Effect of Oil Price Shocks on the Real Sectors of the Nigerian Economy

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ABSTRACT
This study focused on the effect of oil price shocks on the real sectors of the Nigerian economy. To assess the effect of shocks emanating from oil price, a vector autoregressive (VAR) model was estimated for agricultural sector output (LNAGR), industrial sector output (LNINDP), manufacturing sector output (LNMAN), money supply (LNM2) and Oil price (LNOILP) utilizing annual data spanning between 1981 and 2018. The result of the impulse response functions (IRF) shows that at impact, shock to LNOILP causes LNAGR to rise temporarily above equilibrium level but declines below the equilibrium level from the 4th year throughout the forecast horizon. Shock to LNOILP causes an initial decline on LNINP in the first two years of the forecast horizon but the effect becomes positive after three years of the initial shock as LNINP rises above equilibrium level but dips below equilibrium in the remaining years of the forecast period. Shocks on LNOILP shows that, at impact, there is an initial increase in LNMAN above the equilibrium level up till the 5th year but it declined below the equilibrium level after about five years. Impulse response function of LNM2 to shock on LNOILP shows that, at impact, there is an initial increase in LNM2 above the equilibrium level in the first year but declined below the equilibrium level throughout the forecast horizon. The result of the pairwise granger causality shows that there is no evidence of granger causality between oil price and the real sectors. Thus, there is evidence of independence between oil price shocks and the real sectors. Our result shows that there is long run negative impact of oil price shocks on the real sector of the Nigerian economy. Real sectors has continued to underperform despite huge revenue accruing from the oil sector. We recommend that government should invest the petrodollar accruing from the sale of crude oil in the real sectors to boost its activities. We recommend the investment of oil revenue towards infrastructural development as well as the diversification of the Nigerian economy away from oil by harnessing other natural resource endowments.

Keywords: Real sector, oil price, shocks, vector autoregressive model

1. INTRODUCTION
Oil is a crucial energy source for modern economies and remains a major energy commodity traded in the international market. The demand and supply of oil depends on the internationally determined market price which can be affected by unpredictable global events. Fluctuations in oil price affect economic activities in both importing and exporting countries. Thus, oil price movements can trigger economic shocks which can be propagated and transmitted through all the economic sectors which can be a significant determinant of global real economic activity. Generally, oil price shocks are unexpected change in oil price in the international oil market which can be caused by both political and economic factors. It affects aggregate output through its impact on different sectors of the economy. However, the impact of oil price shocks on the real sector has been of great concern to economic analysts (Oduyemi, 2013). The role played by the real sector is particularly significant and strategic as it is the pivot upon which the production and distribution of goods and services are hinged. The Central Bank of Nigeria (CBN, 2013) classifies the real (activity) sector of Nigerian economy into agricultural; industrial, building and construction; wholesale and retail trade and services sectors. According to Ovia (2008),
traditional real sector is an aggregation of sectors including agriculture, manufacturing, building and construction, communication and transportation, mining and quarrying. Real sector is the part of the economy that is concerned with the actual production of goods and services as opposed to that part of the economy that is concerned with the buying and selling on the financial markets. The aggregation of production output from these sectors reflects the growth level in the Nigerian economy and can be used as a yardstick to judge economic performance. A strong real sector provides the right conditions necessary to meet the consumption demand of an economy. It drives economic growth and development, and provides an indication on the living standard of the citizens of an economy and the effectiveness of government’s macroeconomic policies. Accordingly, it facilitates the creation of economic linkages with other sectors and helps in capacity building, employment and income generation (Anyanwu, 2010).

Given the theoretical linkage between oil and economic activities, serious debates about the role of oil on the Nigerian economy have continued to rage. The issues emanating from these debates followed the structural imbalance created by oil boom era of the 1970’s. Before and after independence, the real sector led the economy with the agricultural sector as the main stay of the Nigerian economy contributing 64 percent to the GDP. Following the discovery of oil in commercial quantity in 1956, the economy began to gradually overlook the agricultural sector and by 1973, oil overtook the agriculture as the major source of foreign exchange to the government. The emergence of oil as the leading sector soon became a problem for the real sector survival. Thus, the agricultural sector began to suffer negligence, the industrial capacity utilization was retarded while mining and quarrying was abandoned (Unachukwu, 2016).

Despite the incessant call for diversification, the Nigerian government has failed to strengthen the real sector due to overdependence on oil. Prior to the first oil price shock of 1973, it was observed that non-oil revenue which was driven by real sectors constituted over 73 percent of total government revenue. Specifically, non-oil revenue constituted ₦467.4 million out of about ₦634 million total government revenue in 1970 while oil revenue constituted about ₦167 million (26.3%) of total government revenue. In 1981, total government revenue was ₦13.29 billion out of which ₦8.56 billion (64.4%) came from oil while ₦4.73 billion (35.56%) came from the non-oil sector and the trend continued till date. Figure 1 shows that since 1981, the non-oil sector has continued to underperform in terms of revenue generation to the government.

