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Oil Price Volatility and the Nigerian Economy: ARDL and Granger Causality Approaches

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Abstract. For the past four decades, crude oil has been a major source of revenue, energy and foreign exchange for the Nigerian economy. Nigeria depends heavily on revenue from crude oil but volatility in price of the product has always put the country in precarious economic situation. Against this background, this paper analyzed the relationship between crude oil price volatility and the Nigerian economic performance from 1970 to 2018. It applied Granger causality test and autoregressive distributed lag (ARDL) model as estimation techniques. It could be inferred from the findings that the influence of oil price volatility, gasoline domestic pump price and exchange rate are both short-run and long-run phenomena while that of inflation and monetary policy rate are only long term phenomenon. It was found that crude oil price volatility, domestic pump price of gasoline, exchange rate, inflation rate and monetary policy rate have significant positive impact on economic growth on the long-run periods, which means that increase in earnings from crude oil and appreciation of Naira increases the economic growth of the country and decrease in crude oil earnings and depreciation of Naira decreases the economic growth of the country. Therefore, government should diversify its earnings by developing agriculture, industrialization and investment in order to reduce the heavy reliance on crude oil and income fluctuation resulting from the fluctuation in crude oil prices in order to protect the country's economy. In addition, government should reduce gasoline pump price by deregulating the downstream sector and at the same time encouraging private sector's participation in crude oil refining in order to encourage competition thereby bringing down the price of fuel. Considering the importance of exchange rate variable, these findings eventually suggest that a systematic exchange rate via monetary policy should be properly developed to promote the stability and sustainability of economic growth in Nigeria.

Keywords: Crude Oil Prices, Economic Growth.

1. Introduction

Crude oil as a source of energy since its discovery in the 1800s has been very important to the world economy. Crude oil has an important position in society as a crucial input to global, national and individual production and consumption. Therefore, it is a strategic resource that attracts the interest and attention of nearly everyone on the planet. The prominence of oil has risen to the extent that in a world suddenly without oil, all the major distribution systems that allow economic transactions on a more than local basis would fail and the global economy would collapse (Hathaway, 2009).

Fluctuation in the price of crude is a common phenomenon in the global oil market as the world economy has witnessed a number of changes in the price of crude oil at different times. These price changes, often referred to as crude oil price volatilities are usually described by the events that herald their occurrences. As Hamilton (2011) succinctly puts it, the major post-World-War-II oil volatilities are the Suez Crisis of 1956-57, the OPEC oil embargo of 1973-1974, the Iranian revolution of 1978-1979, the Iran-Iraq War initiated in 1980, the first Persian Gulf War in 1990-91, and the oil price spike of 2007-2008. Crude oil price surged to a historic height in 2008 when it was sold at $140 per barrel; this was about the highest price recorded in

the oil market in recent times (Sanya, 2015).

However, the second half of 2014 marked the beginning of another wave of oil price volatility. By the year 2015, crude oil price had dropped by more than half of its price in the previous year with its attendant consequences on countries of the world. The immediate cause of this fall was the market imbalance sparked by excess supply of crude oil to the market by oil producing countries. Maugeri (2016) noted that the significant output growth experienced by major oil producers like the United States and Iraq as well as the imposition of the policy of no production cutbacks by Saudi Arabia on the Organization of Petroleum Exporting Countries (OPEC) created an output level that could not be absorbed by demand. The steep crash in the prices of crude oil in the international market which was at a time selling above $140 per barrel to selling as low as $40 per barrel occurred too sudden for government to take proactive actions to either prevent or minimize its effect.

The oil revenues play a key role in the economic structure of the oil exporting countries. In most of these countries, the oil revenues are an important source of financing the budget and the government budget dependence on oil revenues is very high. It is expected that volatility of the oil market influenced economy aggregate demand, because the government budget constitutes a significant portion of aggregate demand (Yusuf, 2015). Nigeria as a major exporter of oil is not an exception about this matter among OPEC countries. On the one hand, Nigeria's oil exports was rationed by OPEC, on the other hand, the oil price was determined by the global supply and demand. So, the macroeconomic variables were influenced by the change of the oil revenues following the global changes of the oil prices. This dependence of the macroeconomic variables on oil affected the economic growth. So that the impact of declining oil price is reflected much broader on the economic activities. Increasing in the oil price caused a transfer of income from oil- importing countries to the oil-exporting countries. Since the oil sector is one of the important economic sectors in the oil-exporting countries and it has a major contribution in the economic value added, increasing the oil price caused the development of the oil sector which increases the domestic and foreign investment in these countries, and following that the tide of economic growth has flowed.

The major economic investment undertaking by the government in Nigeria is in construction and infrastructural development which arose from increases in oil revenue. The gross domestic product (GDP) is increased by upsurge in the amount of investment in construction projects, and therefore the government has experienced positive economic growth. In contrast, decline in the oil price decreased the oil revenues in these countries, so at the same times, the government expenditure reduced as a result of declining in the oil revenues. This problem reduces the GDP and subsequently reduces economic growth.

Since the 1970s, oil producing states have experienced rising budget deficit largely due to the volatile global crude oil prices, and as a result, rising debt-to-gross domestic product (GDP) ratios. In the world's largest crude oil exporter, Saudi Arabia, public debt has been fluctuating since the years following the oil boom (Muye, Kaita, & Hassan, 2016). The recent crash in oil prices undoubtedly plunged Nigeria into an economic quagmire with debilitating effects on some of her major macroeconomic variables. For instance, inflation rates began a steady rise while the exchange rate continued to depreciate, causing enormous economic difficulties among the populace. Interestingly, as crude oil price was falling at the global market, domestic pump price of petrol in Nigeria suffered distortion and upward review (Ogboru, Rivi & Idisi, 2017).

The stronger naira during the oil boom encouraged import-oriented consumption habit that soon turned Nigeria into a perennial net importer, which became a major problem when oil earnings decreased with lower international oil prices. External reserves collapsed, fiscal deficits mounted and external borrowing ensued with the "jumbo loans" taken in 1979. Nigeria's debt profile is rising and currently stood at N31.01trn (US$85.90bn).

Most of Nigeria's macro-economic indices became unstable and worrisome as there was a progressive decline of GDP with the value of naira over the years. For instance, the GDP growth rate which was 25% in 1970 when the naira was N0.7 to a dollar declined to 5% GDP growth rate when the nation's currency depreciated to N101.7 in 2000 and further reduced to 2% GDP growth rate when naira nosedived to N363.5 per dollar in 2018. The progressive decline of GDP also correlates with increases in crude oil and gasoline pump prices as well as unemployment rate and oil rents from 1970 to date. Nigeria's unemployment rate as at the second quarter of 2020 was 27.1%, indicating that about 21,764,614 (21.7 million) Nigerians remain unemployed. Ayoola (2013) argued that Nigeria as a mono-product

economy remains susceptible to the movements in international crude oil prices. Yusuf (2015) also contended that oil plays a critical role in Nigeria in the conduct of fiscal and monetary policies because it accounts for an average of 80% of government revenue, 90-95% of the foreign exchange earnings and 12% of the real gross domestic product. Despite such windfall, Nigeria has an increasing proportion of impoverished population and experienced continued stagnation of the economy (Okonjo-Iweala & Osafo-Kwaako, 2007).

Nigeria's dependence on oil revenue has been a cause for concern, especially as oil is an internationally traded commodity whose price is subject to unpredictable changes. The volatility in price of oil has various implications for both oil importing and exporting countries alike. However, oil export revenue dependent nations are more prone to the consequences, especially during periods of negative volatility. Nigeria's economy is highly dependent on crude oil export revenue, hence, fluctuations in oil prices affects Nigeria's macroeconomics. As was indicated before, Nigeria is a big oil producing country in Africa and its economy depends heavily on crude oil exports revenue. In addition, she imports refined gasoline to meet up with domestic demand due to inadequate local production. Consequently, Nigeria's case is cut in the irony of being an exporter of crude oil as well as an importer of refined petroleum products. This scenario makes Nigeria unique when considering the oil price and economic growth nexus.

Based on the research problems identified above, this study shall provide answers to the following questions:

- What is the causal relationship between crude oil price volatility and economic growth in Nigeria?
- What is the causal relationship between gasoline pump price and economic growth in Nigeria?
- Which of the crude oil price volatility and domestic pump price of gasoline has more impact on economic growth in Nigeria?

The main objective of this paper is to examine the impact of oil price volatility and gasoline pump price on Nigerian economy. Following this introduction, the rest of the paper is organized as follows. Section II presents the literature with conceptual framework, theoretical framework and the empirical review. Section III presents the methodology and Section IV focuses on pre-tests and analysis. Section V presents estimation results and discussion while Section VI concludes the study with policy implications,

2. Literature Review

2.1 Conceptual Framework

2.1.1 Concept of Oil Price Volatility

Oil price volatility (OPV) is defined as the standard deviation of oil prices in a given period while an oil price shock is a manifestation of extreme volatility (Ebele, 2015). For the purpose of this study which focuses on oil price volatility as opposed to shocks, it is reasonable to understand the distinction between both measures in terms of the size of price deviations. Acute deviations in oil prices, such as those seen in early 2008 are termed shocks, while relatively minor price deviations are referred to as price volatility (Ebrahim, Inderwildi, & King, 2014). According to Donwa, Mgbame, and Aigboduwa (2015), the term oil price volatility refers to instability, changes, a rise or fall, in the supply or demand side of oil prices in the international oil market. The rise or flux in the prices of oil can be termed positive (i.e. a rise) or negative (i.e. a fall).

2.1.2 The Concept of Economic Growth

An economy's growth is measured by the change in the volume of its output or in the real incomes of its residents (World Bank, 2006). Economic growth is the continuous expansion of the productive potential of an economy; it means that the capacity utilization to produce goods and services as well as to meet the wants of the populace is increased. Apart from the productive expansion in the goods market, it also refers to a situation whereby improvements in the quality and quantity of resources (including technological improvements) contribute to the overall growth in the real domestic output of an economy. The measurement of economic growth could be in either real or nominal terms; real growth implies that inflationary and exchange rate adjustments had been taken into consideration. Nevertheless, macroeconomic output is generally measured by Gross Domestic Product (GDP) or one of the other national accounts.

