A Re-Investigation of Selected Macroeconomic Variables' Response to Oil Price Shock in Nigeria (1981-2015): A VAR Model Approach

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Abstract

The effect of the oil price shock on macroeconomic variables cannot be overemphasized. This has prompted some economics research on the implications of oil price on major macroeconomic variables, such as economic growth, inflation, and exchange rate. This study re-investigated the implications of crude oil price shock on some selected macroeconomic variables in Nigeria. The empirical analysis applied the vector autoregressive (VAR) model technique to the annual data on the Nigeria economy for the period 1981-2015. The study revealed that a one-time shock to the price of crude oil in the global oil market will produce a persistent and significant effect on real GDP and unemployment rate in Nigeria; the response of real GDP to oil price shock was persistence over a long term; variation in real GDP over time was as a result of oil price shock; and oil price shocks had negative effects on unemployment in the long and short run, while exchange rate responded to shock with dollar appreciation against the naira. The study thus recommended the need for policymakers to formulate implementable policies on diversification of the productive base of the economy from oil to other sectors, such as agriculture, manufacturing, tourism and services to break the overdependence of the economy on the oil sector, among others.

Keywords: Oil price shock, macroeconomic analysis, Nigeria
JEL Classifications: E64, P42, Q43

Introduction

The impact of oil price fluctuation on the economy cannot be overemphasized globally, despite the sector's competitiveness with alternative sources of energy like wind, water, nuclear and solar energy. To this extent, researchers have found the high impact of oil, and numerous studies have been carried out on its impacts on various macroeconomic variables. It is believed that oil price hike can lead to a decline in economic growth of net import countries, such as Nigeria. Moreover, fluctuation in oil prices can trigger higher inflation in the net export countries, thus leading to instability in the global market.

The origin of crude oil price increase can be traced to 2005, when crude oil rose from $38.27 p/b in 2004 to $70.85 p/b. In December 2007 and July 2008, the prices of crude oil reached $100 p/b and $140 p/b respectively. These two phenomena can be linked to both demand and supply-side explanatory factors. There was high demand for oil from East Asian. China alone increased its consumption by 840,000 barrels a day in 2005. Hamilton (2009b) posited that large flow of investment into commodity futures market and shift in demand curve as a result of limited increase in oil supply led to the increase in oil price from $55 to $142 in 2008.

Global economy is facing turbulences, with increasing financial losses, falling prices of assets and a deep downturn caused by shock in oil prices. From 2010 until mid-2014, world oil prices were fairly stable, at around $110 a barrel. But after June 2014, prices fell by more than half: Brent crude dipped below $50 a barrel for the first time since May 2009. The reasons for these changes were in twofold: there was weak demand by many countries as a result of insipid economic growth; and there was supply-side issue. Ebinger (2014) analysed the free fall in oil price from the demand and supply side and found that, aside from slowing global economic growth as mentioned earlier, foremost among the reasons for the fall in price were also in twofold: a rise in global oil production and, hence supply to the market (from North America and unexpected resumption of oil production in Libya, Nigeria, and South Sudan); and a drop in demand in Europe, China, Japan, Brazil, India and some emerging markets, coupled with Japan's decision to restart some of its nuclear reactors, which reduced drastically the demand for fuel oil in the power sector.

Being a crude oil net-exporting country and a quasi-importer of refined petroleum and its bi-product, Nigeria is not insulated from the global oil price shocks. Most studies on Nigeria that applied vector autoregressive (VAR) model to analyse the effect of oil price shock on macroeconomic variables have been focusing on money supply, inflation, exchange rate volatility, and economic growth. The study therefore aims at re-examining oil price shock to economic growth and exchange rate volatility; it also introduced unemployment as an uncommon variable in existing literature on Nigeria. The report is presented in five sections: introduction, empirical literature, econometric methods and data, discussion of results, and conclusion and recommendations

2. Empirical Literature

In economic literature, there are quite a number of empirical studies on the impact of oil price shock on various macroeconomic variables. Jiménez-Rodríguez and Sanchez (2004) employed VAR in a linear and non-linear model to investigate the effects of oil price shock in industrialised economies of G-7 countries and the euro area with inclusion of two net oil exporting countries of Norway and United Kingdom. They found a significant interaction between oil prices and macroeconomic variables. Oil price increase was found to have negative impact on all countries in the study, except Japan. The uniqueness of Jiménez-Rodríguez and Sanchez study was that they found asymmetric effects of oil price on GDP. This was evidenced against the linear approach, because an oil price effect on GDP differs when there is increase and decrease in oil price.

