adequacy influenced the performance of banks.

Furthermore, table 3 also showed that the lag of return on asset, liquidity, and non-performing loans determined the performance of DMBs for all Nigerian banks and the SIBs based on the return on asset result. It revealed that a 1 per cent increase in non-performing loans raised return on asset by 11 and 15 per cents for the banks and SIBs. This was expected, given that loans were part of the asset components of banks' balance sheet. The findings also reinforced the fact that high liquidity levels could affect the performance of banks. Nevertheless, capital adequacy ratio was found to be insignificant in all the models, indicating that it did not influence the profitability of banks in Nigeria. In other words, capital adequacy ratio reflected more of qualifying capital than served as a buffer against important exogenous shocks.

Comparatively, the results for the other Nigerian banks and the foreign Nigerian banks revealed that leverage levels and liquidity conditions of banks explained the performance of these banks, using the return on equity as a basis for performance. It indicated that a 1 per cent increase in the banks' leverage resulted in about 0.25 per cent increase in the banks return on equity. However, the estimated regulatory variables did not affect banks performance, based on the return on assets. The policy implication is that return on equity might be more appropriate in measuring the impact of prudential variables on banks, as return on asset reflected more of a broad-based element and could be affected largely by the level of non-performing loan.

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[11] Most of these post estimation results were omitted for lack of space.

Panel A: Summary of Results - ROE

	All Banks (DGMM)	SIBS (DGMM)	ONBNKS (RE)	FNBKS (FE)
Constant	-2.5941**	-1.1904**	-3.0174**	0.0357
	(0.7817)	(0.4625)	(1.6332)	(1.4664)
CAR	0.0116	0.0064	0.0108	-0.0064
	(0.0187)	(0.0154)	(0.0260)	(0.0521)
LQR	0.0264**	-0.0014	0.0433**	0.0070
	(0.0109)	(0.0083)	(0.0223)	(0.0117)
NPL	6.6202**	9.7675**	2.5609	-2.9243
	(3.3124)	(4.1181)	(3.3620)	(4.9774)
LEV	0.3485**	0.7457**	0.2984**	0.2531**
	(0.0538)	(0.0709)	(0.0753)	(0.0304)
Sargan test for over identifying restrictions	94.09 (0.0010)	94.08 (0.0002)		
ROE(-1)	0.1952	0.8016**		
	(0.1974)	0.1197		
N	16	8	6	8
Observation	80	27	46	24

NB: ** Statistically significant at 5 per cent, while * is significant at 10 per cent. The numbers in parenthesis are the standard errors.

In addition, the post estimation analysis indicated that the difference GMM performed better in "all Nigerian banks" and "the systematically-important banks". For the other Nigerian banks, the findings revealed that random effect (RE) model was appropriate, while the fixed effect (FE) was preferred to the RE, in case of the foreign Nigerian banks.

Panel B: Summary of Results - ROA

	All Banks (DGMM)	SIBS (DGMM)	ONBNKS (RE)	FNBKS (FE)
Constant	-0.0336	-0.0104	-0.0392	0.0244**
	(0.0118)	(0.0089)	(0.0256)	(0.0096)
CAR	0.0044	-0.0001	0.0003	-0.0009
	(0.0002)	(0.0003)	(0.0004)	(0.0004)
LQR	0.0003*	0.0001	0.0005	0.0000
	(0.0001)	(0.0001)	(0.0003)	(0.0001)
NPL	0.1147**	0.1502**	0.0499	-0.0624
	(0.0485)	(0.0786)	(0.0539)	(0.0443)
LEV	0.0008	0.0014	0.0009	0.0002
	(0.0007)	(0.0012)	(0.0256)	(0.0003)
Sargan test for over identifying restrictions	4.8714 (0.5604)	4.75 (0.5759)		
ROA(-1)	0.1538 (0.5455)	0.9220** (0.4341)		
N	16	8	8	8
Observation	80	24	46	24

NB: ** Statistically significant at 5 per cent, while* is significant at 10 per cent. The numbers in parenthesis are the standard error

V.3   Discussion of Findings

From the various models estimated, the results revealed that bank leverage levels, liquidity condition and non-performing loans were statistically significant for all the banks examined, although the non-performing loan was not correctly signed. This result is intuitive, given that the more liquid banks are, the more likely intermediation of banking activities would be. Furthermore, higher leverage keeps banking activities afloat and gives room for banks to make more profits. However, the positive relationship between the return on equity and non-performing loans could be attributed to the unique nature of banking business and the conditions of banks in Nigeria. During the post global financial crisis, most of the toxic assets were reported as off-balance sheet items. Thus, many Nigerian banks declared profits even when their NPLs were high[12] particularly the systemically-important banks.

Furthermore, the result of the systemically-important banks exhibited similar trajectory with the industry analysis. It revealed that both leverage condition and non-performing loans explained banks performance significantly, using return on equity, while non-performing loan was significant, in return on asset, over the study period. This suggested that the SIBs influenced the general banking industry behaviour in Nigeria, significantly. For instance, most of the SIBs posted huge profits, despite the rising NPLs, indicating that banks did invests heavily on other portfolios that are less-risky, such as FGN bonds and Treasury bills. Thus, given the sizes of these banks in the industry, there is need to strengthen regulation in the banking industry and moderate non-performing loans to improve the health of the financial system.

For the other Nigerian banks, the results showed that leverage ratio and liquidity determined the performance of banks, based on the return on equity significantly, while none of the regulatory variables were significant using the return on asset. For the foreign Nigerian banks, the results indicated that leverage condition of banks significantly explained the return on equity by 25 per cent. The results were not as expected, as the relatively the small banks posted more profits than the big banks but did not have the capacity to post huge non-performing loans.

Overall, the result indicated that leverage, liquidity ratio and non-performing loans were all significant regulatory variables that influenced the performance of commercial banks in Nigeria. These findings justified the reason why banks are active players in the bond market to augment their domestic equity. Another striking revelation was that CAR did not affect bank's profits. Most financial analysts do argue that CAR does not determine banks profit in an environment where core banking activities are not in practice.

VI.   Conclusion and Policy Implication

The study examined the impact of prudential measures on banks performance in Nigeria utilising Annual data, spanning 2007 to 2015. These data covered selected 17 banks, reflecting the big (SIBs), small and foreign banks in Nigeria. The study applied a panel data technique that covered all the selected Nigerian banks, the systematically-important banks, other Nigerian banks and the foreign banks operating in Nigeria, using the difference GMM, developed by Arellano and Bonds (1991) including the fixed and random effects models, to estimate the impact of the prudential variables on banks performance, measured by the return on equity and return on assets. Overall, the results

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[12] Unethical behaviours of banks that affected their books.

indicated that banks leverage, liquidity conditions and non-performing loans were the regulatory variables that influenced the performance of commercial banks performance in Nigeria. The result showed that a 1 per cent increase in the leverage condition of banks affected their profits by over 0.35 per cent. This justified the reason why banks are active players in the bond marks and seeking for foreign capital flows to augment their domestic equity. The study also revealed that capital adequacy did not influence the profit-characteristics of banks in Nigeria. Furthermore, the results affirmed that the profit behaviour of the SIBs underscored the pattern of the industry's performance in Nigeria.

Therefore, the paper concluded that for regulatory purposes, these are needed to strengthen the regulatory function of the monetary authorities to ensure that banks are well capitalised, liquid and credit-oriented. However, for profit motive, the central bank should reassess the regulatory framework, critically given the high profit propensities of Nigerian banks in the midst of rising non-performing loans. Consequently, this paper recommends the need to strengthen regulation of the banks, by critically reviewing their books to guide against under-reporting of NPLs. Also, the study recommends the need to apply categorical rules based on the sizes of banks to ensure that the small banks are not just viable, but able to cope with critical regulatory standards.

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Evaluating the Efficacy of Forecast Combinations: A Case of Inflation Forecasting Models in Nigeria

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Abstract

This paper employs a range of single equation and vector autoregressive models to forecast inflation in Nigeria, and evaluate different forecast combination methods in the presence of structural breaks, particularly during the global financial crisis. The findings show that the unconditional VAR appears to be the best model for forecasting headline inflation, irrespective of whether it is crisis or normal period. Furthermore, It was found that no single model could predict inflation accurately in the presence of structural breaks and regime shifts; and lastly, the relative forecast performance (using inverse of mean square errors) outperformed the trimmed and shrinkage forecasts and is suited for forecasting headline and core inflation in the pre- and post-crisis periods. The author concluded that performance-based forecast combination has the potency for better value-addition than poor forecast performance from single models, thereby making the forecast more robust.

I.   Introduction

Models are useful and coherent frameworks for policy analysis, which can help to identify sources of fluctuations, answer questions about structural changes, forecast and predict the effect of policy changes, and perform counterfactual experiments (Berg, et *al.*, 2006; Mordi, et *al.*, 2012). Such features have attracted the attention of central banks around the world, some of which have already developed and employed various models to inform decisions of monetary authorities. A model approach called the "suite of models" is identified as an effective strategy adopted by central banks (Berg et *al.*, 2006).

In forecasting inflation, different techniques have been identified in the literature; ranging from univariate to multivariate models (Mordi *et al.*, 2012). Apart from univariate models, which are essentially used for forecasting, the multivariate extensions have also been developed and used for forecasting and policy analysis. However, the use of different models for forecasting (e.g. inflation), poses a challenge of how best to summarise the most important information content in different inflation forecasts in real time. For example, two different models, using the same variables, may provide separate set of forecasts, due to independent information contained in the models, which can be utilised in a performance-based forecast combination method.

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In the literature, the need for forecast combination is premised on the possibility to reduce mis-specification bias, and address structural breaks. It has been shown in the literature that a useful strategy to hedge against structural breaks, for instance, is to use forecast combination (Clements and Hendry, (2002). Stock and Watson (2004) demonstrate the superiority of combined forecasts over individual forecasts; further, Aiolfi and Timmermann (2006) justify the need for a forecast combination that uses weights. It is, thus, significant to appraise whether the combined forecast outperforms the forecast of individual models and, identify which combination method performs best. In an institution, like Central Bank of Nigeria (CBN), it is informative to combine forecasts from different inflation forecasting toolkits to obtain a single inflation rate. However, the individual models are still relevant to understanding the combined inflation forecast (Hubrich and Skudelny, 2016).

Against this background, the paper employs a range of single equation (univariate) and vector autoregressive (multivariate) models to forecast inflation in Nigeria and employ different forecast combination methods to evaluate headline inflation and core (i.e. headline inflation, excluding food and energy) inflation, in terms of forecast performance and accuracy. It also examines the possibility of variation in forecast accuracy, using forecast combination methods, in the presence of structural breaks, particularly during the global financial crisis.

The paper is structured as follows. Section 2 reviewed the literature on approaches of combining forecast, while Section 3 reflected on some theoretical and empirical facts on forecast combination methods and techniques. Section 4 focused on the data and the models used for forecasting inflation, including the methods of evaluation. Section 5 presented the results of the forecast evaluation for the individual models, as well as forecast combination methods; while the final Section provides the summary of findings and concluding remarks.

II.   Review of Theoretical and Empirical facts on Forecasts Combination

According to Clemen (1989), there has been unanimous conclusion that combining forecasts results perform extremely well; leading to increased accuracy of forecasts. Most of the methods analysed information, using only a single forecasting technique; thereby disregarding substantial information from other techniques (Werner and Ribeiro, 2006). The complexity of the market demands the need to include all available information for forecasting, which may not be available in a single technique. Since the time of Bates and Granger (1969), emphasis has been placed on the need to develop forecasting techniques that are accurate with minimal error. This is found in combining forecasts from different approaches. Irrespective of how combination is achieved, its result is designed to improve the accuracy of the individual estimates. This is so because individual forecasting techniques are based on different approaches that reflect unique characteristics of the series, in addition to allowing the combination benefit from such characteristics (Armstrong, 2001).

Armstrong (2001) discusses the number of techniques available in model combination. He discovers that the combination of five forecasts reduces the amount of errors, but when

more than five techniques are combined, the errors become larger and larger at each addition. He then concludes that five models are suitable for efficiency. The author anchors his recommendation on the increasingly rapid behaviour of the combination gains.

In the literature, two combination approaches are defined: that is the objective approach and the subjective one. While the objective approach covers methods that use a mathematical function, so that results can be repeated, the subjective approach includes intuitive efforts to combine forecasts, by means of knowledge and opinion (Mancuso & Werner, 2013).

Objective methods of combination of forecasts began with Bates and Granger (1969). They proposed the method to combine the forecasts through a linear combination of two non-biased objective and found the factor that minimises the error variance of the combined forecast. The combination of forecasts was extended from two to "n", and combined methods started to be interpreted as a structured form of regression (Newbold & Granger, 1974). Thereafter, several authors have advocated new thoughts and developed sophisticated methods of comparing model combination. However, Mancuso & Werner (2013) showed that the arithmetic mean is still one of the most commonly used methods, as demonstrated by Marques (2005). He the simple average, the average weighted by the inverse of the mean square error, the optimisation with weight restriction and without constant and the optimisation without weight restriction, with constant.

Since the publication of the article by Bates and Granger (1969), various forms of combination forecasts have been developed, extending from the simple arithmetic mean to more sophisticated approach. However, there is no agreement in the literature that a sophisticated combination method is superior to simple ones, such as the average of individual forecasts. Clemen (1989) demonstrates that the combination via simple average, which, although lacks optimal weights, provides better results, when compared to more sophisticated methods. Moreover, in establishing the accuracy of a forecast using objective approach, the use of Mean Absolute Percentage Error (MAPE), Mean Square Error (MSE) and Mean Absolute Error (MAE), is observed as the key measures to assess model performance in several studies (Mancuso & Werner, 2013). However, variations in the Root Mean Square Error (RMSE), among others, are also commonly applied.

The subjective approach of combination is still considered unpopular, given that perception can hardly be repeated (Mancuso & Werner, 2013; Werner & Ribeiro, 2006). This approach is usually applied to scarce data, while launching a new product. Armstrong (2001), considers the opinion of experts and human judgement as the first step in combining forecast and concludes that combining forecasts are influenced by the individual characteristics of predictors, including the aspects of the forecasting context.

III.   Models and Methods of Evaluation

In practice, central banks, all over the world, require 'large amounts of data on the state of the economy and the rest of the world' (Svensson, 2004). These data are 'collected,

processed, and analysed, prior to major decision'. Thus, econometricians gather large macroeconomic data sets and develop different techniques of processing them for forecasting. In this direction, Stock and Watson (1999) develop originate the use of factor models that summarise large data set in an atheoretical way. They advocate the use of standard models for forecasting, which are simple to implement, perform comparatively well, in practice, and is easy to interpret.

In the literature, a number of forecast combination methods have been developed, including: simple average (equal weights) combination forecasts; discounted Mean Square Forecast Error (MSFE) method; and shrinkage forecasts. There are variations in these methods, arising from the use of historical information to compute the combination forecast; coupled with the degree the weights attached to individual forecasts are allowed to vary, over time.

III.1   Shrinkage Method

In shrinkage forecasts, weights are computed as an average of all the weights, using the recursive OLS estimator. The shrinkage forecast is computed as follow:

$$w_{it} = \lambda \hat{\alpha}_{it} + (1-\lambda)(1/n) \qquad (1)$$

Where $\hat{\alpha}_{it}$ is the ith estimated coefficient from a recursive OLS regression with no intercept.

$$\lambda = \max \{0, 1 - \kappa[n/(t-h-T_0-n)]\},$$

κ is a constant that controls the amount of shrinkage towards equal weighting (Stock and Watson 2004).

Equation 1 is interpreted as a Bayes estimator, in which the weight κ is estimated, using empirical Bayes methods (Diebold and Pauly, 1990; Stock and Watson, 2004). The shrinkage method, which works with a large number of explanatory variables, is used when: first, the variances of the forecast errors are the same; second, all the pair-wise covariances across forecast errors are the same; and third, the loss function is symmetric. Stock and Watson (2004), Diebold and Pauly (1990), and Aiolfi and Timmermann (2006) demonstrate that equal weights tend to perform better than many estimates of the optimal weights.

III.2   Discounted Mean Square Forecast Error (MSFE) Forecasts

Using this method, the combination forecast, is computed as weighted averages of the individual forecasts with the weights varying inversely with the historical performance of each individual forecast (Diebold and Pauly, 1987; Stock and Watson, 2004). The discounted MSFE combination h-step-ahead forecast is of the form:

$$f_{t+h|t} = \sum_{i=1}^{n} w_{it} \hat{Y}_{i,t+h|t}^{h}$$ (2)

Where: $\hat{Y}_{i,t+h|t}^{h}$ denotes the ith individual pseudo out-of-sample forecast of Y_{t+h}^{h}, computed at date t, that is, the ith forecast in the combined forecasts of inflation; $f_{t+h|t}$ is the combination of forecast, with the weight of:

$$w_{it} = m_{it}^{-1} / \sum_{j=1}^{n} m_{it}^{-1} \text{ where } m_{it} = \sum_{s=T_0}^{t-h} \delta^{t-h-s} (Y_{s+h}^{h} - \hat{Y}_{i,s+h|s}^{h})^2$$ (3)

Where δ is the discount factor (Stock and Watson, 2004: p. 412). Diebold and Pauly (1987) advocate weighting by inverse discounted h-step ahead forecasts, so that the near future is given more weight than the current, but information is obtained about several horizons.

III.3 Trimmed Method

The trimmed mean is an interpolation between the simple average and the median. It is an appealing simple, rank-based combination method that is less-sensitive to outliers than the simple average approach, and has been proposed by authors, such as Armstrong (2001), Stock and Watson (2004), and Jose and Winkler (2008). Trimmed mean combination forecast is employed when individual forecasts have large errors that emanate from miscalculations, errors in data, or misunderstandings. This may require throwing out the high and low forecasts, which make it speculative in nature. A trimmed mean is desirable if one combines forecasts, resulting from five or more methods. In this paper, trimmed mean combination forecast is computed by averaging the forecast of the first and second models.

