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OIL SECTOR PERFORMANCE AND NIGERIAN MACROECONOMIC VARIABLES

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ABSTRACT

Nigeria as an oil exporting mono-economy is vulnerable to world oil prices fluctuations. About10 percent of GDP and 86 percent of the government's export revenues come from the oil and gas sector. The study assessed the impact of the Nigerian oil sector performance on the macroeconomic variables between 1980 and 2017 in light of this overdependence. It carried out pre-estimation tests namely descriptive statistics in order to understand the nature of the variables. The Augmented Dickey Fuller and Phillip Perron tests were also deployed to determine stationarity level of the variables. The long-run co-integration test was conducted after determining the optimal lag. The Error Correction model technique was applied to determine the possible existence of short-run relationship among the variables. The Toda Yamamoto modified Wald's test was employed in order to know the direction of causality. The Impulse Response Function together with other post-estimation tests was also used. The result showed a uni-causality direction from oil revenue in the direction of all the macroeconomic variables. It also revealed significant positive long run relationship between the oil sector and both GDP and unemployment. The other variables were however inversely associated. The study recommended that the government of Nigeria take diversification more seriously, besides investing in refinery acquisition and management.

JEL Classification: E24, E43, E60, E62, F31

Key words: Oil sector, Macroeconomic variables, Gross Domestic Product, Exchange rate, Foreign Direct Investment

1. INTRODUCTION

Nigeria joined the ranks of oil producers in 1958 when its first oil field came on stream producing 5,100 barrels per day after crude

oilwas discovered in 1956 at Olobiri in its Niger Delta. The economy has over the years relied heavily on crude oil export for government revenues and its foreign exchange earnings. This dependence on the oil sector has had both salutary and deleterious impacts. Indeed, the oil and gas sector accounts for about 10 per cent of gross domestic product, and petroleum exports revenue represents almost 86 per cent of total exports revenue (OPEC, 2018).

On the other hand, in 2016, the economy recorded its first recession in twenty-five years when the combined effect of global oil prices, which reached a 13-year low and oil production crashed by vandalism and militant attacks in the Niger Delta, resulting in severe contraction of oil GDP. This underperformance in the oil sector spilled over to the non-oil sector through the monetary and exchange rate channels (World Bank, 2017).

The transmissions mechanisms through which oil prices affect real economic activity are through the demand and supply channels. The supply-side effect is felt through the cost of production in which oil derivatives are significant inputs. Consequently, a rise in oil price causes production cost increase. The demand side effect is borne out on consumption and investment. Nigeria is both an exporting (crude oil) and importing (refined petroleum products) economy (Oriakhi and Osaze, 2013). The exogenously induced volatile fluctuations in oil price by the Organization of the Petroleum Exporting Countries (OPEC) and other players in the international energy market pose great implications for macroeconomic variables performance with concomitant challenges in policy making. Alhassan and Kilishi (2016) submitted that the economy is susceptible to both external shocks (oil price and exchange rate), and internal dynamics (GDP volatility, interest rate unemployment, inflation rate).

Managing these macroeconomic variables (interest rate, exchange rate, inflation rate, unemployment rate and of course the GDP) is conducted through the fiscal, monetary and trade policies. These policies are sometimes complementary yet conflicting. The Phillips curve for example as an economic concept postulated an inverse and stable relationship between inflation and unemployment rates. In addition, economic growth which comes with inflation leads to jobs growth and reduced unemployment and correlates with higher rates of wage rises (Phillips, 1958). The applicability of this trade-off between inflation and unemployment has been refined to be obtainable only in the short run (Phelps, 1967; Friedman, 1968).

The literature is replete with studies on the nexus between oil sector performance and macroeconomic variables. However, the findings are contradictory. Some researchers such as Akpan (2009)and Sibanda (2014) found a positive relationship among variables. Some others found negative relationships (Dogah, 2015; Nchor, 2016; Olanipekun, 2016; Riadhand Arafet, 2016). Some others saw no relationship among the variables. Others went ahead to analyze the short run and long run relationship (Aktas, Özenç and Feyza, 2010). Adeleke, Ngalawa, and Kutu (2019) revealed that the reaction of output to sharp volatility in oil prices differs. It is also observed that structural inflation accompanies sharp declines in oil prices more than monetary inflation, since both outputs and investment decline significantly. The countervailing policy outcomes as reported by Narayan and Narayan (2007) and Salisu and Fasanya (2013) make it difficult to predict the impact of the oil sector on overall economic performance.

Given these disparate results, this study is motivated to further understand the relationship between the oil sector performance and the fiscal, monetary and trade policies in Nigeria. These policies are encapsulated in the macroeconomic variables (inflation, unemployment rate, international trade, exchange rate and the lagged GDP). This research involving data spanning thirty-seven years (1981 to 2017) is sufficiently large enough to cover major economic volatilities in the country.

2. LITERATURE REVIEW

This section covers the theoretical and empirical reviews.

2.1 THEORETICAL REVIEW

The study assessed the impact of the Nigerian oil sector performance on the macroeconomic variables (GDP, exchange rate, interest rate, and inflation rate). The macroeconomic literature offers little guidance on a theory underlining the nexus between oil revenue and macroeconomic variables. Indeed, a single theory cannot be discerned. The main adaptive theory is the Dutch disease theory which identified the apparent causal relationship between the rise in the economic development of a specific natural resources sector (in this case the oil sector revenue) and concomitant decline in other

sectors (Auty and Mikesell, 1998). It is usually associated with natural resource discovery and endowments; it also denotes "any development that results in a large inflow of foreign currency, including a sharp surge in natural resource prices, foreign assistance, and foreign direct investment" (Corden, 1984).

