

RELATING OIL PRICE DIFFERENTIALS TO INDUSTRIAL PRODUCTION IN NIGERIA: BVAR APPROACH

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ABSTRACT

In the protracted quest for the diversification of the Nigerian economy, empirical conclusions have been made that oil price shocks are negatively related to output growth. Many studies on oil price –macroeconomy relationship in Nigeria have been conducted without considering the net differential of the oil price change which contributed in muddling up the results. In a bid to overcome this, we employed the EGARCH model to extricate only the increases in oil price and used the conditional volatility measure in the Bayesian Vector Autoregression (BVAR) model based on monthly data (1986M1 to 2015M12) for industrial production index and selected macroeconomic variables in Nigeria. Our results show that shock to oil price causes a rise in industrial production which may indicate that positive oil price increase is favourable to output growth in Nigeria. Therefore, the authorities should take advantage of the increased revenue accruing from rise in oil price to diversify into industrial and manufacturing productions and further stimulate industrial capacity growth through appropriate policies.

Keywords: Oil price, EGARCH, industrial production, BVAR

JEL Codes: C11, E24, E61, F41, H54, L16, L21

1.0 Introduction

Oil has been a strategic commodity to the Nigerian economy and has remained the major export commodity as well as the main source of foreign exchange and revenue to the Nigerian government. Economic history of Nigeria has constantly been dictated by oil related activities since the 1970s while Nigeria's fiscal policy tend to revolve around oil as government has excessively depended on oil export for revenue generation. This over-dependence led to the neglect of other sectors, particularly the agricultural sector which was the initial source of revenue to the government at independence. However, the Nigerian economy has constantly been buffeted by shocks emanating from frequent fluctuations in the international price of crude oil which usually affect revenue from oil accruing to the government.

As at 1960 when Nigeria attained political independence, agricultural production dominated economic activities and accounted for the highest proportion of our national income through primary agricultural products export. Empirical evidence show that the share of agriculture in Gross Domestic Product (GDP) stood at 63 percent and contributes about 80 percent of our export earnings. At that time, industrial activities was very low while foreign companies engaged in trade and commerce especially in the importation and distribution of (foreign) manufactured

goods(Ekpo,2014). According to Banjoko et al(2012), laying a solid foundation for the development of an industrial economy for Nigeria was not part of the colonial economic policy. Instead colonies were made perpetual producers of primary raw materials for foreign industries while manufactured goods were imported. However, industrialization was made the highest priority area for the Nigerian economy as experiences from other countries showed that industrialization promotes economic growth and development faster than agriculture (Roberts and Azubuibe, 2005).

Over the years, Nigerian government had formulated and implemented different industrial policies and strategies to facilitate industrialization of 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 and structural adjustment programme. Huge public investment were made in the industrial sector with the establishment of industrial research and training institutes to provide the necessary foundation for growth of the industrial sector of the country by providing the basic engineering infrastructure for the production of raw materials, spare parts, equipment components and machinery needed in the various industrial establishments in Nigeria. These include Industrial Core Projects (ICPS), Federal Institute for Industrial Research (FIIR), Project Development Agency (PRODA), Raw Materials Research Development Centre (RMRDC) and implementation of the National Industrial Revolution Plan (NIRP)etc. Given all the laudable efforts put in place towards industrialization, one would expect that the industrial sector should have overcome earlier teething challenges and contribute greater proportion towards the overall economic development and structural change of Nigeria. But close observation shows otherwise.

In a bid to diversify their economies, developing countries like Nigeria have pursued industrialization as a major policy route towards achieving competitiveness in the global market as well as the creation of a wider range of commodities through expansion of their productive base. Historical evidence shows that most industrialized economies had adopted policies that supported economic transformation through structural change from low to high productive economic activities. Thus, industrial development is seen as the driver of structural change as well as the key to the process of economic diversification (Naudé et al,2013). Empirical evidence further suggests that modern economic development requires structural change through growth in the industrial sector which remains the engine of growth in the development process.

Naudé et al (2013) further argues that virtually all cases of high, rapid, and sustained economic growth in modern economies have been associated with industrialisation, particularly growth in manufacturing production. The structural change argument posits that there is higher productivity in the industrial sector than in the agricultural and mining sector due to transfer of resources from agriculture to manufacturing and from manufacturing to services. The manufacturing sector in turn provides opportunities for capital accumulation and technological advancement in developing countries. This provides the reason why the growth of manufacturing sector has been so important in the process of growth and development. For instance, manufacturing sector contribution to GDP of emerging economies like Brazil ,China, Malaysia and Thailand stood at 20 percent, 34 percent, 30 percent, 35 percent and 28 percent respectively. While the manufacturing sector contribution to Nigeria`s GDP between 1970 to 2015 was about 6 percent which is a far-cry when compared to other emerging economies(Ogbu, 2012).