IV. Data Set and Forecasting Models
IV.1 Data Set

The author employs monthly frequency data, covering the period 2001M1 to 2017M10, on the following variables of interest: headline inflation; headline inflation excluding energy and food; education CPI; transport CPI; housing CPI; communication CPI; official exchange rate of naira to dollar; and Premium Motor Spirit (PMS). Figure 1 shows the trend of Headline, core and food inflation in Nigeria, showing the periods of volatilities up to 2009 and periods of relative stability of these variables from 2010 to 2016, before the economy went into recession. The breakdown of inflation into its components helps in understanding its behaviour and provides better understanding on how best to forecast the components. Empirically, it has been shown that, in the short-run, the performance of aggregate inflation forecast is less than that of aggregated component forecast (Hubrich, 2005; Stock and Watson, 2004). This reason may be due to the fact that the information contents in the

disaggregated CPI components are more than the aggregated CPI, which make its forecast performance better than the aggregated inflation forecast.

Figure 1: Headline, Core and Food Inflation (Per cent)
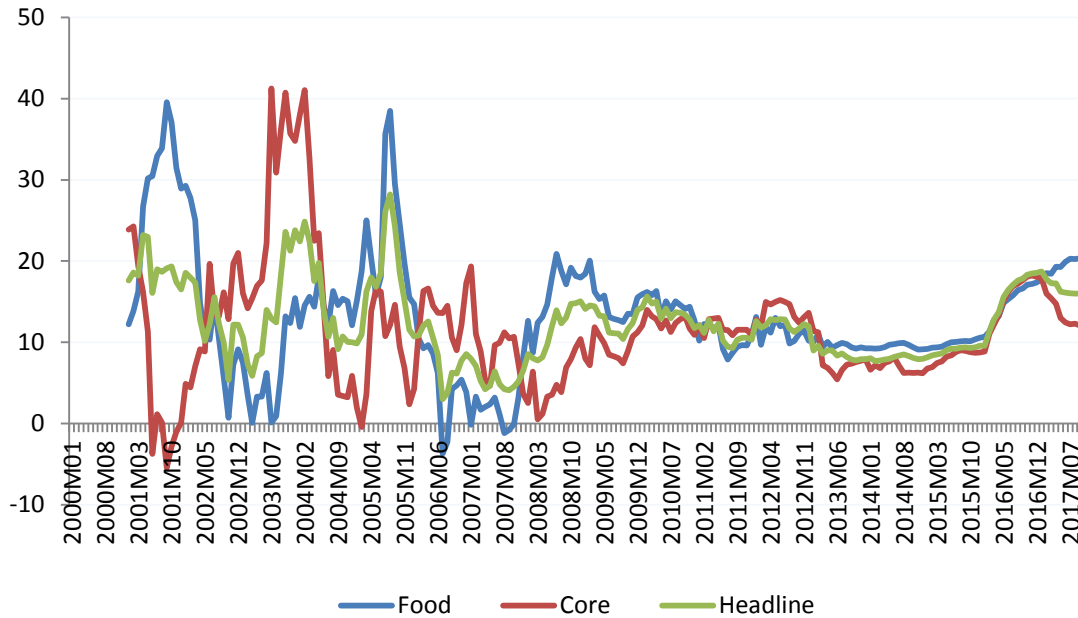
IV.2   Models Specification

In this paper, four models were estimated: two univariate and two multivariate models.

IV.2.1   Random Walk (RW)

One simple benchmark is a random walk model that is found to forecast pretty well. It is simple, but yet the most important model in time series forecasting. The model assumes that in each period the variable takes a random step away from its previous value, and the steps are independently and identically-distributed in size. If the random walk model predicts that the value at time "t" will equal the last period's value plus a constant, or drift (a), and a white noise term (ε_t), then the process is random walk with a drift. However, if the constant term in the random walk model is zero, it is a random walk without drift.

According to Clements and Hendry (2002), random walks are robust to common forms of structural change, particularly, the intercepts shift. The form of this model is given by:

$$h_t = h_{t-1} + \varepsilon_t \qquad\qquad (4)$$

where h_t is the headline inflation or core inflation.

The h-step ahead forecast from this model is in the form:

$$E(h_{t+h\backslash t}) = h_t \tag{5}$$

Where $E(h_{t+h|t}) = E(h_{t+h} \backslash H_t, h_{t-1}, ...)$ is the h-step ahead forecast.

IV.2.2 Autoregressive Integrated Moving Average (ARIMA) Model

First attempt to study time series, particularly in the 19th century, was championed by Yule (1927), who postulated that every time series could be seen as the realisation of a stochastic process. With this notion, a number of time series methods were developed since then. Yule, first formulated the concept of autoregressive (AR) and moving average (MA). Box and Jenkins (1970) formulated an approach that was coherent, versatile three-stage iterative cycle for time series identification, estimation, and verification. The discovery of the computer, however popularised the use of autoregressive integrated moving average (ARIMA) models and their applications in many areas of science.

The ARIMA methodology is premised on the idea that any stationary stochastic process can be approximated correctly by autoregressive moving average (ARMA) process. For instance, if we assume that a process is integrated of order one, an ARIMA model of order (p, 1, q) can be expressed in the form:

$$\Delta h_t = \alpha_1 \Delta h_{t-1} + \alpha_2 \Delta h_{t-2} + ... + \alpha_p \Delta h_{t-p} + \mu_1 h_{t-1} + \mu_2 h_{t-2} + ... + \mu_q h_{t-q} \tag{6}$$

where p and q give the number of autoregressive and moving average terms, respectively; Δ represents the first difference; and μ_t is the error term, which is assumed to follow a white noise process, with constant variance.

IV.2.3 Autoregressive (AR) Model

AR model is of the form:

$$h_t = \alpha_0 + \sum_{i=1}^{p} \alpha_i h_{t-i} + \varepsilon_t \tag{7}$$

Where h_t is headline inflation or core inflation, while lag order p is chosen by using the Akaike Information Criterion (AIC). The forecasts from the VAR model are computed, recursively by

$$E(h_{t+h\backslash t}) = \alpha_0 + \sum_{i=1}^{p} \alpha_i h_{t+h-i} \tag{8}$$

Where $h_{t+h-i} = E(h_{t+h-i\backslash t})$, if t+h –i >t and h_{t+h-i} otherwise. The lag order, p, is selected, using the AIC. Two types of VAR models were used to generate forecasts. The first model (unconditional VAR), comprised headline, food and core inflation, but excluded

exogenous variables on which the forecast was conditioned. This model was included in the forecast combination scheme, due to its simplicity, by taking into consideration the interrelationship and second-round effects between the different components of inflation (Hubrich and Skudelny, 2016).

The second model (conditional VAR) did not incorporate food and core inflation, but included exchange rate (interbank rate) and the Premium Motor Spirit (PMS)[1] as exogenous variables. In this model, forecast errors were reflected as errors in the assumptions. The conditional VAR complemented the model set, since it took into consideration only the supply side of the economy and some other important determinants of inflation (Hubrich and Skudelny, 2016). However, it is important to note that VARs are among the class of models with the least forecasting potential, due to overparameterisation. Greater attention is placed, sometimes on the forecasting potential of the identified models and attached more weight to specification tests, including the robustness of forecasting performance, with respect to lag order and forecasting evaluation period.

IV.3   Evaluation Procedure

To evaluate the historical performance, out-of-sample forecast of the variable of interest (headline or core inflation) is assumed and computed as follows:

$$h_{t+h}^{h} = \hat{h}_{i,t+h \backslash t}^{h} \tag{9}$$

The combination forecasts, which are weighted average of individual forecast, are computed as:

$$f_{t+h \backslash t} = \sum_{i=1}^{n} w_{it} \hat{h}_{i,t+h \backslash t}^{h} \tag{10}$$

Where $f_{t+h \backslash t}$ is the combination forecast, w_{it} is the weight on the ith forecast in period t, which depends on historical assessment of the individual forecast, and n is the number of forecast in the model. To assess the historical performance, the study is divided into three periods. The observations prior to date T_0, are only used for estimation of the coefficients in the individual forecasting regression (and are varied, depending on whether it is pre- or post-crisis period). The individual pseudo out-of-sample forecasts are computed, starting from period T_0. The recursive MSFE of the ith individual forecast, computed from the start of the forecast period, through date t, is as follows:

$$MSFE_{it} = \frac{1}{t - T_0 - 1} \sum_{s=T_0}^{t} (h_{s+k}^{k} - \hat{h}_{i,s+k|s}^{k})^2 \tag{11}$$

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[1] Evidence has shown that PMS significantly explains inflation behaviour in Nigeria. See Mordi et al., (2012).

The pseudo out-of-sample forecasts for the combination forecasts are computed over $t = T_{1,...,}T_2$.

V.   Models Estimation and Results

VI.1   Empirical Results

The four inflation forecasting models- AR, ARMA, conditional VAR and unconditional VAR- for both headline and core inflation were compared. The core inflation is computed as headline inflation, excluding food and energy. In the second step, the results of the different forecast combination methods (shrinkage forecasts, trimmed forecast and inverse mean square error forecast) are presented for full period, pre- and post-Global financial crisis periods.

Figure 2 shows the forecast for the pre-Global financial crisis, which indicates that AR and ARMA performed poorly in tracking the headline inflation; whereas unconditional VAR appeared to mimic the actual headline inflation more accurately, when food and core inflation were included as explanatory variables. This is followed by conditional VAR, when PMS and exchange rate (BDC) are included as explanatory variables.
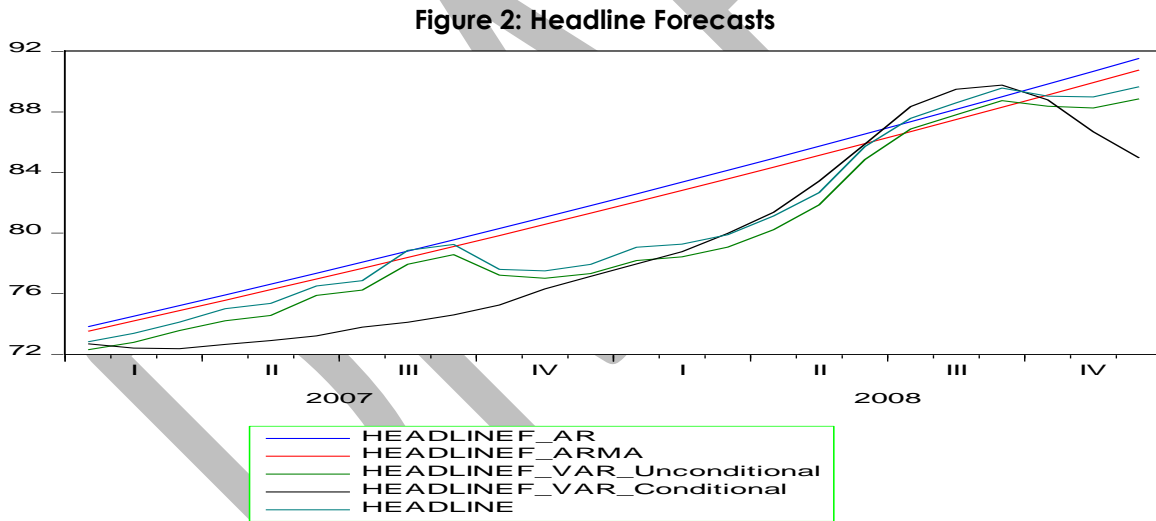
Figure 2: Headline Forecasts

Figure 3 reveals the RSME for headline inflation for pre- and post- crisis period, including the full period. For the full period (2000 - 2017), it is observed that the conditional VAR performed, poorly relative to other models. The relatively weak forecast performance of conditional VAR, for the full period, may be due to the difficulty in forecasting energy and food inflation. Unconditional VAR comes out to be the best model for the full period, followed by ARMA with the lowest forecast error. Similarly, for the pre- and post-crisis (2000-2006) and (2009-2017) periods, respectively, the unconditional VAR still performed best, followed by ARMA. However, conditional VAR outperformed AR during these periods. The policy implication is that unconditional VAR appears to be the best model for forecasting headline inflation, irrespective of whether it is crisis or normal period.

The result is quite different for core inflation (when food and energy are excluded from headline inflation). When considering the pre-crisis period (2000- 2006), for instance the conditional VAR model performed better than other models. However, the unconditional VAR appears to be the best model to forecast core inflation in the post-crisis (2009-2017) period. However, conditional VAR performed poorly for the full period (2000-2017); while AR and ARMA come out to be the appropriate models to forecast core inflation. The implication is that no single model can predict inflation accurately, in the presence of structural breaks.

Figure 3: Results for Univariate and VAR Models for Headline Inflation using RMSE
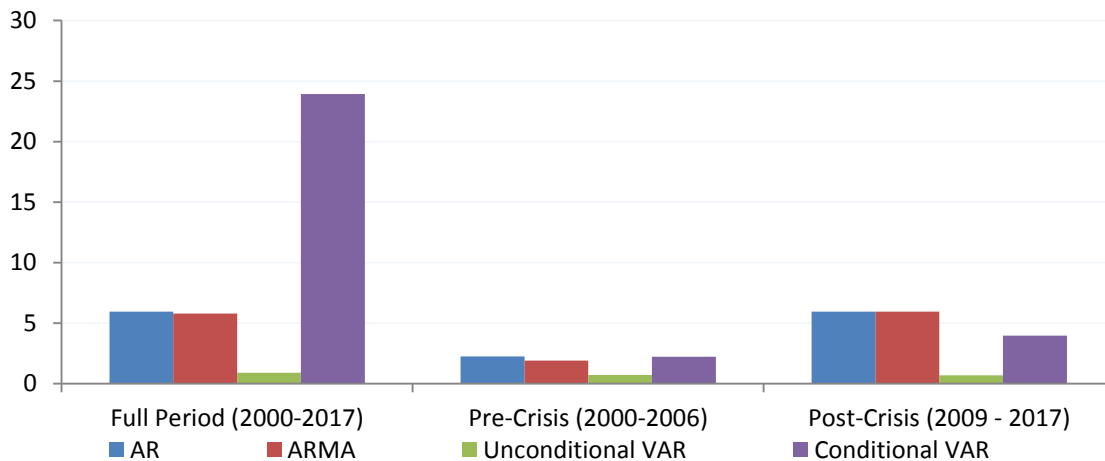
V.2   Core Inflation Forecasts

For core inflation, the ARMA model outperformed the other models, when covering the full sample period (2000- 2017), followed by the AR model. Conditional VAR performed poorly, as shown in Figure 4. However, for the pre-crisis (2000-2006), the conditional VAR model turns out to be the best model, while the unconditional VAR model performed poorly, as indicated by the RMSE.

Figure 4: Results of Univariate and VAR Models for Core Inflation using RMSE
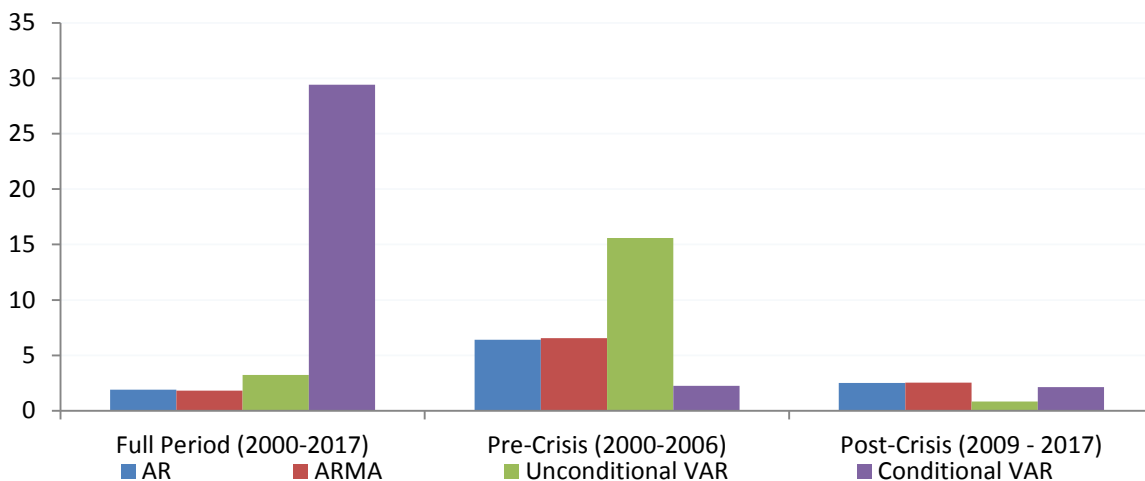
Comparing the forecast of headline with core inflation, the unconditional VAR performed better than core inflation, for the Headline inflation for all the periods. This could be due to the fact that the past movements of all sub-components of the headline inflation explained the current movement for each of them separately, since core inflation is also explained by food and energy prices, although not adequately.

V.3   Combination Results

In this section, an attempt is made to compare the performance of three methods of forecast combinations for the pre- and post-crisis periods, including the full periods. For the first combination (shrinkage forecast), equal weights are attached to the individual models; while in the second combination, trimmed weights are used by selecting AR and unconditional VAR. The third combination employs relative weights, based on inverse mean square errors. Figures 5 summarises the detailed results. For all the three periods, the third combination, which used relative weight method, outperforms the trimmed and shrinkage forecasts. However, by including data generating process (DGP)[2], inverse of mean square errors (MSE) forecast comes second, followed by shrinkage forecast.