2.2 Theoretical Framework

2.2.1 The Mankiw, Romer and Weil's Theory of Economic Growth

In view of the shortcomings of Solow's growth model, the amplified version of the model was specified by Mankiw, Romer and Weil (1992). In this

augmented version of the model, a Cobb-Douglas production function is assumed. This started off by adding human capital accumulation to the Solow model. According to Mankiw, Romer and Weil (1992), the aggregate output of the economy can be written as:

$$Y_T = A_T K_T^{\square} H_T^{\square} L_T^{\square\square\square\square} \quad (1)$$

Where,

A - index of technical change that varies overtime but for the moment held constant, *K* - the capital stock,
L - labour supply and

H- stock of human capital.

It should be noted that the coefficients α and β are assumed to lie between 0 and 1 and $(\alpha+\beta) < 1$, implying that there are decreasing returns to all capital. Assuming *sk* to be the fraction of income invested in physical capital and *sh* the fraction invested in human capital, the evolution of the economy is determined by:

$$kt = skyt - (n + g + \square)\, kt \,, \quad (1a)$$

$$ht = shyt - (n + g + \square)\, ht \,. \quad (1b)$$

Where, $y = Y/AL$, $k = K/AL$, and
$h = H/AL$ are quantities per effective unit of labour.

It is assumed that the same production function applies to human capital, physical capital, and consumption. In other words, one unit of consumption can be transformed at no cost into either one unit of physical capital or one unit of human capital. Human capital (*H*) is the knowledge acquired by workers, often as the result of specific investment in education. Since human capital involves investment just as physical capital, it also depreciates. In a case where $\alpha + \beta$ equals one, then there are no constant returns to scale in the reproducible factors and there will be no steady state for the model. It is implied in equations (1a) and (1b) that the economy converges to a steady state defined by:

$$k^* = \left(\frac{s_k^{1-\beta} s_h^{\beta}}{n+g+\delta}\right)^{\frac{1}{1-\alpha-\beta}}, \quad h^* = \left(\frac{s_k^{\alpha} s_h^{1-\alpha}}{n+g+\delta}\right)^{\frac{1}{1-\alpha-\beta}} \quad (2)$$

Substituting equation (2) into the production function and taking the natural logs gives an equation:

$$In\left[\frac{Yt}{Lt}\right] = InAo + gt - \frac{\alpha-\beta}{1-\alpha-\beta}\, In(s) - \frac{\alpha-\beta}{1-\alpha-\beta}\, In(n + g + \delta) + \frac{\alpha}{1-\alpha-\beta}\, In(sk) + \frac{\beta}{1-\alpha-\beta} In(sh) \quad (3)$$

This equation shows how per capita income (proxy for economic development – a superset of economic growth) depends on population growth and accumulation of physical and human capital. In adopting the model above for this study, the researcher was motivated by Ahmed, Mahalik and Shahbaz (2016) and Odularu (2008) in which focus was restricted to human capital investment in the form of crude oil, ignoring investment in health, among others. This study, therefore, adopted the Mankiw, Romer and Weil's theory of economic growth

2.3 Empirical Review

The idea that oil price volatility affect economic growth was first put forth by Hamilton (1973) and then subsequent enormous scholarly works stemmed out. Several other economists have investigated this relationship but there is no uniformity in their findings as some authors argued that crude oil price volatility could promote growth or has the potential of doing so (Akpan, 2009; Aliyu, 2009; Olomola. 2006; Donwa, Mgbame & Aigboduwa, 2015; Akinlo & Apanisile, 2015; Ogboru, Rivi & Idisi, 2017, etc.) while others said it could also inhibit growth (Darby, 1982; Cerralo, 2005; Cantah & Asmah, 2015 ; El-Anshasya, Mohaddesby & Nugent, 2015). Yet, other findings were inconclusive or insignificant (Ani, Ugwunta, Oliver & Eneje, 2014).

For instance, Amir and Mohammad (2017) investigate the relationship between volatility in oil prices and economic growth in Iran. In their paper, the impact of oil price volatility (OPV) on the economic growth in Iran has been tested by using the threshold regression model on time series data 1980-2014 extracted from the Central Bank of Iran. Findings of their study show that the OPV equal to 1147.77 acts as a threshold value. Also, due to the fact that the coefficient of OPV has decreased in the second regime compared to the first one, the effectiveness amount of the OPV on economic growth has decreased over time. Their assertion that due to the fact that the coefficient of OPV has decreased in the second regime compared to the first one, the effectiveness amount of the OPV on economic growth has decreased over time is too declarative. They should have found out if the decrease in OPV coefficient in the second regime was due to episodic factors that would have necessitated the application of structural breakes.

On the other hand, Jawad (2013) analyzed the impact of OPV on the economic growth of Pakistan using data from 1973 to 2011. Linear regression analysis

used to analyze the dependency among the dependent and independent variables. All variables including oil price, oil supply, oil demand, GDP, public sector investment, private sector investment and trade balance were stationary at 1st difference through ADF test. Results showed that the trade balance, private sector investments have a significant effect on GDP and public sector investment, OPV have insignificant impact on GDP. He believed that the government should make a proper plan and procedure according to Pakistan's economic growth and requirement which would help to maintain the equilibrium of oil demand and supply and decrease the impact of OPV on the economic growth. Meanwhile, the government of Pakistan should focus on trade balance and also tries to increase private sector investment to increase economic growth. The omission of exchange rate variable from Jawad's study could probably accounted for OPV having insignificant impact on GDP.

Moreover, Mureithi (2014) in his study established the causes of oil import volatility and its effect on economic growth in Kenya. His study used quarterly data from Kenyan National Bureau of Statistics (KNBS), Central Bank of Kenya (CBK), and OPEC to determine the long-run and short-run causes of oil import volatility, and to study the effects of the volatility on GDP growth. The variables of interest are GDP growth rate, exchange rate, OPEC oil production, quantity of money (M2), traffic volume, total manufacturing index, international oil prices, and domestic energy (electricity) production. The analysis is based on the Johansen-Juselius approach to co-integration test and vector error correction. Results indicate that exchange rate was has a statistically significant effect on oil import volatility in the short-run. In the long-run, oil import volatility is determined by several macroeconomic variables. Specifically, exchange rate, traffic volume, total manufacturing index, and GDP growth rate have positive and statistically significant effects on oil import volatility. OPEC oil production has a negative relationship with oil import volatility. Mureithi used too many variables (8 variables) with some of them like domestic energy (electricity) production irrelevant. He should have used domestic energy (gasoline) pump price.

Moreover, Ani, Ugwunta, Oliver and Eneje (2014) investigated chiefly the casual relationship between oil prices and key macroeconomic variables in Nigeria in a multivariate framework using time-series data from 1980 to 2010. To examine whether there is prediction between oil prices and macroeconomic indicators (inflation, interest rate, exchange rate and real GDP) as well as the impact of oil prices on the applied macroeconomic indicators, their research adopted the Granger causality and the Ordinary Least Square (OLS) respectively. After ensuring data stationarity, their results suggest that in the short-run, changes in the GDP is not influenced by oil price volatility, nor do they found evidence of influence on key macroeconomic variables. Again, the findings indicated that there is a positive but insignificant relationship between oil price and the Nigerian GDP and that, overall, oil prices have no significant impact on real GDP and exchange rate in Nigeria. Their findings suggested that Nigeria has a special case of the Dutch Disease, where a country seemingly good fortune proves ultimately detrimental to its economy. The authors employed outdated models like OLS and Granger causality test and yet they didn't utilize important variables like gasoline price and monetary policy rate that would have shed more light on the relationship between oil price volatility and economic growth in Nigeria.

In addition, Akinlo and Apanisile (2015) investigated the impact of the volatility of oil price on economic growth in 20 Sub-Saharan African countries from the period of 1986-2012. These countries were divided into Group A and Group B. Group A consists of 10 oil exporting countries, while Group B consists of non-oil exporting countries in sub-Saharan Africa. Panel data were used for the analysis. Panel pooled OLS, panel fixed effect model and generalized method of moment (GMM) models were employed in the estimation for both oil exporting and non-oil exporting countries. The estimation of panel A model consisting of the oil exporting countries showed that the OPV has a positive and significance effect on the economic growth of oil exporting countries. The result of panel B consisting of non-oil producing countries showed that the volatility of oil price also has a positive and insignificant impact on economic growth. The Panel pooled OLS, panel fixed effect model and generalized method of moment (GMM) models employed by Akinlo and Apanisile for this study are not appropriate for this study. The most appropriate model should have been Panel ARDL.

Similarly, El-Anshasya, Mohaddesby and Nugent (2015) examined the long-run effects of oil revenue and its volatility on economic growth as well as the role of institutions in this relationship. They collected annual and monthly data on a sample of 17 major oil producers over the period 1961 to 2013, and used the standard panel autoregressive distributed lag (ARDL) approach as well as its cross-sectionally augmented version (CS-ARDL) for estimation. Therefore, in contrast to the earlier literature on the resource curse,

the authors took into account all three key features of the panel: dynamics, heterogeneity and cross-sectional dependence. Their results suggest that (i) there is a significant negative effect of oil revenue volatility on output growth, (ii) higher growth rate of oil revenue significantly raises economic growth, and (iii) better fiscal policy (institutions) can offset some of the negative effects of oil revenue volatility. They, therefore, argue that volatility in oil revenues combined with poor governmental responses to this volatility drives the resource curse paradox, not the abundance of oil revenues as such. Their conclusion that that volatility in oil revenues combined with poor governmental responses to this volatility drives the resource curse paradox and not the abundance of oil revenues as such is questionable and against realities. It is endemic corruption in the oil industry in Nigeria for instance which retard growth.

