OIL PRICE VOLATILITY AND MACROECONOMIC VARIABLES IN NIGERIA

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ABSTRACT

This study examines the effect of oil price volatility on macro-economic variables in Nigeria as it affects consumer price index, gross domestic product, government expenditure and real effective exchange rate using monthly data covering the period 1975-2014. The empirical analysis is carried out by an unrestricted VAR approach. Generalized impulse response functions and generalized forecast variance decomposition are employed to analyze the effect of oil price volatility on the Nigerian economy. The findings revealed that oil price volatility does not affect GDP and inflation rate in Nigeria but it does significantly affect real exchange rates and government expenditure. There is a strong need for policy makers to focus on policies that will stabilize the macroeconomic structure of the Nigeria economy with specific focus on alternative source of government revenue.

Keywords: Oil Price Volatility, macroeconomic variables, Unrestricted VAR,

INTRODUCTION

The concept of volatility in oil price has gained prominence both in theory and practice, this is due to availability of data, possibility of time varying volatility (referred to as conditional Hetero- scedasticity) (Harris and Sollis, 2004). Changes in oil prices have persisted for a while. This could be regarded as a permanent shock. The result of the shock was a favourable investment climate, increased national income within the period although a slight decline was observed in the growth rate of the GDP. Despite this perceived benefit of oil price change, the macro-economic environment in Nigeria during the booms was undesirable. For instance, inflation was mostly double digit in the 1970s, money supply grew steeply while huge fiscal deficits were also recorded (Akpan, 2009). The Nigerian economy, which for so long has been criticized for its mono-cultural nature relies heavily on export of crude oil. The Nigeria's oil statistics shows that the country has an estimated 36.2 billion barrels of oil reserve which places the country as the second largest in terms of oil reserve in the entire African continent.

The Nigerian oil sector accounts for over 95 percent of export earnings and about 85 percent of government revenues. Budget deficit, exchange rate fluctuation and unstable fuel world price has put unnecessary pressure on the budget capacity of the Nigerian government to stimulate the economy in recent times. These problems have both short and medium term implication for the country's economy. In response to this problem and the need to address the problem, the government has designed a fiscal policy framework that involves radical structural changes in its fiscal operation which is in the line of removal of fuel subsidy which has been largely criticized by the public. This increase in domestic oil price has effect on macroeconomic aggregates of both net oil importers and exporters. Also, an increase in petroleum price tends to have a contra dictionary impact on world demand and growth in the short term. Higher prices raise inflation. Overtime, the impact of rising oil prices on economic and social activities and inflation depends also on policy responses and supply side effects (IMF, 2005). This effect is most severe in countries that are over dependent on oil with limited access to international capital markets.

It is generally argued that for net-oil exporting countries, a price increase directly increases real national income through higher export earnings, though part of this gain would be later offset by losses from lower demand for exports generally due to the economic recession suffered by trading partners. It is against this backdrop that this paper sets out to examine the impacts of oil price volatility on macroeconomic variables in Nigeria as an oil dependent economy.

The remainder of the paper is organized as follows: Section 2 provides review of literature. Section 3 describes the methodology adopted for the paper. Section 4 presents the empirical results and section 5 concludes the paper.

REVIEW OF LITERATURE

Issues on the relationship between oil price and other macroeconomic variables have been longstanding in the energy literature in general. These include the various oil exporting and importing countries. A few of these are on Nigeria. Some of which are herein reviewed. The oil price shock of 1973 and the subsequent recession gave rise to plethora of studies analysing the effects of oil increases on the economy. The early studies included Pierce and Enzler (1974), Rasche and Tanton (1977), Mork and Hall (1980), Hamilton (1983), Nasseh and Elyasiani (1984), Lillien (1982), Loungani (1986), Dohner (1981) and Darby (1982) all of which documented and explained the inverse relationship between oil price increases and aggregate economic activity.

Empirical studies which included Bartlect and Gounder (2007) examined oil price shocks and economic growth in Venezuella using the Vector Autoregressive (VAR) Methodology based on quarterly data. Three oil price measures were considered following the various theoretical implications that oil price shocks have on economic growth. The authors concluded that since oil consumption continued to increase, there is need for policy makers to consider oil price shocks as a major source of volatility for many variables in the economy.

Raguindin and Reyes (2005) analyzed the effect of oil price shocks on the Philippine economy over the period 1981-2003. The impulse response functions for the symmetric transformation of oil prices showed that an oil price shock leads to a prolonged reduction in the real GDP of the Philippines. Conversely, in their asymmetric VAR model, oil price decreases play greater role in each variable fluctuations than oil price increases.