Figure 5: Forecast Combinations of Headline Inflation using RMSE
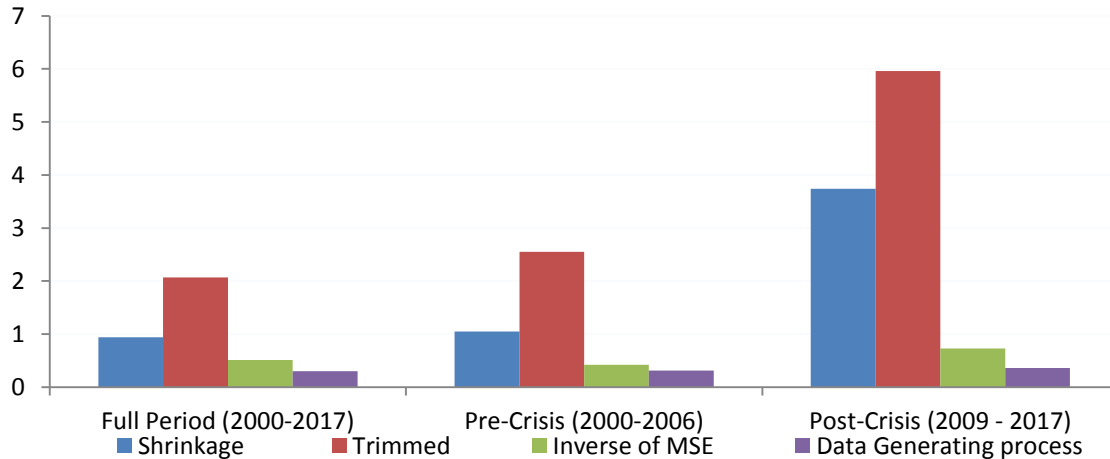
For the headline inflation, it appears that the shrinkage scheme, which gives equal weights to individual models, performs better than the trimmed methods. The simple average method records lower forecast error, which compares with the trimmed method. However, the forecast performance is improved by taking the inverse of MSEs weights.

Similar results are observed for core inflation (see Figure 6). For the full period (2000 - 2017), inverse of MSEs forecast performs best, followed by trimmed forecast. Shrinkage forecast performs poorly for these periods. The DGP does not improve either. For the pre- and post-crisis periods, shrinkage forecast performs better than the trimmed method (that used AR

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[2] The data generating process is the true underlying phenomenon that is creating the data. The model attempts to describe and emulate the phenomenon, though imperfect. Thus, the data generating process may change over time, as historical data become outdated.

and ARMA). This shows that most models outperform the AR in the pre- and post-crisis periods. It could be inferred that the AR is relatively good model for forecasting the volatile component of inflation over a period that is mainly characterised by a trend increase in energy prices, while the individual models, that incorporated partly energy prices (like PMS), do better in periods with higher volatilities of energy prices. However, for the pre- and post- crisis periods, including the full period, inverse of MSEs came out best. Overall, these results suggest that forecast combination improves inflation forecast model significantly in terms of RMSE.

Figure 6: Forecast Combinations of Core Inflation using RMSE
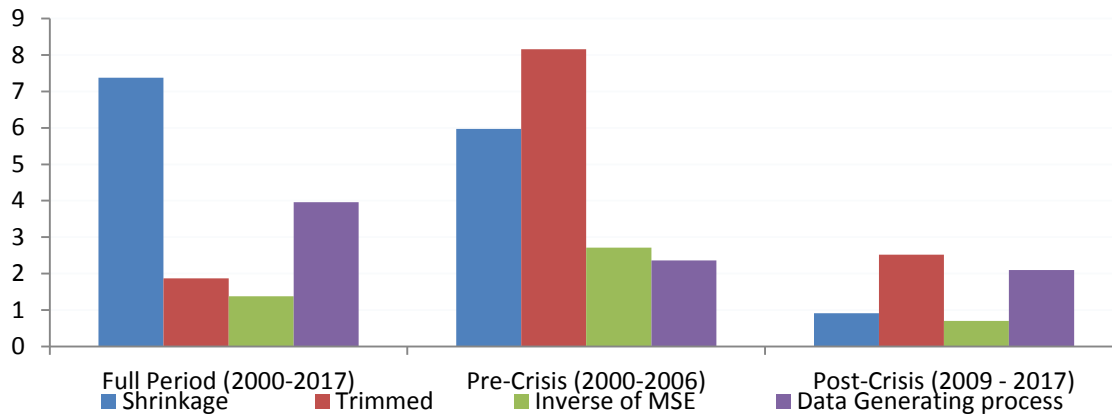
VI.   Summary of Findings and Conclusion

The behaviour of inflation, particularly during the crisis period, necessitated the examination of the modelling techniques for forecasting inflation in Nigeria. Thus, the paper employs two univariate and two multivariate VAR models to forecast inflation in Nigeria, and further evaluates different forecast combination methods for headline and core inflation. The paper also examines the possibility for variation of forecast accuracy of forecast combination methods, in the presence of structural breaks, particularly during the Global financial crisis, as well as normal times. The key findings of the study are as follows. First, the unconditional VAR model appears to be the best model for forecasting headline inflation, irrespective of whether it is crisis or normal period; second, no single model can predict inflation accurately well, in the presence of structural breaks; and thirdly, the relative forecast performance method (using inverse of mean square errors) outperforms the trimmed and shrinkage forecast methods; also this method was good for forecasting headline and core inflation in both the pre- and post-crisis periods; moreover, forecast combination methods shows reasonably high forecast power for both headline and core inflation; lastly, the best model for inflation forecasting varies, depending on whether we are forecasting headline inflation or core headline, and the period under consideration.

The paper thus, concludes that forecast combination, in general, has the potency to hedge against bad forecast performance from single models, thereby making the forecast more robust. However, in the presence of crisis, it may not necessarily improve over the individual or single forecast model.

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Government Borrowing: Implications for Macroeconomic Stability and Growth in Nigeria

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Abstract

This paper empirically examined the dynamics of government borrowing on macroeconomic stability and growth in Nigeria, from 1991Q1 to 2016Q4, using a structural vector autoregressive (SVAR) model. The results revealed that government debts (consolidated, external and domestic) had negative impact on growth, by raising the interest rate but positive effect on macroeconomic stability through the moderating impact of external debt on exchange rate. The paper however, concluded that domestic borrowing had a detrimental effect on macroeconomic growth, while external borrowing had net stabilising benefits. It therefore, recommended that, government should place less emphasis on domestic borrowing.

I.   Introduction

Government borrowing is one of the primary sources of bridging resource gap to stimulate economic activities by the fiscal authorities, particularly in the developing and emerging economies. In this regard, many of these countries recourse to either or both domestic and external funds in financing infrastructure and other critical sectors of the economy. However, imprudent borrowing may become distortionary, particularly, when it narrows the fiscal space and crowds out private sector access to domestic credit, thereby amplifying the vulnerabilities of the economy (Sutherland and Hoeller, 2012).

Nigeria's borrowings, particularly external loans, and the attendant debt burden, since the early 1980's up until 2003, were a major source of macroeconomic distortions to the economy. Most part of the period was characterised by spiraling inflation, financial repression, interest and exchange rates misalignment, high rate of unemployment and economic stagnation. These economic conditions remained precarious until the implementation of government reforms that commenced in the early 2003, and subsequently culminated in the debt relief that resulted in the cancellation of the bulk of the country's US$30.85 billion external indebtedness in 2006. The reforms were undertaken following the realisation that sustained economic growth is only possible within a stable

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macroeconomic framework in which the fiscal policy plays a key role. Thus, following the Paris Club debt deal, the country's burgeoning external debt declined, significantly to about US$3.5 billion in 2007 and created the much needed fiscal space for macroeconomic stability and growth.

However, in the last one decade, government borrowing had assumed an upward trend, as both the domestic and external loans had risen, significantly. The increase was due, in part, to the huge outlay in rebuilding the country's dilapidated critical infrastructure and the need to plug the shallow fiscal space, created by the sharp decline in crude oil price in the second half of 2014, coupled with the disruption of crude oil production in the Niger Delta region, which hampered exports. The price of crude oil declined asymptotically from a peak of US$114 per barrel, in the second half of 2014, to a trough of US$28 per barrel, by the first quarter of 2016 and resulted in a drastic reduction in the Federation revenue over the period. Consequently, Federal government retained revenue, for the first quarter of 2016, amounted to ₦505.07 billion, against the budget benchmark of ₦1.01 trillion (CBN, 2016); indicating over 50.0 per cent decline in revenue. As government revenue declined steadily, its expenditure remained sticky downwards, which necessitated the implementation of some remedial measures, including expenditure rationalisation, widening of tax base and efficient revenue collection, to improve the fiscal space.

Notwithstanding, the financing gap remained, and created the basis for continued borrowing, as public debt grew by 90.8 per cent to about ₦14.5 trillion between end-December 2012 and end-December 2016. Similarly, public debt service at end-December 2016 stood at ₦1.34 trillion (DMO, 2017) and accounted for over 20.0 per cent of the FGN 2016 Budget; thereby stifling government fiscal operations.

The resurgence of large domestic and external borrowings, by the government, has, therefore, rekindled further interests on the desirability or otherwise of public sector borrowing in Nigeria. Eze and Ogizi (2016), Obademi (2012) and Egbetunde (2012) found a positive impact of consolidated government borrowing on the Nigerian economy. On a disaggregated level, Anyanwu and Erhijakpor (2004) observed a positive relationship between domestic debt and economic growth. Similarly, by focusing on external loans, Eze and Ogizi (2016), Hassan and Mamman (2013) and Olusegun et al., (2013), found a positive relationship, thereby suggesting that external borrowing induced economic growth. However, Hassan (2015), Ijeoma (2013), and Ezeabasil et al., (2011) found a negative relationship.

Generally, the need to further understand the debt dynamics is important for aligning fiscal and monetary policy objectives, to provide insight into optimal policy outcomes. The concern with borrowings stems largely from the associated problems of huge fiscal deficit, high and rising public debt, debt service payments and the apparent disincentive created by a large public sector, among others.
Past studies have investigated the influence of either domestic or external debt on economic growth and macroeconomic stability. This paper represented a departure from others, as it examined the influence of external and domestic borrowing on economic growth and macroeconomic stability. In addition, the paper employed recent quarterly

data series, compared to annual data used in past studies. This is important because a key component of the Federal government budget, which is capital expenditure, is executed on quarterly basis. Given the provision of the Fiscal Responsibility Act FRA 2007 that limits the use of borrowing to capital expenditure, it is believed that quarterly data would capture the dynamics of debt in Nigeria, effectively. The objectives of this study, therefore, are to: examine the effects of domestic and external borrowings on macroeconomic stability and growth; and ascertain the dynamics and feedback effects, if any, between public debt and macroeconomic stability and growth in Nigeria.

Towards this end, the study adopted a structural vector autoregressive (SVAR) estimation technique, which explicitly traced the impact of fiscal shocks to government borrowing on the macroeconomy. The degree of response of the selected macroeconomic variables to innovations in government borrowing determines their stability.

The rest of the paper is organised as follows; Section 2 discussed the review of literature, encapsulating the theoretical and empirical reveiws, while Section 3 provided an overview of government debt and the institutional framework for borrowing in Nigeria. Section 4 presented the data and methodology of the study, while Section 5 contained data diagnostics and the empirical results. Section 6 concluded and highlighted the policy implications.

II.   Literature Review
II.1   Theoretical Review

Public debt has, perhaps, generated the most controversies among economists, academia and policy makers in the history of modern government. Early economists, such as Smith (1776), Ricardo (1820) and Mill (1848) had challenged the government on the productiveness or otherwise of government borrowing. Smith (1776) was vehemently against government borrowing, because he believed that it was counter-productive to private sector investment and wealth accumulation for the nation. He argued that public debt destroyed existing capital by reducing savings and moving a portion of the annual produce, earmarked for the maintenance of productive labour, towards unproductive labour. He further stated that public borrowing hampered future investment because of the need for debt redemption, which would lead to increased taxation, domestic capital flight and the devaluation of the currency, with negative effects on domestic producers (Smith, 1776). Smith agreed, however, that public debt could be accumulated only in periods of emergencies, pestilence, such as wars and natural disasters.

Ricardo (1820) corroborated Smith's position that government's expenditures were unproductive and financing them through public borrowing would reduce funds for productive private sector investments and the ability of the nation to accumulate wealth. Although, he admitted that financing the public deficit through taxation might result in same effects, as public borrowing, nevertheless he posited that "… the ruinous results of public borrowing in society's capacity to accumulate are even worse than those caused by taxation" (Tsoulfidis, 2011, pp.3). According to Ricardo, this is because borrowing drained savings meant for productive investment, while taxation lowered current incomes,

which might or might not be invested. Consequently, he postulated that taxation and not borrowing should be used for government unproductive expenditures, while borrowing or taxation could be used to finance productive government expenditure.

Mill (1848) generally argued along the line of Smith and Ricardo, but noted that public debt could be beneficial for a nation if the loan is from foreign sources, unproductive domestic savings or domestic savings that would have otherwise been invested in foreign countries. This was hinged on the premise that when government borrowed from surplus savings, the pressure on interest rate reduced, but increased when government competed with the private sector over funds that could be used for productive ventures. In order words, government borrowing from productive investible funds was tantamount to reducing the accumulative capacity (income) of a nation.

Keynes (1936) noted the importance of government during the great depression and postulated that government intervention in the economy was inevitable to stimulate aggregate demand that would eventually reflate the economy. Keynes maintained that the marginal propensity to consume (MPC) of individuals, which was positive and less than one, would create the multiplier that would raise output by more than the rise in consumption. Thus, Keynes advocated for expansionary fiscal policy to promote output growth and increase employment. These proposition formed the main tenet of the Keynesians believe that government should run deficits in the period of economic slowdown and budget surpluses during boom. They posited that business cycles were integral characteristics of capitalism and that the accumulation of surpluses during booms would enable governments to engage in temporary deficit spending to combat recession without creating the long-term danger of exploding national debt (Filger, 2015). Therefore, increasing the deficit by a certain amount would cause output to increase by the spending multiplier. In addition, with increasing output, effective money supply would rise as businesses would borrow more. The crowding-out created by the government would be eliminated by the banking system's desire to create new money to fund the increased business borrowing (Perry, 2014).

Buchanan (1976) proposed the "Ricardian Equivalence", a postulate that when government tries to stimulate the economy by increasing debt-financed government spending, the aggregate demand remains unchanged. He argued that this was due to the fact that the public would save its excess money to pay for the expected future tax increases by the government to pay off the debt. Barro (1974) model, posited that consumers and agents are not fooled when government reduces taxes and finance the deficit by raising bonds. This is because they know that government must service the debt and since debt has no infinite maturity, it must be repaid in the future. Thus, for a given level of government expenditures financed by borrowing, future taxes must be increased by the government for debt service and the eventual redemption of the debt. As a result, consumers do not view bonds as an increase in net wealth; rather they will deduct the present value of the future taxes from it by reducing current consumption in favour of higher savings. Consumers are thus debt-tax neutral, that is, indifferent between paying taxes now and repaying public debt in the future. Overall, the central tenet of the Ricardian equivalence is that consumers and economic agents increase savings in

anticipation of future tax increases, which brings about a reduction in private sector spending that is equivalent to the increase in government spending and, therefore, no effect on aggregate demand.

The Neoclassical economists advocated that government intervention may become necessary in an economy where market imperfections and price rigidities prevent the actual output from attaining the equilibrium level. However, they cautioned that such a fiscal impulse was effective only in the short-run and must be within a "reasonable" level of deficits. This was due largely to the fact that a relatively-excessive bond-financed budget deficit would reduce private savings, which, in turn, raises interest rates and cuts back private investments. Frank and Bernanke (2001) opined that when government fund a deficit through government bonds, interest rates would increase across the market. This crowding-out of credit in the financial markets would create a reduction of the capital stock, which consequently impact on real wages and economic growth.

II.2   Empirical Literature

Several empirical studies have been undertaken to examine the impact of government borrowing on the economy, in different jurisdictions. These studies had been conducted using various methodologies, variables and time-frame with different outcomes. Sunge and Matsvai (2015) applied the bound testing approach to co-integration and error correction model (ECM) within the context of the auto-regressive distributed-lag (ARDL) framework to annual data from 1980-2013. Their findings could not support the Ricardian equivalence hypothesis in Zimbabwe. The results, however, showed a long-run association from gross domestic product (GDP), government expenditure, tax revenue, total public debt and interest payments to private consumption. Thus, giving credence to the Keynesian view that public debt is an important fiscal policy tool.

Also, Adji and Alm (2016) adopted the ARDL and invalidated the Ricardian equivalence hypothesis in Indonesia for the period 1972-2003. Their results, however, supported the neoclassical view that debt finance would increase interest rates, retard exports and stimulate imports through currency appreciation. Similarly, their findings corroborated the Keynesian view that debt finance would increase consumption in favour of future consumption. Traum and Yang (2010) employed the Bayesian DSGE framework on quarterly data, spanning 1983Q1 to 2008Q1 to test the crowding-out effects of government debt for the United States. They observed that the crowding-in or crowding-out of private investment in the short-term depended on the fiscal shock that prompted the debt accumulation. They noted that the degree of crowding-out was also a function of the monetary authority's responses to inflation and output fluctuations in the course of distortionary financing to redeem the public debt.

Sarwar (2015) used annual data, spanning 1970–2014 to test the relationship between budget deficits and macroeconomic performance in Pakistan, by incorporating key macroeconomic variables into a demand for money function that was estimated with the Johansen co-integration technique. The results rejected the Ricardian equivalence in favour of the Keynesians theory in Pakistan. Also, Teboho et al., (2017) applied the ARDL co-integration methodology on annual data for two sample periods, 1980–2014 and 1988–

2014, and could not find evidence to support the Ricardian equivalence hypothesis in Lesotho. The study discovered that an increase in government debt or government expenditure decreased household consumption per capita. Thus, their results also invalidated the Keynesian view that fiscal policy is an effective tool for economic stabilisation, but supported the classical view that government debt does not have a positive impact on macroeconomic activities.