However, the wide swing in the price of crude oil and its attendant macroeconomic consequences on the Nigerian economy has strongly renewed the quest as well as the expectations concerning the policy choices of a sustainable economic pathway to follow towards the diversification of the economy. Several policy options have been implemented towards this direction which range from both fiscal and monetary policies to a more neo-liberal market economy stance. Even though the economy recorded impressive economic growth rate of about 6.5 percent prior to 2016 economic recession, the percentage contribution of the real sectors as key drivers have comparatively remained abysmal while inflation and unemployment rates remained high at 16 percent and 19 percent respectively. Following the aforementioned economic recession that began during late 2014, it is easily observable that the Nigerian government has perennially failed to harness the petrodollar accruing from crude oil export to stimulate investments in the non-oil sector as well as to bring about structural transformation of the economy. While it is laudable to create economic buffers by the establishment of the special funds [Excess Crude Account (ECA) and Sovereign Wealth Fund (SWF)] as it is being done by other countries, the Nigerian case has been utilized to finance consumption (demand-side) against production (supply-side) given rise to a consumptionist economy which impedes growth (Nwokoye et al, 2017). Against this background, therefore, it is arguably necessary for the proceeds of oil export to be channelled towards the development of the productive sectors if the desire for an auspicious economic diversification would ever be achieved as over-reliance on oil as a major export commodity and source of revenue to the government have proven unsustainable.

Despite all the policies and industrialization strategies by the Nigerian government and the huge resources expended towards the industrialization of the economy, the oil sector still dominates the export baskets while the non-oil sectors have continuously been underperforming. More so, economic analysts have attributed the poor performance of the non-oil sectors to shocks emanating from oil price fluctuations which transmits to the entire economy. However, Nigeria being an oil exporting countries records increased revenue during oil price hikes which empowers the government to stimulate productivity growth. The objective of this study, therefore, is to ascertain if increase in oil price is favourable for industrial production. The rest of the paper is organized as follows: section two is devoted to selected review of literature; section 3 dwelt on model specification and data sources; section 4 is devoted to analysis of result and section 5 contains the conclusion and recommendation of the study.

2.0 Selected Literature Review

Conceptual Issues

Industrialization is the process of building up a country's capacity to produce many varieties of products – extraction of raw materials and manufacturing of semi-finished and finished goods. Industrialization can be seen as establishment and expansion of industries in a particular place, region or country (Obioma and Ozughalu, 2005). It involves the introduction of many industries in different parts of the country. As many industries are established in a country many different types of products are produced. According to Anyanwu et al (1997), industrialization is the process of building up a nation's capacity to convert raw materials and other inputs to finished goods and to manufactured goods for other production or for final consumption. Industrialization enhances the utilization of productive inputs (labour, capital and raw materials), given the country's technology, to produce non-durable and durable consumer goods, intermediate goods and capital goods for domestic consumption, export or further production. This implies that industrialization

is the process of transforming raw materials, with the aid of human resources and capital goods into consumers goods, new capital goods which allows more consumers goods (including food) to be produced with the same human resources, and social overhead capital, which together with human resources provides new services to both individuals and businesses (Ekpo, 2005).

Following the finding of Hamilton (1983) that oil price was a significant determinant of real economic activity in the United States, many studies on oil price-macroeconomy relationship emerged with attempts to establish a causal link between economic activities and oil price changes. However, the transmission mechanisms of oil price shocks to the economy has remained a contentious issue. This stems from the asymmetric effect of oil price changes on the economy and the apparent breakdown of the statistical power of oil price shocks to affect economic growth. Mork (1989) argues that the combination of rising oil prices with falling prices have muddled the relationship between oil prices and macroeconomic activities and such asymmetric effects of oil prices have combined to weaken the oil-macroeconomy relationship. Against this background, therefore, this study deviates from the empirical trend to assess the impact of oil price differential on industrial production (proxied by industrial production index) growth in Nigeria by focusing only on the net positive differential of oil price changes through the estimation of Exponential Generalized Autoregressive Conditional Heteroskedasticity (EGARCH) proposed by Nelson (1991) to measure the conditional volatility of oil price. The advantage is that EGARCH is specified in log forms which preclude imposing parameter restrictions which ensures that the conditional variance of oil price is non-negative. This is then incorporated into a Bayesian vector autoregressive (BVAR) model to investigate the relationship between oil price and industrial production in the Nigerian economy.