Habib and Kalamoya (2007) studied the effect of oil price on the real exchange for three countries Norway, Saudi Arabia and Russia. The result showed that a positive long-run relationship existed between oil price and exchange rate, although the positive impact did not occur in Norway and Saudi Arabia. Their results may be as a result of two big net exporting countries. Norway and Saudi Arabia are net exporters of oil; hence, the positive long-run relationship should not be expected a priori. Also, Gounder and Bartlee (2007), using both linear and nonlinear oil price transformation, observed a direct link between net oil price shock and economic variables of New Zealand. This was partly in line with the findings of Hamilton (2009b) who studied many countries.

Chen and Chen (2007) used panel cointegration to analyse the long-run relationship between oil price and exchange rate by using a monthly panel data of G7 countries. Their analysis revealed that oil prices had been the dominant source of exchange rate movement and, more so, had significant predictive power. If this is the case with G-7 countries, it will be more so for countries that are mono-economies like Nigeria. The studies of Dibooglu (1996), Amano and Van Norden (1998), Chen and Chen (2007), and Basher et al. (2012), using an error correction model (ECM) and Granger causality test, showed that there is a stable relationship between oil price and foreign exchange for the period 1972- 1993. The authors also established a unidirectional causality relationship between oil price and exchange rates, which suggested that an oil price shock can heavily influence exchange rate in the period studied.

Park and Ratti (2007) examined the relationship between oil price and exchange for the period 1980-2005. Employing VAR model, the result revealed that oil price increase has a greater influence on the exchange rate, which connotes that oil price has an impulse response on the exchange rate. Turham et al. (2012) employed daily data series to study the role of oil prices in selected emerging countries' exchange rates. They found that oil prices led to a significant appreciation in US dollar and that oil price dynamics changed significantly in the period sampled.

Aliyu (2009) assessed the impact of oil price shock and real exchange rate volatility on real GDP in Nigeria using quarterly data for the period 1986-2007. He adopted vector autoregressive (VAR) method and found that increase in oil price positively and significantly impacted on real GDP and exchange rate. Umar and Abdulhakeem (2010), in their study, examined how oil price shocks affect the aggregate economy, using a vector autoregressive (VAR) approach. They found that oil price shock had strong impact on GDP and money supply.

Matthew and Adegboye (2014) assessed the impact of oil price shock and exchange rate volatility on growth, using quarterly time series data from 1986 to 2012. Employing Johansen VAR-based cointegration technique, the study revealed that oil price shock and appreciation in the level of exchange rate exerted positive impact on real economic growth in Nigeria. This finding was puzzling because most studies found that appreciation of exchange rate due to oil price shock impacted negatively on economic growth. Obioma and Eke (2015) investigated the interaction between oil price, consumer price and exchange rate in Nigeria, using VAR model for the monthly data of 2007-2015. The study revealed that shock on crude oil price had a negative effect on both exchange rate and consumer price. The evidence of negative effect in this finding lent support to existing literature, as opposed to the puzzling findings of Matthew and Adegboye (2014).

Basically, most of the previous studies have only focused on the link between oil price, exchange rate volatility and economic growth in Nigeria. However, there is no doubt that the Nigerian economy is currently in a state of recession. Theoretically, a recession means consecutive fall in the rate of real GDP and this implies a rise in the level of unemployment in the economy. Previous studies failed to investigate this link empirically. The current study attempts to expand the discussion and bridge the noticeable gap in the literature by focusing on the response of real GDP, unemployment rate and exchange rate to one-time oil price shock and by adopting the quadvariant restricted VAR (vector autoregressive) method.

3. Econometric Methods and Data

In order to examine the influence of oil price shock on real GDP, exchange rate and unemployment rate, a quadvariate vector autoregressive (VAR) representation of the variables was used; the shock-capturing variables ($\varepsilon_t^g \varepsilon_t^e \varepsilon_t^{un} \varepsilon_t^{op}$) are included in the last parts of equations 1, 2, 3 and 4:

$$g_t - \alpha_{11} + \sum_{i=1}^{i=T} \alpha_i g_{t-i} + \sum_{j=1}^{j=T} \alpha_j op_{t-j} + \sum_{k=1}^{k=T} \alpha_k e_{t-k} + \sum_{q=1}^{q=T} \alpha_q un_{t-k} + \varepsilon_t^g \dots\dots (1)$$

$$e_t = \alpha_{21} + \sum_{i=1}^{i=T} \beta_i g_{t-i} + \sum_{j=1}^{j=T} \beta_j op_{t-j} + \sum_{k=1}^{k=T} \beta_k e_{t-k} + \sum_{q=1}^{q=T} \beta_q un_{t-k} + \varepsilon_t^e. \dots (2)$$

$$un_t = \alpha_{31} + \sum_{i=1}^{i=T} \gamma_i g_{t-i} + \sum_{j=1}^{j=T} \gamma_j op_{t-j} + \sum_{k=1}^{k=T} \gamma_k e_{t-k} + \sum_{q=1}^{q=T} \gamma_k un_{t-k} + \varepsilon_t^{un} \dots\dots (3)$$

$$op_t = \alpha_{41} + \sum_{i=1}^{i=T} \delta_i g_{t-i} + \sum_{j=1}^{j=T} \delta_j op_{t-j} + \sum_{k=1}^{k=T} \delta_k e_{t-k} + \sum_{q=1}^{q=T} \delta_k un_{t-k} + \varepsilon_t^{op} \dots\dots (4)$$