A resource boom affects this economy in two ways: direct-deindustrialization in which labor moves to the booming sector from the lagging sector known as the "resource movement effect". The second impact is the rise in the labor demand in the non-tradable sector (services) at the expense of the lagging sector as a result of the extra revenue from the resource boom, known as the "spending effect" or indirect-deindustrialization. Indeed, whereas the crude oil prices are exogenously, internationally determined in the traded good sector, the rise in the non-traded goods demand increases their price resulting in a rise in the real exchange rate. However, Budina, Pang and Van Wijnbergen (2007) and Mehlum, Moene and Torvik (2006) contend that this Dutch disease phenomenon is unlikely to happen in developing countries because of the imperfect market structure. However, where the dependence on oil revenue is high as is in the case of Nigeria, such country is easily afflicted by this disease.

The essence of this study is to understand the nature and direction of the affiliation of the revenue from oil and the government fiscal, monetary and trade policies as reflected in the macroeconomic variables. Given that the research seeks to unearth the relationship between the macroeconomic variables and oil revenue, the review of some of the theories underlining these macroeconomic variables individually and in some cases jointly becomes imperative. These are the Okun's law (GDP and unemployment); Keynesian theory (inflation, interest rate, unemployment GDP); Theory of exchange rate (exchange volatility, interest rate) and Phillips curve theory (unemployment and inflation).

These macroeconomic variables emanate from the three-prong policies of trade, monetary and fiscal authorities are therefore sometimes recursive in impact. The a priori expectation is that the revenue from the oil sector which forms almost 83 per cent of total exports revenue of government shape the direction of these policies and consequently the macroeconomic variables. They therefore form the bases of discussion of the finding of this research.

Keynesian theory posits that inflation can be activated by an upsurge in demand and/or increase in cost (Jhingan, 2005). Indeed the demand-pull inflation which causes the aggregate demand to

outstrip aggregate supply at near or full employment negatively influences the output. The cost-push inflation on the other hand tends to aggravate inflationary tendencies though the consequential rise in the price of supply factors. These theories are sometimes conflicting and require robust discernment.

The theory of exchange rate determination also called the demand and supply theory of exchange stresses the importance of foreign exchange market in determining the foreign money price in relation to the domestic money (Stockman, 1980). In determining the exchange rate, this theory emphasizes the export and import of goods as well as other forces in affecting the demand and supply of foreign exchange.

The overshooting model also known as the exchange rate overshooting hypothesis provides some theoretical explanation for high levels of exchange rate volatility. It was developed by Dornbusch (1976) who posits thatin the foreign exchange rate there exists a temporary over reaction of the changes in monetary policy which compensates for the rigidities in the prices of goods. In effect, the attainment of short run equilibrium level is not achieved through shifts in the prices of goods but via movement in the financial market prices (money, bond, stock, derivatives, and foreign exchange). Frankel (1979) contends that in the long run, as the price of goods become less rigid, it becomes more elastic and adjusts better to the reality of these financial market prices, including the financial exchange market. The hypothesis however suffers from the lack of specificity as the empirical results have shown the absence of overshooting and various levels of overshooting and delayed overshooting. The model has not been able to serve as a consistent tool for accurate exchange rate movement forecasts.

The Phillips Curve theory was developed by Phillips in 1958. The Phillips curve shows the relationship between unemployment and inflation in an economy. The Phillips curve suggests an inverse relationship between inflation and unemployment. The main implication of the Phillips curve is that, because a level of unemployment will influence a rate of wage increase, the two goals of low unemployment and a low rate of inflation may be incompatible. Friedman (1956) criticized the Philips curve arguing that employers and wage earners based their decisions on inflation adjusted purchasing power. The stagflation phenomenon of simultaneous occurrence of high levels of

unemployment and inflation belies the postulated inverse relationship between these two variables.

In its pristine form, Okun's law postulates an inverse relationship between national output and unemployment rate (Okun, 1962). Over the years, new versions have been developed including the gap version (Prachowny, 1993), the "difference version" (Villaverde and Maza, 2009) and the dynamic version (Sögner and Stiassny, 2002). However, a phenomenon of "jobless growth" may arise due to the size of labor, increased productivity or indeed other non-labor related factors.

2.2 EMPIRICAL REVIEW

2.2.1 EVIDENCE FROM DEVELOPED COUNTRIES

In an oil importing economy such as Japan, unexpected hikes in oil prices should lead to lower economic activity and higher inflation. Using data from 1970 to 1990, Jiménez-Rodríguezand Sanchez (2005) detected structural breaks in short and long-term real wages, real interest rates, and the real exchange rate. The research reported positive price shocks on the Japanese macroeconomic development. Cunado and Pérez de Gracia (2005) in a similar vein, confirm the findings on the impact of oil prices on consumer price index and inflation in some Asian countries such as Singapore, Japan and South Korea. The impact is however, only manifest in the long run.

This is contrary to the findings of Aktas et al. (2010) on the impact of oil prices on macroeconomics in Turkey; the authors adopted a Vector Auto regression model which found insignificant relationship between oil price increases and macro-economic variables in Turkey in the short run. Investigation of the relationship between oil price, interest rate and unemployment in an emerging market was conducted by Dogrul and Soytas (2010) who found that both real oil price and interest rate improved the estimation of unemployment in the long run in Turkey. In addition, oil price movement and interest rate movement have negative and insignificant effect on unemployment. Results by Al-Rasasi and Yilmaz (2016) provided evidence suggesting that higher oil prices are associated with rising consumer prices whereas fall in oil price is associated with exchange rate appreciation, but with a delay. On the other hand, unemployment movement has negative and significant effect on oil price, but later it has insignificant effect on it in Turkey.