![Figure 1: Components of Total Government Revenue (1981-2018)](image-url)
Figure 1 further shows that activities in the oil sector dictates the movement of government revenue except in 2016 when international oil price crashed due to low demand of Nigerian oil occasioned by US shale oil and non-oil sector overtook the oil sector in terms of revenue generation. This equally coincided with the most recent economic recession experienced in Nigeria. Within this period, the non-oil sector contributed N2, 922.5 billion (52.04%) out of total government revenue of N5, 616.4 billion. Therefore, the impact of oil price shock to Nigerian economy cannot be in doubt.

Thus, Nigerian government had depended on crude oil sales for fiscal policy in terms of public expenditure. Marwa (2017) explains that the economy has not significantly felt the impact oil revenue despite the huge increase in government expenditure orchestrated by influx of petrodollar. According to Agu-Idika et al (2014), increase in public expenditure stimulates economic activities and act as a stabilizer during recessionary period. However, public expenditure in Nigeria has mostly been on recurrent issues rather than capital expenditure (Ram, 1996). Consequently, there is dearth of critical infrastructure to support real sector activities despite huge oil revenue. Agriculture and the industrial sectors has continued to underperform while the manufacturing capacity utilization continued to decline. It is therefore evident that the real sector of the Nigerian economy has been under-performing which explains why non-oil revenue had remained lower than that of oil revenue. Expectedly, oil revenue should have been channeled towards financing the real sector which in turn provides an alternative to oil revenue and act as a buffer during adverse oil price shock.

Nigerian government had formulated and implemented different industrial policies/industrialization strategies in order to facilitate industrialization of the economy and to diversify the economy. Some of these policies include import substitution approach, export promotion strategy and foreign private investment led industrialization as well as policy reform measures like indigenization policy, structural adjustment programme and financial sector reforms. However, these policies achieved poor results towards the diversification question as the economy still depends critically on oil sector and its incessant fluctuations. In view of this, a discussion of the relationship between the real sector and oil price shock is important. This study, therefore explores the effect of oil price fluctuations on the real sector of the Nigerian economy. The rest of the paper is arranged as follows; Section II is the literature review. Section III deals with the methodology and empirical analysis while Section IV is the conclusion and recommendation.

2. Literature Review

Conceptual Issues

Generally, shocks refer to any disturbance in the economy to internal or external factors. These shocks are mostly unpredictable and come without any signal. It affects almost all the macroeconomic aggregates of the economy. Frisch (1933) defined shock as exterior impulses that hit the economic mechanism that initiates free oscillations in economic activities. According to Sorensen and Whitta-Jacobsen (2003), macroeconomic shock is defined as unanticipated events that trigger shift in the aggregate demand and aggregate supply curves. In this context, economic fluctuation is seen as the economy’s reaction to the demand and supply shocks. A demand shock is any event that causes a sudden and unexpected shift in the aggregate demand curve while a supply shock is any event that causes a sudden and unexpected shift in the aggregate supply curve. Oil price shock, is therefore any event that trigger a sudden and unexpected shift in the international price of crude oil which affect its global demand and supply. Shocks to oil price have been a recurring decimal in the international oil market. The market has been characterized by erratic movement of oil price starting in the 1970s. These oscillations in oil price and production constituted major sources of economic shocks globally. There has been varied sources and origins of these shocks. Due to the implications of these shocks, researchers sought to understand their origins in order to make appropriate policy to guide against frequent oil shocks.

Sources of oil price shocks have been broadly classified into two: political and economic factors. Giraud (1995) argues that, though, the day-to-day prices of oil may be determined by free market forces, sharp shifts in price level have been motivated by political factors. Civil strives and unrests in the Middle East from where the greater proportions of crude oil supply emanate remains a typical example of politically
motivated price shocks. Hamilton (2009) posits that supply disruptions from crude exporters due to these political factors trigger oil price volatility. Even though the fluctuations in the price of oil dissipate after the events, it emerges with another event, thus creating shocks and disequilibria.

From an economic viewpoint, Baumeister and Peerman (2009) explain that low price elasticity of demand and supply can trigger oil price shocks. The disequilibrium caused by low price elasticity of demand and supply requires large price variation to clear the market and to restore the market equilibrium. Hamilton (2008) and Fattouh (2007) concur that, in the short run, crude oil price elasticity can be very low. This is due to technology lock-up; that is, it takes some time before energy-consuming appliances/capital stocks are replaced with more energy-efficient substitutes. However, in the longrun substitution takes place and price elasticity becomes much larger. Furthermore, supply of crude oil is found to be price inelastic. This may result from time lag between exploration and production activities, making supply less responsive to price changes (Fattouh, 2007). Besides the decreasing elasticity of crude oil demand function, Baumeister and Peerman (2009) further posit that shifts in demand for oil explain some of the price volatility. These shifts result from economic growth in oil-importing countries. However, Kilian (2006) explains that, in the past few decades, the shifts in global oil demand and the attendant increase in oil price is traceable to shocks/changes in inventory/precautionary demand planning (against probable future oil scarcity) by oil importers. Some other factors that trigger oil price shock include reduction in the productive capacity of oil; the slow rate of discovery of new oil wells and the dearth of infrastructural investment in the oil sector in most oil producing countries; fixation of price by collusion in OPEC cartel; information asymmetry among market participants; large crude oil inventories; disagreements on production quotas amongst the producers; weather problems; short-term political developments; transportation problems (shipping, pipeline etc.) and regional agitations (Ebrahim et al.2014; Konrad,2012; Aremo et al,2012)