Empirical Reviews

Enormous literature exists on oil price-macroeconomic relationship. Most of these studies explored the causal link between oil price shocks and economic growth. However, the link has remained controversial with divergent conclusions. In this study, we present a selected review of relevant literatures as the entire literature is very vast and cannot be exhausted herein. The general conclusions by the pioneering researchers in this regard, particularly for developed countries, was that oil price has a negative correlation with real output and that economic activities slowed down following oil price increase particularly for net oil importers (Hamilton, 1983; Gisser and Goodwin, 1986). Loungani (1986) found that oil price shocks caused disturbances in the labour reallocation process. Contrary to initial findings, Mork (1989) found that there is asymmetric effect of oil price shock on economic activities. That is, a decrease in oil price and an increase have different effect on the economy. This finding triggered a new way of studying oil price and its impact on the economy. A common conclusion of the oil price asymmetry is that oil price increase causes a downturn in economic activities while a decrease did not necessarily stimulate the economy (Mork, Olsen and Mysen, 1994; Lee et al, 1995; Ferderer, 1996). Even though, this initial studies assumed a linear relationship in the oil price-macroeconomy nexus.

However, Hooker (1996) challenged the linear relationship between oil price volatility and economic activity used by earlier researchers. He argued that oil price volatility is non-linear and should be modeled as such considering the amount by which oil prices changed over the previous period. Hooker (1996) noted that the pattern of influence between 1948 and 1972 was different compared to 1973 and 1994. While there was a significant effect of oil price shock on GDP growth and employment in the first period, such effect faded away in the second period.

The above exposition suggests that the measure of oil price shock is important if the actual relationship between oil price and economic activities will be ascertained. In this regard, Hamilton (2003) supported the finding of Lee et al. (1995) that oil price shocks have higher implications on the economy of a country if they occur in a less volatile period. According to Hamilton (2003), an increase in oil price is much more important than a decrease in oil price to predict the growth of GDP.

Following the controversy as outlined above, Lee et al. (1995) became popular for assessing the asymmetric impact of oil price shock by estimating a non-linear model of oil price based on the univariate generalized autoregressive conditional heteroscedasticity (GARCH,1,1) by extracting the unanticipated component as well as the time-varying conditional variance of oil price changes. The oil price volatility measure was then incorporated in a VAR model where the result showed that oil price volatility is highly significant in explaining economic growth with positive shocks having a stronger effect on growth than negative shocks. In the same spirit, Ahmed and Wadud (2011) utilized the EGARCH model of oil price asymmetry proposed by Nelson (1991) to investigate the role played by oil price shocks on Malaysian macroeconomic activities using monthly time series data covering 1986 to 2009 in a structural vector autoregressive model. Their result show that a positive oil price shock has a prolonged dampening effect on economic growth and price level in Malaysia.

Due to the strategic nature of oil to the Nigerian economy, several studies have been conducted on oil price-macroeconomy relationship. Some of these studies followed the linear approach while others followed the non-linear approach. Even though majority of these studies concentrated on the effect of oil price shocks on the macroeconomy, very few included industrial sector variable in their study. Ayadi et al (2000) examined the effects of oil shocks on the Nigerian economy using time series data covering 1975 to 1992 on oil production, output, the real exchange rate and inflation in an unrestricted VAR model. They found that a positive oil shock causes output to rise with a reduction in inflation and a depreciation of the domestic currency. Similarly, Ayadi (2005) examined the effects of oil price shocks on the Nigerian economy using a standard VAR modeling approach. The variables utilized include oil price, output, the real exchange rate and inflation. The study found negligible responses of output, inflation and the real exchange rate following an oil price shock.

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. 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. Iwayemi and Fowowe (2011) studied 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 while utilizing the GARCH model as proposed by Lee et al (1995) in a VAR model. Their findings support the existence of asymmetric effects of oil price shocks as negative oil shocks significantly cause output and the real exchange rate to move away from equilibrium.

Hodo et al. (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 from 1970

to 2010 in a VAR framework. They found that public investment, private investment and industrial production responded to oil price shock negatively while government expenditure had positive response to oil price shock. 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. Their findings showed that oil price volatility significantly impact the selected macroeconomic variables and that Nigeria's economy was vulnerable to upheavals in the international oil market and might be responsible for Nigeria's macro-economic instability.