Khalid (1996) investigated the validity of the Ricardian Equivalence Hypothesis (REH) and the sources of deviation for a large sample of developing countries. Although the results were mixed, they found that the presence of liquidity-constrained individuals might be the source of deviation from the REH. He found also that public spending was a poor substitute for private consumption, implying that temporary increases in public spending may have some expansionary effect on aggregate demand. Carrasco (1988) tested the crowding-out hypothesis for the United States with quarterly data for two sub-periods, 1970-1982 and 1970-1997 on Cebula's (1985) model. The model related the aggregate investment/GDP ratio to budget deficit/GDP ratio, inflation rate, rate of corporate profits, index of expected versus actual selling prices and retail trade. The results were mixed, as the first model corroborated the Neo-Classical view that an increase in budget deficits would crowd-out private investment. The second model, however, suggested that Cebula's model was not robust enough when the variables were de-trended over the time period.

Several studies (Obademi, 2012; Egbetunde, 2012; Sulaiman and Azeez, 2012; Aminu, et al., 2013; Eze and Ogizi, 2016; and Essien et al., 2016) have also investigated the potential influence that public debt has on economic growth and its impact on macroeconomic stability in Nigeria. These studies differ from those that employed simple methodologies to those that utilised relatively complex methods of analysis. The time-frame and characteristics of the series also vary across studies. As expected, the results and conclusions were also mixed. The most interesting issue in the debt-growth studies is whether or not causality exists between them and in what direction. While the former tells policy makers about the extent of influence debt has on the economy, the latter provides information on whether or not that influence is negative or positive; thus, enabling the design of policy responses where needed.

Obademi (2012) observed that public debt had positive impact on economic growth, particularly in the short-run. Egbetunde (2012) utilised Granger-causality test in the context of a vector autoregressive (VAR) model to investigate the nexus between public debt and economic growth. He found positive bi-directional causality between domestic and external debt, with growth and concluded that government borrowing was good for economic growth. Also, Eze and Ogizi (2016) used ECM to investigate the implication of deficit financing on economic stability in Nigeria from 1970-2013. They found that external debt, non-bank domestic debt and exchange rate had a significant and positive impact on macroeconomic stability. Ways and Means Advances, and banking system financing, however, had negative impact on economic stability. They concluded that government external debt and domestic debt financing, through the non-bank public, was beneficial to economic stability, while domestic debt financing, through the banking system, as well

as Ways and Means Advances, reduced economic growth and caused macroeconomic instability.

Essien, et al., (2016) adopted the VAR methodology, using annual data from 1970 to 2014 to examine the impact of public sector borrowing on prices, interest rates, and output in Nigeria. They found that shocks to external debt increased prime lending rate with a lag. Also, that the level of external and domestic debt had no significant impact on both the general price level and output. Matthew and Mordecai (2016) applied the ECM to examine the impact of public debt on economic growth and development in Nigeria from 1986-2014. The study revealed that external debt stock and external debt servicing had insignificant and negative relationship with economic growth. Domestic debt servicing, however, had significant, but negative relationship with economic growth, while domestic debt stock had a positive and significant relationship with economic development. Also, Aminu, et al., (2013) applied ordinary least squares (OLS) to annual data from 1970-2010 and found negative relationship between external debt and economic growth in Nigeria, while the impact of domestic debt was positive. They concluded that external debt was inimical to the economy and recommended that government should rely more on domestic debt in stimulating growth.

Hassan and Mamman (2013) applied the OLS to annual data to examine the contribution of external debt to economic growth in Nigeria from 1970-2010 and concluded that external debt was important for economic growth. Similarly, Olusegun, et al., (2013) employed OLS on annual data from 1981-2009 to examine the impact of external debt on economic growth in Nigeria and established a positive relationship. Also, Sulaiman and Azeez (2012) applied OLS on annual series from 1970-2010 and found that external debt had positive effect on the economic growth in Nigeria. However, Mbah et al., (2016) using the ARDL bound testing approach to co-integration and error correction models for the periods 1970-2013, established a negative relationship between external debt and economic growth. Hassan et al., (2015), used the OLS to examine the effect of government debt on economic growth in Nigeria from 1986-2013 and found that external debt had a negative and insignificant impact on economic growth. They concluded that external debt had contributed minimally to real gross domestic product, over the years, and recommended that government should curb further external borrowing to forestall adverse effects on the economy.

In addition, using the ECM, Ezeabasili et al., (2011) found a negative but significant relationship between external debt and economic growth in Nigeria from 1975-2006. Specifically, they noted that a 1 per cent increase in external debt reduced the GDP by 0.027 per cent and concluded that external debt accumulation should be matched with timing of repayment to ameliorate its impact on economic growth. Ogunmuyiwa (2011) used the vector error correction model (VECM) to investigate whether or not external debt promoted economic growth in Nigeria from 1970-2007. The study indicated no causality between external debt and economic growth during the period.

In the study by Anyanwu and Erhijakpor (2004), OLS was applied on annual data spanning 1970-2003 to investigate the growth effects of domestic debt accumulation in Nigeria. The study showed that past domestic debt had positive and significant effect on economic

growth. Specifically, they stated that a 1 per cent increase in past accumulated domestic debt, increased economic growth by 0.30 per cent. Ozorumba and Kanu (2014) disaggregated Nigeria's domestic debt into types of instruments and used them as explanatory variables in a multiple regression framework, with GDP as the dependent variable. The results suggested that FGN bond impacted positively on growth, while development stock had inverse relationship with economic growth in the short-run. Treasury Bills, however, had positive influence on growth in the long-run. Nwannebuike et al., (2016) applied OLS on annual time series on GDP, external debt stock, debt service payment and exchange rate to ascertain the impact of external debt on economic growth in Nigeria from 1980-2013. They discovered that external debt had a positive and significant relationship with GDP in the short-run, but a negative relationship in the long-run. External debt service payment was also found to have a negative relationship with economic growth, while its relationship with exchange rate was positive. Ijirshar, et al., (2016) applied the ECM on annual data series from 1981-2014 to examine the relationship between external debt and economic growth. Their findings showed that external debt stock impacted positively, while external debt service impacted negatively, on economic growth both in the long-run and the short-run.

Furthermore, Adeniran, et al., (2016) adopted the VECM to annual data spanning 1980-2014 to examine the impact of external debt on economic growth. They established uni-directional causation from external debt service payment to real GDP and from real GDP to external debt stock. However, they discovered that external debt service payment had negative impact on the growth of real GDP per capita during the study period. Chinaemerem and Anayochukwu (2013) also applied VECM to a disaggregated external debt stock series from 1969-2011 to explain the impact of external debt financing in Nigeria. The study revealed that the London debt financing had positive impact on economic growth, while the Paris debt, multilateral and promissory note, had inverse relationship with growth. Richard (1991), used a two-stage least squares simultaneous equation model and estimates of key monetary and real variables for the 1975-1986 period and found that external debt had no statistically significant influence on the naira exchange rate in Nigeria.

II.3   A Framework of Analysis

Overall, the classical and neoclassical schools central idea is that expansionary fiscal policy reduces national output and economic growth by reducing aggregate demand, private savings, but raises the interest rates. Consequently, the increase in interest rates reduces private investments and real wages. It also reduces the net exports by attracting foreign capital, which appreciates the domestic currency and hence makes export more expensive than import. On the other hand, the Keynesians opined that expansionary fiscal policy can stimulate aggregate demand and stir the economy towards full employment during economic recession, but creates inflationary pressures during economic boom.

A synthesis of both the classical and Keynesians positions reveals that public debt affects output. The transmission channel is obviously different, but there exist key macroeconomic variables through which the transmission of impulse from public debt to output happens. A

very critical question, regarding the relationship between public debt and output via key macroeconomic variables is: What is the direction of causality, if any? Is there a feedback relationship between public debt and output? Is there a relationship between public debt and other relevant macroeconomic variables? The answers to these questions are critical to the understanding of this study, particularly the functional form of the model to be estimated and the methodology to use.

Although it is difficult to choose a unique relationship defining public debt, key macroeconomic variables and growth in one universal theory, without being biased towards a particular school of thought, this difficulty is assuaged by the fact that a developing economy, such as Nigeria is a highly-improbable jurisdiction for testing any of those ideological theories. Thus, the best, which the Classical and Keynesians positions could do was to shed light on potential transmission channels. A more effective approach to investigating the relationships in question is to adopt an eclectic approach, where the key variables are identified and a testable hypothesis based on that, formulated. In this regard, this study has identified the following key variables and their transmission mechanism, as a basis for its testable framework: output, interest rates, inflation, exchange rate, current account balance, external debt, domestic debt and fiscal deficit.

III.   Government Borrowing in Nigeria

The Federal Republic of Nigeria (FRN) Constitution 1999 provides the legal framework for government borrowing in Nigeria. The Second Schedule of the Exclusive Legislative List (Items 7 and 50) of the Constitution confers on the National Assembly the exclusive powers to make laws that regulate domestic and external borrowing. Hence, the National Assembly is statutorily mandated to approve all domestic borrowing by the Federal Government; and all external borrowings by all the three-tiers of government in Nigeria.

III.1   Legal and Institutional Framework for Government Borrowing
III.1.1   Debt Management Office

Prior to the establishment of the Debt Management Office (DMO) in 2000, the institutional framework for debt management was characterised by duplication of responsibilities across various government Ministries, Departments, and Agencies (MDAs) which resulted in operational inefficiencies and coordination problems. As a result, debt management roles were undertaken by various MDAs, including the Central Bank of Nigeria (CBN), Federal Ministry of Finance (FMF) and Office of the Accountant General of the Federation (OAGF). The DMO (Establishment) Act 2003 provides for the establishment of the DMO as an independent government agency, responsible for managing public debt. It also empowers the DMO: to advise government on funding of its budget deficits and borrowing limits; issue guidelines on both domestic and external borrowing by the three-tiers of government and their agencies; determine the level of Federal government's contingent liabilities that may result in extra-budgetary spending; and recommend appropriate action for dealing with them (DMO, 2013). Thus, DMO was created to ensure good debt management practices through prudent sourcing of finance for government

deficits; avoid debt crisis and achieve orderly growth and development; and improve the country's borrowing capacity and efficiency in debt management.

III.1.2 The Fiscal Responsibility Act 2007

The Fiscal Responsibility Act (FRA) 2007 was enacted to provide prudent management of the national economy and ensure greater accountability and transparency in the fiscal operations of government. It offers opportunities for improved efficiency by regulating fiscal conducts and imposing limits on government spending, prohibiting certain fiscal actions and imposing debt controls by allowing borrowing for only capital projects and human capital development. In addition to providing a framework for the preparation of a Medium-Term Expenditure Framework (MTEF), which is the basis for the annual budget, the FRA makes provisions for the size of fiscal deficit, public borrowing and indebtedness. Part IX of the Act stipulates the framework for public debt management. Specifically, Sections 41 and 42 outline the following:

 i.   Borrowing limits for the three-tiers of government to be determined by the Federal government, subject to approval by the National Assembly;
 ii. Borrowings for all tiers of government should only be strictly for capital expenditure and human development and on long and concessional terms with low interest rate;
 iii. The level of public debt, as a proportion of GDP, should be maintained at a sustainable level, as prescribed by the National Assembly from time to time; and
 iv. Non-compliance with the provisions on borrowings would result to prohibition from new domestic and external borrowings, except for the refinancing of existing debts.

Any tier of government that exceeds the borrowing limit shall be brought within the limit, not later than the end of three consecutive quarters, with a minimum of 25.0 per cent reduction in the first quarter.

III.1.3 Other Legal Arrangements

Apart from the 1999 Constitution of the Federal Republic of Nigeria and the DMO (Establishment) Act of 2003, being the major legal frameworks for government borrowing in Nigeria, other supporting enactments include:

 i.   **Investment and Securities Act (ISA) 2007** provides for borrowing from the domestic capital market by the three-tiers of government and their agencies, as well as the private sector;

 ii. **Central Bank of Nigeria Act (CBN) 2007** enables the CBN to, among other things, act as a banker to the government, grant advances to the Federal Government not exceeding 5 per cent of its previous year revenue, and register, discount or rediscount bonds issued by any tier of government and their agencies;

iii. **Local Loans (Registered Stock and Securities) Act (1979)** provides for the issuance and redemption of registered stocks, Government Promissory Notes and bearer bonds. This is to enable the Federal Government raise funds;

iv. **Treasury Bills Act (1959)** empowers the Federal Ministry of Finance, through the CBN, to issue Treasury bills on behalf of the Federal Government and credit the Consolidated Revenue Fund (CRF) with the proceeds of the subscription;

v. **Treasury Certificate Act (1959)** authorises the Federal Government to raise short-term loans (less than 2 years tenor) through the issuance of Treasury certificates; and

vi. **Government Promissory Notes Act (1960)** empowers the Federal Government to issue Promissory Notes to raise any sum of money by loan or repay government debt (DMO, 2013).

III.2   Overview of Federal Government Borrowing

Nigeria has witnessed remarkable changes in the growth and structure of public debt stock over decades in line with macroeconomic fundamentals, particularly the need to bridge the financing gap in the Federal Government budget. As a result, total public debt rose from an annual average of ₦32.0 billion in 1981-1985 to ₦865.0 billion and ₦5,116.0 billion in 1991-1995 and 2001-2005, respectively. The total public debt, however, trended downwards, declining to an annual average of ₦3,343.0 billion in 2006-2010, but rose to an annual average of ₦9,600.0 billion in 2011-2016. A disaggregation of total debt stock showed that domestic accounted for the bulk of the public debt stock at an annual average of 72.0 per cent between 1980 and 1984.

Figure 1: Composition of Total Debt: 1981-2016 (₦'million)
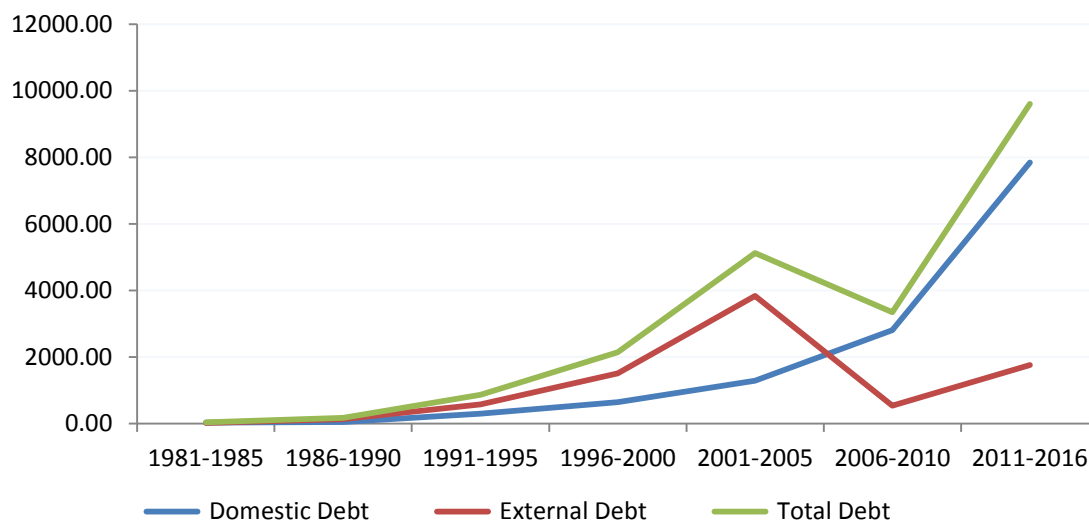
This trend was reversed from 1985-2004, as external debt overtook domestic debt and accounted, averagely, for 69.0 per cent of the total, annually. After the Paris Club debt

relief of 2005, there was another structural shift in the public debt composition in consonance with government policy of deepening the domestic bond market and accessing its financing requirements at more cost effective way. Consequently, the stock of domestic debt became predominant and accounted, averagely, for 73.0 and 83.0 per cent of the total annually in the periods, 2005-2009 and 2010-2016, respectively.

III.2.1 Domestic Debt

Domestic debt rose from ₦11.2 billion in 1981 to ₦116.2 billion in 1991 and trended upward steadily to ₦11,058.2 billion in 2016. As a ratio of GDP, however, it remained well below the acceptable international debt/GDP threshold of 40-60 per cent and averaged 9.0 per cent per annum between 1981 and 2016.

A disaggregation of domestic debt by holders indicated that for the period 1981-1985, an annual average of ₦14.0 billion (71.0%) of domestic debt was held by the banking system, while the non-bank public accounted for the balance of ₦6.0 billion (29.0%). Of the ₦14.0 billion held by the banking system, ₦8.0 billion (40.0%) was held by the Central Bank of Nigeria (CBN), while the commercial and merchant banks accounted for ₦6.0 billion (28.0%) and ₦1.0 billion (3.1%), respectively. The holding structure, however, remained unchanged for the remaining part of the review period, with the banking system maintaining its status as the dominant holder of the outstanding domestic debt instruments. During the 2001-2005 era, the quantum of non-bank public holdings increased to an annual average of ₦230.0 billion (18.0%) and the banking system holdings also rose to an annual average of ₦1,052.0 billion (82.0%) of the total. Banking system holdings further declined to an annual average of 69.0 and 59.0 per cent in 2006-2010 and 2011-2016, respectively. Within the banking system holdings, the commercial banks and the CBN accounted for an annual average of ₦239.0 billion (62.0%) and ₦143.0 billion (37.0%), respectively, for the period 1981-2005. This trend persisted as holdings by the commercial banks and CBN rose further to ₦3,903.0 billion (85.0%) and ₦510.0 billion (11.0%) in 2011–2016, while the balance of ₦200.0 billion (4.0%) was held in the sinking fund.