The analysis of the oil price shocks and their effects on economic activity in Portugal was conducted by Francisco (2016) using a Structural Vector auto regression model. The result provided evidence that the rise in oil price translated into a higher inflation rate while employment and GDP in the private sector follows a depressive profile. Similar investigation in Spainby Gómez-Loscos (2011) reported insignificant impact on GDP and inflation.

2.2.2 EVIDENCE FROM DEVELOPING COUNTRIES

The investigation by Nchor (2016) using the vector auto regression model and vector error correction model (VECM), reported nonlinear adverse impact of oil price shocks on the Ghanaian economy. Using similar method, Dogah (2015) and Nchor (2016) came to the same conclusion. Riadhand Arafet (2016) in a study assessing the macroeconomic impacts of oil price shocks on inflation and real exchange rate in selected MENA countries (Tunisia, Morocco, Algeria, Saudi Arabia, Iran, Bahrain) using a vector auto regression model concluded that in Algeria and Bahrain oil price shock induces an appreciation in domestic currency in the short run; the response to real exchange rate to oil price shocks is negative, however, and that oil price fluctuation reduces the domestic currency value in Tunisia and Morocco. Using similar methodology, Izatov (2015) on the contrary found out that prices for oil and devaluation have substantial supportive effect on the economic activity of Russia. In Russia, an oil endowed country, oil revenues play a major role in determining the real exchange rate in the short run.

Khalid and Ahmed (2017) in a study assessing the links between oil price shocks and macroeconomic indicators on the SAARC region (India, Pakistan, Bangladesh, Sri Lanka, and Bhutan) adopted a multivariate cointegration analysis and structural vector autoregressive model and found that oil price shocks affect the output, interest rate, inflation and exchange rate in five SAARC (India, Pakistan, Bangladesh, Sri Lanka and Bhutan) nations in the short run and as well as in the long run except inflation and exchange rate in Bangladesh and Sri Lanka respectively, as indicated by impulse response functions. All in all it was discovered that oil price shocks have significant impact on economies of five SAARC countries in both short and long run. However, it is observed that each country in a study group responds differently to an oil price

shock. Mahmoodi (2017) investigated oil price reduction impacts on the Iranian economy; in order to simulate this shock, the global trade analysis project (GTAP) model with its data is used with positive result.

The analysis of Xunpeng and Sizhong (2010) using a vector auto regression model showed that the Indian economy is more sensitive and volatile than the Chinese economy when responding to oil price shocks. Muhammad and Malik (2017) employed a structural vector autoregressive model to investigate oil price and its impact on the macroeconomic variables in Pakistan and found that Pakistan is highly dependent on imported oil with the domestic oil price linked to the international prices thus making Pakistan's economy more vulnerable to oil price shocks. Muhammad, Nawaz, and Qayyum (2011) came to the same conclusion in Pakistan. Nguyen (2017) in a Vietnamese study using a vector auto regression model reported a similar unfavorable impact. Sibanda (2014) using a generalized Autoregressive conditional heteroscedastic model, established that oil prices have a significant effect on the exchange rate, and also established a positive relationship between interest rates and the exchange rate in South Africa.

The investigation conducted by Adeleke et al. (2019) examined the effect of crude oil price shocks on the macroeconomic performance of the eight largest producers of crude oil in Africa (Algeria, Angola, Egypt, Equatorial Gabon, Guinea Nigeria and Congo Republic) with the exclusion of Sudan due to data constraints. They utilized the Hamilton Index (1996) and a Panel Structural Vector Auto-Regression model in the investigation which covered thirty-seven years (1980 and 2016) - a period with high crude oil price volatility. The results revealed different reaction of output to oil price shocks. The response of structural inflation was sharper than monetary inflation and both investment and outputs recorded significant decline in response to negative oil price shocks.

2.2.3 EVIDENCE FROM NIGERIA

The analysis of Gunmi, Buhari, and Muhammed (2017) revealed insignificant long run relationship between oil price and economic growth in Nigeria in a study covering 1974 to 2014. Apere and Ijomah (2013) utilized the exponential generalized autoregressive conditional heteroscedasticity model to investigate similar nexus and came to the same conclusion that oil price volatility did not have

substantial effects on government spending, output and inflation rate in Nigeria. Indeed, it is not the oil price itself but rather its manifestation in real exchange rates and interest that affects the fluctuations of aggregate economic activity proxy, the GDP. The same conclusion was reached by Olomola and Adejumo (2006) and Chikwe, Ujah and Uzoma (2016) who analyzed the effect of oil price on Nigerian macroeconomic variables using a vector auto regression model. Inflation rate was found to depend on oil price shocks to output and the real exchange rates. Both Ahuru and James (2015) and Olanipekun (2016) also found Nigeria's macro-economy vulnerable to upheavals in the international oil market.

A contrary effect was reported by Gunmi, Buhari, and Muhammed (2017) using the same vector auto regression model. Their report revealed significant influence of oil prices on GDP, money supply and unemployment. The choice of the autoregressive conditional heteroscedasticity model by Ochoche (2015) also supported this position. The positive nexus was also reported by Oloruntuyi and Ogunsakin (2017) who utilized the exponential generalized autoregressive conditional heteroscedasticity (EGARCH), structural vector autoregressive model (SVAR), and Granger causality tests as estimation techniques. Overall, the findings in the literature are mixed, hence reinforcing the need for this study.