The above expression can be presented in a compact vector form thus:

$$Y_t = A_0 + \sum_{m=1}^{m=T} \delta_m Y_{t-m} + V_t \dots\dots\dots\dots\dots\dots\dots\dots\dots (6)$$

Where Y = {g, e, un, op}, A_0 is the column vector of constant parameters and the V is the vectors of shocks.

Equation 5 is suitable for variables that are stationary at level. Since VAR accommodates non-cointegrated variables, first differencing of integrated variables may lead to a loss of long-run information. Equation 5 is called the unrestricted version because it accounts for cointegration, and estimating such an equation may turn out to be spurious and inconsistent. To account for possible cointegration, the vector equation is transformed into a first difference form by losing a lag and

$$\Delta Y_t = \Pi Y_{t-n} + \sum_{m=1}^{m=n-1} \Gamma_m \Delta Y_{t-m} + V_t \dots\dots\dots\dots\dots\dots\dots (7)$$

accounted for past period equilibrium correcting term.

Where

$$\Pi = \left(\sum_{m=1}^{n} \delta_m\right) - I_g \; and \; \Gamma_m = \left(\sum_{j=1}^{m} \delta_{mj}\right) - I_g$$

There are two test statistics for cointegration under the Johansen approach, which are the Trace and Maximum Eigen statistics. The Trace statistics is a joint test, in which null is when the number of cointegrating vectors is less than or equal to *r* against an unspecified or general alternative that there are more than *r*. The Maximum Eigen statistics conducts separate tests on each eigenvalue, and has its null hypothesis that the number of cointegrating vectors is *r* against an alternative of r+1. The data for the study were gathered from three notable sources. The data on real GDP were from the World Bank databank, in order to circumvent the re-basement bias. Exchange rate data were from the Central Bank of Nigeria's statistical bulletin, while those of crude oil prices were also from the World Bank databank. Lastly, data on unemployment rate were from the Nigeria Bureau of Statistics. The data spanned 1981 to 2015.

Results

Table 1 shows the descriptive statistics of the log of real GDP (g), exchange rate (e), log of oil price (op) and unemployment rate (un). The variables employed contained 35 observations; all the variables were positively skewed; they were also platykurtic, as their respective kurtoses were less than three. The coefficient of variation statistics was computed to show the unit less dispersion comparison of the three variables, and it showed that there was less variation in the log of real GDP (g), followed by those of oil price (op) , unemployment rate (un) and, lastly, exchange rate (e). The probability values of the Jarque-Bera normality test were not statistically significant; hence, the null hypothesis of normality was accepted. In other words, the acceptance of the joint null normality hypothesis means that all of the variables were normally distributed.

Unit root test

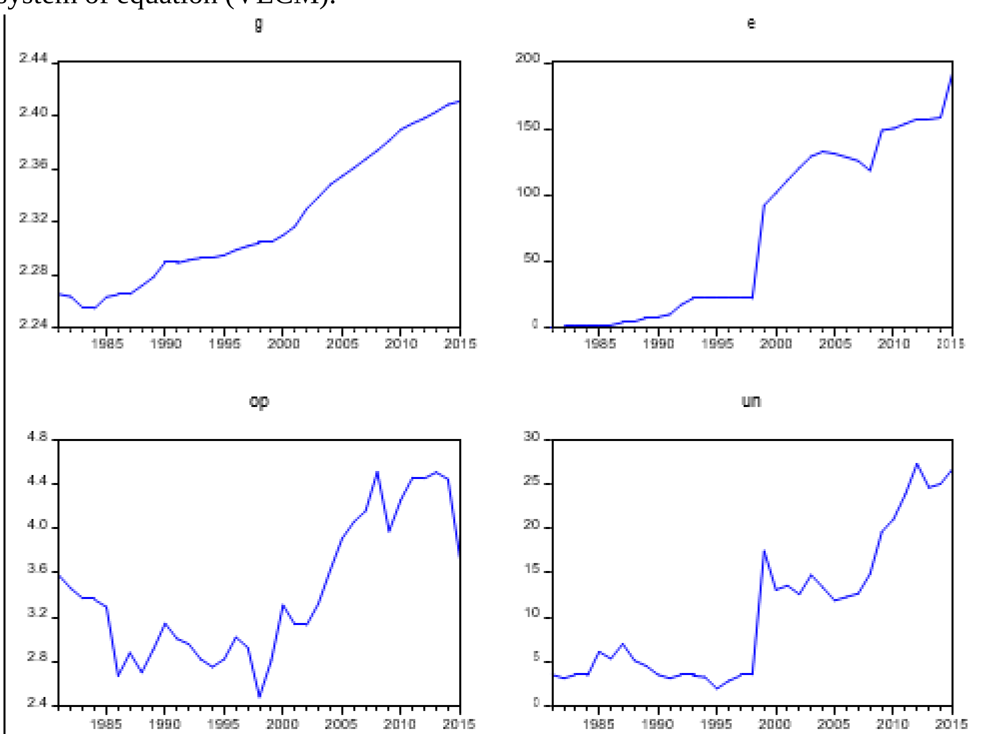
Prior to the formal pretest(s), it is always advisable to plot the time series under study, as it may reveal the integrating nature of the series. The variables (log of real GDP (g), exchange rate (e), oil price (op) and unemployment rate (un)) used in this study are shown in figure 1, which showed that all the variables were upward trended. There was no tendency for the variables mean reverting and variance constancy over time. However, no statistical fact could be derived numerically from the graphical inspection of the variables in question. Based on this caveat, the Phillip-Perron (PP) Augmented Dickey-Fuller (ADF) unit root tests were employed to investigate statistically the integration property of the log of real GDP (g), exchange rate (e), log of oil price (op) and unemployment rate (un).