A further breakdown of domestic debt by instruments showed that Treasury bills accounted for ₦12.0 billion (60.0%), treasury certificate ₦4.0 billion or 21.0 per cent and development stock ₦4.0 billion or 19.0 per cent in 1981-1985. The pattern was sustained until 2006-2010, when FGN Bonds became the dominant instrument and accounted for ₦1,631.0 billion (58.0%), while Treasury Bills, Treasury Bonds and Promissory Notes constituted ₦763.0 billion (27.0%), ₦398.0 billion (14.0%) and ₦13.0 billion (1.0%), respectively, and development stocks explained the balance. FGN Bonds have continued to be the dominant instrument in the total domestic debt stock from 2010 till date.

An analysis of the maturity structure of domestic debt showed the predominance of short-term instruments of 1-2 years, followed by instruments with long-term maturity of over 10 years; while medium-term instruments with maturity of 3-5 and 5-10 years accounted for a smaller proportion during the period 1981-2005. In 2006-2010, instruments with 1-2, 3-5 and 5-10 years maturities rose from ₦1,366.0 billion(49.0%), ₦635.0 billion (23.0%) and ₦326.0 billion (12.0%) to ₦2,638.0 billion (34.0%), ₦2,384.0 billion (30.0%) and ₦2,497.0 billion (32.0%), respectively, in 2011-2016. In the same period, however, instruments with over 10 years

maturity fell from ₦478.0 billion (17.0%) to ₦327.0 billion (4.0%), showing a structural shift in the maturity structures, arising from concentration of government borrowings in longer term instruments in order to minimise the cost of deficit financing.

Figure 2: Domestic Debt by Holders: 1981–2016 (₦'million)
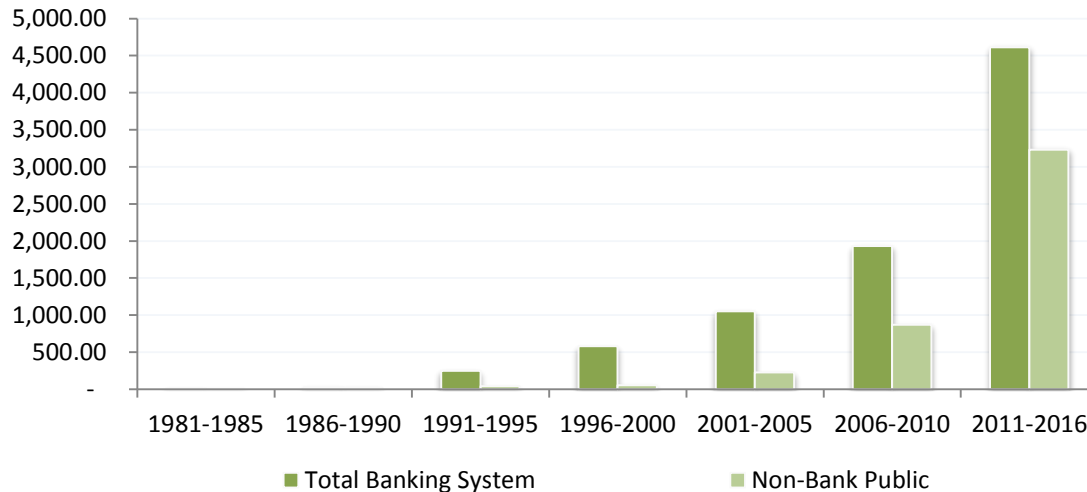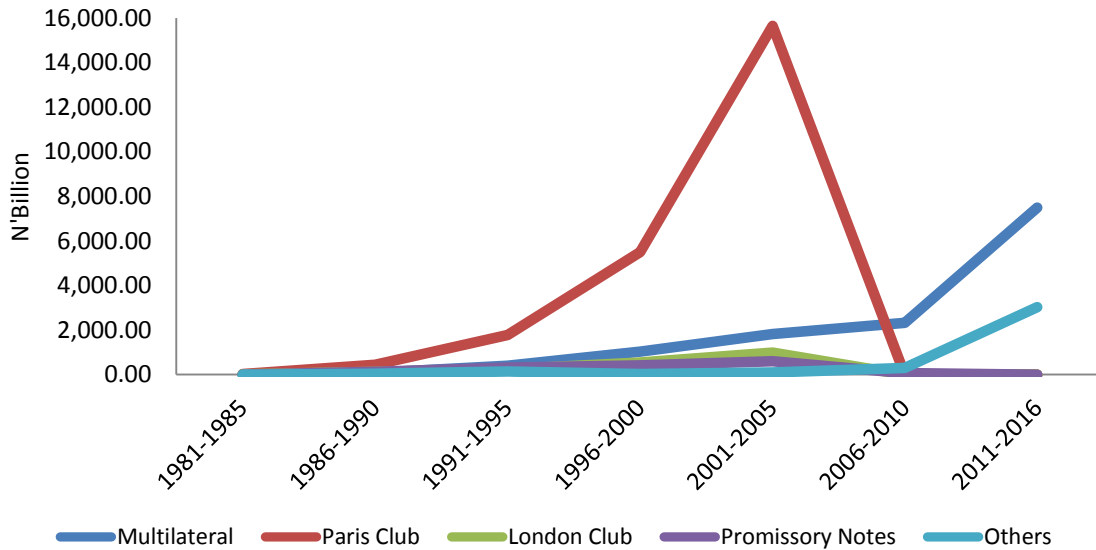

III.2.2 **External Debt**

Prior to the 1980's, the external debt stock was relatively minimal and incurred on concessional terms, without any major burden on the economy. The oil glut of the mid-1980's, however, led to the decline in government revenue and foreign exchange earnings which necessitated more borrowing from both concessional and non-concessional sources. A cursory look at the external debt stock showed that the total external debt stock of the FG rose steadily from an annual average of ₦11.0 billion (US$19.0 billion) in 1981-1985 to ₦3,835.0 billion (US$30.0 billion) in 2001-2005. It declined to an annual average of ₦539.0 billion (US$4.0 billion) in 2006-2010, but trended upward to an annual average of ₦1,753.0 billion (US$9.0 billion) in 2011-2016. As ratio of GDP, external debt increased from 7.0 per cent in 1981-1985 to 27.0 per cent in 2001-2005. It declined to 1.0 per cent in 2006-2010, but increased slightly to 2.0 per cent in 2011-2016.

A further examination of the external debt stock from 1981–1985 showed the prevalence of the Paris Club debts at an annual average of ₦6.0 billion (US$2.0 billion) or 51.0 per cent; while ₦3.0 billion (US$1.0 billion) or 30.0 per cent, ₦1.0 billion (US$0.3 billion) or 7.0 per cent, ₦1.0 billion (US$0.4 billion) or 6.0 per cent and ₦1.0 billion (US$1.0 billion) or 6.0 per cent were from the London Club, Multilateral Institutions, Others and Promissory Notes, respectively. The share of the Paris Club increased significantly to an annual average of ₦3,132.0 billion (US$24.0 billion) or 82.0 per cent in 2001-2005. The country, however, had a structural change in external debt stock composition after the debt relief initiative of 2005. The initiative led to the cancellation of 60.0 per cent of the Paris Club of Creditors, ₦2,309.0 billion (US$18.0 billion)[1] of Nigeria's total debt stock. Consequently, debts owed to Multilateral Institutions became the bulk of the total debt stock at ₦466.0 billion (US$3.0

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[1] Paris and London Clubs Debts were completely paid off in 2006, while the promissory notes were written off in 2007.

billion) or 87.0 per cent, while Promissory Notes and Others accounted for ₦13.0 billion (US$0.1) or 2.0 per cent and ₦60.0 billion (US$0.5) or 11.0 per cent of the total, respectively, in 2006-2010. In 2011-2016, the share of Multilateral Institutions declined to an annual average of ₦1,249.0 billion (US$6.0 billion) or 71.0 per cent, while Others stood at ₦504.0 billion (US$2.0 billion) or 29.0 per cent.

Figure 3: Composition of External Debt by Holders (1981–2016)

III.2.3 Debt Service

A breakdown of total debt service shows the dominance of the domestic debt component at an annual average of ₦1.0 billion or 64.0 per cent, compared with ₦1.0 billion or 36.0 per cent for external debt for the period 1981-1985. With the increase in external debt stock, the trend reversed from 1986-2005 with external debt service at ₦130.0 billion, accounting for 69.0 per cent of total debt service, while domestic debt service at ₦57.0 billion, accounted for the balance of 31.0 per cent. Similarly, owing to the 2006 debt relief, external debt stock declined, resulting to a decline in external debt service to ₦138.0 billion (18.0%), while domestic debt service amounted to ₦640.0 (82.0%) from 2006-2016. The debt service to GDP ratio stood at 1.0 and 4.0 per cent in 1981-1985 and 2001-2005. From that period it fell to 2.0 and 1.0 per cent in 2006-2010 and 2011-2016, respectively.

III.3   Recent Debt Management Policy Initiatives

To minimise the burden of debt and its constraints on the economy, the Federal Government enunciated various policy initiatives for debt management. This sub-section discusses some recent policy developments in debt management in Nigeria.

III.3.1 National Debt Management Framework

The result of the debt sustainability analysis (DSA) serves as a major input to the National Debt Management Framework (NDMF). The NDMF is a policy guideline for debt

management adopted by the DMO shortly after Nigeria's exit from the Paris and the London Club debt overhang. The first framework was developed for the period 2008–2012 and was aimed at ensuring a sustainable debt management consistent with economic growth and development. The specific objectives included: making public debt management a poverty reduction and growth instrument; maintaining public debt sustainability; and strengthening the legal, institutional and policy frameworks to ensure the efficient management of debt in Nigeria. It also contained guidelines on both external and domestic borrowing by state governments and the Federal government's On-lending or Guarantees to States, as well as their agencies (DMO, 2013).

To adhere to international best practices in debt management, a second NDMF was developed for the period 2013–2017. It consolidates the achievements of the first framework and provides a broader policy direction for the efficient and effective management of public debt in Nigeria. It also contains the policies and strategies targeted at ensuring efficiency in government borrowing and the growth and development of the domestic and international securities' markets (DMO, 2013).

III.3.2 Medium-Term Debt Management Strategy

The Medium-Term Debt Management Strategy (MTDS) was developed by the World Bank and the IMF as a systematic and comprehensive framework to help countries develop an effective medium-term (three-to-five years) debt management strategy (World Bank, 2012). It determines the appropriate composition of the debt portfolio, taking into cognisance the market environment and macroeconomic indicators. It shows government's cost and risk tradeoffs for different debt management strategies and manages the risk exposure entrenched in a debt portfolio (World Bank, 2012).

The latest MTDS for Nigeria is for the period 2016 – 2019 and was prepared by the DMO in collaboration with other government agencies. The strategy aims at guiding the borrowing decisions of the Federal government. To provide a robust debt management strategy, the World Bank/IMF Debt Management Strategy Analytical Tool was employed in simulating and comparing the cost and risk profile of different financing options, debt compositions and cost-risk trade-offs. In Nigeria, the MTDS covers Federal and state governments' external debt, as well as the Federal Government's domestic debt and financing needs. However, it does not cover state governments financing options (DMO, 2016).

III.3.3 Debt Sustainability Analysis

The Debt Sustainability Analysis (DSA) is part of the broader Debt Sustainability Framework (DSF) developed by the World Bank and the IMF in 2005 to assess and monitor the risks of a country's debt default through a comprehensive analysis of indicators of debt distress (CBN 2010). Prior to 2006 when the DSA was introduced in Nigeria, efforts aimed at debt management in the country were often not underpinned by technical analysis. However, since 2006, the DMO has consistently conducted the DSA on the country's debt portfolio on an annual basis. The main objectives of the DSA are to: analyse current and future debt portfolio to assess debt sustainability and detect potential risks; advice the Government on

its borrowing decisions; set borrowing limits and recommend financing options; and provide information and input into the budgetary process (DMO, 2013).

The results of the DSA hinge on the evaluation of solvency and liquidity indicators, such as the net present value (NPV) of total public debt/GDP ratio, NPV of total public debt/exports ratio and debt service/revenue ratio, among others. These are usually marked against established international benchmarks for the country's peer group for public debt (DMO, 2013). From all the DSA exercises conducted, Nigeria has performed well below the distress benchmarks. This outcome was attributed largely to the Paris Club debt relief of 2005. Furthermore, the DSA has been able to instill discipline in debt accumulation, with emphasis on concessional loans.

IV. Methodology

The study employed the SVAR methodology to determine the impact of government borrowing on growth and other macroeconomic variables (inflation rate, exchange rate and interest rate) in Nigeria for the period 1991Q1- 2016Q4. Three models were estimated, representing each component of government borrowing normalised on GDP. Hence, the government borrowing variables were; consolidated, domestic and external debt as per cent of GDP, respectively. It also included domestic, external and total debt service as per cent of GDP. Based on the literature, macroeconomic stability is measured by five variables, namely: low and stable inflation; low long-term interest rates; low national debt relative to GDP; low deficits; and exchange rate stability (Kolawole, 2013). Thus, this study made the claim that macroeconomic stability is achieved when at least two of the variables of interest move in the desired direction.

The SVAR builds on Sims (1980) approach, but attempts to identify the impulse responses by imposing apriori restrictions on the covariance matrix of the structural errors and/or on long-run impulse responses themselves. This approach is developed by Bernanke (1986), Blanchard and Watson (1986) and Sims (1986), who considered apriori restrictions on contemporaneous effects of shocks, and subsequently by Blanchard and Quah (1989), Clarida and Gali (1994) and Ashtley and Garret (1996) who used the restrictions on long-run impact of shocks to identify the impulse responses.

SVAR was chosen for this study, due to its flexibility in modeling simultaneous relationships and its ability to decompose the steady state coefficients into interpretable components. Furthermore, SVAR affords an opportunity to study dynamics of the relationships in question, which a non-vector methodology may be incapable of providing. In contrast to the unrestricted VAR approach, which is atheoretical, SVARs explicitly attempt to provide some economic intuitions behind the covariance restrictions and thus, aim to avoid the use of arbitrary or implicit identifying restrictions associated with orthogonalised impulse responses (Garratt et al., 1996). It assumes that movements in variables come from the cumulated effect of current and past shocks (Martel, 2008).

IV.1   Data

The data used in the SVAR model were quarterly observations covering the period 1991Q1 - 2016Q4. The data on nominal GDP (Y) and consumer price index (CPI), as proxy for inflation, were sourced from the National Bureau of Statistics (NBS). The exchange rate (EXRT), consolidated debt stock (CDEBT), domestic debt (DDEBT), external debt stock (EDEBT), total debt service (TDS), domestic debt service (DDS), external debt service (EDS) and interest rate, proxied by the maximum lending rate (MLR), were sourced from the CBN online database.

IV.2   SVAR Specification and Identification

One of the key elements in SVAR estimation is the imposition of restrictions of residual structural matrices. Identification necessitates the imposition of some structure on the system. It is on the imposition of this structure that SVARs differ from the traditional VAR analysis. SVAR uses additional identifying restrictions and estimation of structural matrices to transform VAR errors into uncorrelated structural shocks. Obtaining structural shocks is central to a wide range of VAR analysis, including impulse response, historical decomposition, and other forms of causal analysis (Amisano and Giannini, 1997; Martin, et al., 2011).

To assess the effects of government borrowing on growth and macro-economic stability, the SVAR is specified as follows:

$$A_0 x_t = A(L)x_{t-1} + B\varepsilon_t \qquad (1)$$

Where;

A_0 is the matrix of contemporaneous influence between the variables,

x_t, is a (n x 1) vector of the endogenous macroeconomic variables (national debt (external and domestic borrowing) shocks, on total debt service, exchange rate, consumer price index, maximum lending rate (MLR), and GDP),

$A(L)$ is a (n x n) matrix of lag-operator L, representing impulse-response functions of the shocks to the elements of x_t; B is an **n** by **n** matrix that captures the linear relations between structural shocks and those of the reduced form; ε_t is a vector of structural shocks.

The structural shocks are uncorrelated and identically-normally distributed. To estimate the SVAR model, the reduced form is determined by multiplying equation (1) by an inverse matrix A_0^{-1}. This produces the following equation:

$$x_t = C(L)x_{t-1} + u_t \qquad (2)$$

Where:

$$C(L) = A_0^{-1}A(L); \; u_t = A_0^{-1}B\varepsilon_t.$$

u_t is an **n** by **1** vector of shocks in reduced form that are uncorrelated and normally-distributed but contemporaneously correlated with each other. The relationship between structural shocks and reduced form shocks is:

$$A\varepsilon_t = Bu_t \quad\quad\quad (3)$$

$$\varepsilon_t = Su_t \quad\quad\quad (4)$$

$$\Psi\varepsilon_t = Fu_t \quad\quad\quad (5)$$

Where Equation 3 is the restrictions of the factorisation matrices A and B; Equation 4, is the restrictions of the short-run impulse response, matrix S; and Equation 5, is the restrictions of the long-run impulse response matrix F or C or a combination of the equations 3, 4, and 5. Using the Choleski decomposition identification scheme, Equations 2 and 3 are presented in matrices A and B as follows:

$$A = \begin{pmatrix} 1 & 0 & 0 & 0 & 0 & 0 \\ a_{21} & 1 & 0 & 0 & 0 & 0 \\ a_{31} & a_{32} & 1 & 0 & 0 & 0 \\ a_{41} & a_{42} & a_{43} & 1 & 0 & 0 \\ a_{51} & a_{52} & a_{53} & a_{54} & 1 & 0 \\ a_{61} & a_{62} & a_{63} & a_{64} & a_{65} & 1 \end{pmatrix} , B = \begin{pmatrix} a_{11} & 0 & 0 & 0 & 0 & 0 \\ 0 & a_{22} & 0 & 0 & 0 & 0 \\ 0 & 0 & a_{33} & 0 & 0 & 0 \\ 0 & 0 & 0 & a_{44} & 0 & 0 \\ 0 & 0 & 0 & 0 & a_{55} & 0 \\ 0 & 0 & 0 & 0 & 0 & a_{66} \end{pmatrix}$$

IV.3   Pre-Estimation and Preliminary Analysis

To understand the data characteristics, pre-estimation analyses were carried out. The measures of central tendency and dispersion revealed the properties of the data and gave indication for their transformation. The unit root analysis revealed further properties and gave indication for the second level transformation, consistent with the OLS assumptions. Graphical analysis was also conducted to enrich the discussion. In addition, appropriate tests were conducted to select the optimal lag length given that, in trying to avoid exclusion restrictions, VAR analysis can quickly become over-parameterised, losing important degrees of freedom for estimation purposes.