Most of the literature investigated the relationship between oil price and all or some of the macroeconomic variables. This study however, examined the linkage between oil revenue and the macroeconomic variables because oil price is essentially exogenously determined by the Organisation of Petroleum Exporting Countries (OPEC) in concert with other world oil producers including Russia and United States of America. This is outside the control of the producers. This is one of the gaps that this research seeks to fill. Overall, the findings in the literature are mixed, hence reinforcing the need for this study.

3. METHODOLOGY

3.1 RESEARCH DESIGN

The research design used in the study is an ex-post facto research design and it describes what exists (descriptive statistics), while

employing the secondary quantitative data obtained from the Central Bank of Nigeria (several years), analyzed with the E-views 9.0 software.

3.2 MODEL SPECIFICATION

The theoretical framework is based on the IS–LM model, or Hicks–Hansen model which is a two-dimensional macroeconomic tool that shows the relationship between the financial sector and the real sector of the economy in this case, real output in goods – oil revenue. This is in the context of Keynesian theory of aggregate demand and aggregate supply within the context of the endogenous growth theory. These macroeconomic variables emanate from the three-prong policies of trade, monetary and fiscal authorities and therefore are sometimes recursive in impact. The a priori expectation is that the revenue from the oil sector which forms about 83 per cent of total exports revenue of the Nigerian economy shape the direction of these policies and consequently the macroeconomic variables. The adapted model from the works in Tochukwu and Dewari (2017) is given as:

$$(1) \quad OILR = b_0 + b_1 GDP_{t-1} + b_2 INF + b_3 REXR + b_4 RIR + b_5 UNEMP + \mu_t$$

where

$OILR$ = Oil Revenue
GDP_{t-1} = Gross Domestic Product (Lagged)
INF = Inflation Rate
$REXR$ = Exchange rate
RIR = Interest rate
$UNEMP$ = Unemployment
μ_t = Error Term.

In order to reduce potential heteroskedasticity in the model, the data in rates and absolute terms were converted into the log-log form as follows:

$$(2) \quad \widehat{lnOILR} = \hat{b}_0 + \hat{b}_1 lnGDP + \hat{b}_2 INF + \hat{b}_3 REXR + \hat{b}_4 RIR + \hat{b}_5 UNEMP + \mu_t$$

where

$\hat{b}_1$ = parameters for lagged economic growth (GDP_{t-1})
$\hat{b}_2$ = inflation rate,
$\hat{b}_3$ = real exchange rate,
$\hat{b}_4$ = real interest rate, and
$\hat{b}_5$ = unemployment.

3.3 ESTIMATION TECHNIQUES

For the first step in the estimation process, the studyexamined the nature of the variables using descriptive statistics. Thereafter, the Augmented Dickey-Fuller and the Phillips Perron tests were deployed to confirm the stationarity of the series. Since all the variables were stationary at the first difference, the Johansen co-integration test was conducted after determination of the optimal lag length criterion (Johansen, 1988, 1991). The basic test of long-term cointegration of the variables is determined by conducting the Trace and Eigenvalue statistic tests and the Johansen cointegration test.

In order to know the rate of reaction to the oil revenue shocks in the short term, the Vector Error Correction model (VECM), a special case of the Vector Autoregressive model appropriate for variables that are stationary at difference was deployed. The response of variables to the introduction of oil shocks assailing the economic system was also employed using the Impulse Response function which describes the impact along a specified time horizon.

Although both the Johansen cointegration and VECM provided information on the long and short term relationship of the variables, we need to understand the direction of causality. This necessitated deployment of the Toda Yamoto causality method.Some post estimation tests were also carried out to confirm model robustness.These included the Durbin-Watson (DW) statistic test autocorrelation; heteroscedasticity test to check if the disturbance term has the same finite variance; normality test to check if the disturbance term follows a normal distribution; Ramsey reset test to check if the dependent and independent variables have a linear relationship and the Coefficient of Determination (R^2).

4. FINDINGS

4.1 PRELIMINARY ANALYSIS

The results of the descriptive statistics are represented in Table 1.

TABLE 1
Descriptive Statistics

Statistics	*Loilr*	*Lgdp*	*Inf*	*Rexr*	*Rir*	*Unemp*
Mean	26.75	24.91	19.60	150.89	-0.11	11.35
Median	27.03	24.54	12.55	99.15	3.22	8.05
Maximum	29.81	27.07	72.84	531.20	25.28	33.20
Minimum	22.70	23.48	5.38	48.97	-43.57	1.80
Std. Dev.	2.48	1.09	17.69	121.50	16.59	8.77
Skewness	-0.40	0.76	1.66	1.74	-0.94	0.83
Kurtosis	1.72	2.25	4.53	5.14	3.78	2.57
Jarque-Bera	3.44	4.32	20.12	24.99	6.20	4.45
Probability	0.18	0.12	0.00	0.00	0.04	0.10
Sum	963.03	896.89	705.71	5431.99	-3.83	408.50
Sum Sq. Dev.	214.96	41.65	10,953.29	516,707.40	9,637.02	2,691.97
Observations	36	36	36	36	36	36

Source: Author's computation using E-views 9.0 (2018)

The large difference between the minimum and maximum values of the series showed significant variations in the trends of the variable over the period of consideration. Also, the series are positively skewed except for oil revenue and real interest rate. The values for oil revenue, gross domestic product and unemployment rate which are 1.72, 2.25 and 2.57 respectively are all platykurtic because all values are less than 3. While the other variables such as inflation rate, real exchange rate, and real interest rate with values 4.53, 5.14 and 3.78respectively are leptokurtic indicating a flatter than normal distribution. The Jacque-Bera statistics result showed existence of non-normality in all the variables. However, the stationarity test had to be conducted to determine the stability of the variables.