Cantah and Asmah (2015) employed the ARDL approach to cointegration to examine the relationship between crude oil price and Ghana's economic growth using annual data set from 1967 to 2011. Unlike previous studies on crude oil price economic growth relationship for Ghana, this study controlled for the effect of fiscal policy in the relationship. The results of the study indicated the existence of a long run relationship between crude oil price and economic growth in Ghana. Also, the study revealed that oil price increases had a negative impact on economic growth in both the short run and long run and this was reinforced by increases in government expenditure in response to the oil price in the form of fuel subsidies. The policy implications are that fuel subsidies should be removed and the country should consider alternative sources of energy such as Compressed Natural Gas (CNG), liquefied Petroleum Gas (LPG), or Ethanol (Fuel made from sugar cane) which are cheaper relative to crude oil price. The ARDL approach to cointegration employed by Cantah and Asmah to examine the relationship between crude oil price and Ghana's economic growth was appropriate but the weakness of their study was omission of domestic pump price of gasoline.

On the other hand, Ogunsakin and Oloruntuyi (2017) examined the relationship between oil price volatility and macroeconomic performance in two top net oil exporting countries in Africa (Angola and Nigeria). Quarterly data which were sourced from international monetary fund online database and Central Bank of Nigeria and Angola were used to carry out the empirical analysis. Structural Vector Autoregressive model (SVAR), E(GARCH) and Granger Causality test were used as estimation techniques. Findings from the results showed that oil price volatility has marginal impact on growth rate of Gross Domestic Product of both countries. However, both Impulse Response Function and Variance Decomposition showed that shocks to exchange rate from oil price volatility was the highest. That is, exchange rate appreciates when oil price increases and depreciates when oil price reduces. This has much impact on the economies of Angola and Nigeria being net oil exporting countries. The Granger causality test showed that the direction of causality between oil price volatility and macroeconomic variables in Nigeria was bi-directional while the relationship in Angola was uni-directional during the study period. Based on these findings, it is recommended that, both countries Angola and Nigeria should improve upon their crude oil refining capacity. Also Economic diversification should be strengthened to promote indigenous production so as to reduce importation of those goods that could be endogenously produced.

Amagoh, Odoh and Okuh (2014) in their multivariate study of the implications of pump prices of petroleum products change on some economic variables reveals that PMS has significant impact on all economic variable studied. The AGO also has significant impact on only GDP and Per capita GDP while DPK only has significant impact on GDP per capita. Ocheni (2015) examined the impact of fuel price increase on the Nigerian economy in 2014. The study adopted a survey research design approach to evaluate the level of effect the fuel price increase has on the Nigeria economy. Finding revealed that there is a significant relationship between the recent increases in fuel prices and economic growth in Nigeria. It was also discovered that the Nigeria economy is not developing because of the effect of fuel price hike on purchasing power and finally the finding showed that there is significant relationship between increase in pump price of petroleum and food security.

Nwosa (2013) examined the effect of gasoline price on economic sectors in Nigeria from 1980 to 2010. The objectives of the study are to examine the long and short run relationship between gasoline price and sectoral output in Nigeria. Six sectors (agriculture; manufacturing; building and construction; wholesale and retail; transportation and communication) of the economy were examined. The long run regression estimate showed that gasoline price is a significant determinant output in all sectors examined with exception to the building and construction sector while the short run error correction estimate revealed that only output of the agriculture and the manufacturing sectors of the Nigerian economy is

affect by gasoline price increase in the short run.

In the same vein, Donwa, Mgbame and Aigboduwa (2015) based on the empirical review found that there is a significant and positive relationship between OPV and Nigeria economic growth. He believes that oil price changes determines government expenditure level, rate of inflation, level of unemployment, which in turn determines the growth of the Nigerian economy. Considering the destabilizing effects of oil price fluctuations on economic activity and government spending in Nigeria, the study makes some recommendations which includes that the country should diversify its export revenue base as a means of minimizing reliance on crude oil and petroleum product thereby diversifying to agriculture, operations of budgetary, fiscal prudence, corporate governance, encourage savings and proper accountability. This will further protect the economy from the impact of OPV on the economy, and thus prevent the effect of the shocks from attaining a statistical significance level. The study by Donwa, Mgbame and Aigboduwa (2015) was only an empirical review and as such, didn't estimate the relationship between oil price and economic growth in Nigeria.

In contrast, Alhassan and Kilishi (2016) (2016) gave a diagnostic insight on macroeconomic modelling and oil price volatility in Nigeria. They used GARCH model and its variants (GARCH-M, EGARCH and TGARCH) with daily, monthly and quarterly data. They found that the macroeconomic variables included in the model in terms of (real gross domestic product, interest rate, exchange rate and oil price) are exceptionally unstable; the asymmetric models (TGARCH and EGARCH) outperform the symmetric models (GARCH (1 1) and GARCH – M); and oil price is a noteworthy source of macroeconomic fluctuation in Nigeria. By suggestion, the Nigerian economy is vulnerable to both internal shocks (interest rate volatility, real GDP volatility) and external shocks (exchange rate volatility and oil price volatility). In this way, it is reasoned that more assurance ought to be given to symmetric models in dealing with macroeconomic volatility in Nigeria and oil price volatility should be considered as pertinent variable in examining macroeconomic fluctuations in Nigeria. The authors employed many models and variables yet they didn't utilize important variables like gasoline price and monetary policy rate that would have shed more light on the relationship between oil price volatility and economic growth in Nigeria.

Likewise, Mai-Lafia, Eneji and Nnandi (2016) assessed the impact of oil price volatility on macroeconomic variables and sustainable development in Nigeria. They argued that the significant role of oil in the Nigerian economy cannot be overestimated. They acknowledged that there were studies by other researchers on oil prices and macroeconomic variables, but the findings by such studies were contentious and country-specific. They used secondary time series data in a Vector Autoregression (VAR) analysis. They found that fluctuations in oil prices do substantially affect the real GDP, exchange rates, Unemployment, Balance of payments and interest rates in Nigeria, and that negative volatility in the international oil market, have significant impact on price fluctuations. They concluded that due to increased imports in the Nigerian economy, inflationary pressures are inevitable and are pronounced and that government revenues and expenditures have decreased significantly. They, therefore, recommended diversification of the economy and energy sources for sustainable development in Nigeria. The study didn't utilize important variables like gasoline price and monetary policy rate that would have shed more light on the relationship between oil price volatility and economic growth in Nigeria.

However, Orlu, (2017) investigated the impact of Premium Motor Spirit (PMS) Price on the growth of Nigerian economy as well as the effect of gross domestic investment (GDI), labour employment (LEMP) and lending interest rate (LIR) between 1970 and 2013 on economic growth of Nigeria. The study focused on PMS pricing due to government foot dragging on the deregulation of PMS Price in Nigeria. For his study, secondary data were obtained from Statistical fact sheets of National Bureau of Statistics (NBS) and Central Bank of Nigeria (CBN) publications. Using the Error Correction Mechanism approach, the study reveals that increase in PMS Price had a negative significant impact on the Nigerian economy (Real GDP) at 5% level of significance. This indicates that 1% rise in PMS price of one year lag leads to 0.7% decrease in Real GDP. That is, increase in energy (PMS) price will negatively impact on the production of the firms, individuals (household) or Government Institutions, which will consequently lead to a fall in real GDP.

Similarly, Ogboru, Rivi and Idisi (2017) empirically examined the impact of changes in crude oil prices on economic growth in Nigeria from 1986 to 2015. Variables used were crude oil price, inflation rate, real effective exchange rate, fuel pump price and GDP growth rate. They applied Ng-Perron and Zivot-Andrews Tests, Johansen's co-integration Test, Granger Causality Test and the Vector Error

Correction Model (VECM) as techniques of analysis. The time series property examined showed the existence of co-integration among the variables while the empirical results suggest that the ECT coefficients have negative signs and are statistically significant in all VECMs. In addition to that, the significance of ECT also exhibits that if the system is exposed to shock, it will converge to the long-run equilibrium at the following speed: for GDP (-0.8002), inflation (-0.6714) and real effective exchange rate (-0.5715). VECMs compare to the convergence speed of fuel pump price (-0.6047) and crude oil price (-0.0436), VECMs. The study found out that a positive and unidirectional relationship that runs from crude oil prices to GDP growth rates exists. The value of R2 and that of adjusted R2 stood at 0.6177 and 0.5085 respectively. The value of F-statistic is 5.6570 and it is greater than the tabulated value of 2.76. The study concluded that crude oil price exert positive influence on the economic growth of Nigeria. The study recommends the need for diversification, building of buffers, more refineries and overhaul of the existing ones as well as the adoption of floating exchange rate policy. A critique of this study is in the choice of methodology: Johansen's co-integration Test, Granger Causality Test and the Vector Error Correction Model (VECM) as techniques of analysis. It has been demonstrated that ARDL bounds test approach to cointegration gives more robust results in small samples than the Johansen's approach.

Yakubu and Akanegbu (2019) examined empirically the effect of oil price volatility on economic growth in Nigeria using annual time series data from 1985 – 2016. Their study adopts the econometric method of multiple linear regression approach using Ordinary Least Square (OLS). The findings revealed that OPV has a negative and insignificant effect on economic growth in Nigeria. It was also found that the variables used in the study have a long-run relationship and finally no evidence of causality was found between oil price volatility and economic growth in Nigeria. The study recommends that exploring other alternatives has the potential to make the Nigerian economy stronger to face volatility crisis. Their findings are conflicting. It indicates problems of multicollinearity, model misspecification and inappropriate stationary test as well.