From the selected literature reviewed and to the best of the researchers' knowledge, no studies in Nigeria had explored the EGARCH model and the Bayesian vector Autoregressive model to study the oil price- macroeconomy. This constitute a gap which this study intends to fill. This option became necessary as earlier studies on asymmetric nature of oil price in Nigeria failed to distinguish the difference between oil price increases and oil price decreases on the economy. This may have led to the conclusion that oil price changes are unfavourable for economic growth in Nigeria which have helped to fuel the diversification debate. Thus, we adopted the methodology of Ahmed and Wadud (2011) to assess the impact of oil price differential on Nigeria's industrial production.

3.0 Model Specification and Data Sources

In this section of the study, we present the models utilized to achieve the objective of the study. We deployed the EGARCH model and the Bayesian vector autoregressive (BVAR) model to ascertain the effect of oil price differential on industrial production.

EGARCH model of oil price volatility

The EGARCH model was developed by Nelson (1991) and have been used to model volatility. The rationale for the preference of EGARCH model is that standard ARCH models assume that positive and negative error terms have a symmetric effect on volatility in the model. However, given the oil price behavior, oil price volatility may not react uniformly due to problem of asymmetry (Lee et al. 1995). More so, EGARCH is specified in log forms which precludes parameter restrictions being imposed as it's usually done. This ensures that the conditional variance of oil price is non-negative. The functional form of EGARCH is presented as follows:

$$\log(\sigma_t^2) = \omega + \beta \log \sigma_{t-1}^2 + \alpha \left| \frac{\varepsilon_{t-1}}{\sigma_{t-1}} \right| + \gamma \frac{\varepsilon_{t-1}}{\sigma_{t-1}} \quad (1)$$

Where σ^2 is the conditional volatility of the crude oil price and ω is the unconditional variance with constant mean. Negative shocks have an impact of $(\alpha - \gamma)$ on the log of the conditional variance while positive shocks have an effect of $(\alpha + \gamma)$. The presence of leverage effects can be tested by the hypothesis that $\gamma < 0$. There is asymmetric effect if $\gamma \neq 0$. The estimated conditional volatility from the EGARCH above is then used as an input of oil price volatility in the Bayesian vector autoregressive (BVAR) model below.

Bayesian vector autoregressive (BVAR) Model

The standard unrestricted Vector Autoregressive (VAR) models have been severally utilized to investigate the interrelationship among many time series variables especially the oil price macroeconomy relationships. 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 (2007), a stable VAR model of order p is given as

$$y_t = v + A_1 y_{t-1} + A_2 y_{t-2} + \dots + A_p y_{t-p} + A_p z_{t-p} u_t \quad (2)$$

Where

y_t represents a $(K \times 1)$ vector of dependent (endogenous) variable in the system with a lag order p , A_i represents $(K \times K)$ matrix of coefficients, z_t is a vector of exogenous variables, v is $(K \times 1)$ vector of intercepts and u_t represents a K -dimensional vector of white noise or innovation process (i.i.d $N(0, \Sigma_t)$).

Equation (2) can be express compactly as

$$y_t = v + \sum_{i=1}^p A_i y_{t-p} + u_t \quad (3)$$

However, the unrestricted VAR model has been criticized for having over-fitting properties that yield inefficient estimates as well as suffering the curse of dimensionality (Todd,1984 and Litterman ,1984). Similarly, the structural form of the VAR model have been known to impose identifying zero restrictions that may be far from true values. Specifically, the standard VAR model is highly over parameterized which yields inefficient estimates when estimated by the ordinary least squares (OLS) and possess higher likelihood of suffering multicollinearity. In order to resolve the aforementioned shortcomings of the standard VAR model, Todd (1984) and Litterman (1984) recommended the Bayesian method of estimation. Hence, the Bayesian Vector Autoregression (BVAR).The Bayesian approach allows the use of prior beliefs in the form of probabilities. This is possible because in Bayesian statistics, coefficients are regarded as random variables. The priors come with a specification of an extensive system of confidence in each of the pre-specified coefficient. A statistical procedure is then used to revise these prior beliefs in light of the evidence in the data. BVAR reduces the over-fitting by reducing the data's influence on the parameters. The BVAR makes alternative assumptions about the uncertainty around the true value of the VAR parameters. This ensures that the posterior distribution is derived through a combination of the prior distribution and likelihood function. More importantly, there is an assumption of near-zero restrictions on the coefficients in the longer lags than the shorter lags. This is usually implemented by specifying normal prior distribution with means equal to zero and small decreasing standard deviations as the lag increases. To achieve the imposition of these restrictions, Equation (3) is re-expressed in a normal distribution context as

$$Y_{(nT \times I)} = (I_n \otimes X) \beta + \varepsilon \quad \varepsilon \sim N(0, \Sigma \otimes I_T) \quad (4)$$

