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Oil Price Volatility and Sustainable Output Growth in Nigeria

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Abstract
The paper examines the impact of oil price volatility on sustainable output growth in Nigeria between 1980 and 2017. The study employs ARCH to establish the existence of volatility in oil price or otherwise and the result confirms the presence of volatility in oil price in Nigeria. Also, pairwise granger causality was carried out to ascertain the direction of causality and the result shows that, oil price volatility granger-cause output growth in Nigeria. Again, the results of unit root test show that the variables are stationary at both level and first difference which suggest that Autoregressive Distributed Lag (ARDL) is appropriate technique to employ for the analysis. The results of ARDL suggest that, Oil Price Volatility has positive but insignificant impact on sustainable output growth in Nigeria both in short-run and in long-run. However, Inflation (INF) and Real Effective Exchange Rate (REER) said to have negative but significant impact on sustainable output growth in Nigeria in the long run. Based on these findings, government is therefore advised to formulate policies gear towards reducing the current level of inflation in Nigeria as well as ensure the appreciation of naira and exchange rate stability for the desired level of sustainable output growth to be achieved in Nigeria.

Keywords: Oil Price, Output Growth, Volatility, ARCH, Pairwise Granger Causality, ARDL and Nigeria.

1.1 Introduction

Crude oil has been referring to as the bedrock of the Nigerian economy. Revenues from crude oil play an important role in the economic structure of net exporting oil countries like Nigeria as the revenue generated from oil sales is the major source of financing their budgets. Revenue from crude oil sales constitutes the bulk of revenue generation in Nigeria and it said to contribute about 80 per cent of the Nigerian external reserve and this accounted for about 90 per cent of foreign exchange earnings (CBN, 2016). It is expected that volatility in oil price impacts aggregate demand in such economy, because government budget takes a major proportion of aggregate demand (Abrishami, et al, 2008 & Amir, et al, 2017). Fluctuations in oil price has been found to have adverse effects on some macroeconomic variables performance such as stock and bond prices, inflation, interest rate e.t.c. (Kang & Ratti, 2015; Bastianin, et al, 2016; Kang, et al, 2017; Ahmed, et al, 2018; Wesseh & Lin, 2018; Waheed, et al, 2018; Naser, 2019 and Nazloglu, et al, 2019). It has also been noted that, upward movement in oil price has an inverse relationhip with the economic growth both in advanced and less developed economies (Kilian, 2008; Kilian & Vigfusson, 2011; Narayan, et al, 2014 and Humaira,Ying, Hashim & Yasir, 2019).

Volatility is measure of tendency of price or exchange rate to change frequently within a period of time say, a day, a week, a month, or a year while price volatility refers to the degree to which price rises or falls over a period of time (Ogiri, Amadi, Uddin & Dulon, 2013, Donwa, et al, 2015).Demand and supply of crude oil by OPEC and Non-OPEC members' decision, transportation problems, difference in information as well as economic recession have been identified as some of the factors responsible for frequent changes in oil price (Donwa, et al, 2015).

Volatility in oil price had attracted the attention of scholars, investors, policy makers and government across the globe in recent past as attempts have been made to explain the effect

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of oil price fluctuations on sustainable output growth within the economy. However, they are difference opinion as regards to the impact of oil price volatility on sustainable output growth. Studies such as, Donwa, et al, 2015; Ibrahim, 2018 and Umoru, Ohiomu & Akpeke, 2018, were of the opinion that volatility in oil price has direct relationship with output growth while Kilian, et al, 2011; Narayan, et al, 2014; Oriakhi & Iyoha, (2013); Amir & Mohammed, 2017; Kilian, 2018 and Humaira, et al, 2019, submitted that oil price volatility has inverse relationship with output growth.