4.2 STATIONARITY TEST

The result of stationarity test can be seen in Table 2.

TABLE 2
Results of the Augmented Dickey Fuller (ADF) and Phillip Perron(PP) Test at First Difference

Variables	5% Critical value	Equation specification	ADF / PP at levels/ first difference (probability)	ADF test at levels/ first difference	PP at first difference	Order of integration
LOILR	-2.95	Intercept	0.00	-5.99	-5.99	I(1)
LGDP	-2.95	Intercept	0.00	-5.25	-5.27	I(1)
INF	-2.95	Intercept	0.00	-5.42	-9.06	I(1)
RIR	-2.95	Intercept	0.00	-7.37	-34.64	I(1)
REXR	-2.95	Intercept	0.00	-4.10	-4.06	I(1)
UNEMP	-2.95	Intercept	0.00	-3.98	-4.03	I(1)

Source: Author's computation using E-views 9.0 (2018)

The test results using Augmented Dickey Fuller (ADF) and Phillip Perron (PP) technique, confirmed the stationarity of the variables at the first difference since the absolute test statistics are greater than the absolute 5% critical values at constant at intercept.

4.2.1 OPTIMAL LAG LENGTH SELECTION

The next step was the selection of an optimal lag length. This was very essential before carrying out a Johansen co-integration test because it is lag sensitive. Five criteria were assessed and tested at 5% level of significance. These were the sequential modified LR test statistic (LR), Akaike information criterion (AIC), Final prediction error (FPE), Hannan- Quinn information criterion (HQ) and Schwarz information criterion (SC).

The results in Table 3 revealed different lag length criteria. The study accepted the optimal criterion of lag (2) in line of the recommendation of Liew (2004) that the Akaike Information Criterion (AIC) and Final prediction error (FPE are superior when the number of observations are less than 120. This is because, as is in this case, they possess the capacity to maximise the chance of

recovering the true lag length while minimizing possible under estimation) (Gutiérrez, Souza, and Teixeira de Carvalho, 2009).

TABLE 3
Results of the Lag Length Criteria

Lag	LogL	LR	AIC	FPE	HQ	SC
0	-677.06	NA	40.18	1.14e+10	40.27	40.45
1	-504.98	273.29	32.16	3,929,594.	32.82	34.06*
2	-458.30	57.67*	31.55*	2,585,066.*	32.74*	35.05

Source: Author's computation using E-views 9.0 (2018), * indicates lag order selected by the criterion

4.2.2 CO-INTEGRATION TEST RESULTS

The result of the Johansen test with respect to the Trace and Eigenvalue statistic tests are presented in Table 4.

TABLE 4
Results of the Johansen Co-Integration Test Based on Trace and Eigenvalue Statistics

Hypothesized No. of CE(s)	Eigen value	Trace Statistic			Max-Eigen Statistic		
		Statistic	Critical Value	Prob.**	Statistic	Critical Value	Prob.**
None *	0.84	142.37	95.75	0.00	62.91	40.08	0.00
At most 1*	0.56	79.46	69.82	0.00	28.17	33.88	0.21
At most 2 *	0.45	51.30	47.86	0.00	20.32	27.58	0.32
At most 3*	0.36	30.97	29.80	0.01	15.08	21.13	0.28
At most 4 *	0.34	15.89	15.50	0.04	14.34	14.26	0.05
At most 5*	0.04	1.55	3.84	0.21	1.55	3.84	0.21

Source: Authors computation using E-views 9.0
Notes: Trace test indicates 2 cointegrating equation(s) at the 0.05 level; Max-eigenvalue test indicates no cointegration at the 0.05 level; * denotes rejection of the hypothesis at the 0.05 level; **MacKinnon-Haug-Michelis (1999) *p*-values

The series were co-integrated because the Trace and Max-Eigen statistic are greater than their respective critical values at the 5% level of significance. In effect, the Johansen co-integration test confirmed the long run relationship among the variables.

The result was normalized after conducting the Johansen regression co-integration test by multiplying the equation with the minus (-) sign. The Johansen Co-integration test long run estimated result is presented in Table 5.

TABLE 5
Results of the Long Run Cointegration Estimation

Variable	Co-Efficient	Standard Error	T-Statistic
DLOILR	1.00		
DLGDP	0.93	0.53	-1.80
DINF	-0.15	0.03	-5.13
DREXR	-0.01	0.00	-3.21
DRIR	-0.23	0.03	-7.23
DUNEMP	0.08	0.07	1.13

Source: Authors computation using E-views 9.0 (2018)

The estimation result is also given algebraically in (3):

$$(3) \quad LOILR = 0.93LNGDP_{t-1} - 0.15INF_t - 0.01REXR_t - 0.23RIR_t + 0.08\,UEMP_t$$

Adjusted *R*-squared ($\overline{R^2}$) = 0.73*F*-statistic: 1.25

There is a positive and significant relationship between lagged GDP and oil revenue. Similar significant relationship existed with respect to unemployment rate. However, an inverse relationships existed between each of inflation rate, real exchange rate and real interest rate on the one hand and oil revenue on the other. The overall significance of the model is manifested since the calculated *F*-Statistics test value of (1.25) was less than the F-tabulated value (2.71). The investigation into the short-run relationship is displayed in the next section, using the Vector Error Correction model (VECM).