Y is a (TXM) matrix that stacks in columns T observations on each endogenous variable next to each other such that ε designate the stackings of the errors in conformity with Y . From the foregoing, if the set of parameters, (β, Σ) is denoted by θ , the prior distribution is given as $\pi(\theta)$, the likelihood function is given as $l(y|\theta)$ while the posterior distribution of θ given the endogenous variables is given as $\pi(\theta|y)$, then y is obtained through Equation (5) as follows

$$\pi(\theta|y) = \frac{\pi(\theta)l(y|\theta)}{\int \pi(\theta)l(y|\theta)d\theta} \quad (5)$$

Where $\int \pi(\theta)l(y|\theta)d\theta$ is a normalizing constant such that the posterior is proportional to the product of the likelihood function and prior given as $\pi(\theta|y) \propto \pi(\theta)l(y|\theta)$. However, there are different types of priors in Bayesian econometrics with their respective advantages (Litterman/Minnesota, normal-Wishart, Sims-Zha, normal-Wishart and Sims-Zha normal-flat priors). In this study, we used the Minnesota/Litterman prior proposed by Litterman (1986) and Doan, Litterman, and Sims (1984). This prior type assumes that there are four hyper-parameters in the estimation of the VAR coefficients θ : the prior mean μ_1 which is set close to zero to lessen the risk of overfitting in the model; λ_1 which measures the overall tightness on the variance of the first lag and control the prior information relative to the sample information; λ_2 represent the relative tightness of the variance of other variables and λ_3 which measures the relative tightness of the variance of the lags (lag decay). This prior type is known to yield simple posterior inference. Finally, the estimated BVAR model is analysed using the impulse response function and variance decomposition.

This study utilized monthly data from 1986M1 to 2015M12. The choice of data starting from 1986 is partly motivated by the findings of Mork (1989) that prior to 1986, oil price shocks were predominantly positive but a large fall was observed in 1986. The data include: oil price (OILP), industrial production index (INDP), prime lending rate (INTR) and real effective exchange rates (REER). All the dataset used for this study were sourced from the IMF International Financial Statistics (IFS) as such high frequency data is difficult to assess locally. All variables are expressed in natural logarithm except the prime lending rate.

4.0 Analysis of Result

Pattern of conditional volatility based on EGARCH model

In this section of the study, we start by presenting the time series pattern of oil price volatilities based on the estimated EGARCH model. This represents the volatility dynamics in relation to economic events.

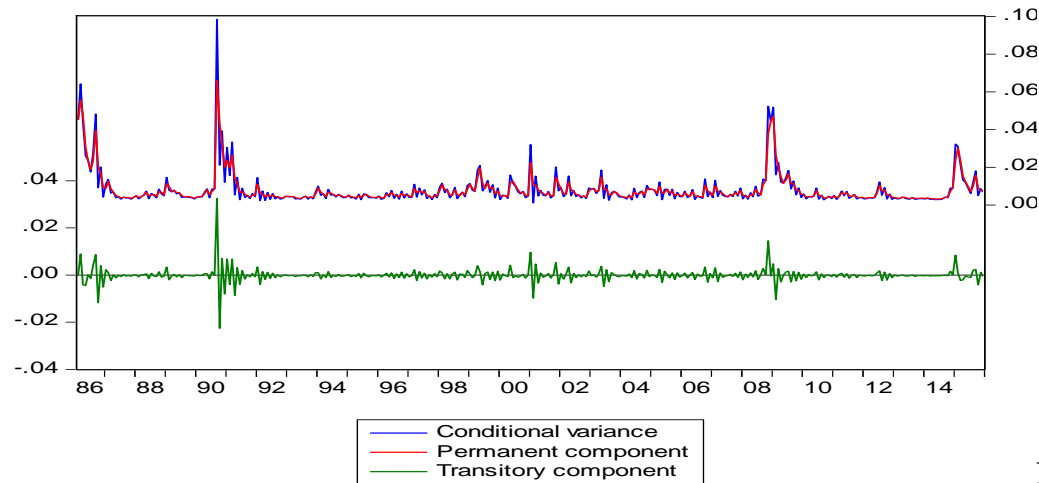


Figure1.