Aliyu (2009) examined the impact of oil price shock and exchange rate volatility on the economic growth in Nigeria: An empirical investigation on the basis of quarterly data from 1986-2007. The empirical analysis started by analyzing the time series properties of the data which is followed by examining the nature of causality among the variables. Furthermore, the Johansen VAR based cointegration techniques is applied to examine the sensitivity of real economic growth to changes in oil prices and real exchange rates volatility in the long run while short run dynamics was checked using a vector error correction model. The findings revealed that oil price shock and appreciation in the level of exchange rate exert positive impact on real economic growth in Nigeria.

Aliyu (2009b) examined the non-linearity or asymmetry in the relationship between oil price shocks and the Nigerian macro economy. While Olomola and Adejumo (2006) also examined some form of non-linearity by modeling oil price volatility through the stochastic volatility approach. Akpan (2009) analyzed the dynamic relationship between oil price shocks and major macroeconomic variables in Nigeria applying a VAR approach. The variables are real oil price, real government expenditures, real industrial GDP, inflation, real exchange rate and real import. The study used the Johansen co-integration test and observed two co-integration equations. The study observed that the Nigerian macro economy is susceptible to oil price shocks and real government expenditures, but the impact of oil price fluctuations on industrial output growth is marginal.

Eregha and Oziegbe (2013) examined the effect of oil price increase and oil price volatility on inflationary dynamics in Nigeria. The study adopts two measures of volatility which are unanticipated and anticipated oil price changes. An instrumental variable technique was used for the estimation and the study found that they influenced inflationary dynamics negatively and significantly.

Isola and Saibu (2013) examined the nexus between energy price and macroeconomic performance in Nigeria for the period spanning 1986 to 2010. The study used a Vector Error Correction Method (VECM) for analyzing the relationship between oil price and macroeconomic variables. The findings of the study showed no evidence of long run causal relationship between energy price hike and other macroeconomic variables but in the short run it was observed that a positive unidirectional causation exist from energy price to government expenditure and interest rate. The study further showed that the inflation consequence of price hike is greater than the positive impact of increased government expenditure induced by increased revenue from the price hike.

Alley, Asekomeh, Mobolaji and Adeniran (2014) employed the general methods of moment (GMM) to examine the impact of oil price shocks on the Nigerian economy for the period spanning 1981 to 2012. They found that oil price volatility insignificantly retards economic growth while oil price itself significantly improves it. The conventional principle that oil price increase is beneficial to oil-exporting country like Nigeria is supported by the

significant positive effect of oil price on economic growth. They added that shocks however create uncertainty and undermine effective fiscal management of crude oil revenue; hence the negative effect of oil price volatility. Ogundipe, *et al.* (2014) examined the effects of oil price, external reserves and interest rate on exchange rate volatility in Nigeria using annual time series data spanning 1970 to 2011. The Johansen Cointegration technique was used to determine the long run relationship among the variables while the vector correction mechanism was used to examine the speed of adjustment of the variables from the short run dynamics to the long run equilibrium. They found that a proportionate change in oil price leads to a more than proportionate change in exchange rate volatility in Nigeria; which implies that exchange rate is susceptible to changes in oil price.

Mgbame, Donwa, and Onyeokweni (2015) examined the conceptual impact of oil price volatility on Nigeria economic growth. The study revealed that there is positive significant relationship between oil price volatility and Nigeria economic growth. They established that oil price changes determines government expenditure level, rate of inflation, level of unemployment, which in turn determines the growth of the Nigerian economy. Ekong and Effiong (2015) employed a structural vector autoregressive (SVAR) model where oil price shocks were disentangled into three components: oil supply shocks, aggregate demand shocks and oil-specific demand shocks, to investigate the effects of demand and supply shocks in the crude oil market on Nigeria's economy for the period 1986–2011. The three shocks are recovered in the first analysis and conditioned on selected macroeconomic variables within a VAR framework in the second stage. The impulse response analysis shows that the macroeconomic aggregates are associated with different response pattern to each type of oil price shocks. However, their relative importance showed marginal effects.