IV.3.1 Descriptive Statistics

The description of the data employed in the study is shown in Table 1(a) and (b) and the trends in Figure 4. As per cent of GDP, the consolidated debt stock of Nigeria averaged 41.1 per cent, for the period 1991Q1 to 2016Q4, compared with the international threshold of 30.0 per cent, indicating that debt burden was high over the period. The high range is indicative of changes in nominal values like inflation and exchange rate and to a larger extent, the persistent borrowing pattern of the government. The result also revealed that

over the period, total debt stock is driven, largely, by domestic debt. The domestic debt component recorded an average of 19.8 per cent, while external debt was 21.3 per cent. The kurtosis statistic showed that all the three variables were platokurtic. In terms of skewness and normality properties, consolidated debt stock was negatively-skewed and normally-distributed, while domestic and external were positively-skewed and non-normal.

Table 1a: Summary Statistics

Sample: 1991Q1 2016Q4

	CDEBT	DDEBT	EDEBT	TDS	DDS	EDS
Mean	41.06	19.81	21.26	0.78	0.60	0.17
Median	41.22	13.70	15.54	0.61	0.43	0.13
Maximum	74.89	47.90	57.10	3.26	2.94	0.87
Minimum	7.167	5.70	1.26	0.03	0.02	0.00
Std. Dev.	16.19	13.07	16.33	0.57	0.56	0.1
Skewness	-0.19	0.66	0.59	1.91	1.79	1.49
Kurtosis	2.60	1.92	1.97	7.71	6.87	6.63
Jarque-Bera	1.31	12.61	10.61	159.01	120.40	95.74
Probability	0.52	0.002	0.005	0.00	0.00	0.00
Observations	104	104	104	104	104	104

Source: Authors Computation using e-views 10

Total debt service as per cent of GDP averaged 0.8 over the period. It was, however, driven by its domestic component, which recorded 0.6 per cent. The external debt component recorded the balance of 0.2 per cent. The distribution of the three variables showed that they are leptokurtic and positively skewed. The probability of Jaque-bera showed that the variables were not normally distributed at 1 per cent significance level (Prob. less than 0.01), which is typical of time-series, hence the need for further enquiry into more superior properties of the variables. This necessitated the need for transformations at different levels.

Table1b: Summary Statistics Continued

Sample: 1991Q1 2016Q4

	CPI	EXRT	MLR (%)	Y (N' Billion)
Maximum	213.56	444.22	38.9	34,169.69
Mean	70.37	128.12	23.5	12,189.09
Minimum	2.75	11.59	18.0	525.93
Std. Dev.	56.68	69.88	4.1	94.69
Coeff. Of Vartn.	80.534	54.55	17.2953	77.68
Skewness	0.77	1.5490	1.1778	0.5569
Kurtosis	2.52	8.3663	4.7665	2.1507
Jarque-Bera	11.26	166.3788	37.5673	8.5024
Probability	0.00	0.0000	0.0000	0.0142
Observations	104	104	104	104

Source: Authors Computation using e-views 10

Within the sample period, the average exchange rate was ₦128.12/US$, with a maximum of ₦444.22/US$ and a minimum of ₦11.59/US$. Specifically, the rate depreciated steadily from January 1999, when the dual exchange rate was abandoned, up to the fourth quarter 2016. The development was due to the continuous speculative activities in the foreign exchange market and the recent crash in crude oil prices in the international market, which eventually led to the depletion of the external reserves. The CPI and MLR peaked at ₦213.56 and 39.0 per cent in 2016Q4 and 1993Q4, respectively. The gross domestic product (GDP) was highest at ₦34,169.70 billion in 2007Q4. It recorded the lowest product at ₦525.94 billion in 1991Q1. Overall, It averaged ₦1,2189.10 billion over the period 1991Q1 – 2016Q4.

Figure 4: Trends of Variables in the Model (1991Q1 – 2016Q4)
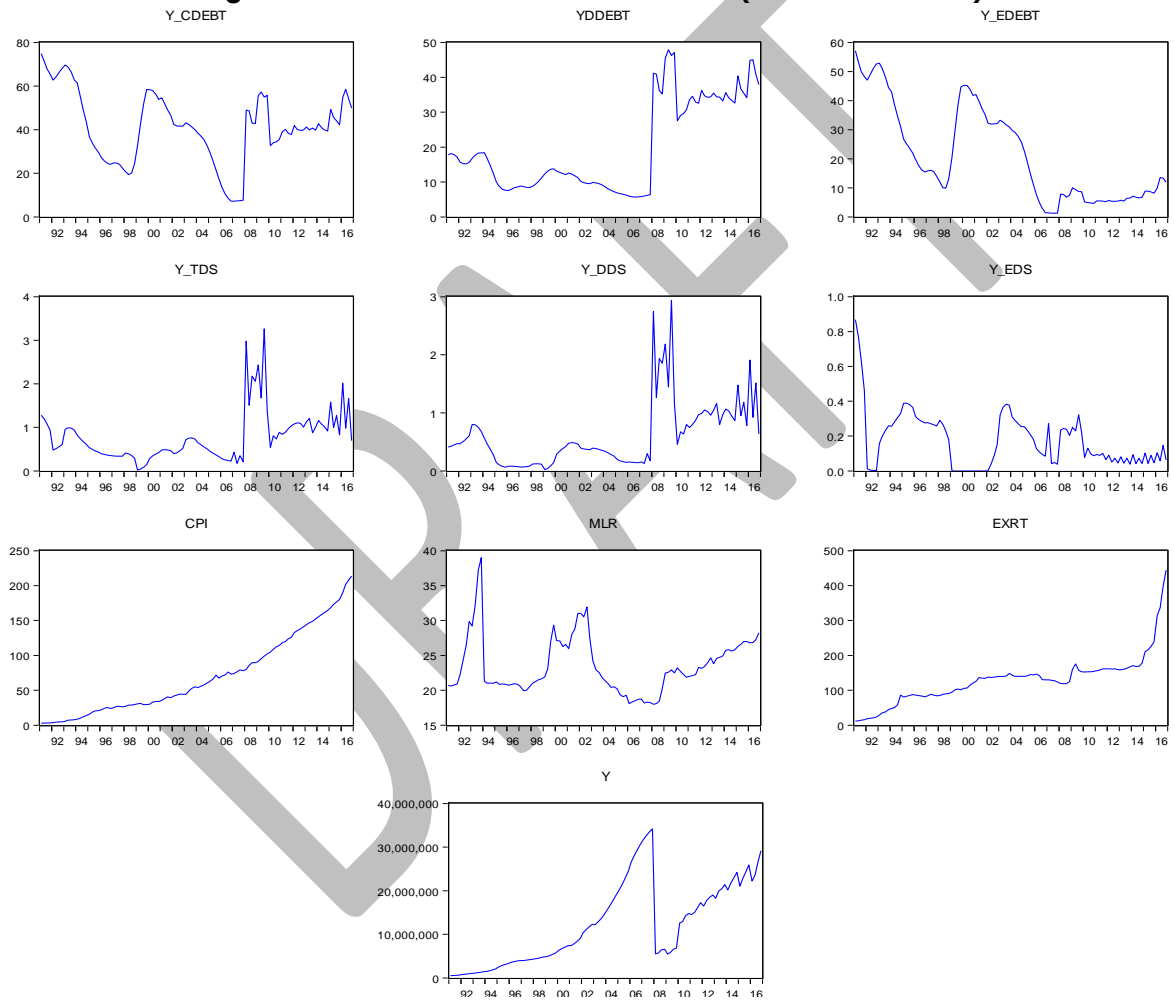
Source: Authors Computation using e-views 10

IV.3.2   Data Transformation and Stationarity

In a bid to bring the data to a common measure and for ease of interpretation, the first level of data transformation involved taking the natural log of the GDP, CPI and EXRT, which were trending as observed in Figure 5. This was done to avoid the difficulties associated with the interpretation of co-series coefficients in a model with different units of

measurement. As observed, the trends of the variables are better smoothened compared to the trends in Figure 4.

Figure 5: Trends of Smoothened Series, Log form, unless otherwise stated (1991Q1 – 2016Q4)
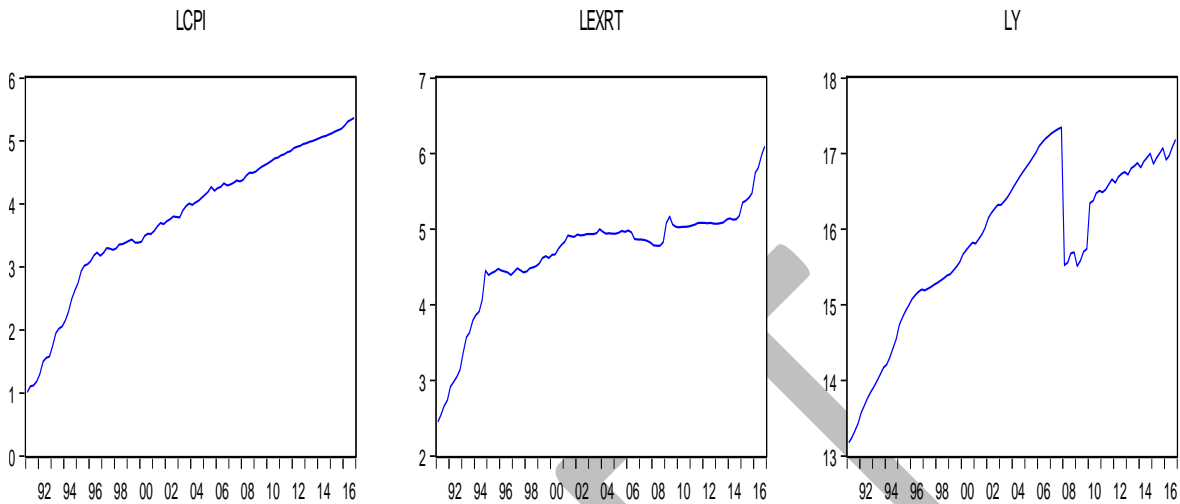
Source: Authors Computation using e-views 10

Unit root test was carried out on all the series to ascertain if they were stationary or not. One of the conventional unit root tests methods; the Augmented Dickey Fuller (ADF) was adopted.

Table 2: Unit Root Test (ADF Method)

Series	Prob.		Lag		Max Lag	Decision
	I(0)	I(1)	I(0)	I(1)		
CDEBT	0.1310	0.0000	0	0	12	I(1)
DDEBT	0.5511	0.0000	0	0	12	I(1)
EDEBT	0.2215	0.0018	1	0	12	I(1)
YTDS	0.0806	0.0000	1	0	12	I(1)
YDDS	0.1771	0.0000	1	0	12	I(1)
EDS	0.2804	0.0000	0	0	10	I(1)
LCPI	0.1520	0.0321	4	3	12	I(1)
LEXRT	0.0864	0.0000	1	0	12	I(1)
MLR	0.0857	0.0000	0	0	12	I(1)
LY	0.2060	0.0000	0	0	12	I(1)

Source: Authors Computation using e-views 10

Given the results in Table 2, using the ADF, the null hypothesis that all the variables had a unit root at levels I(0) was not rejected at the 5 per cent level of significance. This implied that all the variables were at first difference I(1) to fulfill the stationarity condition (Table 2), hence, the need to transform the variables, as shown in Figure 6. The presence of unit roots in the variables can give rise to spurious regression if the VAR is estimated in levels. Therefore, it is necessary to use first differences to ensure stationarity in the case of shocks that have permanent effects.

Figure 6: Trends of Differenced Log Form Series, unless otherwise stated (1991Q1 – 2016Q4)
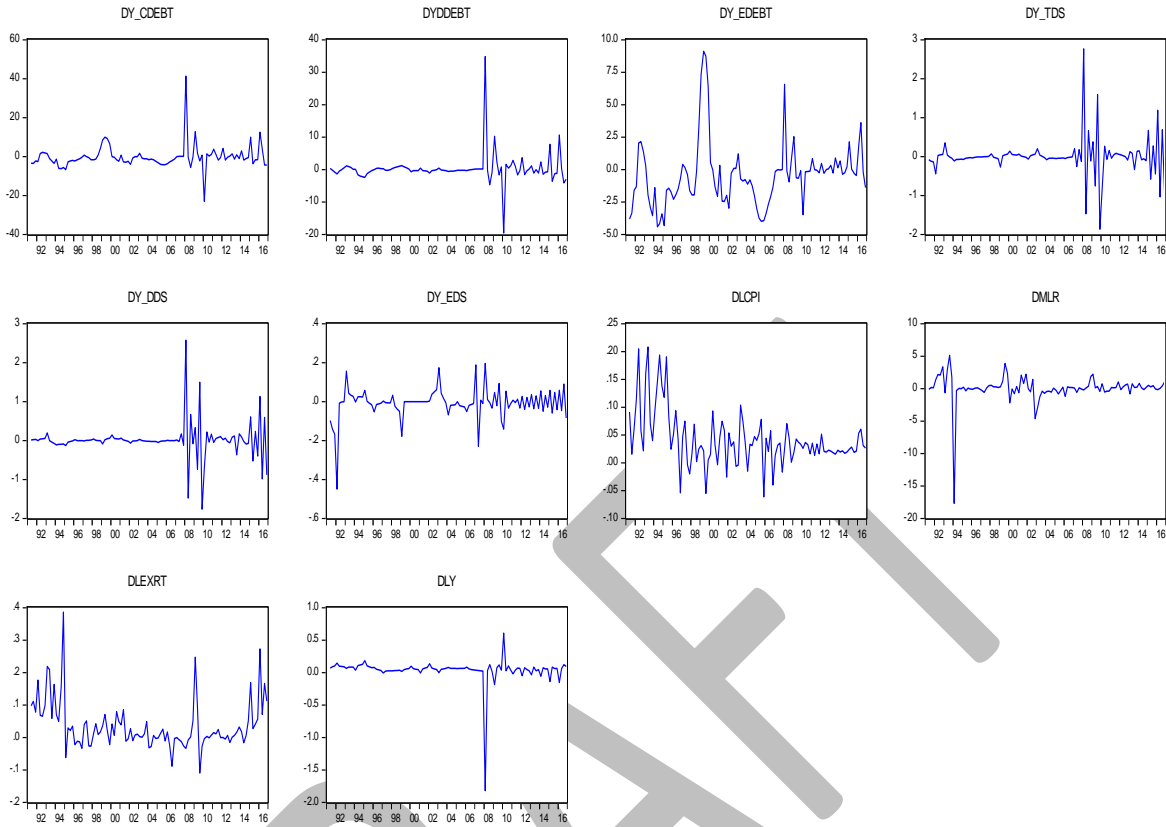
Source: Authors Computation using e-views 10

IV.3.3   VAR Lag Length Criteria

Table 3 summarised the choice of optimal lag length for the operation of a VAR, given the variables in the formulated three (3) models and the sample period covered. The lag chosen in each model represented the consensus among the five conventional lag order criteria (*LR, FPE, AIC, SIC and HQ*).

Table 3: Optimal Lag Length Criteria

S/N	Model	Optimal Lag Length	Criteria				
			LR	*FPE*	*AIC*	*SIC*	*HQ*
1.	d(cdebt) d(tds) d(lexrt) d(lcpi) d(mlr) d(ly)	1	7	8	8	√	√
2.	d(ddebt) d(dds) d(mlr) d(lcpi) d(lexrt) d(ly)	4	5	√	8	1	√
3.	d(edebt)) d(eds)) d(lexrt) d(lcpi) d(mlr) d(ly)	8	√	√	√	1	√

Source: Computed by the Authors using e-views 10

The SIC and HQ criteria indicated lag order 1 in model one. The FPE and HQ picked optimal lag order 4 for Model 2, while lag order 8 was adopted as the optimal lag length for model 3, as selected by all the criteria except for SIC.

IV.4   Empirical Results

The matrices with the estimated parameters, the impulse response, structural and historical decomposition, were provided in this section[2]. The section, however, focused on model one (1), but highlighted the results of models two (2) and three (3) for robustness. Again, only the model one (1) structural estimation, impulse response functions (IRFs) and its variance and historical decomposition were analysed, while the analysis of models two and three (2 and 3) were limited to structural estimation and the IRFs only.

IV.4.1   Model One: Total Debt Stock: Implications for Macroeconomic Stability and Growth
A.   Estimation Result of Model One (1)

Table 4 showed the estimates for the impact of shocks emanating from total debt stock to macroeconomic variables and economic growth in Nigeria. The model was over-identified and collectively significant. This implied that total debt stock was relevant in explaining the macroeconomic dynamics and growth variation in the Nigeria economy.

In the short-run, inflation rate and real GDP responded negatively by 0.01 and 0.01 per cent, apiece, while total debt service, exchange rate and interest rate responded positively by 0.25, 0.0002, and 0.53 per cent, respectively. In the long-run, however, total debt service and interest rate responded positively to the shocks to consolidated debt stock. A 1 per cent shock to total debt stock resulted in an increase of total debt service and interest rate of 0.2 and 1.0 per cent, respectively. On the other hand, a negative response was recorded from exchange rate, inflation and real GDP. Naira appreciated by 0.02 per cent and inflation declined by 0.04 per cent, but, surprisingly, GDP declined by 0.14 per cent. While other variables were significant, implying that they were susceptible to shocks to consolidated debt, exchange rate response was found to be insignificant. Examining the price variables (exchange rate, inflation, and interest rate), only the interest rate increased positively, reinforcing the adverse impact of borrowing on the cost of fund for investment. Thus, the increase in interest rate, due to shocks to consolidated debt stock, had a retrogressing multiplier effect on growth, since production would decrease, due to high cost of capital. This, therefore, lent credence to the hypothesis that excessive borrowing (particularly, domestic) by the government would lead to the crowding out of the private sector from the 'loanable' funds market, as interest rate increases.