Table 1: Descriptive statistics

	g	*e*	*Op*	*un*
Mean	2.320597	71.40880	3.428067	10.72286
Median	2.303966	22.06540	3.310178	7.000000
Maximum	2.410740	192.4405	4.516120	27.40000
Minimum	2.254541	0.617708	2.477378	1.900000
Std. Dev.	0.050459	66.18510	0.622828	8.194513
Skewness	0.446150	0.225740	0.489319	0.697788
Kurtosis	1.824942	1.349790	1.951892	2.164621
Jarque-Bera	3.174732	4.268583	2.998713	3.858005
Probability	0.204463	0.118328	0.223274	0.145293
Sum	81.22089	2499.308	119.9823	375.3000
Sum Sq. Dev.	0.086568	148935.9	13.18910	2283.102
Observations	35	35	35	35

Source: Author's computation.

The result of the PP and ADF unit-root tests are presented in table 2. The result shows that the variables (log of real GDP (g), exchange rate (e), the log of oil price (op) and unemployment rate (un)) were stationary at first difference; that is, they were trending and were, therefore, not stationary at level. The stationarity nature of the variables had been suggested earlier by their graphical inspection in figure 1. The empirical implication of the PP and ADF unit root results is that log of real GDP (g), exchange rate (e), log of oil price (op) and unemployment rate (un) had unit root features. Thus, modelling these series in their level form, given their stationarity status, may result in spurious regressions, the consequence of which would be spurious indication of significant relationship even when that is not the case. However, since all the variables were all I(1) variables, there is a tendency for the presence of cointegration among them. Based on this, the Johansen cointegration test was utilized, as it is capable of detecting more than one cointegrating vector; more than one cointegrating vector aid the stability of the system of equation (VECM).



Source: Author's computation.

Table 2: PP and ADF unit root test

		ADF @ level				ADF @ First difference			
		G	op	Un	e	G	op	Un	e
C	t-stat	0.6110	-1.2486	-0.2863	0.3285	-3.4954	-5.3778	-7.0184	-5.2200
	Prob.	0.9879	0.6416	0.9168	0.9765	0.0145**	0.0001***	0.0000***	0.0002***
C and T	t-stat	-2.3741	-2.3445	-2.2296	-2.2153	-3.6461	-5.2573	-7.1063	-5.2916
	Prob.	0.3854	0.4002	0.4590	0.4664	0.0410**	0.0008***	0.0000***	0.0007***
No C and T	t-stat	2.6799	-0.1260	0.8904	1.8986	-2.0864	-5.4686	-6.6536	-4.5093
	Prob.	0.9975	0.6330	0.8962	0.9843	0.0372**	0.0000***	0.0000***	0.0000***
Remark						I(1)	I(1)	I(1)	I(1)
		PP @ level				PP @ First difference			
		G	op	un	e	G	op	Un	e
C	t-stat	1.6887	-1.2226	-0.0637	0.3366	-3.3364	-5.3778	-7.0184	-5.2176
	Prob.	0.9994	0.6532	0.9456	0.9769	0.0211**	0.0001***	0.0000***	0.0002***
C and T	t-stat	-2.4735	-2.3273	-2.1342	-2.2153	-3.4936	-5.2453	-7.1701	-5.2913
	Prob.	0.3383	0.4088	0.5092	0.4664	0.0566*	0.0008***	0.0000***	0.0007***
No C and T	t-stat	4.4444	-0.1260	1.3028	1.8986	-1.8995	-5.4686	-6.6171	-4.5438
	Prob.	1.0000	0.6330	0.9482	0.9843	0.0558*	0.0000***	0.0000***	0.0000***
Remark						I(1)	I(1)	I(1)	I(1)

Source: Author's computation.