The result of the Vector Error Correction model test of short run relationship is presented in Table 6. Since each of the *t*-statistics calculated values was less than the corresponding tabulated values, there exists short run relationship between each of the dependent variables and the oil sector performance.

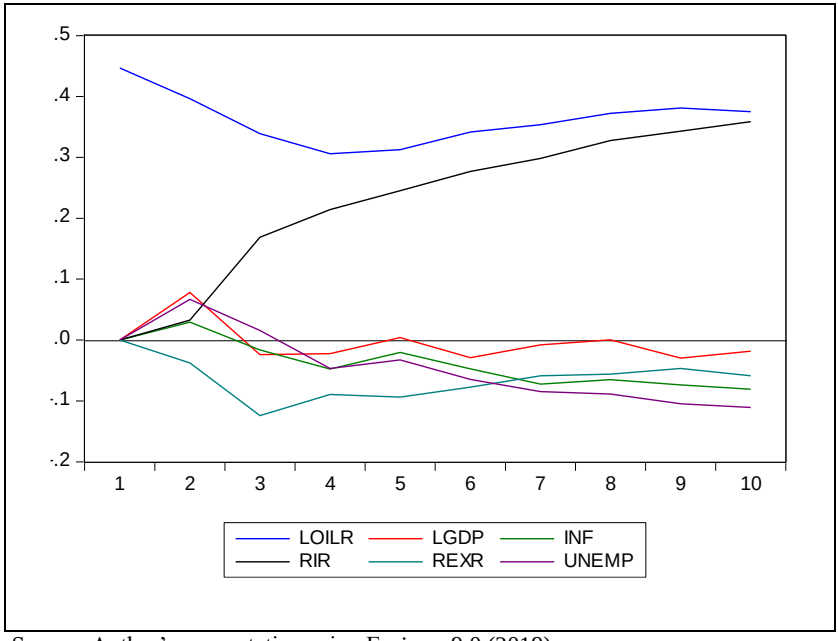
TABLE 6
Result of Short Run Relationship of Variables.

Error Correction	D(*LOILR*)	D(*LGDP*)	D(*INF*)	D(*REXR*)	D(*RIR*)	D(*UNEMP*)
Cointegration Eq1						
Coefficients	-0.06	0.08	3.50	4.11	-3.37	-0.19
Standard error	(0.07)	(0.02)	(1.60)	(11.7)	(2.54)	(0.34)
t-statistics						
Calculated	[-0.81]	[3.74]	[2.18]	[0.35]	[-1.32]	[-0.54]
t-statistics						
Tabulated		2.06	2.06	2.06	2.06	2.06

Source: Author's computation using E-views 9.0 (2019)

4.2.3 IMPULSE RESPONSE

FIGURE 1
Response of LOILR to Cholesky One S.D. Innovation



Source: Author's computation using E-views 9.0 (2019)

The impulse response function in Figure 1 corroborated the findings of the Johannsen cointegration test that all the

macroeconomic variables except unemployment rate responded negatively to oil revenue shock.

4.2.4 TODA AND YAMAMOTO CAUSALITY MODIFIED WALD TEST

The assessments of MWALD test presented in Table 7 followed the chi-square distribution with 2 degrees of freedom. This is in keeping with the applicable lag length selected in consort with their related probability. The decision criteria which is the acceptance of the null hypothesis if the *p*-value is greater than 10% probability, showed uni-directional relationship of oil revenue in the direction of lagged GDP, inflation rate, exchange rate, real interest rate and unemployment rate. This means that whereas the revenue from the oil sector granger caused variation each of the macroeconomic variables, the reverse is not the case.

TABLE 7
Toda-Yamamoto Causality (Modified WALD) Test Result

Null Hypothesis	Chi-sq	Prob.	Granger Causality
LOILR does not granger cause *LGDP*	7.13	0.03	Unidirectional Causality
LGDP does not granger cause *LOILR*	1.55	0.46	*LOILR* → *LGDP*
LOILR does not granger cause *INF*	5.10	0.08	Unidirectional Causality
INF does not granger cause *LOILR*	0.83	0.66	*LOILR* → *INF*
LOILR does not granger cause *REXR*	5.79	0.06	Unidirectional Causality
REXR does not granger cause *LOILR*	0.58	0.75	*LOILR* → *REXR*
LOILR does not granger cause *UNEMP*	5.24	0.07	Unidirectional Causality
UNEMP does not granger cause *LOILR*	0.68	0.71	*LOILR* → *UNEMP*
LOILR does not granger cause *RIR*	11.35	0.00	Unidirectional Causality
RIR does not granger cause *LOILR*	3.73	0.16	*LOILR* → *UNEMP*

Source: Author's computation using E-views 9.0 (2019)
Note: Degree of freedom is 2

4.3 POST-ESTIMATION TESTS

This section covers the following post estimation tests aimed at determining the validity and robustness of the model.

4.3.1 BREUSCH-GODFREY SERIAL CORRELATION LM TEST

The result of the Breusch-Godfrey Serial Correlation is presented in Table 8. Since the prob. (chi-square) – (0.00) was less than the 5% level of significance, the presence of serial correlation among the variables was manifest.