Conditional variance of monthly oil price from AR(1)–EGARCH(1,1)

Figure 1 shows the conditional variance of monthly crude oil price from the estimated EGARCH model. The blue line represents total conditional volatility of the oil price. As indicated by Figure 1, fluctuations in the conditional volatility are primarily driven by fluctuations in the transitory

volatility (green line). This is in conformity with Ahmed and Wadud (2011) who observed that there is a clear link between oil price volatility (with significant transitory swings) and market uncertainty prompted by various global events such as the 1987 stock market crash, the first Gulf War (1989–1990), the Asian Financial Crisis (1998–1999), the September 11 attack (2001), the global financial crisis (2007–2009) and the crash in the price of crude oil (2014-2015). Table 1 below reports the parameter estimates from the EGARCH model.

Table 1: Estimate from EGARCH Model

Parameter	Estimated Coefficients	p-value
ω	-1.1410	0.0020
β	0.847***	0.0000
α	0.465***	0.0000
γ	-0.0680	0.2511

***significant at 1% level

The result from the conditional variance equation as shown in Table 1 is fairly consistent as both the ARCH and GARCH terms are significant. It is important to note from the variance equation that the parameter estimate $\gamma < 0$ suggests that there is an asymmetric effect of an oil price shock on the conditional volatility of the oil price.

BVAR Result

In order to estimate the BVAR model, we first selected the optimal lag length based on the reduced form VAR. The result is presented in Table 2

Table 2: Lag Selection Criteria

Lag	LR	FPE	AIC	SC	HQ
0	NA	482038	26.7398	26.7837	26.7573
1	3318.47	370.908	17.2674	17.4869*	17.3548
2	66.1665	34.955*	17.1654*	17.560	17.3227*
3	21.1654	344.660	17.1939	17.7647	17.4210
4	29.675	345.520	17.1962	17.9426	17.4932
5	34.367*	341.176	17.1833	18.1053	17.5502
6	17.0480	354.803	17.2221	18.3197	17.6589
7	25.6209	359.132	17.233	18.5069	17.7403
8	23.2111	365.969	17.2518	18.7007	17.8284

* indicates lag order selected by the criterion

Most of the information criteria favoured two lag lengths. Based on Akaike and Hannan-Quinn information criteria, we selected two lag lengths to estimate our model.

The main objective of this study is to ascertain the influence of positive oil price differential on industrial production and selected macroeconomic variables (prime lending rate and real effective exchange rate). The impact is measured through impulse response analysis from the BVAR model which we estimated in levels of the variables. Sims (1980) and Sims *et al.* (1990) recommended estimating a VAR in levels of the variables as the goal of a VAR analysis is to determine the interrelationships among the variables, not to determine the parameter estimates. Therefore, differencing of variables may cause the loss of important information concerning the comovements in the data (Enders, 2004). Moreso, Bayesian statistics require the preservation of the data generating processes in order to obtain efficient prior and posterior estimates. The impulse response functions (IRF) of oil price shocks on industrial production index (INDP), prime lending rate (INTR) and real effective exchange rates (REER) are plotted in Figures 2 to 4. We selected three years (36 months) as the response period in order to account for both short-run and long-run effect. The IRF was estimated based on cholesky one standard deviation.