Eneji, Mai-Lafia and Nnandi (2016) used secondary time series data in a vector auto regression analysis to consider the impact of oil price volatility on macroeconomic variables and sustainable development in Nigeria and found that fluctuations in oil prices do substantially affect the real GDP, exchange rates, unemployment, balance of payments and interest rates in Nigeria. It was also discovered in the study that negative shocks in the international oil market, have significant impact on price fluctuations. Also, Alhassan and Kilishi (2016) employed GARCH model and its variants (GARCH-M, EGARCH and TGARCH) with daily, monthly and quarterly data, to analyse macroeconomic responses to oil price volatility in Nigeria. The study revealed that the Nigerian economy is vulnerable to both internal shocks in relation to interest rate volatility and real GDP volatility; and external shocks in relation to exchange rate volatility and oil price volatility.

From the foregoing, there are inconsistent findings; conflicting results exist even for the same Country. The current trend of fall in the world's oil price and unstable exchange rate in Nigeria necessitate this new study with a different approach.

DATA AND METHODOLOGY

The study adopts quarterly observations for the period 1975 to 2014. Data for the study are obtained from the IFS CD Rom. To investigate the response of macroeconomic variables to asymmetric and innovations in oil prices, an unrestricted Vector Autoregressive model (VAR) is adopted. The VAR model provides a multivariate framework where changes in a particular variable (oil price) are related to changes in its own lags and to changes in other variables and the lags of those variables. The VAR treats all variables as endogenous and does not impose *a priori* restrictions on structural relationships. Since the VAR expresses the dependent variables in terms of predetermined lagged variables, it is a reduced-form model. Once the

VAR has been estimated, the relative importance of a variable in generating variations in its own value and in the value of other variables can be assessed using the Forecast Error Variance Decomposition. Forecast Error Variance Decomposition assesses the relative importance of oil shocks in the volatility of other variables in the system. The dynamic response of macroeconomic variables to innovations in a particular variable can also be traced out using the simulated responses of the estimated VAR system using the Impulse Response Functions.

We first undergo to study the unit root properties of the variables using two different unit tests and proceed to examine cointegration among the variables.
The VAR Model is given as:

$$y_t = Ay_{t-1} + Ay_{t-2} + - + A_k y_{t-k} + Bz_t + \varepsilon_t$$

Where,
Where y_t is a vector of endogenous variables, z_t is a vector of exogenous variables, A_j and B are coefficient matrices and k is the lag length determined by lag selection criterion like Aikake Information Criteria and Shwartz Information Criteria. The innovation process $£_t$ is an unobservable zero-mean whitenoise process with a time invariant positive-definitive variance -covariance matrix.

The list of variables used in the VAR model includes: Oil Price (Oilp), Real GDP (rgdp), Government expenditure (gexp), exchange rate (exr) and Inflation rate (Infl). Hence, y_t=[Oilp, rgdp, gexp, exr and Infl], since all variables are endogenous.

EMPIRICAL ANALYSIS

Present below is the empirical results of the analysis using the methodology specified earlier . First is the unit root result for testing the time series status of the variables, followed by the cointegration result and then the VAR result.

Unit Root Result

The study adopts the Augmented Dickey Fuller (ADF) and Philip-Perron tests for the unit root tests and the result is presented below. From Table 1, the results show that the variables are non- stationary in their levels. They only became stationary after first difference.

Table 1: Unit Root Test Result

Variables	ADF		PP	
	Level	1st Difference	Level	1st Difference
Rgdp	-2.65*	-4.05***	-2.01*	-15.45***
Exr	-1.21	-11.69***	-1.34	-11 23***
Infl	-3..06**	-6.32***	-3.30	-8.76***
Gexp	-1.05	-18.13***	-1.23*	-35.8***
Oilp	-8.76***	-10.04***	7.82***	-25 7***

*Note: *, **, *** represent significance at 10, 5 and 1 percent respectively.*

This result implies that the variables in the model follow an I(1) process. The second step is to test if a long run relationship (cointegration) exists among the variables and this is shown below.

Cointegration Result.

The study employed the Johansen Cointegration approach to test for the existence of cointegration among the variables and the result is presented below.

Table 2: Cointegration Result. Series:RGDP,OILP,GEXP,EXR,INFL

Rank	Max Eigen Statistics	Rank	Trace Statistics
r=0	121.23***	r=0	130.41***
r=	82.32***	r<1	84.23***
r=2	28.87	r<2	23.18
r=3	11.25	r<3	8.65
r=4	2.63	r<4	1.89

Note *** indicates 1 per cent confidence level.

From Table 2 above, the result of the test statistics indicate that the hypothesis of no cointegration among the variables can be rejected for Nigeria for the period under review. The results reveal that at least two cointegrating vectors exist among the variables of interest. This is confirmed by both the maximum Eigen statistics and the trace statistics. This implies that there is a long run relationship among the variables.

Variance Decomposition Result.