From the perspective of the trilemma, the three prices, namely; inflation, interest and exchange rates, cannot be achieved simultaneously in the desired direction, as appropriate trade-offs are expected. Therefore, this study empirically laid claims that, though, total debt stock was inimical to the economy in the short-run; its economic gains were evident in maintaining macroeconomic stability in the long-run. Despite this outcome, growth, however, declined.

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[2]Note; that the long-run restrictions 'F', implies that the short-run 'S', can be imputed, but it is not possible to decompose the A or B. Coefficients of the SVAR identification restrictions are estimated using the OLS method.

Table 4: Model of Total Debt Stock: Implications for Macroeconomic Stability and Growth

Sample (adjusted): 1991Q3 2016Q4					
Included observations: 102 after adjustments					
Estimation method: Maximum likelihood via Newton-Raphson (analytic derivatives)					
Convergence achieved after 27 iterations					
Structural VAR is over-identified					

Model: e = Phi*Fu where E[uu']=I

F =

D(CDEBT)	0	0	0	0	0
D(TDS)	D(TDS)	0	0	0	0
D(LEXRT)	0	D(LEXRT)	0	0	0
D(LCPI)	0	0	D(LCPI)	0	0
D(MLR)	0	0	0	D(MLR)	0
D(LY)	0	0	0	0	D(LY)

including the restriction(s)
@VEC(F)=NA,NA,NA,NA,NA,NA,0,NA,0,0,0,0,0,0,NA,0,0,0,0,0,0,NA,0,0,0,0,0,0,NA,0,0,0,0,0,0,NA

	Coefficient	Std. Error	z-Statistic	Prob.	
D(CDEBT)	8.1246	0.5688	14.2828	0.00	
D(TDS)	0.1955	0.0240	8.1146	0.00	
D(LEXRT)	-0.0149	0.0119	-1.2538	0.20	
D(LCPI)	-0.0407	0.0080	-5.0458	0.00	
D(MLR)	1.0221	0.2361	4.3280	0.00	
D(LY)	-0.1372	0.0183	-7.4831	0.00	

Log likelihood	-210.3799				
LR test for over-identification:					
Chi-square(10)	175.8116		Probability	0.00	

Estimated S matrix:

4.5963	-0.5976	0.5290	1.8525	-0.4815	-2.6313
0.2544	0.3124	0.0088	0.0697	-0.0036	0.0007
0.0002	0.0012	0.0829	-0.0187	-0.0080	0.0016
-0.0114	-0.0001	-0.0236	0.0539	0.0076	0.0108
0.5350	0.0086	0.4354	-0.8548	2.1270	-0.6052
-0.11421	0.0122	-0.0170	-0.0579	0.0018	0.1616

Estimated F matrix:

8.1246	0.0000	0.0000	0.0000	0.0000	0.0000
0.1955	0.2002	0.0000	0.0000	0.0000	0.0000
-0.0149	0.0000	0.1197	0.0000	0.0000	0.0000
-0.0407	0.0000	0.0000	0.0762	0.0000	0.0000
1.0221	0.0000	0.0000	0.0000	2.2729	0.0000
-0.1372	0.0000	0.0000	0.0000	0.0000	0.1577

Source: Authors Computation using e-views 10

B.   Impulse Response Analysis of Model 1

Figure 7 showed the impulse of SVAR innovations to consolidated debt stock (shock 1) and the responses of the macroeconomic variables.

Figure 7: Impulse Response Function (IRF) of Model 1
Response to Structural VAR Innovations ± 2 S.E.
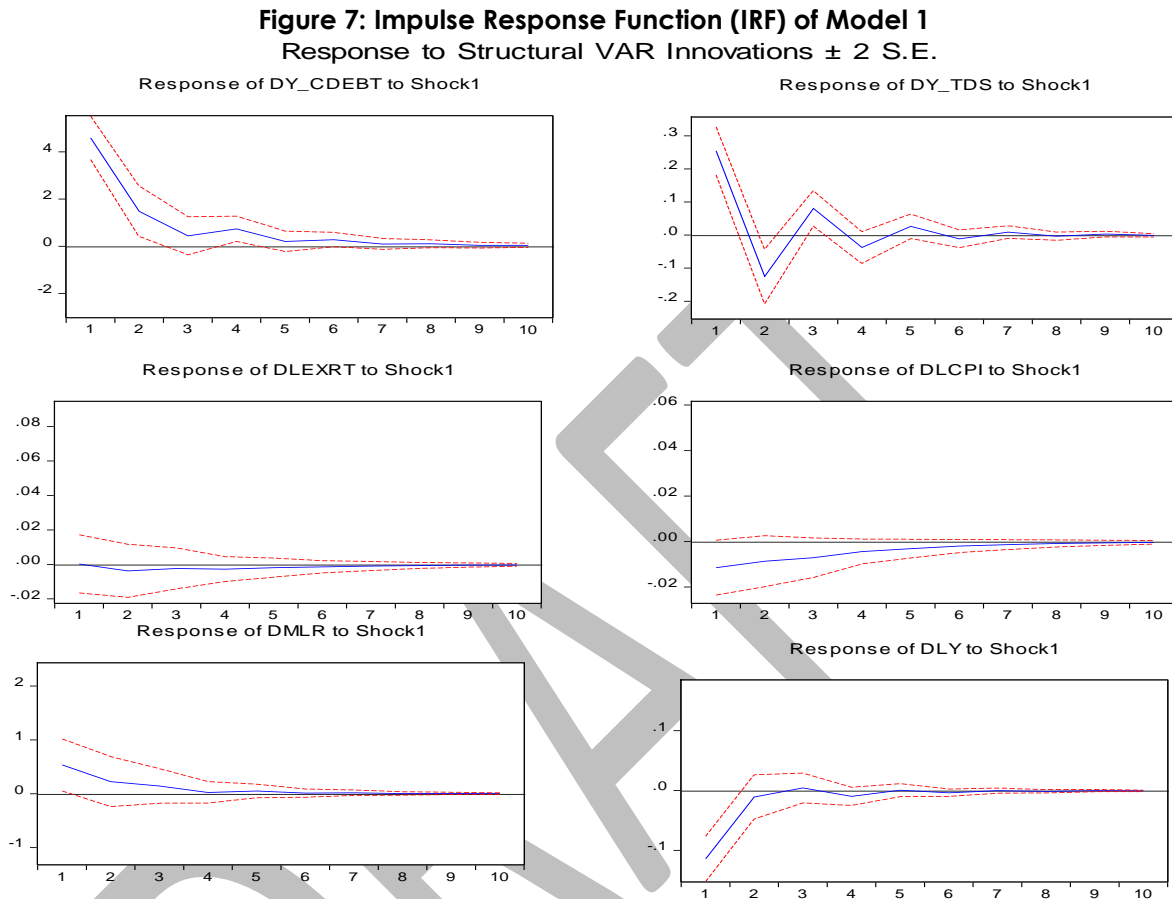
Source: Authors Computation using e-views 10

Figure 7 indicated the responses of all the macroeconomic variables to shocks to the consolidated debt stock. All the variables maintained a direct relationship with the total debt shock, except exchange rate. Thus, consolidated debt stock had a permanent positive response to its own shocks, though, successively low over the ten (10) periods. The positive response of debt service to shocks to total debt stock did not last beyond the fifth (5th) period, with some degrees of temporary negative responses after which it died off. Exchange rate responded negatively throughout the ten (10) periods but stabilised from the eighth (8th) period. Inflation responded negatively and died-off over time from the ninth (9th) period. Interestingly, interest rate was positive, stabilising at the sixth (6th) period up to the tenth (10th) period. A high interest rate would not be favourable to investment and consequently economic growth. As a result, the negative response of GDP to shocks to consolidated total debt was obvious, stabilising at the fifth (5th) period, before dying off.

When the above IRF results were compared with those of the structural parameters presented in Table 4, it was clear that the IRF depicted the dynamics of the macroeconomic variables from the instantaneous short-run to the long-run. For instance,

the IRF showed that total debt service would instantaneously respond positively to shocks to consolidated debt stock in line with theoretical predictions in the first period. In the second period, it became negative, and rose again in the 3rd period, falling in the 4th period, and rising yet again in the 5th period before stabilising. The impulse response analysis is, therefore, adjudged to be more informative than the structural parameter estimates.

C. Forecast Error Variance Decomposition of Model 1

The IRF allows a researcher to examine responses from a given variable induced by shocks to another or the same variable, while the forecast error variance decomposition (FEVD) provides further evidence of interaction, by quantifying the contribution of the different shocks to the variance in the relevant variables. In other words, the FEVD indicates how much of a change in a variable is due to its own and other variables shocks. The results of the FEVD were presented in Table 5.

Table 5: Variance Decomposition

Period	S.E.	CDEBT	TDS	EXRT	CPI	MLR	LY
1	5.6879	65.3032	1.1042	0.8653	10.6082	0.7168	21.4024
2	6.1648	61.4071	2.8170	0.9747	13.2411	0.6289	20.9312
3	6.2413	60.4217	3.3738	1.1826	13.3498	0.7250	20.9471
4	6.3128	60.4385	3.5459	1.3155	13.0512	0.7238	20.9251
5	6.3252	60.3105	3.5892	1.3356	13.0403	0.7233	21.0011
6	6.3355	60.3181	3.6032	1.3449	12.9982	0.7233	21.0123
7	6.3376	60.3021	3.6062	1.3473	12.9941	0.7235	21.0268
8	6.3392	60.3030	3.6072	1.3485	12.9877	0.7236	21.0301
9	6.3396	60.3009	3.6073	1.3488	12.9868	0.7236	21.0328
10	6.3398	60.3009	3.6073	1.3489	12.9858	0.7236	21.0335

Factorisation: Structural

Source: Authors Computation using e-views 10

The structural variance decomposition showed that the response of consolidated debt stock to its own shock was high and estimated between 60.3 and 65.3 per cent over the ten (10) periods. This was followed by the response of the GDP estimated at 21.4 and 20.9 per cent, through period five, when it became 21.0 per cent for the rest of the periods. Inflation responded to the shocks total debt stock by 10.6 to 13.3 per cent. Exchange rate response was approximately 1.0 per cent throughout the ten (10) periods, while the responses of total debt service ranged between 1.1 to 3.6 per cent. Notwithstanding the proportion, interest rate and the GDP followed the same pattern of response to consolidated debt stock, again, reiterating the close relationship between the two.

The findings of this study corroborated the study of Adji and Mada (2016) who tested the debt neutrality for Zimbabwe and favoured the Neo-classical view that public debt caused interest rate to rise. It also validated the study by Cebula (1985), which found that debt accumulation crowds-out private investment. In addition, it aligned with the findings of the studies by Ijeoma (2013), Aminu et al., (2013), Hassan et al., (2015) and Mathew and Modecai (2016) that found negative relationship between debt accumulation and economic growth in different periods. However, it refuted the study by Mamman (2013), Egbetunde (2012) and Obademi (2012), which found positive relationship between debt and GDP.

D. Historical Decomposition of Model 1

The historical decomposition of all the variables in the study from the shocks to total debt stock over time is anlysed was depicted in Figure 8. A cursory observation revealed that total debt stock throughout the period under observation (1992Q1 and 2016Q4) was driven, significantly, by own shocks. In the mid-90s, naira depreciated, and inflation rose, due to shocks to total debt stock. It was not until 1994 before interest rate responded to shocks to the total debt stock. Interest rate tapered significantly in 1994Q1.

Figure 8: Historical Decomposition of Model 1
Historical Decomposition using Structural VAR Weights
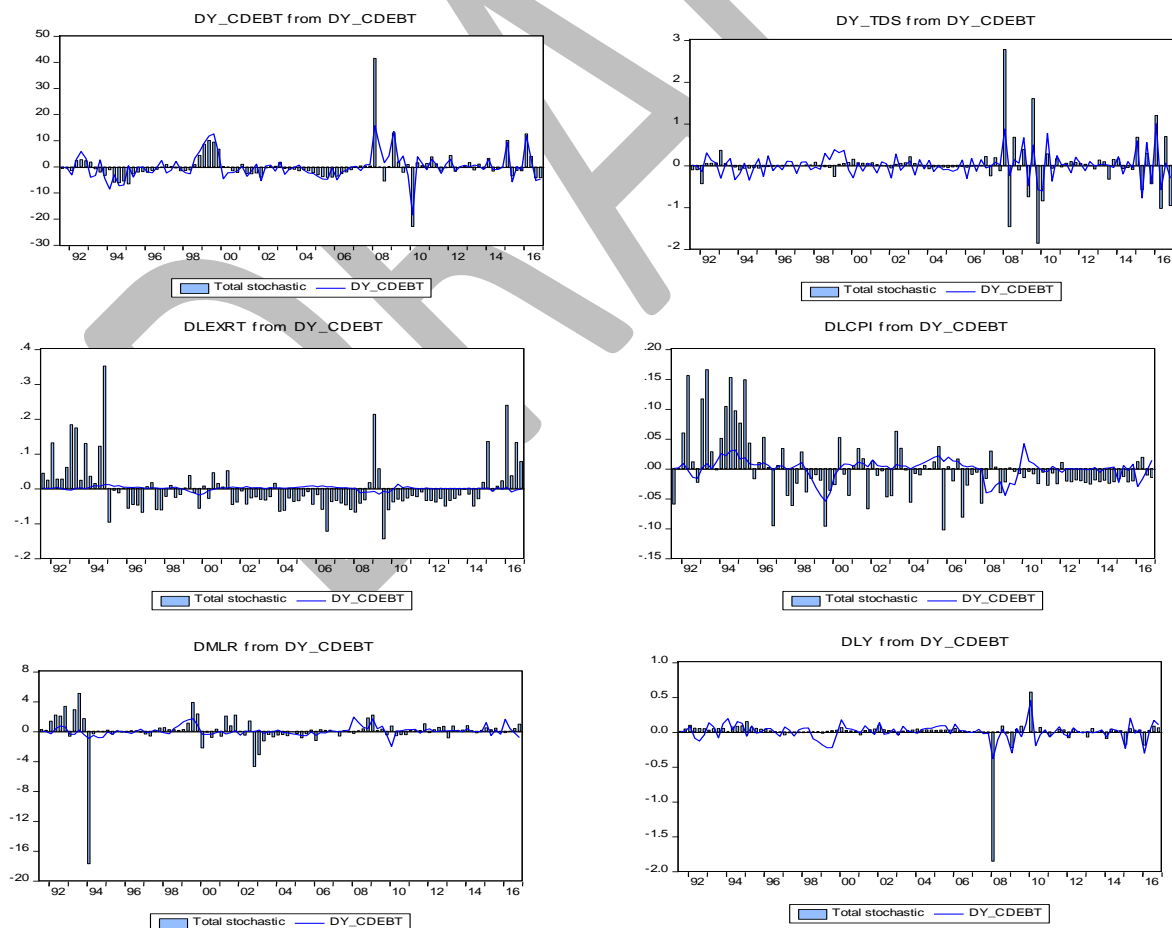
Source: Authors Computation using e-views 10

The period 1995 to 2006 registered the recovery of the economy, as naira appreciated and inflation fell in response to the shocks to total debt stock. However, in the aftermath of the 2007-2009 Global financial crisis (GFC), all the variables did not fare well. Interest rate, inflation and total debt stock as well as debt service, rose, due to shocks to total debt stock. In this period, naira also depreciated, and GDP contracted. Inflation rate, total debt stock and debt service remained high till 2016Q1, but declined thereafter. Naira maintained persistent depreciation throughout the period, while the economy contracted further.

IV.4.2 Model 2: Domestic Debt Stock: Implications for Macroeconomic Stability and Growth
A. Estimation Result of Model 2

The significant nature of the result indicated that the innovations from domestic debt were important drivers in explaining variations in domestic debt service, inflation, exchange rate and the interest rate. In other words, these variables collectively and individually respond significantly to shocks to domestic debt stock. In the short-run, interest rate, inflation rate, exchange rate, and real GDP responded negatively by 0.51, 0.01, 0.03, and 0.16 per cent respectively, while domestic debt service responded positively by 0.25 per cent. In the long-run, the response of domestic debt service, and interest rate to domestic debt stock shocks, were positive. A 1 per cent shocks to domestic debt stock led to 0.17 per cent increase in domestic debt service. This reflected the nature of continuous interest payment, the amortisation, and interest penalty, as and when due, as well as subsequent borrowing from the domestic 'loanable fund'. Government continuously redeemed its payment obligations on government Treasury bills and borrowed again, using the various tenors of treasury bills.

Interest rate responded positively by 0.20 per cent. The crowding out effect of government borrowing in Nigeria increased the interest rates. After the big jump in domestic debt, as per cent of GDP, from 6.4 in 2007Q4 to 41.1 in 2008Q1, interest rate had remained in double-digits till the end of 2016Q4, which this study covered. Inflation remained negative by about -0.04 per cent, despite the increase in interest rate unlike in the short-run, probably reflecting the structural nature of Nigeria's inflation and its drivers. It also reflected the effectiveness of various fiscal incentives provided by the government and the quasi-fiscal operations of the CBN, which hitherto, intervened in the real sector, offering loans at concessional rates. GDP declined by 0.20 per cent in the long-run, due to the interest rate. This again showed that the fall in GDP was via the interest rate channel, as exchange rate response was found to be insignificant.