Fig 2: Response of INDP to OIL PRICE SHOCK

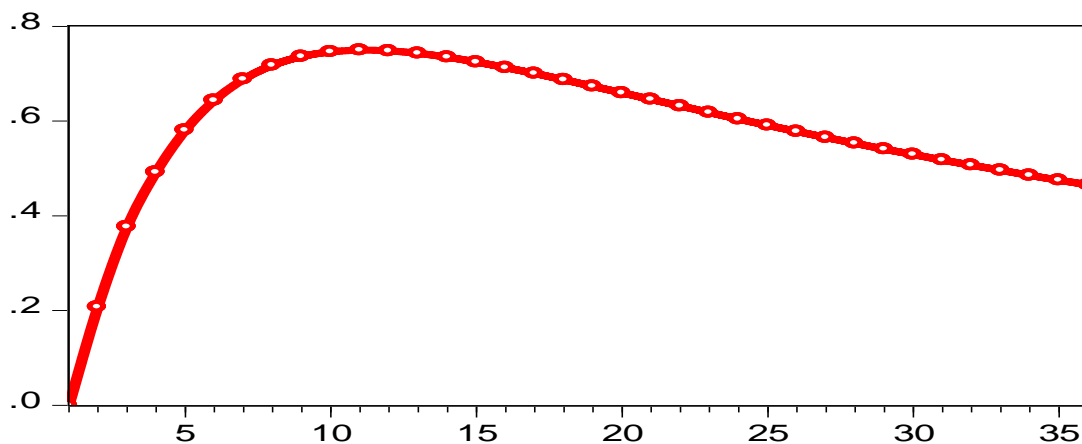


Figure 2 shows that a shock to oil price as measured by the positive price differential on impact causes an increase in INDP up to about the 12th month before a decline. However, the effect on INDP remained significantly positive up to the 36th month. This implies that oil price increases is favourable for industrial productivity growth. Expectedly, the inflow of foreign exchange accruing from crude oil export improves the fiscal position of the government as well as the foreign reserve. The most cogent explanation of the transmission mechanism in this regard is through government spending. Consequently, strategic resource allocation to critical sub-sectors of the industrial and manufacturing sector stimulates growth and easy access to raw materials and inputs required for industrial production in the economy.

Fig 3 :Response of INTR to OIL PRICE SHOCK

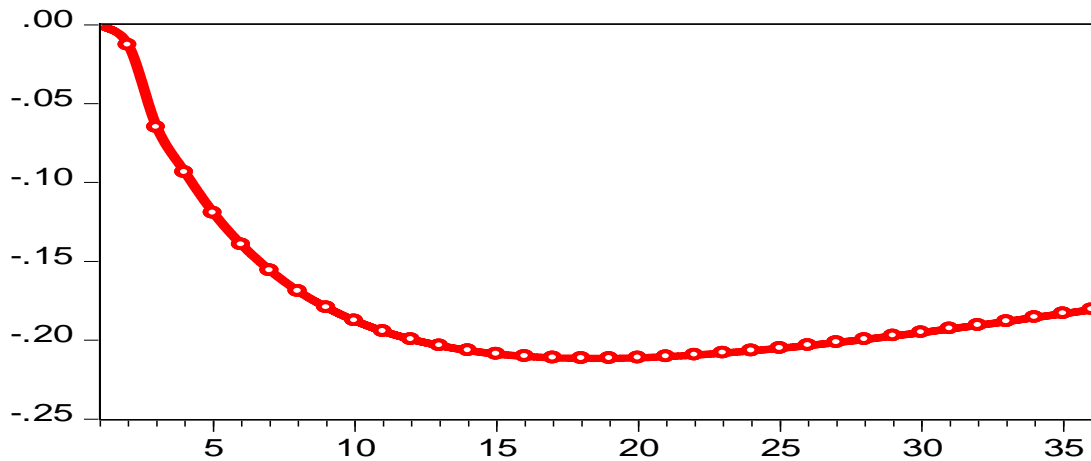


Figure 3 shows that a shock to oil price as measured by the positive price differential on impact depresses the INTR through out the entire three year horizon. From a monetary policy perspective, Figure 3 shows that the central bank tends to reduce interest rate (INTR) as the unsterilized oil revenue penetrate the economy and inadvertently causes an increase in the money supply. This cheapens the cost of borrowing and in turn stimulate further investment in industrial production. This explains part of the growth in industrial production.

Fig 4 :Response of REER to OIL PRICE SHOCK

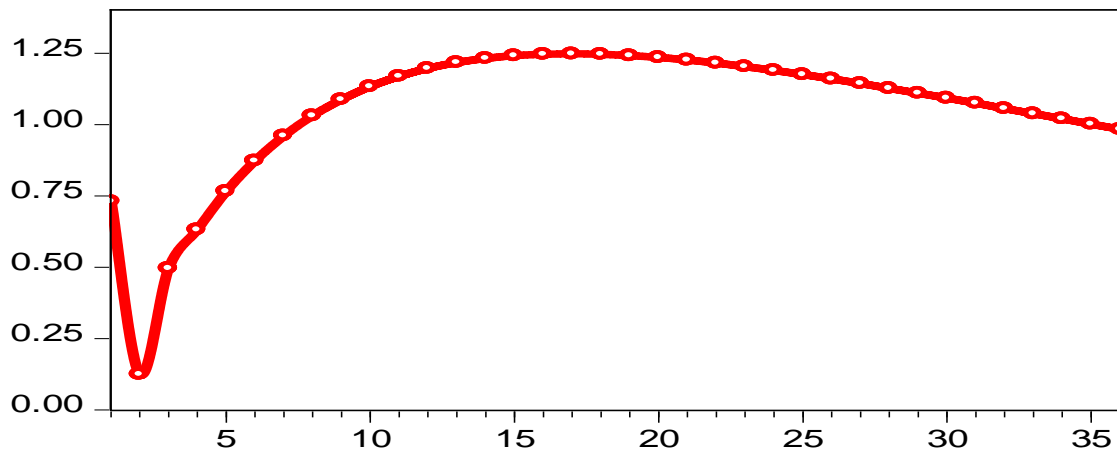


Figure 4 shows that a shock to oil price as measured by the positive price differential on impact causes a decrease in real effective exchange rate (REER) within the first quarter but the REER gradually increase through out the three year horizon. This result confirms literature that oil price shocks significantly affect the real exchange rate (Amano and Van Norden ,1995). This supports the wealth transfer effect that favours oil exporting countries in the event of oil price increase.