Note * (**) (***) denotes significance at 10%, 5% and 1% respectively

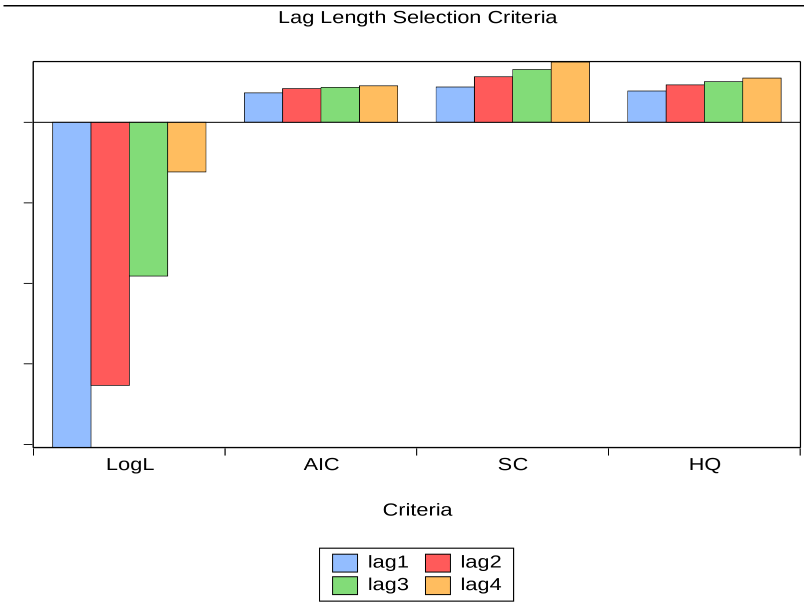
C represents Constant while T represents Trend.

VAR lag order selection criterion

The Johansen cointegration test is highly sensitive to the nature of data generating process and the choice of lag length; hence, it became necessary that series of nested likelihood ratio tests were tested on level VARs to determine the optimal lag length (p) prior to performing the cointegration test. Thus, the lag selection results in the context of this study are represented in figure 2 and table 3. Figure 2 shows that the blue bar, which denoted lag1, minimized the most information loss and was selected by the entire lag length selection criterion. Likewise, table 3 shows that the lag selection criteria chose optimal lag of 1 for the VAR model in level. Adherence to this was to avoid specification error and inconsistency, both in the parameter estimates and innovation accounting. The VAR of lag length 1 was selected and estimated in level, while Johansen cointegration test was conducted without losing cognizance of lag length zero.

Figure 2: Lag length selection criteria Table 3: Length selection criteria

Criteria	*lag1*	*lag2*	*lag3*	*lag4*
LogL	-40.4*	-32.7	-19.1	-6.2
AIC	3.6*	4.2	4.3	4.5
SC	4.4*	5.7	6.6	7.5
HQ	3.9*	4.7	5.1	5.5



Source: Author's computation

Note: * Means lag selected by the selection criteria

Johansen cointegration test

The Johansen cointegration test centres on whether intercept or trend or both are included in the potentially cointegrating relationship and/or VAR. It is usually a good idea to examine the sensitivity of the result to the type of specification used. A test based on all this assumptions was conducted and the result is summarized in table 4.

Table 4: JJ-CT results summary

Data Trend	*None*	*None*	*Linear*	*Linear*	*Quadratic*
Test type	No intercept No trend	Intercept No trend	Intercept No trend	Intercept trend	Intercept trend
Trace	2	1	1	1	1
Max-Eig	2	1	1	1	1

Source: Author's computation

*Critical values based on MacKinnon-Haug-Michelis (1999)

The data in table 4 reveal that: 1) the null hypothesis of no cointegration vector was rejected after taking into consideration the intercept or trend, or both in the Johansen cointegration test; 2) all the four specifications jointly agreed that there was one cointegrating vector. The study thus chose the third specification, as it was common to the data generating process. Consequently, there was evidence of cointegration (long-run relationship) among the variables (log of real GDP (g), exchange rate (e), log of oil price (op) and unemployment rate (un)) employed. The study proceeded to the VECM (vector error correction model) in order to capture both short and long-run effects among the variables.