**Oil Price Shocks and Macroeconomic Performance**

Empirical studies suggest that oil price movements have been a major source of business cycle fluctuations since the mid-1970s. But there is no consensus on the validity of a peculiar transmission channel that helps to explain the processes by which fluctuations in oil prices influence the macro economy. Hamilton (1983) reported that several post-war recessions in the US were preceded by oil price shocks. According to Hunt et al (2001), oil prices increases can influence the economy through many channels depending on whether the economy is an oil importer or exporter. Firstly, there is transfer of income from oil-importing to oil-exporting countries. This leads to a decrease in global demand in the oil-importing nations. In turn, the demand decrease in the oil-importing countries outweighs the demand increase in the oil-exporting countries because of an assumed low propensity to consume in the oil-exporting countries.

Hunt et al (2001) further argues that given constant level of capital stock and assuming that wages are relatively inflexible in the short run, an increase in input costs of production via oil price increase will result in decrease of non-oil output. This idea follows from the understanding that crude oil is a basic input in production. Therefore, an increase in oil price leads to an increase in production costs. Depending on the definition of core inflation, positive oil price change affects consumer prices. An increase in energy prices raises the consumer price index, leading to calls for action from the central bank. Policy response in the face of increased prices takes the contractionary route. Therefore a tightened monetary policy has dire consequences on economic output.

On his part, Finn (2000) had argued that oil price increase causes sharp, simultaneous decreases in energy use and capital utilization. The decrease in energy use works through the production function, directly reducing output and labour’s marginal product. The fall in labour’s marginal product reduces wages, which, in turn, leads to a reduction in the labour supplied.

The third channel is when workers and producers resist a decrease in their real wages and profit margins. Consequently, there will be upward pressure on prices to accommodate labour costs. The fourth channel is through the definition of core inflation. Abel and Bernanke (2001) argues that increases in oil prices cause the general price level to rise. This is consistent with other theories that are focused on the production function. Oil is one of the major inputs in a production process. Thus, when the price of oil increases, firms respond by using less of the commodity, which leads to a contraction in output. Thus, an
increase in energy prices raises the consumer price index, which elicits policy response from the central bank. However, monetary policy response may have dire consequences on economic output since oil demand is inelastic.

Conversely, Hess (2000) observes that oil price shocks only led to lower real gross domestic product GDP prior to the 1980s. Thereafter, there was weak relationship between changes in oil prices and the real GDP as subsequent oil changes had no effect on US economic activity. Hess (2000) further argues that oil price changes are generally short-lived and may not have a direct effect on economic activity. He reaffirms that the oil spikes of 1973 and 1979 precipitated downturns in the US economy and that the evidence reported for 1980 by other researchers was much weaker. Hooker (1996) equally noted that real growth in GDP prior to 1980 was negatively affected by oil price changes. However, the post-1980 relationship between oil prices, economic growth and inflation statistically disappeared. This is because the oil price changes had not brought about a statistically significant effect on real GDP growth, the rate of inflation, or unemployment since 1980.

In studying the short and long-term effects of oil shocks on the Chinese economy, Tang et al. (2010) identified six transmission channels. These include: Supply-side shock effect which focuses on the direct impact on output from change in marginal costs of production caused by oil-price shock; wealth transfer effect which emphasizes on the different marginal consumption rate of petrodollar and that of ordinary trade surplus; inflation effect that analyzes the relationship between domestic inflation and oil prices; real balance effect, investigating the change in money demand and monetary policy; sector adjustment effect, estimating the adjustment cost of industrial structure, which is mainly used to explain the asymmetry in oil-price shock impact; and unexpected effect, focusing on the uncertainty over oil price and its impact. These channels have been proven to be valid in industrialized countries.

Oil and the Nigerian Economy

Oil was discovered in commercial quantities at Oloibiri, Nigeria’s Niger Delta region in 1956, but production did not start until 1958. The country became a member of the Organization of the Petroleum Exporting Countries (OPEC) in 1971. Crude oil has redefined the structure of Nigerian economy. The impact of crude oil on Nigerian economy has been double-edged as it has benefited the country in some ways while constituting a curse in some other ways (Ogwumike and Ogunleye, 2008). Prior to the discovery of crude oil in commercial quantity in 1956 (Adedipe, 2004; Odularu, 2007), agriculture was the mainstay of the Nigerian economy. Even though economic activities were mainly agrarian the economy was stable and growing at a steady rate of 6 percent (Canagarajah and Thomas, 2001). Thus, agriculture played a dominant role in terms of contribution to GDP and foreign exchange earnings through to the late 1960s. Agriculture contributed about 67 percent to Nigeria’s gross domestic product. However, the stability and gradual growth of the economy was truncated with the oil dominated economy that started in early 1970s. At this time, GDP grew at an average of 11 percent while oil revenue represented almost 90 per cent of foreign exchange earnings and about 85 per cent of total exports as the economy became excessively dependent on oil. The oil shock created a structural problem in the economy as the agricultural sector began to suffer neglect. Inflation rate rose to 16 per cent while unemployment rate stood at 7.34 per cent. The decline in agriculture was traced to growing activities of oil and mining industry in the country. Balogun (2001) attributed this problem to the poor management of public resources and inappropriate incentives, which in turn may not be unconnected with overwhelming inflow of oil revenues in the 1970s.