Nigerian economy expressed recession in 2015 due to crash in oil price at international market. This led to inability of so many state governments in Nigeria to pay salary of their worker for several months between 2015 and 2016. During this period, a lot of private organizations down sized their workforce due to the inability to meet their financial obligations as a result of fall in oil price. Up till now, many state governments are yet to settle these salary arrears in their respective states. This coupled with the response of private sector in response to economic recession due to fall in oil price has led to retrenchment of some worker and brought about an increment in the level of poverty in Nigeria. Again, the price war between Saudi Arabia and Russia coupled with the outbreak of Coronavirus epidemic codenamed COVID-19 which had to free fall in price of crude oil in international market, to the extended that, the price of crude oil has fell to all-time low of 5 dollar per barrel in last decades. This has forced the Nigerian government to review downward the benchmark price for crude oil for preparation of 2020 budget from 57 dollar per barrel to 30 dollar per barrel.

Empirically, the impact of oil price volatility on sustainable economic growth has been investigated by Oriakhi, et al, 2013; Jawad, 2013; Donwa, et al, 2015; Amir, et al, 2017; Ibrahim, et al, 2018; Umoru, et al, 2018; Humaira, et al, (2019). Amir, *et al*, (2017), examine the impact of oil price volatility on economic growth in Iran from 1980 t0 2014 using GARCH and Threshold Regression model. The study reveals that, oil price volatility has negative impact on economic growth in Iran. Again, Oriakhi, et al, (2013), analyze the implications of oil price volatility on economic growth in Nigeria between 1970 and 2010. The study employs VAR as an estimation technique and the result indicates that oil price volatility has a negative impact on

economic growth in Nigeria. Humaira, et al, (2019), investigate the empirical evidence of influence of oil price volatility on real sector growth in Pakistan between 1976 and 2017 using ARDL as an estimation technique. The study reveals that, oil price fluctuation has a negative effect on manufacturing, livestock and electricity sectors both in short run and long run while volatility in oil price said to have a significant direct impact on transportation and communication sectors in Pakistan. Also, Donwa, et al, (2015), examine the correlation between oil price volatility and economic growth in Nigeria from 1970 to 2013. The study submitted that, fluctuations in global oil price have a direct impact on the Nigerian economy in the short run but it has a negative impact on the Nigerian economy in the long run. However, Ibrahim (2018), investigates oil price fluctuations and output performance in Nigeria between 1970 and 2015. The study employs Johanson cointegration technique and the result shows that, fluctuations in oil price have positive influence on economic growth in Nigeria. Jawad (2013), analyzes the impact of oil price volatility on economic growth in Pakistan from 1973 to 2011, using linear regression analysis. The study found that, oil price volatility has insignificant impact on economic growth in Pakistan. Again, Umoru, Ohiomu & Akpeke (2018), examine the influence of oil price volatility on selected macroeconomic variables in Nigeria between 1918 and 2016. The study made used of Vector Autoregressive (VAR) as an estimation technique and the result reveals that, fluctuations in oil price demonstrates different degrees of impact on exchange rate variability, external reserves, government expenditure and real gross domestic product in Nigeria,

1.2 Methodology

The study adopts a single linear equation to examine the impact of oil price volatility on sustainable output growth in Nigeria. This equation is robust enough for the empirical model for representation of impact of oil price volatility on sustainable output growth in Nigeria. According to theoretical proposition of John M. Kenye's approach to the impact of income and expenditure on national output which was adopted and modified by Donwa, et al, (2015) in modeling their study. This model of this study mirrors the studies mentioned above with little modification.

$$GDPgr = f(OILPV, INT, INF, REER) \qquad \ldots 1$$

The model is explicitly specified thus:

$$GDPgr = \beta_0 + \beta_1 OILPV + \beta_2 INT + \beta_3 INF + \beta_4 REER + \mu \qquad \ldots 2$$

1.3 Source of Data

The data set for this study comprises of annual time series spanning from 1980 to 2017 for the purpose of investigating the impact of oil price volatility on sustainable output growth in Nigeria. Data on the growth rate of Real Gross Domestic Product (RGDPgr), Real Effective Exchange Rate (REER), Oil Price (OILP), Inflation (INF), as well as Interest Rate (INT) are sourced from World Development Indicator WDI (2016) while data on Oil Price Volatility is collected from GARCH results.