TABLE 8
Results of Breusch-Godfrey Serial Correlation LM Test Result

F-statistic	29.62	Prob. *F*(2,28)	0.00
Observed **R*-squared	24.45	Prob. Chi-Square(2)	0.00

Source: Authors computation using E-views 9.0 (2018)

4.3.2 VECTOR ERROR CORRECTION RESIDUAL HETEROSCEDASTICITY TESTS

The result of the White (1980) statistical test validates whether the variance of the errors in a regression model is constant (homoscedasticity) is presented in Table 9. Since the prob. chi-square value (0.16) was greater than the 5% level of significance, there is homoscedasticity in the error term.

TABLE 9
Result of White Heteroscedasticity Test

F-statistic	1.68	Prob. *F* (5,30)	0.17
Observed **R*-squared	7.86	Prob. Chi-Square (5)	0.16
Scaled explained SS	2.74	Prob. Chi Square (5)	0.74

Source: Authors computation using E-views 9.0 (2018)

4.3.3 DURBIN WATSON AUTO-CORRELATION TESTS

The result of the Durbin Watson test performed to determine the level of auto-correlation presented in Table 10 was positive.

TABLE 10
Result of the Durbin Watson Test

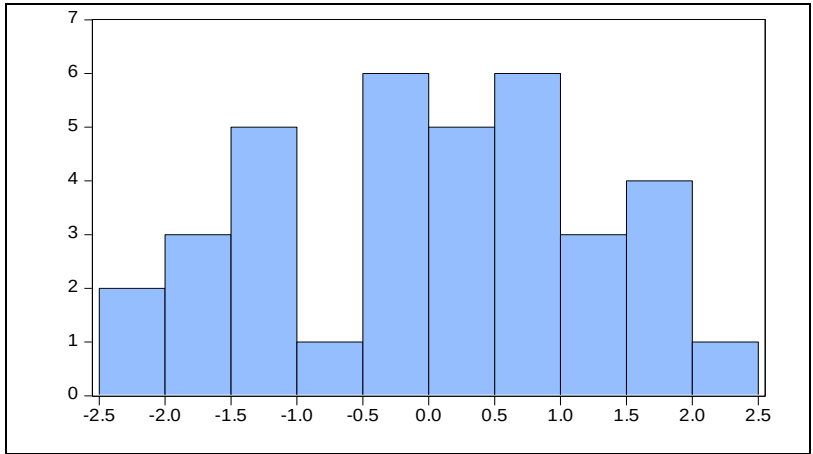
D	D-UPPER	D-LOWER	DECISION
1.62	1.66	0.87	Positive autocorrelation

Source: Authors computation using E-views 9.0 (2018)

4.3.4 VECTOR ERROR CORRECTION (VEC) RESIDUAL NORMALITY TESTS

The Vector Error Correction (VEC) Residual normality test result presented in Figure 2indicated that with a probability of 0.41 is greater than 5% level of significance. This means that the model is largely normally distributed.

FIGURE 2
Vector Error Correction (VEC) Residual Normality Test



Mean	2.39e-15		Median	0.3234
Skewness	-0.2142		Kurtosis	2.0023
Jacque-Bera	1.7684		Probability	0.4130

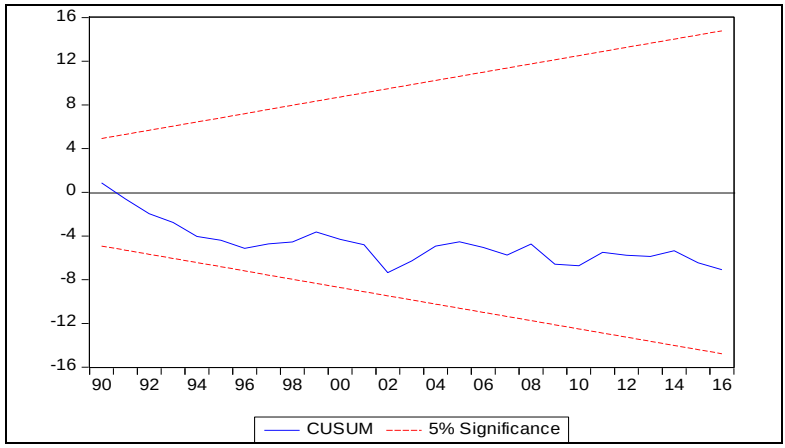
Source: Authors computation using E-views 9.0 (2018)

4.3.5 STABILITY TEST

The CUSUM test is necessary to test for the stability of the variables. The blue line in Figure 3 is seen to be inside the red lines which show that the variables are stable in the 5% level of significance.

The graph in Figure 3 showed stability in the estimated regression model because the blue line was in between the red lines. The results of the diagnostic post estimation tests confirm in part that the model can be relied upon for replication with enough integrity for policy formulation.

FIGURE 3
The Stability of the Estimated Regression Model



Source: Author's computation using E-views 9.0 (2019)

5. DISCUSSION OF FINDINGS

The result of the research showed a long run negative relationship between oil revenue and all the macroeconomic variables except lagged GDP and unemployment with positive connection. The existence of uni-directional relationship between oil revenue in the direction of lagged GDP, inflation rate, exchange rate, real interest rate and unemployment rate was also established. This is because the oil revenue is exogenously determined. Indeed, the production and export quota for crude oil is determined by the Organization of Petroleum Exporting Countries (OPEC). The oil price is also fixed by international price mechanism. The Nigerian fiscal, monetary and trade policies are therefore shaped by the heavy reliance on the oil and gas sector (OPEC, 2018).