Variance Decomposition

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. Furthermore, variance decomposition provides insights on the transmission channels through which policy-specific

shocks spills over. 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. In order to ascertain the importance of the positive oil price differentials in explaining industrial production and the selected variables in the Nigeria economy, we utilize the variance decomposition. Table 3 reports the proportion of the variations of the variables of interest over a 36 months (three years) horizon for oil price shocks.

Table 3: Variance decomposition

PERIOD	OILP	INDP	INTR	REER
INDP				
12th month	7.009616	87.99886	4.396763	0.594764
24th month	13.71209	80.34631	4.498776	1.442820
36th month	16.99228	75.27864	4.363637	3.365434
INTR				
12th month	3.845610	2.277056	89.66753	4.209801
24th month	10.06557	2.099574	81.59642	6.238439
36th month	14.81184	2.083299	77.10821	5.996652
REER				
12th month	0.806815	0.535020	0.901188	97.75698
24th month	1.860652	1.182455	2.003872	94.95302
36th month	2.697806	1.599315	2.317086	93.38579

In order to ascertain both short run and long run variations to the variables in our model attributable to the respective shocks, we divided the contributions of each shock into three horizons. That is, 12th, 24th and 36th months which represents the variations in the 1st year, 2nd year and 3rd year respectively. From Table 3, shocks to industrial production shows that apart from its own shock, oil price shock in the second most important determinant of its variation. By the 12th month, oil price shock is responsible for 7.0 percent of the variation in industrial production and the effect increased to about 13.7 percent in the 24th month and about 17 percent in the 36th month. This is an indication that positive oil price shock is beneficial to industrial output growth both in the short run and in the long run. This equally reinforces the result in the impulse response function. This confirms that industrial and manufacturing productivity in Nigeria is not negatively influenced by oil price increases but experiences growth as a result. This result is contrary to the findings of Olomola and Adejumo (2006) and Iwayemi and Fowowe (2011) who found that oil price does not significantly affect output in Nigeria. Shocks to oil price contributed about 3.8 percent to the fluctuations in the interest rate in the 12th month and 10.0 percent and 14.8 percent for the 24th and 36th month respectively. This implies that the monetary policy response to positive oil price shocks is largely determined by the dynamics and money market interactions. The variance decomposition of the shock to real effective exchange rate shows that oil price shock does not contribute a significant percentage to the variation of exchange rate. By the 36th month, only about 3 percent of the variation in exchange rate is explained by oil price shock. This result is counter-intuitive and contradicts the literature that oil price shocks significantly affect the real exchange rate (Amano and Van Norden, 1995). According to Olomola and Adejumo (2006), a high real oil price may give rise to wealth transfer effects that appreciates the exchange rate. This squeezes the tradable sector and may give rise to the Dutch-Disease syndrome in Nigeria.

5.0 Conclusions and Recommendation

This study focused on the relationship that exist between oil price differential and industrial production in Nigeria. Contrary to previous empirical studies, we utilized EGARCH model to estimate the conditional volatility measure of oil price and extracted oil price increases before incorporating this into the BVAR model based on monthly data from 1986M1 to 2015m12. The major finding of this study is that shock to international oil price as measured by the positive price differential stimulates growth in industrial production in Nigeria. Similarly, shock emanating from oil price increase causes a decline in prime lending rate. This suggests that there is need for monetary authorities to consider variations in oil price in the process of policy making as there is covert pass-through of shocks to money market activities. Oil price increases also exerts insignificant rise in the exchange rate in Nigeria. Based on our result, we recommend that the revenue from oil export be utilized to stimulate industrial capacity growth which constitute a major target sector in Nigeria's quest for economic diversification. There is inherent potential of the industrial sector to create more employment, reduce poverty and improve aggregate demand. We equally recommend that the monetary authorities should focus more on exchange rate management rather than inflation targeting as there is significant exchange rate pass-through to the domestic economy through the importation of refined fuel.

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