All the other indicators show evidence of substantial growth. In particular, total export, total import, money supply (RM2), private consumption and gross fixed investment were growing at 11.36 percent, 16.64 percent, 10.53 percent, 4.19 percent and 23.59 percent, respectively. This was the era in which the economy became heavily dependent on oil revenue. However, oil boom era provided surplus funds in the economy while government expenditure skyrocketed. Consequently, Dutch disease syndrome emerged in the economy. This manifested in the appreciation of the real exchange rate resulting from oil revenue expenditure which made Nigeria’s traditional exports less competitive in the world markets. In addition the appreciation of the exchange rate made import substitution industries less competitive in the domestic market. In spite of the enormous revenue contributions to the government, the oil sector’s contribution to
the generation of employment in the country had been very low. The contribution has relatively been insignificant due to weak linkages with the rest of the economy (Odularu, 2007). As a result, the sector employs only 1.3% of the total modern sector employment in Nigeria (Odularu, 2007).

As noted earlier, the advent of oil has altered the structure of the economy. Contributions of other sectors to GDP have relatively declined while that of oil grew. For instance, the United States Agency for International Development (2006) noted the association between sharp rise in oil production in Nigeria in 2003 and decline in agriculture as a percentage of GDP from 29 percent in 2003 to 16% percent in 2004. Similarly, contribution of the manufacturing sector as a percentage of GDP also declined from 26% to 25% (Adedipe, 2004).

The 2008 global financial crisis affected the Nigerian economy as oil revenue dropped. Around 2009 crude oil price tumbled down from $147 to $43 per barrel. However, the presence of fiscal buffers such as the excess crude account (ECA) created by the financial authorities helped the government to withstand the drop in revenue. During the global financial, Nigeria’s foreign reserves stood at $62bn. Thus the dwindling oil revenue was shored up from sharing of the ECA account. From 2010, there was a sharp rise in oil prices to $106 which speedily brought the economy to greater viability. This high price lasted for long which provided a lot of revenue to the government. Recently, between 2010 and 2014 period the government revenue was more than previous period. But around June 2014, oil prices nosedived to 66.8% from $114/barrel to $38.0 by December 2015. But by 2015, fiscal buffers did not exist, as Nigeria refused to build reserves. Poor oil production and bogus importation bills have ensured Nigeria struggled financially.

Oil Prices witnessed further crash to $31.4 as at early 2016 due to global glut in oil supply and slowing demand. Thus oil price volatility posed a great problem for government revenues while the implicit multiplier effects for the entire economy, have been most staggering and pervasive. During the first quarter of 2016, the economy shrank by 0.36 percent to hit its lowest point in 25 years. By second quarter of 2016, Nigeria’s economy (GDP) contracted by 2.06 percent to record its lowest growth rate in three decades (NBS report).

Marwa (2017) argued that the Nigerian economy experienced economic downturn following the decline in oil prices that began in 2014. Authorities had projected a robust economic growth of about 7 percent per annum in line with the average growth rate experienced over the previous two decades before the oil price shock. However, the oil shock contributed to slow-down in terms of economic growth in 2015 while the economy experienced outright contraction in 2016. Thus, the economy witnessed the worst economic recession in its history. Marwa (2017) further opined that the unexpected decline in oil production in 2016 explains only part of the cause of the recession. Other causes could easily be traced to activities in the non-oil sectors. Even though the non-oil sectors accounted for about 90 percent of the total economy, it had continuously been underperforming and sharply slowed during the recession.

A cross country study of other oil exporters on the response of their respective economies to the decline in oil price shows that countries with a stronger fiscal position, higher international reserves, a more diversified export base, a history of price stability, and a flexible exchange rate regime were able to weather the recent oil price shock better than others (Marwa, 2017). In terms of policy options, Marwa (2017) suggested fiscal consolidation and building a more substantial reserve cushion. This would help build buffers to allow the economy to weather the sizable fluctuations typical of oil prices. A track record of price stability would also create space for countercyclical monetary policy while allowing the exchange rate to flexibly adjust to external conditions. This would reduce the transmission of oil shocks to the non-oil sector.

**Theoretical Issues**

**The Dutch-Disease Model**

The Dutch-Disease is a concept that has been used to explain the possible detrimental effect of a natural resource boom on the manufacturing sector of natural resource–rich country. Corden and Neary (1982) pioneered the use and theoretical analysis of the Dutch disease syndrome in their study of how small open country could suffer from de-industrialization following a natural resource boom. Their analysis is based...
on the assumption that the natural resource country has two sectors i.e the tradable and non-tradable sectors. Natural resource boom will affect the natural resource-rich country via the resource movement effect and the spending effect. The resource movement effect is the tendency for the booming sector to draw labour away from the non-tradable sector, thereby reducing output in that sector. The spending effect entails increase in government expenditure occasioned by boom, which increase domestic absorption and concomitantly exchange rate appreciation (Neary and Van Wijnbergen, 1986).