The findings support the Dutch disease theory which is the main underlining postulation. The discovery and upsurge in the oil revenue have led to adverse performances of exchange rate, interest rate and inflation rate. This is consistent with the findings of Nweze and Edame (2016) and Tochukwu and Tewari (2017) which showed the presence of a long run relationship. Apere and Ijomah (2013) indeed found that GDP did not granger cause oil revenue but oil revenue granger caused GDP changes as reported by this study.

The discovery of crude oil in Nigeria has led to a 'resource movement effect' causing production to shift toward this booming

sector at the expense of agricultural and manufacturing sectors and the service sectors. This consequently led to direct-deindustrialization resulting in increases in the labor demand in the oil sector away from the other lagging sectors. However, this effect was negligible, since the hydrocarbon and mineral sectors tend to employ few people especially foreigners. The second impact is the "spending effect" of the oil boom leading to heavy reliance on the oil and gas sector (OPEC, 2018). This made the economy susceptible to the vagaries in the international oil prices combined with the deleterious impact of domestic production and transportation disruptions unleashed by local terrorist groups. The economic recession of 2016 is a case in point.

The twin problems of low oil price and low output, forced down the country's foreign exchange earnings, reduced the country's revenue, engendered a devaluation of the local currency – the Naira due to scarcity of foreign exchange and brought about a general hike in the prices of goods and services, starting with the petrol price hike. With the general hike in prices, inflation figures skyrocketed, trade and industrial activity dropped sharply, unemployment rose sharply, while GDP, figures declined in more than two quarters. By Q2'17, the Nigerian economy exited recession recording a positive growth rate of 0.5 percent year on year. The recovery was in part due to a sharp recovery in the oil sector, driven by improved oil prices and production volumes. In addition, the non-oil sector recorded a positive growth for the second consecutive quarter, spurred by ongoing recovery in the manufacturing sector due to improved foreign exchange (FX) liquidity. Besides the improvement in real GDP, the performance across several other macro-indicators suggests that the economy is on track for a broad-based recovery (PWC, 2017).

The findings of this study are contrary to the exchange rate overshooting hypothesis with respect to exchange rate. Unlike the postulations of the theory, this study found short term relationship between changes in the revenue from oil and the rate of exchange. This can be ascribed to the over reliance on oil revenue for major funding of the foreign exchange market. The non-oil sector makes insignificant contributions of foreign exchange market engendering the continuous devaluation of the Naira due to scarcity of foreign exchange. The result is consistent with the reports of Jiménez-Rodríguez and Sanchez (2005) and Al-Rasasi and Yilmaz (2016)

who provided evidence suggesting that higher oil prices are associated with exchange rate depreciation

The result of this study is contrary to the postulations of Okun's law regarding the inverse relationship in this case between oil revenue and unemployment rate. This positive relationship between the oil sector performance and the unemployment rate, in the face of negative relationship between the sector and the rate of interest, is however consistent with the Phillips Curve theory. The theory provided for an inverse relationship between unemployment and inflation in an economy. This can be attributed to the dominance of the oil sector in the Nigerian economy; it meant the shift of labor from the non-oil sector contributing about 90 percent of the GDP to the oil sector. The abandonment of agriculture has resulted in structural unemployment. It has also led to inflationary trend due to increased domestic consumption in the face of reduction in agricultural and manufacturing production. Indeed, the shift in emphasis from the non-oil sectors to the oil sector has implications for the Phillips curve because an increased level of unemployment of human and physical resources will influence the rate of wage increase. The two goals of low unemployment and a low rate of inflation may be incompatible in the face of sub-optimization of the domestic non-oil sector. The stagflation phenomenon of simultaneous occurrence of high levels of unemployment and inflation belies the postulated inverse relationship between these two variables.

6. CONCLUSION

The purpose of this research was to find the relationship between oil revenue and macroeconomic variables in Nigeria (1981-2017). A positive and significant relationship exists between oil revenue and lagged GDP. Similar significant and positive connection existed with respect to unemployment rate. However, an inverse relationship was recorded between oil revenue on the one hand and each of inflation rate, real exchange rate and real interest rate on the other. The path of causality is uni-directional from oil revenue in the direction of lagged GDP, inflation rate, exchange rate, real interest rate and unemployment rate. This means that whereas the revenue from the oil sector granger caused each of the macroeconomic variables, the reverse is not the case. The reason is that the oil revenue is exogenously determined.

The positive impact on economic growth over the years was not sufficient to engender inclusive growth in the face of jobless growth experienced in the country. The Dutch disease is also manifest as the study recorded negative connection of other macroeconomic variables (inflation, exchange and inflation rates) with oil revenue.

The government is enjoined to privatize the oil refineries which have hitherto been run at heavy losses. This has consequential loss of value adding negative externalities including unemployment and higher cost of domestic production. The macroeconomic variables should also be properly managed by ensuring good fiscal and monetary policies are put in place. It is important for these policies to be coherent in order to achieve the macroeconomic objectives and in turn sustainable development. Diversification of the economy is also needed; it has been stressed on how the Nigerian economy needs to diversify and focus on other prominent sectors of the economy such as the service sector, agricultural sector, and industrial sector. Nigerian dependence solely on the oil sector is a major problem because the oil price volatility affects the revenue accrued.

Other prominent sources of energy such as wind, solar, hydroelectric, biomass should be considered and looked into; since oil is a non-renewable energy and it is not known when it will end, Nigeria should consider other sources of energy that will benefit the country not only in generating revenue but also increasing the welfare of the citizens.

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