2.3.1 Research Gaps

From the foregoing review of literature it was found that the debate on oil price and economic growth relationship remains largely unresolved with three strands emerging. One thought argued that changes in crude oil prices have positive impact on economic growth, others opined that the effect is a negative one and yet still, the third category of researchers saw no link between the two. The combination of these factors provoked many questions than answers and further stimulates the need for this study. Moreover, Nigeria's case is cut in the irony of being an exporter of crude oil as well as an importer of refined petroleum products. As such, it will be difficult to make a conclusive and authoritative statement on the impact of oil price on the Nigerian economy without a simultaneous assessment of the joint effect of crude oil price volatility and gasoline price on growth. However, very few studies (Ogboru, Rivi, & Idisi, 2017) simultaneously considered the joint effect of crude oil price and domestic pump price of gasoline in the study of the relationship between oil price and the Nigerian economy. Even then, no specific study on the impact of oil price volatility on the Nigerian economy has concurrently applied crude oil price volatility and gasoline pump price as variables. As such, the area of research is still pretty grey and would require further investigation compared to other fields with abundant extant literature. Hence, there is the need to fill the gap by adding gasoline pump price to the model in order to test for its simultaneity impact with crude oil price volatility on economic growth in Nigeria.

In addition, even though Olubusoye, Oloko, Isah and Ogbonna (2016) added monetary policy rate (MPR) to their model, their study focused on impact of oil price and monetary policy shocks on macroeconomic fundamentals and not on oil price volatility. Hence, this study filled this gap by adding the MPR to the model of assessing the impact of oil price volatility on the Nigerian economy. This is in line with Bohi (1989), Bernanke, Gertler and Watson (1997), DeLong (1997), Barsky and Killian (1999), Clarida, Gali and Gertler. (2000) and Hooker (2002) who suggested that there is a role for monetary policy when dealing with oil price volatilities.

Moreover, this research encompassed the time period from 1970 to 2018, thereby captured most of the known volatility time frame which makes the scope of this study wider when compared to previous researches. In addition, the adoption of the Autoregressive of order one [AR (1)] model to extract volatility from annual data instead of the ARCH/GARCH and the standard deviation methods commonly used to extract volatility from daily, weekly and monthly dataset makes this study unique in terms of methodology in the Nigeria's setting. Even though few studies (Loayza & Ranciere, 2006; Shahbaz, 2013; and Devereux & Sutherland, 2009)

used an approach similar to AR(1) method to generate volatility in foreign countries, its application in Nigeria is still lacking. The addition of a stochastic or deterministic time trend to the AR(1) which absolute value of the residuals is extracted as the oil price volatility is still a grey area in application in the Nigeria's setting. Hence, the need to fill this gap with an adoption of AR(1) with a stochastic or deterministic time trend to extract oil price volatility. Finally, the combination of Granger causality test with ARDL models for estimation enables a comparative analysis of findings which make this study unique.

3. Methodology

The quantitative method and ex-post factor research design were adopted in this study as the data used is available in secondary form from reputable sources such as the National Bureau of Statistics (NBS), the Central Bank of Nigeria (CBN), the World Bank, the International Monetary Fund (IMF) and the World Trade Organization (WTO). Since it is a time series study where the mean of the variables are expected to be time variant, that is, non-stationary (Obaka & Arshed, 2019), ordinary least square (OLS) estimation cannot be used as time variant variables violate OLS assumptions. As the emphasis of this study is to examine the relationship between crude oil price volatility as well as domestic pump price of gasoline and economic growth, the most suitable estimation techniques to adopt are a cointegration analysis, error correction modeling (ECM) and causality tests. Accordingly, this study has opted to use Autoregressive Distributed Lags (ARDL) estimation method (Pesaran, Shin, & Smith, 2001) and Granger Causality Test (Granger, 1969).

Hamilton (2003) suggests that the regressions of output growth on its own lagged values and lagged oil price changes can have a causal interpretation. The causality test examine whether there is a prediction between crude oil/gasoline prices and macroeconomic indicators (inflation, exchange rate and GDP). The Granger causality test determines whether one time series is useful in predicting another time series.

However, the choice of ARDL methodology is because of its flexibility and ability to handle variables with different stationarity levels such as I(0) and I(1) as well as allowing for policy analysis, multiplier analysis, mean and median lag and forecasting. In addition, ARDL modeling incorporates adequate number of lags to capture the data generating process from general to specific modeling framework (Laurenceson & Chai, 2003 as cited in Shrestha & Chowdhury, 2005). Also, the ARDL approach to cointegration gives more robust results in small samples than the Johansen approach (Pesaran & Shin, 1999). Thus, the ARDL approach to cointegration is more efficient in finite samples compared with the Johansen approach that requires large data samples for one to get a valid result (Pesaran & Shin, 1999). In addition, the problem of endogeneity is addressed in this technique.

Pesaran and Shin (1999) argued that modeling the ARDL with the appropriate lags will adjust for both serial correlation and endogeneity problems. Jalil and Feridun (2011) contend that endogeneity is less of a problem if the estimated ARDL model is free of serial correlation. The problem of endogeneity is primarily important since the causal relationship between crude oil price volatility as well as domestic pump price of gasoline and economic growth cannot be ascertained in advance (Cantah and Asmah, 2015). The use of the ARDL approach is further justified by the relatively small sample size of this study dataset covering annual dataset from 1970 to 2018. The dataset is small because it is annual and not a high frequency dataset of daily, weekly, monthly or quarterly. The ARDL approach is, therefore, considered to be very suitable for analyzing the underlying relationship.

To undertake the empirical analysis, secondary data and Eviews 10 statistical package were used. The period of study was from 1970 to 2018, which was dictated by the availability of data. Since the crude oil price data is annual and not quarterly or monthly there was no arch effect to necessitate the adoption of the commonly used Autoregressive Conditional Heteroskedasticity (ARCH) and the Generalized Autoregressive Conditional Heteroskedasticity (GARCH) models to extract crude oil price volatility (OPV). Instead, the study utilized the Autoregressive of order one [AR (1)] model to extract crude oil price volatility (OPV). The AR(1) approach is similar to the method employed by Loayza and Ranciere (2006) and Shahbaz (2013) to generate volatility in which absolute value of residuals that have been acquired by regressing the dependent variable on its lagged value with stochastic time trend was used.

Moreover, the study did not use standard deviation to extract crude oil price volatility as it is commonly done because of its inherent weakness (Shahbaz, 2013). This is because while the AR(1) gives conditional volatility, the standard deviation gives unconditional volatility, which means that there are actually two types of volatility; the unpredictable

volatility and the inherit/inertia volatility which is of past event. In addition, standard deviation is not able to differentiate between both volatilities but AR(1) splits them in which the unpredictable volatility is used. In fact, it has been demonstrated in literature that annual data could be used for volatility (Fatas & Mihov, 2005; Calvacanti, Mohaddes & Raissi, 2011; Khalil, 2011; Dickson, 2012; Ogundipe, Ojeaga & Ogundipe, 2014; Awel & Gashaw, 2018; Latief & Lefen, 2018; and Ho & Iyke, 2018). For estimation in Eviews 10, the extracted OPV was then used with domestic gasoline pump price as key regressors while economic growth proxied by GDP was used as a dependent variable. In addition, the exchange rate of naira to US dollar and inflation rate (INF) were used as control variables.

3.1 The Model

Based on the research questions and the hypotheses, there are three models for this study as follows:

*Ln*GDP = F(OPV, *Ln*GDP, *Ln*DOP, XCR, INF, MPR) (4)
Where,
***Ln*GDP** = Natural log of Gross National Product (GDP).
OPV = Crude oil price volatility.
***Ln*DOP** = Natural log of domestic pump price of gasoline.
XCR = Naira's exchange rate to the US dollar.
INF = Inflation rate.
MPR = Monetary policy rate.

The Granger causality test equation for oil price volatility causes Gross Domestic Product (GDP) is specified as:

$$GDP_t = a_0 + \sum_{i=1}^{n} \alpha_1 \ OPV_{t-1} + \sum_{j=1}^{n} \beta_1 \ GDP_{t-1} + \mu_{1t} \quad (5)$$

Equation 5 above is modified and repeated for each of the dependent and independent variables to show their casual relationships. The ARDL econometric model for this study is specified as:

$$LnGDP = \alpha_0 + \alpha_1 OPV + \alpha_2 LnDOP + \alpha_3 INF_2 + \alpha_3 XCR_3 + \alpha_5 MPR + \varepsilon_t \quad (6)$$

The equation 6 above is the functional relationship between gross domestic product, oil price volatility, domestic pump price of gasoline, exchange rate of naira with the United States (US) dollar, and inflation rate with monetary policy rate as a control variable. It means that gross domestic product: a proxy for economic growth is influenced by crude oil price volatility, gasoline pump price, exchange rate and inflation rate and also controlled by monetary policy rate. The equations 5 and 6 above will both be evaluated by Granger causality test and ARDL estimation technique.

3.1.1 Justification for Inclusion of MPR in the Model

Given its implications on economic activities, the increasing spate of fluctuations of oil price remains a great challenge to policy-makers anywhere in the world and one of the tools of economic stabilization often employ to correct this, is monetary policy (Olubusoye, Oloko, Isah & Ogbonna, 2016). The monetary policy rate (formerly called discount rate) itself is an official interest rate fix by central banks and it is instrumental to changes in various private interest rates in the economy. The fact that the CBN often varies the MPR in reaction to oil price volatility explains the possibility of oil price rise and fall affecting the MPR. Similarly, the MPR has been a very useful monetary policy instrument used by the CBN to channel the movement of interest rate, exchange rate and inflation rate towards achieving price level stability in the country (Olubusoye, et al., 2016). In fact, Bohi (1989) and Bernanke, Gertler and Watson (1997) claim that the downtown in economic activity that often follows oil price fluctuations is caused by a combination of direct impacts of the oil price volatilities as well as the monetary policy response to these volatilities. DeLong (1997), Barsky and Killian (1999), Clarida, Gali and Gertler. (2000) and Hooker (2002) were among others those who suggest that there is a role for monetary policy when dealing with oil price volatilities. Hunt, Izard and Laxton (2001), Bachmeier (2008) and Plante (2014) examine the response of monetary policy to oil price changes and Hunt et al (2001) specifically suggest that the effects of oil price volatilities on economic activities can be limited if appropriate monetary rules are chosen. Therefore, it will be justifiable to assume that MPR affect the exchange rate and inflation rate while in addition to these, oil price volatilities affect the MPR (Olubusoye, et al., 2016). Consequently, this study adopts the MPR as a control variable which is further justified in line with Olubusoye, et al. (2016) who adopted the MPR as a variable in their model.