Dutch Disease Syndrome creates structural imbalances which result from poor management of revenue from oil, and perhaps its shocks. Windfalls that result from volatile oil price surges/shocks overwhelmingly flow through the economy. This causes expansion in the oil sector while penalizing the non-oil sector (Mieiro and Ramos, 2010). The resulting decline in the non-oil sector reinforces sharp decline in the economic growth rate when the price of crude oil falls.

**Empirical Literature Review**

Literature is replete with studies on the linkage between oil price volatility and economic performance. Given the importance of oil to the Nigerian economy, several studies have been conducted on oil price and macroeconomy nexus which produced mixed results. On their part, Olomola and Adejumo (2006) studied the effects of oil price shocks on output, inflation, real exchange rate and money supply in Nigeria using VAR framework. Their result showed that output and inflation are not responsive to oil price shocks. However, they found that, in the long run money supply and the real exchange rate are significantly affected by a shock to oil prices. Similarly, Englama et al (2010) investigated the relationship between oil price and exchange rate in Nigeria using monthly data spanning 1999:1 to 2009:12 while utilizing the VECM methodology. Their result showed that both oil price volatility and the demand for foreign exchange affect exchange rate volatility both in the short-run and the long-run. The major conclusion of their study is that the demand for foreign reserves put more pressure on exchange rate than oil price volatility.

Iwayemi and Fowowe (2011) carried out a study on the impact of oil price shocks on selected macroeconomic variables in Nigeria using quarterly time series data from 1985Q1 to 2007Q4 on the real GDP, government expenditure, inflation, real exchange rate and net export. They utilized the GARCH model as proposed by Lee et al (1995) to compute oil price volatility while employing the unrestricted VAR model to estimate the relationship between oil price shock and the selected variables. Their findings show that oil price shocks do not have major impact on most macroeconomic variables in Nigeria. Their results based on Granger-causality tests, impulse response functions, and variance decomposition analysis showed that different measures of linear and positive oil shocks have not caused output, government expenditure, inflation, and the real exchange rate. However, the tests support the existence of asymmetric effects of oil price shocks as negative oil shocks significantly cause output and the real exchange rate.

Aremo et al (2012) focused their study on the impact of oil price shocks on fiscal policy management in Nigeria from 1980 to 2009. Quarterly data on two key fiscal policy variables (government expenditure (GEXP) and government revenue (GREV)) as well as money supply (MS2) and GDP were examined while utilizing a structural VAR model. The result of this study indicates that oil price shocks affect both government expenditure and government revenue which reflect over reliance of government on oil for its fiscal activities in Nigeria. This study recommended strong diversification drive to cushion the effect of oil price shocks.

Hodo, Akpan and Offiong (2013) examined the asymmetric effect of oil price shocks on exchange rate volatility and domestic investment in Nigeria while employing annual time series data spanning from1970 to 2010. The utilized the unrestricted VAR methodology and the result reveal that government expenditure had positive response to oil price shock but public investment, private investment and industrial production responded to oil price shock negatively. The variance decomposition analysis further reveals that exchange rate, government expenditure and domestic investment are mainly affected by oil price shock, particularly in the short-run.

Ibrahim et al (2014) assessed the impact of oil price shocks on the Nigerian economic growth using data from 1981 to 2012. The study employed the generalize methods of moment (GMM) to examine the impact of oil price shocks on the Nigerian economy on the following variables: real GDP, private
consumption expenditure, government expenditure, non-oil export, crude oil export and oil price. Their result showed that oil price shocks insignificantly retards economic growth while oil price itself significantly improves it. Based on their findings, it was concluded that the positive effect of oil price on economic growth is beneficial to oil-exporting country like Nigeria while shocks to oil price create uncertainty which undermine effective fiscal management of crude oil revenue. On their part, Ahuru and James (2015) studied the macroeconomic effects of oil price volatility in Nigeria using quarterly data covering 1985:Q1 to 2012:Q4 while employing six variables comprising of public expenditure (PE), oil price volatility (OPV), Nominal exchange rate (EXRT), Broad money supply (M2), the growth rate of the GDP (GDPGR) and inflation rate (INFL). They estimated a VAR model and their findings showed that oil price volatility significantly impact Nigeria’s public expenditure and the macroeconomic variables and there seems to be reverse causality between public expenditure and selected macroeconomic variables. They concluded that Nigeria’s economy was vulnerable to upheavals in the international oil market and might be responsible for Nigeria’s macroeconomic instability. Musa (2015) analysed the impact of oil price shocks on the growth of the Nigerian economy using quarterly data from 1970 to 2011. Unlike previous empirical studies, he included a dummy variable to control the effect of unrest in the international oil market as well as agricultural output data amongst other variables. Using a structural vector autoregressive (SVAR) to analyse the impulse response functions and forecast error variance decomposition, the study found that the real GDP(RGDP) responds positively to oil price shock but negatively to unrest (UNRST) proxied by a dummy variable. More so, agricultural output (AGR) response to oil price shock was negative indicating an asymmetric effect when compared to that of the real GDP. However, the measure of oil price utilized in this study may have affected the result.