The long-run analysis

Table 5: Cointegrating vector table

Dependent variable: g			
Variable	*Coefficient*	*Std. Error*	*t-Statistic*
Un	0.007258	0.00331	2.19079
E	0.001542	0.00040	3.89488
op	-0.152958	0.02510	-6.09485
Constant	2.661923	-	-

Source: Author's computation

Note: the result in the table has been rearranged (signs reversed)

Table 5 above shows the Johansen cointegrating result normalized to log of real GDP (g). The long-run relationship can be expressed as:

$$g_t = 2.66 + 0.007258 * un_t + 0.001542 * e_t - 0.152958 * op_t$$

The result shows that exchange rate (e) and unemployment (un) have a positive impact on real GDP (g) in the long run, while oil price (p) has a negative impact on real GDP (lg) in the long run. The value of the coefficient estimated revealed that, on the average, a rise in unemployment rate and exchange rate devaluation increased real GDP (lg) by 0.73% and 0.15% respectively, while 1.0% increase in oil price (op) decreased real GDP (lg) by 0.15 in the long run. The data in table 5 thus show that all the variables significantly impacted on real GDP (lg) in the long run, as depicted by the magnitude of their t-stats. However, the direction of the impact of unemployment on real GDP did not follow the existing economic theories. The unemployment-GDP depicted in Okun's law suggested a negative relationship between unemployment and real GDP.

Short-run dynamic and the vector error correction model

Table 6: The short-run dynamic and the vector error correction model

Error Correction:	*D(g)*	*D(un)*	*D(e)*	*D(op)*
ECM(-1)	-0.029269	6.881951	-26.54209	-1.820022
	(0.00857)	(6.97605)	(33.2171)	(0.58553)
	[-3.41419]	[0.98651]	[-0.79905]	[-3.10831]
Constant	0.004281	0.685294	5.641848	0.004634
	(0.00062)	(0.50829)	(2.42027)	(0.04266)
	[6.85389]	[1.34824]	[2.33108]	[0.10861]

Source: Author's computation

The data in table 6 show the dynamic adjustment of four variables toward their respective long-run path. From the VECM table, the error correction term, which is also known as the speed of adjustment, was correctly signed and statistically significant for real GDP (g). The error correction for exchange rate (e) was explosive and not statistically significant. The error correction term for oil price (op) was correctly signed and significant, but explosive. In essence, this signifies that exchange rate was exogenous in the system. Basically, only real GDP (g) was responsible for the adjustment of the system towards a long-run steady state. The coefficient of ECM for real GDP (lg) shows that about 3% of disequilibrium in real GDP (lg) was corrected in a year.

Innovation Accounting: Forecast error impulse response and variance decomposition

The data in figure 3 show the response of real GDP to oil price shock. The thick line depicted the response of real GDP to oil price shock over time. The dotted line depicted the 95% Hall percentile confidence interval to investigate the significance of the response of real GDP to oil price shock over the horizons. The graph shows that real GDP (g) will respond negatively to oil price (op) shock in the short run, as well as in the long run. Also, real GDP response to oil price shock was statistically significant, both in the short and long run, as shown by the bootstrap confidence interval, not including the positive region. The response of real GDP to oil price shock did not vanish in the economy, as shown by the response line (the thick line) not dying off over the horizons. The reason for this is that oil price shock will lead to stagflation, which implies that both inflation and unemployment will accompany each other in a rising tone in the economy and this effect may not vanished after wrecking its havoc on the economy. The economic implication of this is that necessary policies have to be adopted to avoid economic recession of a long period of time.

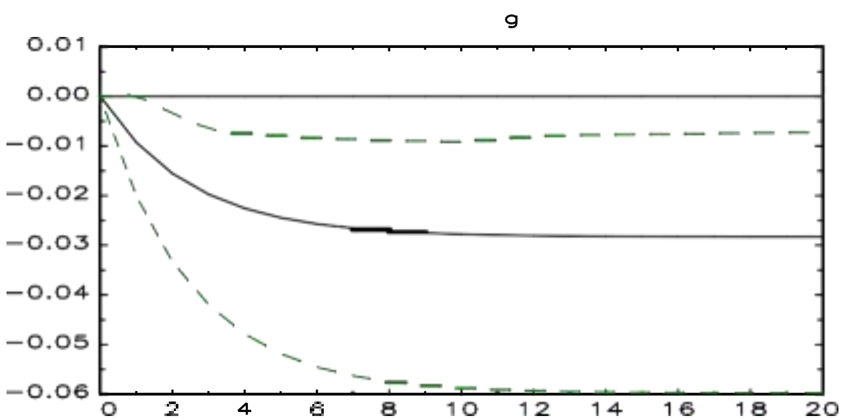


Figure 3: The response of real GDP to oil price shock
Source: Author's computation.