4. Pre-Estimation Test Results

4.1 Descriptive Analysis

The summary statistics and correlation are posted in the appendix and are labeled tables 4 and 5 for descriptive statistics and correlation coefficient respectively. Table 4 reveals the summary statistics

of all the variables used in this research irrespective of the models they are included. It should be noted that not all the relevant variables used for this research was converted to natural logarithm. The GDP and DOP were converted to natural logarithm since there are in local currency unit (LCU) of naira. Other variables that were not expressed in natural logarithm include XCR, INF and XCR because they are already in rates.

Before going into the main regression analysis, to show the relationship between oil price volatility and Nigerian economic growth, it will be important to determine the basic statistical features of the variables used in the research. The GDP shows an average of N27.67134 trillion for the period under study. This indicates that on average, Nigeria's GDP grows at the N27.67134billion annual value approximately for the forty-nine years under review. Oil price volatility (OPV) show a mean of 6.667437 while domestic oil price (LnDOP) has a mean of 1.173100 naira. It should be remembered that even though OPV is in the US dollar it was not logged because its volatility was already extracted. The mean of other variables are 70.90050, 18.41688 and 11.01959 for XCR, INF and MPR respectively.

Table 4: Summary Statistics

Type	LNGDP	OPV	LNDOP	XCR	INF	MPR
Mean	27.67134	6.667437	1.173100	70.90050	18.41688	11.01959
Median	27.57504	4.559038	2.397895	21.88600	12.87658	12.00000
Maximum	32.39488	38.54320	4.976734	363.5000	72.83550	26.00000
Minimum	22.91620	0.022539	-2.813411	0.546781	3.457650	3.500000
Std. Dev.	3.149392	8.176636	2.868204	90.80881	15.76133	4.976040
Skewness	0.069439	2.176181	-0.075030	1.360434	1.902539	0.405864
Kurtosis	1.566886	7.867249	1.311179	4.435602	5.802330	3.044873
Jarque-Bera	4.232583	87.04271	5.869042	19.32248	45.59382	1.349367
Probability	0.120478	0.000000	0.053156	0.000064	0.000000	0.509318
Sum	1355.896	326.7044	57.48192	3474.125	902.4271	539.9600
Sum Sq. Dev.	476.0962	3209.154	394.8764	395819.6	11924.13	1188.527
Observations	49	49	49	49	49	49

***Source**: Author's Compilations using Eviews 10 Edition*

Keynotes: LnGDP= Natural log of Goss Domestic Product in naira, **OPV**= crude oil price volatility, **LnDOP** = Natural log of domestic pump price of gasoline, **XCR** = naira exchange rate (XCR) to US dollar, **INF** = Inflation rate and **MPR**= Monetary Policy Rate.

Median is the middle value of the series when the values are arranged in an ascending or descending order. From table 4 above, the median for LnGDP is N27.58trillion approximately, while the median for OPV, LnDOP and XCR are 4.56, 2.40 naira and 21.89 respectively. Other variables have the following median; 12.88 and 12 for INF and MPR.

Maximum and Minimum is the highest and lowest values of the series for the period under study. The table 4 indicates that the maximum values for LnGDP is 32.39 trillion naira approximately, while the maximum values for OPV, LnDOP and XCR are 38.54, 4.98 naira and N363.50 respectively. Other variables have the following maximum values; 72.84 and 26 for INF and MPR. On the other hand, the minimum values for LnGDP, OPV, LnDOP, XCR, INF and MPR are 22.91 trillion naira, 0.02, -2.81, 0.55, 3.46 and 3.50 respectively.

Standard Deviation is a measure of spread or dispersion in the series. From table 4 above the standard deviation for LnGDP, OPV, LnDOP, XCR, INF and MPR are 3.149392, 8.176636, 2.868204, 90.808881, 15.76133 and 4.976040 respectively. This shows that exchange rate has the largest spread over the period under study while LnDOP has a minimal spread over time, partly due to its conversion to natural logarithm which reduced it absolute value.

Skewness is a measure of the probability distribution of a real-valued random variable about it mean. A normal distribution is symmetrical at point 0. If the value is greater than zero it is positively skewed but if it is less than zero, it is negatively skewed. From the above table 4, it is observed that all the variables have positive skewness except for LnDOP which is also partly due to its conversion to natural logarithm.

Kurtosis measures the peakness or flatness of the distribution of the series. If the kurtosis is above 3, the distribution is peaked or leptokurtic relative to the normal and if the kurtosis is less than three, the distribution is flat or

platykurtic relative to normal. From table 4 above, all the variables are above three, therefore they are leptokurtic relative to normal except for Ln GDP and LnDOP which is also partly due to their conversion to natural logarithm. Jarque-bera is a test statistic to test for normal distribution of the series. From the table 4 above the Jarque-bera for LnGDP, OPV, LnDOP, XCR, INF and MPR are 4.232583, 87.04271, 5.869042, 19.32248, 45.59382 and 1.349367 respectively. The probability value of the Jarque bera statistic of all the variables were found to be less than 5% level of significance which implies rejection of the null hypothesis which states that the residual of the variables is normally distributed with zero means and constant variance except for LnGDP, LnDOP and MPR which are greater than 5% level of significance.

Before formal pretest (unit root tests), the study plot the time series of the variables under study as it may help reveal the integrating nature of the variables. The natural log of GDP, the crude oil price volatility (OPV), the natural log of domestic pump price of gasoline, the naira exchange value to the US dollar (XCR), the inflation rate (INF) and monetary policy rate (MPR) are examined graphically as depicted below in figure 1 which shows clear trend spanned 1970-2018.

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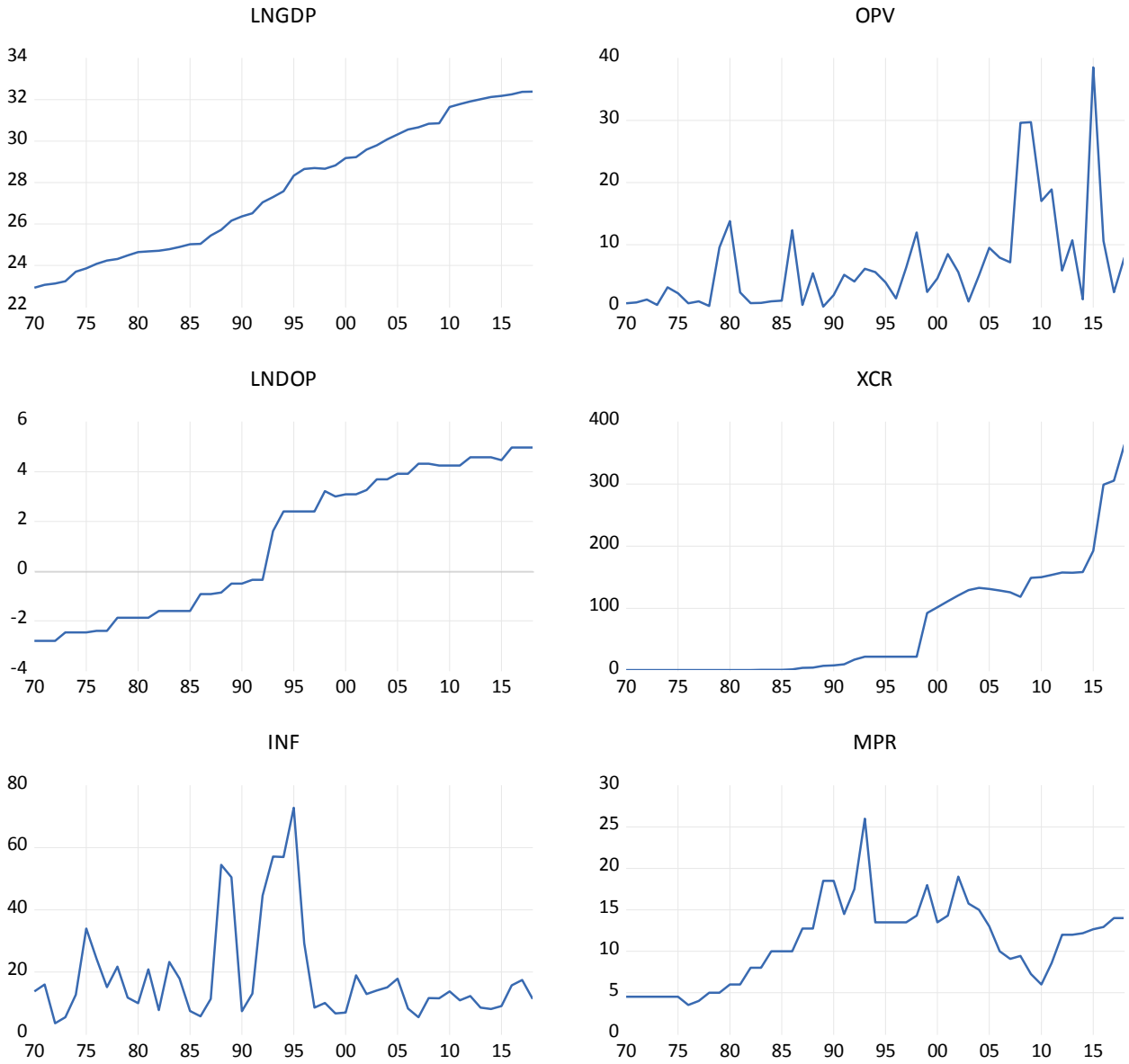

Figure 4.2: Graphs of the variables from 1970-2018.