Variance decomposition measures the proportion of forecast error variance in one variable explained by innovations in it and the other variables. The results of the variance decompositions are presented in Table 3.

Table 3 Variance Decomposition Result for Oil Price Volatility and Macroeconomic Variables

Variance decompositions for GEXP					
Quarter	oilp	Gexp	Rgdp	Infl	exr
1	0.76	90.27	0.01	0.02	0.02
4	2.64	76.15	7.94	3.71	4.72
8	5.47	65.42	11.21	2.36	12.68
12	6.98	58.56	15.05	2.75	12.81
Variance decompositions for RGDP					

Quarter	oilp	Gexp	Rgdp	Infl	exr
1	0.01	6.31	95.34	0.01	0.02
4	2.51	5.05	81.51	5.23	7.05
8	6.21	4.54	76.56	5.12	6.51
12	6.08	3.47	82.13	4.04	5.24
Variance decomposition for INFL					
Quarter	oilp	Gexp	Rgdp	Infl	exr
1	2.43	2.45	0.01	97.27	0.01
4	2.01	7.18	4.45	87.57	1.24
8	1.85	11.21	20.65	55.56	7.04
12	1.34	10.34	23.69	45.71	10.62
Variance decomposition for EXR					
Quarter	oilp	Gexp	Rgdp	Infl	Exr
1	49.21	2.93	0.23	1.24.	95.12
4	42.13	4.76	0.34	4.64	87.23
8	34.02	4.18	0.43	5.07	71.24
12	33.06	3.67	0.78	5.86	72.81

From the table above, the variance decomposition shows that the response of real government expenditure to a one standard deviation shock to positive oil price changes was significantly different from zero. This result confirms the huge monetization of crude oil receipts and subsequent increase in government expenditure in Nigeria.

It could also be deduced from the results that oil price shocks do not significantly affect industrial output in Nigeria. This contradicts the expectations that oil price shocks tend to lower GDP. That is, oil price shocks had marginal impact on output. The oil price shocks contributed about 2.5 per cent to shocks in output in the fourth quarter, and averaged about 6 per cent over the eighth and tenth quarters.

For inflation rate shocks, the contribution to output declined from about 5 per cent in the fourth quarter through 5 per cent in the eighth quarter to about 4 per cent in the twelfth quarter. Output changes accounts for the largest share of shock inflation rate, while oil price shock explained relatively little. Output changes contributed about 45 per cent to changes in commodity price level in the first quarter, declining through 35 per cent in the tenth quarter. Real exchange rate contributed about 10 per cent to changes in inflation rate in the first quarter, rising through 15 per cent in the fourth quarter to about 20 per cent in the tenth quarter. However, oil price explained only 0.3 per cent of changes in inflation rate in the first quarter, rising to about 6 per cent in the eighth quarter and 10 per cent in the tenth quarter. The intuition for inflationary effects of positive oil price changes in Nigeria is through the Dutch disease phenomenon and within the "spending effects". The "spending effect" happens

because higher oil prices lead to higher wages or profits in the oil related sectors, thus increasing aggregate effective purchasing power and demand in the economy.

The variance decomposition suggests that shocks to oil price accounted for about 49 per cent of shocks to real exchange rate in the 1st quarter declining in effects to about 34 per cent in the 8th quarter, and further to about 33 per cent in the 12th quarter. The contribution of output shocks to the shocks in the real exchange rate is not very significant. The result shows a less than 1 per cent contribution over a twelve-month period. Shocks to inflation contributed an average of 5 per cent to real exchange rate shocks over the 4th quarter to the 12th quarter.

CONCLUSION

The study examined oil price volatility effects on macroeconomic variables in Nigeria for the period 1975-2014. The study employed a VAR approach for the analysis and the results shows that the Nigerian economy is very vulnerable to oil price shocks. The real effective exchange rate falls significantly for the entire period. This increases the price of imports, and despite the traditional belief that this should boost the non-oil sector, it reveals otherwise. For real output, which depends heavily on imported raw material and intermediary, will face a down turn and may be forced to downsize. Due to increased imports in the Nigerian economy, inflationary pressures are inevitable and are pronounced. Government expenditures fall at the onset but increase significantly. The study therefore recommends a strong economic restructuring and diversification that will change the Country's export revenue base and enhance fiscal prudence and proper accountability. Policy makers are to focus on policies that will stabilize the macroeconomic structure of the Nigerian economy with specific focus on alternative sources of government revenue and thus prevent the negative effect of oil price fluctuations on economic activities and government spending in Nigeria.

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