3. RESEARCH METHODOLOGY AND EMPIRICAL ANALYSIS

Model Specification and Sources of data

In this section of the study, we present the sources of our data set as well as models utilized to achieve the objective of the study. This study utilized annual data from 1981 to 2018. Data on the Agricultural sector output, Industrial sector output, Manufacturing sector output and Money supply were sourced from the Central Bank of Nigeria (CBN) Statistical Bulletin 2018 while data on Oil price was sourced from the International Financial Statistics (IFS) of the IMF. In this study, the Vector Autoregressive (VAR) model was deployed to achieve the objective of the study. Maddala (1992) stated that a VAR model is a critical starting point in the analysis of interrelationships among various time series. Darnell and Evans (1990) observe that the VAR model provides a straightforward method of producing forecasts that do not discern on how the variables in the model affect one another. As an autoregressive model, each variable in a VAR system is regressed on lagged values of itself and the lagged values of all other variables. An examination of the entire system can then be studied by analyzing impulse response function and the variance decomposition of the system.

According to Lukpohl (2008), a stable VAR model of order p is given as

\[ y_t = v + A_1 y_{t-1} + A_2 y_{t-2} + \cdots + A_p y_{t-p} + A_p z_{t-p} u_t \]  \hspace{1cm} (1)

Where

- \( y_t \) represents a (Kx1) vector of dependent (endogenous) variables in the system with a lag order \( p \),
- \( A_i \) represents (KxK) matrix of coefficients,
- \( z_t \) is a vector of exogenous variables,
- \( v \) is (Kx1) vector of intercepts and
- \( u_t \) represents a K-dimensional vector of white noise or innovation process (i.i.d \( N(0, \Sigma) \)).

169
Equation (1) is further written as

\[ y_t = v + \sum_{i=1}^{p} A_i y_{t-p} + u_t \]  

(2)

The vector of endogenous variables is given as

\[ Y_t = (AGR_t, INDP_t, MAN_t, M2_t, OILP_t) \]  

(3)

\( AGR_t = \) Agricultural sector output
\( INDP_t = \) Industrial sector output
\( MAN_t = \) Manufacturing sector output
\( M2_t = \) Money supply
\( OILP_t = \) Oil price

Thus, the econometric model in natural logarithm for each of the endogenous variables of this study is specified as follows

\[ \ln AGR_t = \beta_{0.1} + \beta_{1.1} \sum_{i=1}^{p} \ln INDP_t + \beta_{2.1} \sum_{i=1}^{p} \ln MAN_t + \beta_{3.1} \sum_{i=1}^{p} \ln M2_t + \beta_{4.1} \sum_{i=1}^{p} \ln OILP_t + u_t \]

\[ \ln INDP_t = \beta_{0.2} + \beta_{1.2} \sum_{i=1}^{p} \ln AGR_t + \beta_{2.2} \sum_{i=1}^{p} \ln MAN_t + \beta_{3.2} \sum_{i=1}^{p} \ln M2_t + \beta_{4.2} \sum_{i=1}^{p} \ln OILP_t + u_t \]

\[ \ln MAN_t = \beta_{0.3} + \beta_{1.3} \sum_{i=1}^{p} \ln INDP_t + \beta_{2.3} \sum_{i=1}^{p} \ln AGR_t + \beta_{3.3} \sum_{i=1}^{p} \ln M2_t + \beta_{4.3} \sum_{i=1}^{p} \ln OILP_t + u_t \]

\[ \ln M2_t = \beta_{0.4} + \beta_{1.4} \sum_{i=1}^{p} \ln MAN_t + \beta_{2.4} \sum_{i=1}^{p} \ln AGR_t + \beta_{3.4} \sum_{i=1}^{p} \ln INDP_t + \beta_{4.4} \sum_{i=1}^{p} \ln OILP_t + u_t \]

\[ \ln OILP_t = \beta_{0.5} + \beta_{1.5} \sum_{i=1}^{p} \ln M2_t + \beta_{2.5} \sum_{i=1}^{p} \ln AGR_t + \beta_{3.5} \sum_{i=1}^{p} \ln INDP_t + \beta_{4.5} \sum_{i=1}^{p} \ln MAN_t + u_t \]

\( \beta_{0.1}, \beta_{1.1}, \beta_{2.1}, \beta_{3.1}, \beta_{4.1}, \beta_{0.2}, \beta_{1.2}, \beta_{2.2}, \beta_{3.2}, \beta_{4.2}, \beta_{0.3}, \beta_{1.3}, \beta_{2.3}, \beta_{3.3}, \beta_{4.3}, \beta_{0.4}, \beta_{1.4}, \beta_{2.4}, \beta_{3.4}, \beta_{4.4}, \beta_{0.5}, \beta_{1.5}, \beta_{2.5}, \beta_{3.5}, \beta_{4.5} \)