Source: Author's computation in Eviews 10 Edition
Keynotes: LnGDP= Natural log of Goss Domestic Product in naira, **OPV**= crude oil price volatility, **LnDOP** = Natural log of domestic pump price of gasoline, **XCR** = naira exchange rate (XCR) to US dollar, **INF** = Inflation rate and **MPR**= Monetary Policy Rate.

The correlation result is shown in table 4.2 below

Table 5: Correlation

Variable	LNGDP	OPV	LNDOP	XCR	INF	MPR
LNGDP	1.000000	0.515470	0.984752	0.863895	-0.124495	0.457290
OPV	0.515470	1.000000	0.496145	0.405368	-0.182169	-0.007762
LNDOP	0.984752	0.496145	1.000000	0.825724	-0.093729	0.490950
XCR	0.863895	0.405368	0.825724	1.000000	-0.247097	0.257258
INF	-0.124495	-0.182169	-0.093729	-0.247097	1.000000	0.327800
MPR	0.457290	-0.007762	0.490950	0.257258	0.327800	1.000000

Source: Author's computation in Eviews 10 Edition

The correlation coefficients in table 5 above show that none of the independent variables is highly correlated with each other. This will ease the problem of serial correlation. However, it is observed that LnGDP is highly and positively correlated with LnDOP as well as with XCR. High correlation of independent variable with dependent variable is good but between independent variable is bad (Gujarati). With ARDL, the issue of serial correlation will be automatically corrected as per Muhammad et al (2018) and therefore is expected not to distort the model during estimation.

4.2 Unit Root Test

The unit root results presented in table 6 below is the augmented dickey fuller test (ADF) which was chosen because it is widely used and its output are said to be robust. The stationarity of the variables is concluded based on the outcome of both ADF at constant only or at constant and trend techniques. The results show that all the variables are stationary at either level or first difference. While the summary result is posted in table 6, the raw outcomes could be seen in table 7. Therefore, based on the result of this stationarity test, the adoption of ARDL technique could be given a pass since none of the variables is stationary beyond order one.

Table 6: Unit Root Test (Constant Only)

Variables	ADF	Critical Values			Order of Integration	Remarks
		1%	5%	10%		
LnGDP	-6.116459	-3.577723	-2.925169	-2.600658	I(1)	No Unit Root
OPV	-4.689965	-3.574446	-2.923780	-2.599925	I(0)	No Unit Root
LnDOP	-6.602309	-3.577723	-2.925169	-2.600658	I(0)	No Unit Root
XCR	-5.151201	-3.577723	-2.925169	-2.600658	I(1)	No Unit Root
INF		-3.574446	-2.923780	-2.599925	I(0)	No Unit Root (5% and 10%)
	-3.414711					
MPR	-7.267343	-3.581152	-2.926622	-2.601424	I(1)	No Unit Root

Source: Author's Computation in Eviews 10

Table 7: Unit Root Test (Constant and Trend)

Variables	ADF	Critical Values			Order of Integration	Remarks
		1%	5%	10%		
LnGDP	-6.042074	-4.165756	-3.508508	-3.184230	I(1)	No Unit Root
OPV	-5.831184	-4.161144	-3.506374	-3.183002	I(0)	No Unit Root
LnDOP	-6.533696	-4.165756	-3.508508	-3.184230	I(1)	No Unit Root
XCR	-6.072153	-4.165756	-3.508508	-3.184230	I(1)	No Unit Root
INF		-4.165756	-3.508508	-3.184230	I(0)	No Unit Root (5% and 10%)
	-3.980718					
MPR	-7.267343	-3.581152	-2.926622	-2.601424	I(1)	No Unit Root

Source: Author's Computation

4.3 Co-integration Test

The Johansen Juselius test for co-integration could not be used for this study due to the mixed levels of integration of the variables at levels [I(0)] and first difference [I(1)]. Consequently F-Bounds Test was employed. The null hypothesis of no co-integration (H0: 1 2 3 0 ψψψ = = =) was tested against the alternative hypothesis of the existence of a co-integration relationship (Ha: 1 2 3). The result of this test presented in Table 8 indicated that the null hypothesis could not be accepted for the period under study (i.e. 1970 to 2018), at 5% level of significance. The F-statistics (5.085611) exceeded the upper bound value (3.38) of the critical value at the aforementioned level of significance, which fulfilled the criteria established by Pesaran et al (2001) that for cointegration the F-statistics must fall outside the lower and upper bounds at 5 percent significant level. Also, in the model following the assumptions and criteria of Banerjee et al (1998) for establishing cointegration in ARDL, it is satisfying that there is a negative ECM_{-1} of -0.246444 which is significant at five percent. As such, a co-integration relationship exists in this case. Therefore, there is a long run relationship between the variables in the model.

Table 8: Co-integration Test

F-Bounds Test — Null Hypothesis: No levels relationship

Test Statistic	Value	Signif.	I(0)	I(1)
			Asymptotic: n=1000	
F-statistic	22.19216	10%	1.99	2.94
K	6	5%	2.27	3.28
		2.5%	2.55	3.61
		1%	2.88	3.99

Source*:* Author's Computation in Eviews 10 Edition

5. Model Estimation and Results Evaluation

5.1 Causality Result

The causal relationship among the variables was examined by employing Granger causality test to test the direction of causality between the variables in the model. The existence of co-integration necessitates the existence of a causal relation in at least one direction. The Granger causality test was used to determine the predictive power of the variables. The Granger causality test results are presented in table 9 below. The result suggests that there is no causality running from crude oil price volatility (OPV) to economic growth (*Ln*GDP). The OPV is crude oil price volatility which is the absolute values of oil price (OIP) regressed against its lagged values with time trend. Thus, OPV does not Granger cause natural log of GDP; in other words, oil prices volatility could not be used to predict changes in economic growth. This direction of causation is in contrast with the conclusions of the causal relationship between oil price (OIP) itself and economic growth (*Ln*GDP) in which it was found that OIP could be used to predict *Ln*GDP,

Table 9. Granger Causality between Dependent and Independent Variables

S.No	Null Hypothesis, H_o	F-statistics	P-value	Direction	Decision
1.	OPV does not Granger Cause LNGDP	1.00126	0.3760	No causality	Accept null hypothesis
2.	LNGDP does not Granger Cause OPV	3.76488	0.0313	Unidirectional	Reject null hypothesis
3.	LNDOP does not Granger Cause LNGDP	3.89537	0.0281	Unidirectional	Reject null hypothesis
4.	LNGDP does not Granger Cause LNDOP	2.84575	0.0693	No causality	Accept null hypothesis
5.	XCR does not Granger Cause LNGDP	1.65036	0.2042	No causality	Accept null hypothesis
6.	LNGDP does not Granger Cause XCR	1.56622	0.2208	No causality	Accept null hypothesis
7.	INF does not Granger Cause LNGDP	3.59041	0.0364	Unidirectional	Reject null hypothesis
8.	LNGDP does not Granger Cause INF	0.84071	0.4385	No causality	Accept null hypothesis
9.	MPR does not Granger Cause LNGDP	6.43867	0.0036	Unidirectional	Reject null hypothesis
10.	LNGDP does not Granger Cause MPR	0.20763	0.8133	No causality	Accept null hypothesis
11.	LNDOP does not Granger Cause OPV	3.55788	0.0374	Unidirectional	Reject null hypothesis
12.	OPV does not Granger Cause LNDOP	0.34481	0.7103	No causality	Accept null hypothesis
13.	XCR does not Granger Cause OPV	4.54276	0.0164	Bidirectional	Reject null hypothesis
14.	OPV does not Granger Cause XCR	11.0783	0.0001	Bidirectional	Reject null hypothesis

15.	INF does not Granger Cause OPV	0.97695	0.3848	No causality	Accept null hypothesis
16.	OPV does not Granger Cause INF	0.15616	0.8559	No causality	Accept null hypothesis
17.	MPR does not Granger Cause OPV	0.14106	0.8688	No causality	Accept null hypothesis
18.	OPV does not Granger Cause MPR	0.04106	0.9598	No causality	Accept null hypothesis
19.	XCR does not Granger Cause LNDOP	0.24503	0.7838	No causality	Accept null hypothesis
20.	LNDOP does not Granger Cause XCR	0.05824	0.9435	No causality	Accept null hypothesis
21.	INF does not Granger Cause LNDOP	1.31087	0.2804	No causality	Accept null hypothesis
22.	LNDOP does not Granger Cause INF	1.60032	0.2139	No causality	Accept null hypothesis
23.	MPR does not Granger Cause LNDOP	4.84274	0.0128	Unidirectional	Reject null hypothesis
24.	LNDOP does not Granger Cause MPR	2.51463	0.0930	No causality	Accept null hypothesis
25.	INF does not Granger Cause XCR	0.25775	0.7740	No causality	Accept null hypothesis
26.	XCR does not Granger Cause INF	0.99748	0.3774	No causality	Accept null hypothesis
27.	MPR does not Granger Cause XCR	0.26089	0.7716	No causality	Accept null hypothesis
28.	XCR does not Granger Cause MPR	0.00199	0.9980	No causality	Accept null hypothesis
29.	MPR does not Granger Cause INF	3.54997	0.0376	Unidirectional	Reject null hypothesis
30.	INF does not Granger Cause MPR	3.14213	0.0535	No causality	Accept null hypothesis

Source*:* Author's Eviews 10 output

The natural log of the domestic pump price of gasoline (*Ln*DOP) does granger cause economic growth (LnGDP) in Nigeria but it is a unidirectional causality. That means at the beginning, increase in gasoline price may tend to increase the revenue to the nation as an immediate impact. The reverse causality shows that economic growth does not granger cause gasoline pump price. This means that the price of gasoline is fixed by government.