In sum, the short-run response showed that macroeconomic stability was attained with the accumulation of domestic debt. However, the outcome of the long-run model was inconclusive in maintaining same conclusion. There was, therefore, the likelihood that domestic debt in the long-run would threaten macroeconomic stability and, at the same time, retard growth.

Table 6: Model of Domestic Debt Stock: Implications for Macroeconomic Stability and Growth

Sample (adjusted): 1992Q2 2016Q4
Included observations: 99 after adjustments
Estimation method: Maximum likelihood via Newton-Raphson (analytic derivatives)
Convergence achieved after 22 iterations
Structural VAR is over-identified

Model: e = Phi*Fu where E[uu']=I
F =

D(DDEBT)	0	0	0	0	0
D(DDS)	D(DDS)	0	0	0	0
D(MLR)	0	D(MLR)	0	0	0
D(LCPI)	0	0	D(LCPI)	0	0
D(LEXRT)	0	0	0	D(LEXRT)	0
D(LY)	0	0	0	0	D(LY)

including the restriction(s)
@VEC(F)=NA,NA,NA,NA,NA,NA,0,NA,0,0,0,0,0,0,NA,0,0,0,0,0,0,NA,0,0,0,0,0,0,NA,0,0,0,0,0,0,NA

	Coefficient	Std. Error	z-Statistic	Prob.
D(DDEBT)	3.5835	0.2547	14.0713	0.00
D(DDS)	0.1731	0.0165	10.4943	0.00
D(MLR)	0.2012	0.2183	0.9217	0.36
D(LCPI)	-0.0397	0.0150	-2.6476	0.01
D(LEXRT)	-0.0319	0.0197	-1.6211	0.11
D(LY)	-0.2005	0.0155	-12.9384	0.00

Log likelihood
-90.72624
LR test for over-identification:
Chi-square(10)   316.62   Probability   0.00

Estimated S matrix:

3.1945	2.3628	-0.5509	2.0606	0.5732	1.4928
0.2502	0.0610	-0.0175	0.2549	0.1110	0.1180
-0.1521	0.3397	1.8522	-0.9120	-1.1221	0.2998
-0.0083	0.0197	0.0170	0.1023	0.1014	0.0057
-0.0286	0.0201	-0.0102	0.0206	0.0054	0.0270
-0.1648	-0.0902	-0.0049	-0.1196	0.0088	0.0141

Estimated F matrix:

3.5835	0	0	-	0	0
0.1731	-0.1093	0	-	0	0
0.2012	0	2.1677	-	0	0
-0.0397	0	0	0.15	0	0
-0.0319	0	0	-	-0.1943	0
-0.2005	0	0	-	0	0.0606

Source: Authors Computation using e-views 10

B.   Impulse Response Analysis of Model 2

Figure 9 showed the impulse of SVAR innovations to domestic debt stock (shock 1) and responses of the macroeconomic variables and growth.

Figure 9: Impulse Response Function (IRF) of Model 2
Response to Cholesky One S.D. Innovations ± 2 S.E.
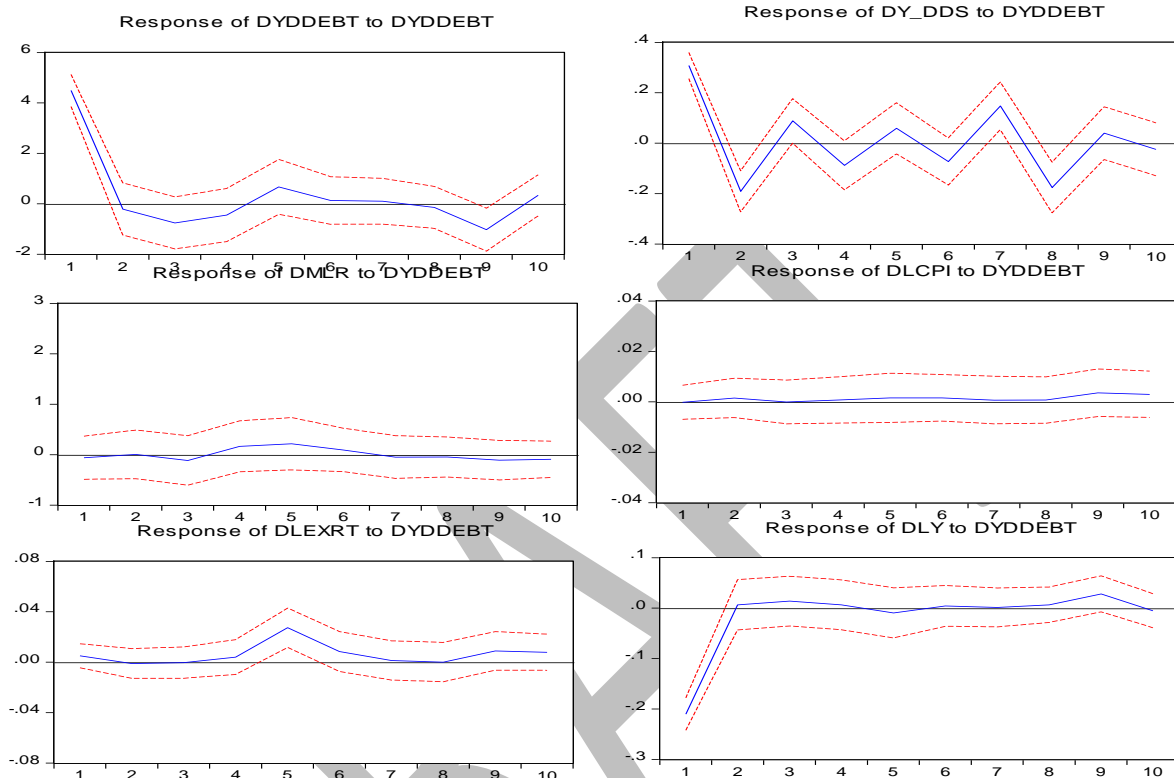
Source: Authors Computation using e-views 10

The response of domestic debt to own shocks was positive, except between the second (2nd) to fourth (4th) period and eighth (8th) to tenth (10th) period when it was negative. Domestic debt service deepened from the first (1st) to second (2nd) period, but remained positive thereafter, except with temporary negative response in periods six (6) and eight (8). Beyond the ninth (9th) period, it stabilised.

Interest rate responded negatively in the first two periods. This could be attributed to the effectiveness of the CBN's monetary policy instruments in managing monetary flows. However, interest rate response remained positive, thereafter, as indicated by the structural model estimates. Inflation remained permanently negative throughout the ten (10) periods, aligning with the structural model estimates, while the result of the response of exchange rate indicated the appreciation in Naira, except in the fifth (5th) and ninth (9th) period that reflected temporary depreciation. The GDP had temporary growth in the third (3rd) and ninth (9th) periods but contracted in the tenth (10th) period in response to shocks to domestic debt.

IV.4.3   Model 3: External Debt Stock: Implications for Macroeconomic Stability and Growth
A.   Structural Model Estimation Result of Model 3

The result revealed that shocks to external debt had significant influence on the macroeconomic variables and growth in the long-run. This indicated that shocks to external debt were important drivers of inflation, exchange rate, interest rate, external debt service, and the GDP. In the short-run, exchange rate, and real GDP responded negatively by 0.03 per cent, apiece, while external debt service, inflation, and interest rate responded positively by 0.002, 0.01 and 0.04 per cent, respectively. In the long-run, exchange rate and GDP remained negative with inflation rate. A 1 per cent shocks to external debt stock led to 0.93 per cent appreciation of the naira, 0.59 per cent decrease in inflation, and 0.25 per cent decrease in GDP. Again, interest rate was positive, necessitating the decrease in GDP, even in the long-run, due to increase in cost of fund.

The negative response of exchange rate to the shocks to external debt stock was expected, indicating appreciation in the naira. This was because the first impact of external debt was on foreign reserves. As foreign reserves grew, naira appreciated. Thus, shocks to external debt stock led to approximately 0.93 per cent appreciation of the Naira and a fall in the level of inflation by 0.59 per cent. However, interest rate was found to have a positive response by approximately 3.8 per cent, causing the economy to contract by 0.25 per cent.

The result of this model was consistent with the intuition from the total debt model. The external debt model showed evidence of instability in the short-run. However, continuous accumulation of external debt would lead to macroeconomic stability, due to productive activities in the economy in the long-run. This implied that the gains from debt accumulation, as seen in the total debt model were influenced by external debt. However, external debt was again found to have implication for growth, underlying the fact that macroeconomic stability could be attained, despite declining economic growth.

Table 7: Model of External Debt Stock- Implications for Macroeconomic Stability and Growth

Sample (adjusted): 1993Q2 2016Q4
Included observations: 95 after adjustments
Estimation method: Maximum likelihood via Newton-Raphson (analytic derivatives)
Convergence achieved after 46 iterations
Structural VAR is over-identified

Model: e = Phi*Fu where E[uu']=I
F =

D(EDEBT)	0	0	0	0	0
D(EDS)	D(EDS)	0	0	0	0
D(LEXRT)	0	D(LEXRT)	0	0	0
D(LCPI)	0	0	D(LCPI)	0	0
D(MLR)	0	0	0	D(MLR)	0
D(LY)	0	0	0	0	D(LY)

including the restriction(s)
@VEC(F)=NA,NA,NA,NA,NA,NA,0,NA,0,0,0,0,0,0,NA,0,0,0,0,0,NA,0,0,0,0,0,0,NA,0,0,0,0,0,0,NA

	Coefficient	Std. Error	z-Statistic	Prob.
D(EDEBT)	20.3370	1.4754	13.7840	0.0000
D(EDS)	0.0025	0.0051	0.4867	0.6265
D(LEXRT)	-0.9314	0.0711	-13.0982	0.0000
D(LCPI)	-0.5906	0.0448	-13.1855	0.0000
D(MLR)	3.7057	0.2803	13.2223	0.0000
D(LY)	-0.2508	0.0300	-8.3636	0.0000

Log likelihood	62.49			
LR test for over-identification:				
Chi-square(10)	462.74		Probability	0.0000

Estimated S matrix:

0.2676	0.3521	0.0975	1.3701	-0.2842	-0.2110
0.0026	0.0268	0.0049	0.0045	-0.0306	-0.0217
-0.0283	0.0024	0.0932	0.1005	-0.0085	-0.0017
0.0122	0.0006	0.0960	0.0969	0.0047	0.0058
0.0365	1.9528	2.0425	1.3055	2.1868	2.3766
-0.0286	-0.0723	-0.1433	-0.3019	-0.0107	0.1476

Estimated F matrix:

20.3370	0	0	0	0	0
0.0025	0.0494	0	0	0	0
-0.9314	0	-0.2159	0	0	0
-0.5906	0	0	0.1273	0	0
3.7057	0	0	0	0.7719	0
-0.2508	0	0	0	0	0.2323

Source: Authors Computation using e-views 10

B.   Impulse Response Analysis of Model 3

Figure 10 showed the impulse of SVAR innovations to external debt stock (shock 1) and responses of the macroeconomic variables and growth.

Figure 10: Impulse Response Function (IRF) of Model 3
Response to Cholesky One S.D. Innovations ± 2 S.E.
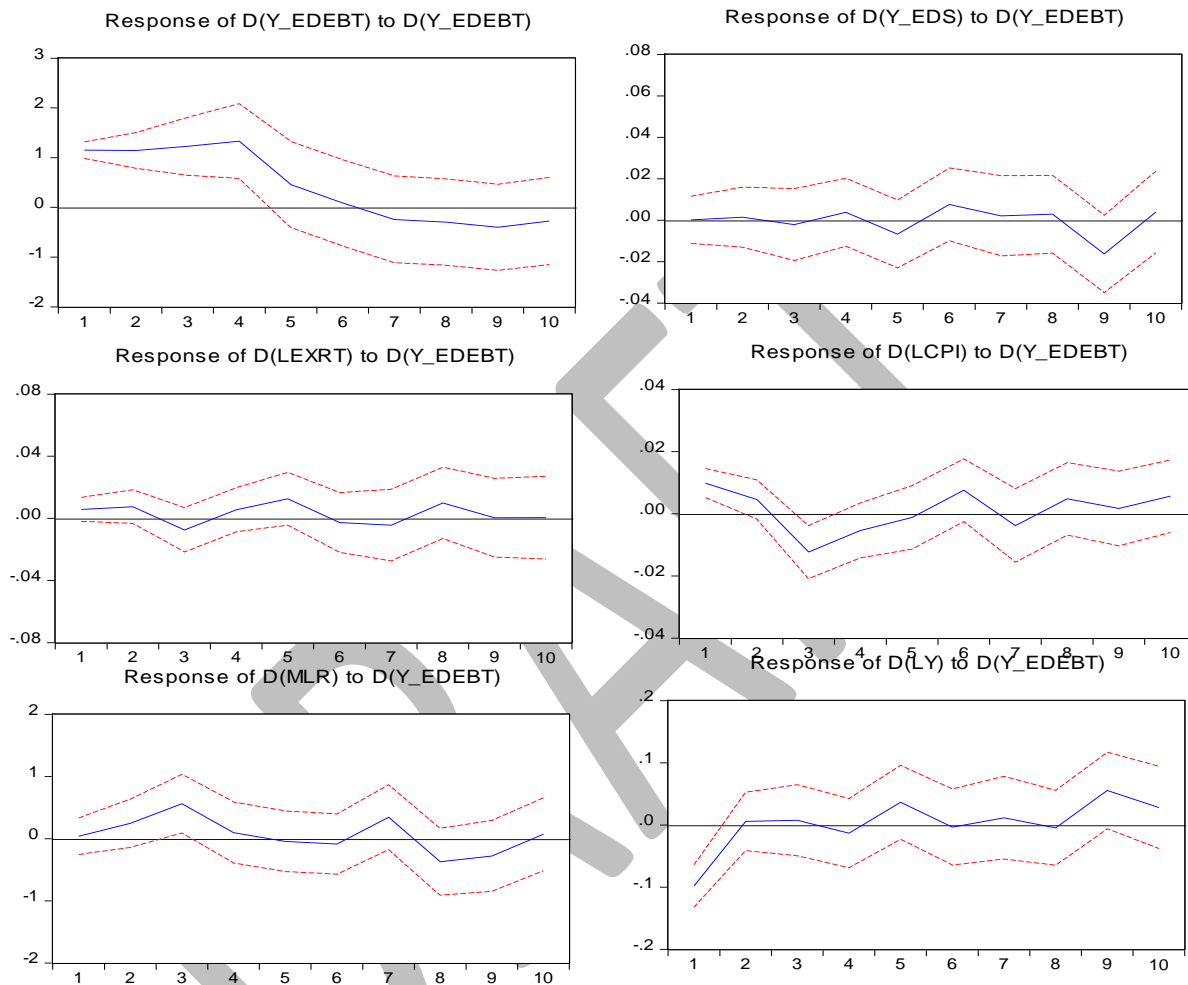
Source: Authors Computation using e-views 10

The impulse response function indicated that shocks to external debt stock led to a moderate rise in external debt service, but with a reduction in its intensity after the first period and temporary negative response in the fifth (5th) and ninth (9th) periods. Conversely, naira appreciated throughout the ten (10) periods, in line with economic theory. The initial response of inflation was positive, but reversed to negative relationship from the second (2nd) period through the ten (10) period. This was expected, as foreign goods became cheaper, due to the appreciation of the Naira, thereby, eliminating the possibility of imported inflation. Interest rate remained, except for the second (2nd) and eighth (8th) periods. As a result, the economy contracted for most of the period, under consideration covered.

V. Policy Implications

The dynamic relationship between government borrowing and macroeconomic stability and economic growth was extensively examined in this study, with empirical evidences provided, using the structural VAR framework. Three inter-related models were estimated with thought-provoking findings about the dynamics of total debt, its component, and their influences on macroeconomic variables, including economic growth. The study resurged the age-long debate on what the priority of macroeconomy policies, including debt policies, should be – stability or growth – given the inherent tradeoffs between both objectives. The study found that consolidated government debt (external and domestic) had negative impact on economic growth by inducing a rise in the interest rate, but positive effect on macroeconomic stability through the moderating impact of external debt on exchange rate. Therefore, if the goal of policy is to achieve macroeconomic stability, it would be more optimal to opt for external borrowing as against its domestic counterpart. This may, however, be at the cost of increasing debt service and potential debt overhang.

Although the result indicated that government borrowing was generally detrimental to long-run growth in Nigeria, it did not ignore the inevitability of borrowing in closing the financing gap. Against this backdrop, government must be cautious and strategic in avoiding debt overhang by pursuing policies that promotes debt sustainability and ensure that borrowings are dedicated to productive uses with net benefits for the economy. This is achievable by aligning growth and debt strategies, and enforcing strict compliance of borrowing for capital projects that supports increased economic activities that are self-financing, over the long-run. Furthermore, given the finding on the distortionary influence of domestic borrowing on the macroeconomy, government should place less emphasis on domestic borrowing.

VI.   Conclusion

This study used the SVAR to investigate the dynamic effects of government borrowing on macroeconomic stability and economic growth from 1991Q1 to 2016Q4. The study adopted the Shapiro and Watson (1988); and Blanchard and Quah (1989), approach in identifying the long-run restrictions and estimation of structural matrices to transform VAR errors into uncorrelated structural shocks. This was simply because the series are I(1) and after being transformed, the shocks were considered as having permanent effects. Evidence from the study revealed that in the long-run, government borrowing significantly affected macroeconomic stability and growth. Shocks to consolidated, external and domestic debts were found to be important drivers of the total debt services and other macroeconomic variables, including inflation, interest rate, exchange rate, and GDP in the Nigerian economy. While consolidated debt and external debt were found to be moderating on the macroeconomy, shocks to domestic debt were distortionary. Also, shocks to government borrowing, in the three models, induced a rise in interest rate and a contraction in GDP. Thus, government borrowing, therefore, crowded-out the private sector and retarded economic growth in Nigeria.

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