Figure 4 shows the response of unemployment to oil price shock. The graph shows that oil price (OILP) shock had a negative impact on unemployment in the short and long run, as depicted by the thick line. By inference, oil price shock can alter the production cost of many big firms and small and medium-scale enterprises in the economy, which may lead to structural unemployment. Also, unemployment rate response to oil price shock was not statistically significant in the first five years, as shown by the bootstrap confidence interval, including the positive region, during the first five years.

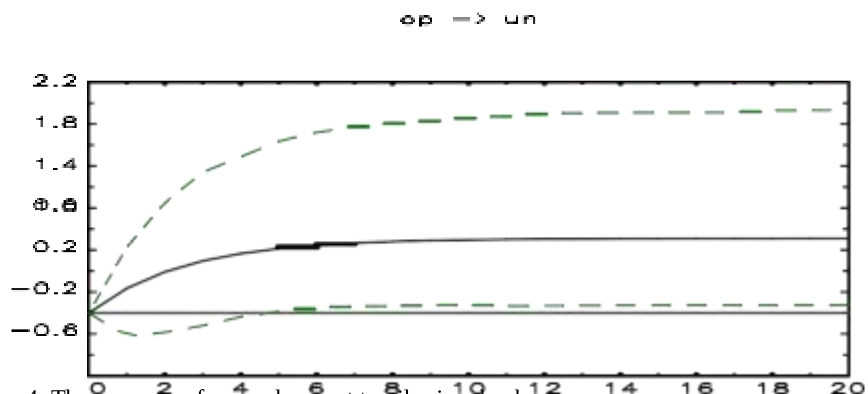


Figure 4: The response of unemployment to oil price shock

Source: Author's computation

This means that the level of unemployment does not have immediate effect on the economy but with lags. Again, the response of unemployment to oil price shock did not vanish in the economy, as shown by the response line (the thick line); meaning that it did not die off over the horizons. The reason for this was the response of real GDP to oil price shock. A fall in real GDP means fall in aggregate demand; a fall in aggregate demand will lead to a reduction in production, reduction in production and, in turn, a fall in sales. Consequently, falling sales means reduction in profit, which implies that firms are not able to cover their cost; hence, this ultimately leads to retrenchment or layoff of workers. In aggregate, the level of unemployment will accumulate over time if necessary actions are not taken to curtail it.

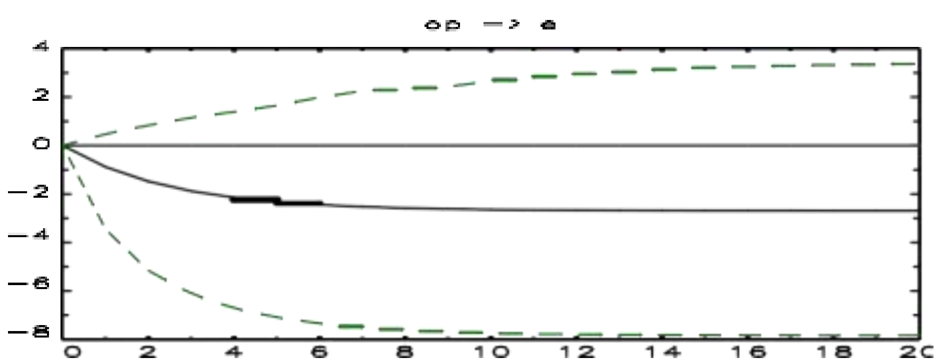


Figure 5: The response of exchange rate to oil price shock

Source: Author's computation.

Figure 5 shows the response of naira-dollar exchange rates to oil price shock. The graph shows that exchange rate (e) appreciated (ratio of dollar/naira falls) in response to oil price (op) shock in the short run, as well as in the long run. This is conforming to the theory that when the dollar appreciates, Nigerians use more naira to buy the dollar. The response of exchange rate to the oil price shock on the economy was persistent, as shown by the response line (the thick line) not dying off over the horizons. However, nothing or little can be said about the economic consequence of the response of exchange rate to oil price shock, as the response was not statistically significant both in the short and long run, as depicted by the dashed line, in both the positive and negative regions.

Figure 3 had depicted the forecast error variance decomposition of the log of real GDP (g), exchange rate (e), log of oil price (op) and unemployment rate (un). It has been observed that oil price accounted for 0% variation in real GDP initially, while it gradually increases in the 2nd year. It accounted for the second largest proportion of variation in real GDP towards the end of the 20th year. Another striking finding from figure 3 is that exchange rate accounted for the largest variation in real GDP. Unemployment rate accounted for the variation in real GDP but the proportion was very small in comparison to that of oil price and exchange rate. The variation in the unemployment rate is accounted for by oil price shock and exchange rate shock only. The real GDP shock accounted for zero variation in the unemployment rate. This implies that real GDP does not Granger cause unemployment rate. There was a visible trade-off between the proportion of variation in unemployment rate accounted for by oil price shock and exchange rate shock in the short run towards long run. Initially, the proportion of variation in unemployment accounted for by exchange rate shock was more than that of oil price, but it reduced in the 2nd year and gradually till they both accounted for the same proportion of variation in unemployment by the end of the 20th year. The variance decomposition of the exchange rate, by inference, depicted that none of the other variables' shocks accounted for its variation both in the short and the long run.