There is no causality running from exchange rate (XCR) to economic growth (*Ln*GDP). The result implies that increase in exchange rate will not increase the economic growth in Nigeria. The reverse causality shows that economic growth does not granger cause exchange rate in Nigeria. The result implies that increase in economic growth will not increase the exchange rate in Nigeria.

On the other hand, inflation rate (INF) does Granger cause economic growth in Nigeria. The reverse causality shows that economic growth does not Granger cause inflation rate in Nigeria. Consequently, the causal relationship between inflation rate and economic growth is unidirectional. Monetary policy rate (MPR) should positively and significantly affect Nigerian GDP because it is a rediscount rate which commercial banks based interest rate on. This expectation seems be in agreement with actual results herein as monetary policy rate (MPR) does Granger cause economic growth in Nigeria. According to result posted in table 9 above, the casual relationship between monetary policy and economic growth is positive (6.43867) and significant with p-value of 0.0036. This robustness of this positive impact indicates that monetary policy does improve the growth of Nigerian economy.

Generally, the pairwise Granger causality also reveals the independence between natural log of domestic pump price of gasoline (*Ln*DOP) and crude oil price volatility (OPV). There is no causality running from domestic petrol pump price to crude oil price volatility. The reverse causality also shows that OPV does not Granger cause *Ln*DOP. This suggests there is no Granger-causality in any direction between *Ln*DOP and OPV. In addition, exchange rate (XCR) does not Granger cause crude oil price volatility (OPV) but the reverse causality shows that crude oil price volatility does granger cause exchange rate which shows a unidirectional causal relationship.

Granger causality also reveals the independence between inflation rate (INF) and crude oil price volatility (OPV). The reverse causality also shows that crude oil price volatility does not Granger cause inflation rate. This suggests there is no Granger causality in any direction between INF and OPV. Similarly, monetary policy rate (MPR) does not Granger cause crude oil price volatility (OPV) and it is the same with the reverse causality in which there is no causality between the two variables. Further analysis of table 9 above shows that there is independence between exchange rate (XCR) and natural log of domestic pump price of gasoline (*Ln*DOP). In other word no causality between exchange rate and gasoline and vice versa. Similar results are obtained between inflation rate (INF) and natural log of domestic pump price of gasoline (*Ln*DOP) where no causality between them indicating independent causal relationship between the two variables. In contrast, there is causality running from monetary policy rate (MPR) to natural log of domestic pump price of gasoline (*Ln*DOP) but no causality in the reverse case.

For a second time, causality reveals the independence between inflation rate (INF) and exchange rate (XCR), same thing with the reverse causality. Similarly, monetary policy rate (MPR) does not Granger cause exchange rate (XCR), also the same with reverse causality, indicating independent causal relationship between the two variables.

Finally, there is causality running from monetary policy rate (MPR) to inflation rate (INF) but the reverse causality shows that inflation rate does not Granger cause monetary policy rate.

5.2 ARDL Result

After tactical and technical consideration of available methods of analysis, the research also favoured use of ARDL technique for the analyses. After establishing a co-integration relationship among the variables, and following the procedures and the lag selection as earlier conducted the result for the model considered in this research is posted in tables 10, 11 and 12. After the bound test for cointegration using ARDL technique, the model reveals that there is cointegration irrespective of the cases considered. All the controls satisfied that there is a long run relationship by meeting all the assumptions and criteria of Banerjee et al (1998) as well as that which was established by Pesaran et al (2001). It should be noted that Banerjee et al (1998) is of the opinion that a long run relationship exists if there is a negative and statistically significant ECM_{-1} while Pesaran et al (2001) is of the opinion that the F-statistics fall outside the lower and upper bounds respectively for any of the respective significant levels. All these were met in the cases which established that in the model there is a long-run relationship between the variables used. In the model following the assumptions and criteria of Banerjee et al (1998) for establishing long-run in ARDL, it is satisfying that there is a negative ECM_{-1} of -0.157554 which is significant at five percent (Table 11). It also fulfilled the criteria established by Pesaran et al (2001) when the F-statistics falls outside the lower and upper bounds at 5 percent significant level. Therefore, there is a long run relationship between the variables in the model.-

Table 10: Model Evaluation

Evaluation	Test
F-statistic	2925.748
Prob(F-statistic)	0.000000
Durbin-Watson stat	2.120348
R-squared	0.998883
Adjusted R-squared	0.998541

Source*: Author's Computation in Eviews 10*

From table 10 above, by examining the overall fit and significance of the model, it can be observed that the model have good fit, as indicated by the high value of the F-statistic, 2925.748 and it is significant at the 5.0 per cent level. That is, the F-statistic value of 0.0000 is less than 0.05 probability levels. More so, the R^2 (R-square) value of 0.99 shows that the model does have a good fit too. It indicates that about 99 per cent of the variation in growth (GDP) is explained by OPV, *Ln*DOP, XCR, INF and MPR collectively, while the remaining 1 percent is captured by the error term (white noise). The Durbin Watson (DW) statistics which is also used to test for the presence of autocorrelation indicates that there is no autocorrelation among the variables as captured by (DW) statistic of 02.06. This shows that the estimates are unbiased and can be relied upon for policy decisions.

Table 11: ECM (Short Run) Estimates

Variables	Coefficients	Standard Error	t-Statistic	Prob.
D(OPV)	0.000126	0.001825	0.069193	0.9452
D(LNDOP)	-0.187228	0.049644	-3.771398	0.0006
D(XCR)	-0.004026	0.000836	-4.818280	0.0000
D(DUM)	0.045194	0.026447	1.708873	0.0961
CointEq(-1)*	-0.157554	0.010819	-14.56223	0.0000

Source*:* Author's Computation in Eviews 10 Edition

5.2.1 Error Correction/Short Run Results Analyses

The error correction model (ECM) is applied for estimation of the short-run coefficient and also used for determination of the error correction which justifies whether there a long-run relationship or not. The application of the techniques is done for the model made available for ARDL method. The result of ARDL with respect to the error correction model is automatically generated by the Eviews software and would automatically drop some variables having no impact on growth on the short run. In so doing, even the major variables could be dropped. The post-diagnostic test will always justify the outcomes. Only two variables (inflation and monetary policy rate) were dropped during estimation which goes a long way to tell that the econometric issues have been corrected. Various stability tests will attest to this fact. The estimations were done taking into consideration the various lag provision made available for ARDL method. Various stability tests will attest to this fact. The estimations were done taking

into consideration lag provision made available for ARDL method.

From the results on table 11 above, the oil price volatility (OPV) has a positive influence on economic growth at level and statistically significant on the short-run. The outcome at level is contrary to the expectation of this research. Oil has been reported to be inelastic both in demand and supply hence, the consumption and supply literarily is not being affected by their price changes. The frequency of the change in price would bring the issue of volatility. The reason why the result at level seems to have positive impact being that as the change in price occurs, consumers may require adjusting and making new budget for future purchase. The new budget will have to take care of the new prices but may literarily not affect the quantity of purchase, since gasoline and other petroleum products seems to be necessity.

The analyses show that the short-run impact of gasoline domestic pump price (DOP) on economic growth is negative and statistically significant at 5 percent at level. That means at the beginning, increase in gasoline pump price may tend to increase the revenue to the nation as an immediate impact but along the line, this will translate into an increase in cost of production resulting to high cost of finished goods of which some are exported. Such increase in cost will hinder people from the outside the nation from patronizing the product of the nation. Again, increase in prices will tend to reduce purchasing power which will further decrease output within the year. This is not far from the reason why the outcome at level yields negative impacts. The impact of *Ln*DOP on economic growth in Nigeria is, therefore, negative at level (-0.187). This result seems to agree with the appriori expectation.

Exchange rate seems to exhibit negative effect on the growth of Nigerian economy given by the result of the analyses but this negative impact seems to be significant at level. The impact although still negative became statistically significant at five percent. This shows that as exchange rate increases, the impact on economic growth tends to be negative and significant on the same year. The result demonstrates that the increase in exchange rate or devaluation will only have a significant negative impact on economic growth within the year it has occurred.

5.2.2 Long Run Estimation Interpretations

Following the procedure adopted for this research, the model is estimated using the ARDL technique. In it all, it has been established there is a long-run relationship between the variables hence, the estimation of long-run coefficients. Considering the impact of the main variables of interest, there are different impacts on economic growth which are subject to lag selection. The long-run results in table 12 below revealed that crude oil price volatility (OPV) is positive and significant at 5% level in determining economic growth in Nigeria. Meaning that increase in crude oil price volatility will increase economic growth likewise decrease in oil price volatility will decrease economic growth. Precisely, a 1% increase in crude oil price volatility will lead to 0.09 percent increase in economic growth. The positive impact of OPV seems to be robust and should be relied on in making inference and conclusion. Oil has been reported to be inelastic both in demand and supply hence, the consumption and supply literarily is not being affected by their price changes. The frequency of the change in price would bring the issue of volatility. The international crude oil price is exogenously determined. Therefore, one may say that as the volatility of oil price increases by one percent, there is the tendency of increase in economic growth by 0.09 percent. This result corroborates the findings of (Aliyu, 2009; Donwa, Mgbame & Aigboduwa, 2015; and Akinlo & Apanisile, 2015). But contradict the finding of Cantah and Asmah (2015) who showed that crude oil price have negative and significant impact on economic growth.