**Unit Root Test**

In order to avoid the problem of spurious regression, we explored the time series properties of the variables. A time series variable is said to be a unit root process or nonstationary if its first and second moments depend on time. The most widely used unit root test for empirical studies is the Augmented Dickey-Fuller (ADF) test for nonstationarity which we adopted for this study. The ADF test for a time series \( Y_t \) is constructed as follows

\[ \Delta Y_t = \beta_1 + \beta_2 t + \delta Y_{t-1} + \sum_{i=1}^{m} \alpha_i \Delta Y_{t-i} + \epsilon_t \]  

(5)

Where \( \epsilon_t \) is a white noise error term that is uncorrelated with the \( Y_t \), \( \beta_1 \) is the intercept of the model and captures any drift in the series, \( \beta_2 \) is a trend parameter that captures any trend in the data, \( \delta Y_{t-1} \) is the first lag of \( Y_t \) that is a measure of the first order serial correlation in the data while \( \sum_{i=1}^{m} \alpha_i \Delta Y_{t-i} \) is the sum of the lagged differenced dependent variable used to augment the model beyond the first order autoregressive scheme. The null hypothesis of a unit root is rejected if the computed ADF statistics is
greater than the chosen level of significance. If the series is nonstationary, then the first difference of the series should be stationary and the series is said to be stationary at first difference or an \( I(1) \) process. In this case, we estimated a VAR in first difference.

**ANALYSIS OF RESULT**

**Unit Root Test Result**

Table 1 presents the result of the ADF unit root test. The p-values of the ADF statistic indicate that all the variables are nonstationary at level but became stationary after first differencing. Hence VAR in first difference can be implemented.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Level</th>
<th>P-value</th>
<th>Variables</th>
<th>First Difference</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>LNAGR</td>
<td>-2.064</td>
<td>0.547</td>
<td>DAGR</td>
<td>-5.850</td>
<td>0.000</td>
</tr>
<tr>
<td>LNINDP</td>
<td>-0.769</td>
<td>0.815</td>
<td>DINP</td>
<td>-5.547</td>
<td>0.000</td>
</tr>
<tr>
<td>LNM2</td>
<td>-0.755</td>
<td>0.819</td>
<td>DM2</td>
<td>-3.662</td>
<td>0.009</td>
</tr>
<tr>
<td>LNMAN</td>
<td>-2.402</td>
<td>0.372</td>
<td>DMAN</td>
<td>-5.254</td>
<td>0.000</td>
</tr>
<tr>
<td>LNOILP</td>
<td>-1.092</td>
<td>0.708</td>
<td>DOILP</td>
<td>-4.666</td>
<td>0.000</td>
</tr>
</tbody>
</table>

**Vector Autoregressive Model Result**

The impulse response functions (IRF) of real sector variables (DAGR, DINP, DM2 and DMAN) to shocks oil price (DOILP) are plotted in Figure 2. The response horizon for the model was fixed at ten years in order to account for both short-run and long-run effect. The IRF was estimated based on cholesky one standard deviation innovations. This result shows that, at impact, shock to DOILP causes DAGR to rise temporarily above equilibrium level but declines below the equilibrium level from the 4th year throughout the forecast horizon of ten years. This is an indicator that oil price shocks dislodges agricultural productivity as the government focuses more on oil revenue rather than implement polices to boost agricultural output.

At impact, shock to DOILP causes an initial decline on DINP in the first two years of the forecast horizon. However, the effect becomes positive after three years of the initial shock as DINP rises above equilibrium level but dips below equilibrium in the remaining years of the forecast period. Similarly, this implies that oil price shocks are unfavourable to industrial production due to lack of sustainable policy and investment in the sector.
Response to Cholesky One S.D. Innovations ± 2 S.E.

![Graphs of impulse response functions](image)

**Figure 2: Impulse Response Function to Oil Price Shocks**

The plot of the impulse response function (IRF) of DMAN to shock on DOILP shows that, at impact, there is an initial increase in DMAN above the equilibrium level up till the 5th year but declined to below the equilibrium level after about five years. This can explain why the quest for diversification of the economy has remained unattainable as oil revenue is not being channeled towards real sector development. The plot of the impulse response function (IRF) of DM2 to shock on DOILP shows that, at impact, there is an initial increase in DM2 above the equilibrium level in the first year but declined below the equilibrium level throughout the forecast horizon of ten years. The plausible explanation is that monetary policy has not been effective in the control of oil price shocks. Generally, the effect of oil price shock to the real sector of the Nigeria economy has been negative as the real sector has continued to underperform and remained uncompetitive to support government fiscal activities. This exposes the structural imbalance in the economy where oil revenue dictates the fiscal policies of the government to the neglect of the real sectors. As a result, the effect of oil price shocks triggers serious economic disequilibrium with no immediate policy response.