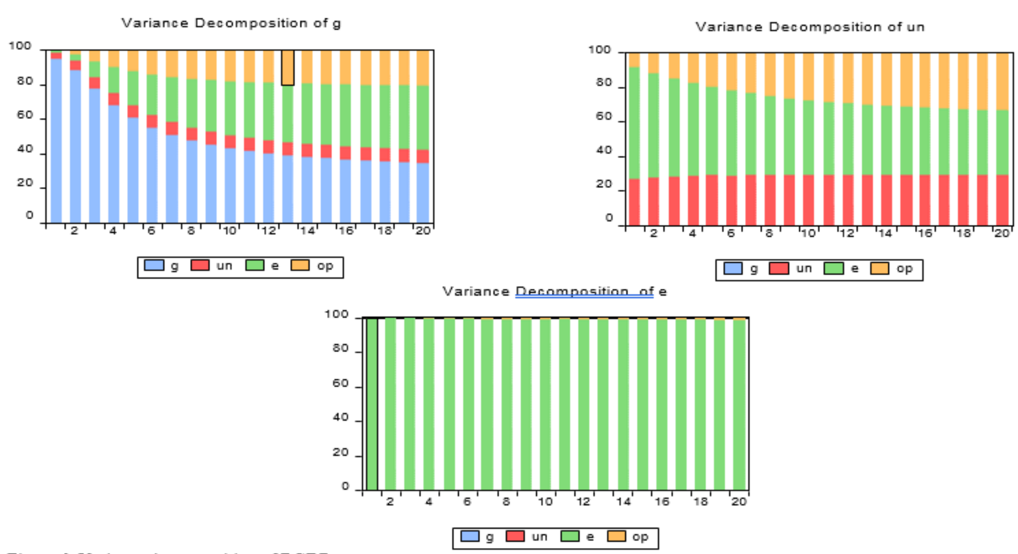


Figure 6: Variance decomposition of RGDP
Source: Author's computation

Residual diagnostic checking

Table 7: VECM serial correlation test

Lags	*LM-stat*	*Prob. Chi-Square(9)*
1	18.88397	0.2747
2	10.84658	0.8189

Source: Author's computation

Table 7 shows the result of the serial correlation test in the VECM model. The null hypothesis was 'there is no autocorrelation in the error terms in the system,' versus its alternative hypothesis of 'serial dependence among the error terms in the system'. The probability values (0.2747 and 0.8189) of the chi-square statistics at lags 1 and 2 respectively were greater than 0.05(5%) level of significance. This signifies that the calculated LM-stat was not statistically significant. The null hypothesis of no autocorrelation was thus accepted; hence the result was reliable and free of serial error correlation.

Conclusion and Recommendations

According to the empirical findings of this study, the ADF unit root test revealed that log of real GDP (lg), log of oil price (lop) and exchange rate (e) contained unit root. Based on this, the study employed Johansen technique to test for the presence of cointegration among the variables, as it suited the nature of the variables employed. The result showed evidence of long-run relationship among the variables. This is similar to the findings of Habib and Kalamoya (2007), Chen and Chen (2007) and Aliyu (2009). The Johansen cointegrating vector normalized to real GDP showed that exchange rate and oil price significantly impacted positively and negatively on real GDP in the long run, as shown by the magnitude of their t-stat respectively. Also, there was evidence that disequilibrium in real GDP was restored to equilibrium within a year where there was any short-run fluctuation in the explanatory variables, because the coefficient of ECM was significant with smaller magnitude despite the correctness of its sign. The innovation accounting revealed that the response of real GDP to oil price shock was persistent in the economy over a long period of time, with evidence of negative effects on exchange rate and unemployment. This is similar to the findings of Obioma and Eke (2015). Likewise, the forecast error variance decomposition revealed that oil price shock accounted for the larger proportion of variation in real GDP over time. Based on these findings, the practical recommendations to policymakers and economic managers are:

1. There is the need to ensure diversification of the productive base of Nigerian economy and explore other notable sectors, such as agriculture, manufacturing, tourism and services. This will help open up a wider spectrum for the inflow of income to the economy and break the overdependence on the oil sector.

2. The economy should be technologically driven to improve efficient productions in the oil sector and reduce importation of its final products. This would help reduce exchange rate volatility and oil price shock to some macroeconomic variables.

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