Table 12: Long Run Estimates

Variables	Coefficients	Standard Error	t-Statistic	Prob.
OPV	0.088233	0.028618	3.083114	0.0039
LNDOP	0.827187	0.105983	7.804899	0.0000
XCR	0.006914	0.002900	2.383973	0.0225
INF	0.033978	0.014149	2.401479	0.0216
MPR	0.106138	0.040615	2.613265	0.0130
DUM	-0.576953	0.379583	-1.519965	0.1373
C	25.62854	0.486459	52.68385	0.0000

Source*:* Author's Computation in Eviews 10 Edition

The domestic pump price of gasoline (*Ln*DOP) is also positive and significant at 5% level of significance which is more stringent at long-run. Meaning that, 1% increase in petrol pump price will lead to 0.83% increase in economic

growth of Nigeria in the long-run. *Ln*DOP seems to influence growth positively in the long-run and statistically significant. That means on the long-run, increase in gasoline pump price may tend to increase the revenue to the nation. This finding is inconsistent with appriori expectations which is of the opinion that the gasoline domestic pump price (DOP) should negatively and significantly affect Nigerian GDP because of it increases cost of transport. Increase in transport cost would a long way lead to increase cost of goods and to large extend, cost of doing business in Nigeria. This result contradicts the findings of researchers such as (Ogboru et al., 2017; Orlu, 2017), who found petrol pump price to be negatively influencing economic growth.

The official exchange rate is also positive and significant at 5% level of significance. Meaning that, 1% increase in exchange rate will lead to 0.01 percent increase in economic growth of Nigeria in the long-run. This result contradicts short-run findings that as exchange rate increases, the impact on economic growth tend to be negative on the same year. However, on the long-run, the impact will change to positive. The long-run demonstrates that the increase in exchange rate or devaluation will only have a positive impact on economic growth years after it has occurred. This result contradicts the findings of researchers such as Habib, Mileva and Stracca (2016), who found exchange rate to be negatively influencing economic growth but the finding is in line with the work of researchers such as Kogid, Asid, Lily, Mulok and Loganathan (2012) who found positive effect of exchange rate on GDP in Malaysia. Our overall conclusion is that the exchange rate does matter for growth in developing economies, but substantially less so in advanced ones, which confirms and strengthens the conclusions of Rodrik (2008)

The official inflation rate is also positive and significant at 5% level of significance. Meaning that, 1% increase in inflation rate will lead to 0.03 percent increase in economic growth of Nigeria in the long-run. Similarly, MPR is said to influence economic growth positively and significant at 5 percent level. This implies that as MPR increases by one unit, it tends to affect Nigerian's economic growth positively by an increasing to the tune of 0.11 units, all things being equal. On the long-run, MPR is said to have a positive coefficient which implies a positive influence on economic growth. This result is in line with the work of researchers like Habib, Mileva and Stracca (2016), who found positive effect of monetary policy rate on GDP in some selected developing countries.

Based on these findings, it could be inferred that the influence of oil price volatility, gasoline domestic pump price and exchange rate are both short-run and long-run phenomena while of that of inflation and monetary policy rate is only long term phenomenon.

5.3 Post Estimation Test Result

Table 13 below shows the result for diagnostic test. This test was done to ascertain the extent of dependability of the model applied in the study. It has absorbed the use of Jarque-Bera test for Normality test, Breusch-Godfrey test for serial correlation Lagrange Multiplier statistics. Two different Heteroscedasticity tests were also conducted, first with Breusch-Pagan-Godfrey and another with Harvey Heteroscedasticity test. All these tests further indicated that the model is normal with no sign of serial correlation and heteroscedasticity. The R-square and Adjusted R-Square are high enough which means the independent variables have high degree of influence over the dependent variable. The null hypotheses for normality test, serial correlation test and heteroscedasticity test could not be rejected (we do not reject the null hypothesis) since their probabilities is greater than 0.05 level of significant, therefore, there is no issue of serial correlation and heteroscedasticity. Generally, this implies that the short run co-efficient in the ECM model are stable and therefore dependable.

The need for stability test could not be over emphasized. It is of necessity to test for the stability of the model employed to ensure dependency and reliability of the results. These tests are conducted to determine the suitability and stability of the model applied in this study. Cumulative sum of recursive residuals (CUSUM) and cumulative sum of squares of recursive residuals (CUSUM of Square) tests were used. The test statistic based on the CUSUM of recursive residuals was introduced in Brown, Durbin, and Evans (1975) and adapted herein. In a model study, Ploberger and Kramer (1992) show that the CUSUM Test based on recursive residuals has better power to detect parameter instability occurring early in the sample than the test based on OLS residuals. Both CUSUM and CUSUM of Square test could be graphically represented to show such needed stability of the models. In the model herein, there is an indication of perfect stability with no specification errors since the plotted lines are within the region of stability. A drift from this region of stability will mean an error in model specification but the result has stated otherwise, hence this report could be relied up for further reference.

Table 13 below is the post-regression diagnostics which shows that there is no autocorrelation (given that p> 0.05). The table also shows that there is no heteroskedasticity, the Ramsey RESET test shows that the model for this paper was not mis-specified (given that p> 0.05).

Table 13: Post regression diagnostics

Diagnostics	Test (Prob)
JB Normality Test	2.12 (0.34)
BG Serial Correlation LM Test	0.63 (0.54)
BPG Heteroskedasticity Test	1.91 (0.07)
RESET Test	0.47 (0.64)

Source*:* Author's Computation in Eviews 10 Edition

Figures 1 and 2 below are the model stability tests (CUSUM and CUSUM of squares), which shows that the model is stable and well fitted.

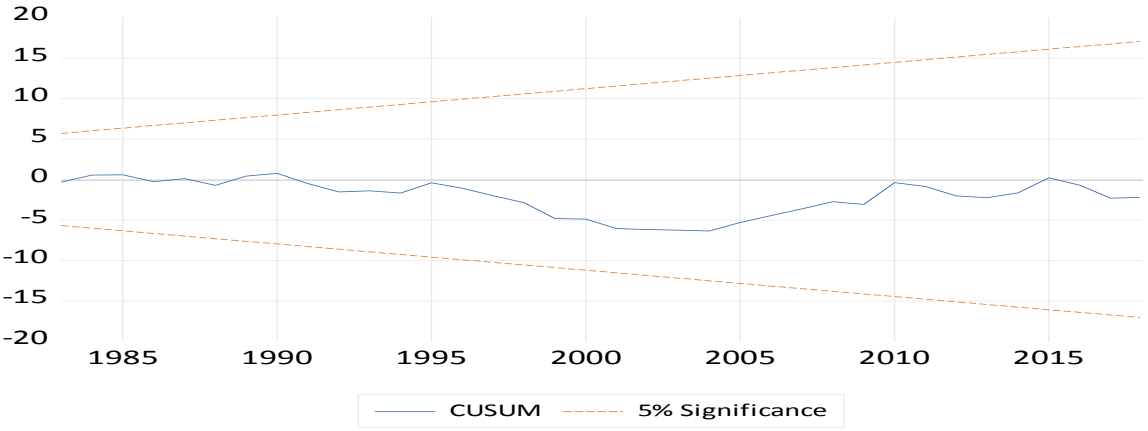

Figure1. Model Stability Test (CUSUM)
Source: Author's Computation in Eviews 10

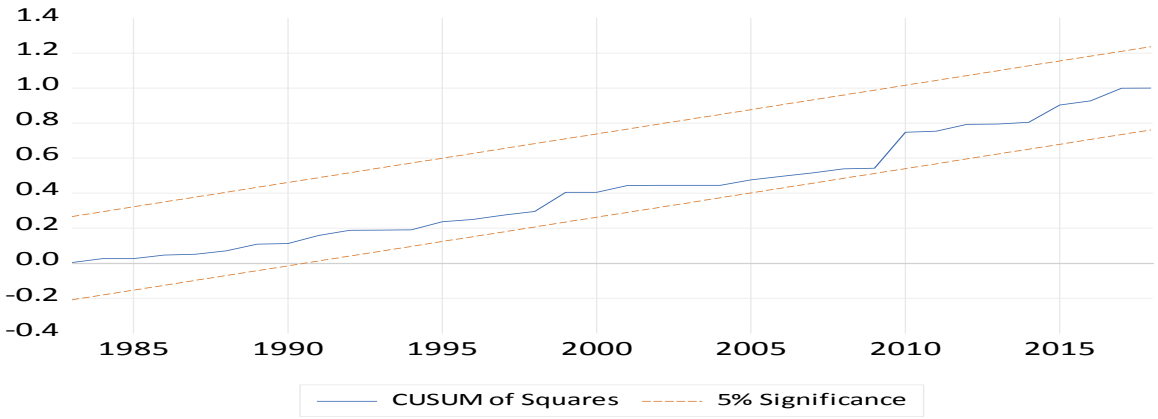

Figure1. Model Stability Test (CUSUM)

Source: Author's Computation in Eviews 10

6. Conclusion and Policy Recommendations

An increase or decrease in crude oil price can both be pain and gain to the Nigerian economy simultaneously because a strong link between the country's budgetary operations and the happenings in the international oil market exists. Therefore, this research employed the Granger causality test and autoregressive distributed lag (ARDL) technique, to empirically investigate into the predictive power and impact of oil price volatility on Nigeria's economy from 1970 to 2018. It could be concluded from the

findings that the impact of oil price volatility, gasoline domestic pump price and exchange rate are both short-run and long-run occurrences while of that of inflation and monetary policy rate is only long term phenomenon. It was also found that crude oil price volatility, domestic pump price of gasoline, exchange rate, inflation rate and monetary policy rate have significant positive impact on economic growth on the long-run. This implies that increase in earnings from crude oil exports as well as the appreciation of Naira increases the economic growth of the country. On the other hand, decrease in crude oil earnings and depreciation of Naira decreases the economic growth of Nigeria. Consequently, government should diversify its earnings by developing agriculture, industrialization and investment in order to reduce the heavy reliance on crude oil and income fluctuation resulting from the fluctuation in crude oil prices so as to protect the country's economy. In addition, government should reduce gasoline pump price by deregulating the downstream sector and at the same time encouraging private company participation in crude oil refining in order to encourage competition thereby bringing down the price of fuel. Considering the importance of exchange rate variables, these findings eventually suggest that a systematic exchange rate regime via monetary policy should be properly developed to promote the stability and sustainability of economic growth in Nigeria.

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