The forecast error variance decomposition is a useful tool to examine the interactions between the variables over the impulse response horizon. It is employed to quantify the relative importance of the various shocks in explaining the fluctuations of the model variables. This is achieved by computing the contributions of the various shocks to the variance of the error made in forecasting a specific variable at a given horizon. Tables 2 to 5 shows variance decomposition result for ten years.
From Table 2, shocks to DOILP is the second most important determinant of the variation in DAGR apart from its own shock. By the 10th year, oil price shock is responsible for 12.1 percent of the variation in DAGR.
agricultural sector output. Table 3 shows that Shocks to DOILP contributed significantly higher than DMAN and DM2 to the variation in DINP throughout the forecast horizon. Shocks to oil price contributed about 7.2 percent to the fluctuations in the industrial sector output in the 10th year of the forecast while shocks to agricultural output contributed about 14.3 percent in the 10 year forecast period. Table 4 shows that shocks to DOILP is the least most important determinant of the variation in DM2 as oil price shock is responsible for about 2.6 percent of the variation in money supply. From Table 5, shocks to DOILP is the third most important determinant of the variation in DMAN apart from its own shock and shocks to DINP. By the 10th year, oil price shock is responsible for 16.1 percent of the variation in manufacturing sector output. The result of this variance decomposition reveal that oil price fluctuations remain a significant determinant of the neglect being accorded to the real sector of the Nigerian economy.

**Granger Causality test**

Granger Causality test was utilized to determine the causal relationship between the oil price and other variables in our model. This provides an understanding of the interactions among the variables in the system and shed light on the directions of the causality. The result is presented in Table 6.

<table>
<thead>
<tr>
<th>Table 6: Pairwise Granger Causality Tests</th>
</tr>
</thead>
<tbody>
<tr>
<td>Null Hypothesis:</td>
</tr>
<tr>
<td>DOILP → DAGR</td>
</tr>
<tr>
<td>DOILP ← DOILP</td>
</tr>
<tr>
<td>DOILP → DINP</td>
</tr>
<tr>
<td>DINP ← DOILP</td>
</tr>
<tr>
<td>DOILP → DMAN</td>
</tr>
<tr>
<td>DMAN ← DOILP</td>
</tr>
<tr>
<td>DOILP → DM2</td>
</tr>
<tr>
<td>DM2 ← DOILP</td>
</tr>
<tr>
<td>Obs</td>
</tr>
<tr>
<td>35</td>
</tr>
<tr>
<td>35</td>
</tr>
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<td>35</td>
</tr>
<tr>
<td>35</td>
</tr>
<tr>
<td>35</td>
</tr>
<tr>
<td>0.1733</td>
</tr>
<tr>
<td>0.1897</td>
</tr>
<tr>
<td>F-Statistic</td>
</tr>
<tr>
<td>2.02263</td>
</tr>
<tr>
<td>0.08614</td>
</tr>
<tr>
<td>1.06646</td>
</tr>
<tr>
<td>2.11338</td>
</tr>
<tr>
<td>0.47229</td>
</tr>
<tr>
<td>1.36279</td>
</tr>
<tr>
<td>0.1733</td>
</tr>
<tr>
<td>0.1897</td>
</tr>
<tr>
<td>Prob.</td>
</tr>
<tr>
<td>0.1500</td>
</tr>
<tr>
<td>0.9177</td>
</tr>
<tr>
<td>0.3569</td>
</tr>
<tr>
<td>0.1385</td>
</tr>
<tr>
<td>0.6281</td>
</tr>
<tr>
<td>0.2713</td>
</tr>
<tr>
<td>0.8417</td>
</tr>
<tr>
<td>0.8281</td>
</tr>
</tbody>
</table>

The Wald test is used to test whether all the lagged values of a selected equation of the system are simultaneously equal to zero with a null hypothesis of no causality. From Table 6, there appears to be no evidence of granger causality between oil price and the real sectors. The p-value of the F-statistic are all above the conventional levels of significance. This corroborates earlier findings of this study that oil price does not significantly affect the real sectors of the Nigerian economy.

### 4. CONCLUSION AND RECOMMENDATIONS

This paper focused on the effect of oil price shocks on the real sectors of the Nigerian economy. The objective of this paper was to ascertain how the real sectors respond to shocks emanating from oil prices. We estimated a vector autogressive model on agricultural sector output, industrial sector output, manufacturing sector output, money supply and Oil price. Our result showed that shocks to oil price affect the real sector of the Nigeria economy negatively as the real sector has continued to underperform despite huge revenue accruing from the oil sector. The result of the pairwise granger causality shows that there is no evidence of granger causality between oil price and the real sectors. Thus, there is evidence of independence between oil price shocks and the real sectors. This exposes the structural imbalance in the economy where oil revenue dictates the fiscal policies of the government to the neglect of the real sectors. Consequently, the impact on the economy from oil price fall has been very daunting. Given the results, there is the need to invest the petrodollar accruing from the sale of crude oil in the real sectors to curb overdependence on oil for government revenue generation. This will help to create more investments and employment in the economy as government can shore up its revenue from different taxes from the real sector. We recommend the investment of oil revenue towards infrastructural development as this will immensely support real sector activities. We further recommend the diversification of the Nigerian economy away from oil by harnessing other natural resource endowments.
REFERENCES


175


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