1.4 Estimation Technique

The estimation techniques employ in this study are GARCH and Auto-regressive Distribution Lag (ARDL).

Unit root test is carried out to determine the time series characteristics of the variables in the study. While examine both the short run and long run impact of oil price volatility on sustainable output growth in Nigeria, ARDL estimation technique was employed.

1.4.1 Volatility Test

Table 1.1: ARCH/GARCH Volatility Test.

Dependent Variable: OILP				
Method: ML ARCH - Normal Distribution (BFGS / Marquardt steps)				
Sample: 1980 – 2017				
GARCH = C(-1) + C(2)*RESID(-1)^2 + C(3)*GARCH(-2)^2 + C(4)GARCH(-1) + C(5)*GARCH(-2)				
Variable	**Coefficient**	**Std. Error**	**z-Statistic**	**Prob.**
C	129.6454	1241.669	0.10444	0.0093
RESID(-1)^2	0.9119	0.9623	0.9476	0.03433
RESID(-2)^2	0.9721	0.0317	30.7183	0.0000
GARCH(-1)	1.1583	0.0358	32.5584	0.0000
GARCH(-2)	0.1782	1.5875	0.1122	0.0016
S.E. of regression	210.1			
Akaike info criterion	10.2213			
Schwarz criterion	10.4368			
Hannan-Quinn criter.	10.2980			

Source: Author's Computation, 2020.

The GARCH ε_{t-1}^2 term is the volatility from previous period measures as the lag of the square residual from the mean equation is 0.9721 and the GARCH term σ_{t-1}^2 is the last period forecast variance is 0.1782 in Table 1.1. They are both significant at 5% level.

The rule of thumb for determining the presence of volatility after summing the root of autoregressive model is that:

If $\alpha + \beta$ is less than 0.5, there is no volatility

If $\alpha + \beta$ fall between 0.5 and 1, there is volatility

If $\alpha + \beta$ is greater than 1, this is a case of overshooting.

The sum of the two coefficients is 0.9721, which is greater than 0.5 which confirms the presence of volatility in oil price. To test for the impact of oil price volatility on sustainable economic growth, a new series is generated and designated as oil price volatility coefficient (OILPV).

1.4.2 Causality Test

Table 1.2: Pairwise Granger Causality Test.

Null Hypothesis:	Obs	F-Statistic	Prob.	Decision
OILPV does not Granger Cause RGDPgr	36	0.0167	0.9885	Reject
RGDPgr does not Granger Cause OILPV		1.3624	0.0020**	Accept
INT does not Granger Cause RGDPgr	36	0.6864	0.5109	Reject
RGDPgr does not Granger Cause INT		0.8161	0.0045**	Accept
INF does not Granger Cause RGDPgr	36	0.8118	0.0043**	Accept
RGDPgr does not Granger Cause INF		1.4795	0.0001***	Accept
REER does not Granger Cause RGDPgr	36	2.5743	0.0092**	Accept
RGDPgr does not Granger Cause REER		1.6983	0.0019**	Accept
INF does not Granger Cause INT	36	0.5130	0.0067**	Accept
INT does not Granger Cause INF		0.3118	0.7344	Reject
REER does not Granger Cause INT	36	2.8069	0.0758*	Accept
INT does not Granger Cause REER		0.6525	0.5278	Reject
OILPV does not Granger Cause INT	36	0.7581	0.4771	Reject
INT does not Granger Cause OIPV		1.1251	0.0033**	Accept
REER does not Granger Cause INF	36	2.3893	0.1084	Reject
INF does not Granger Cause REER		1.6555	0.0074**	Accept
OILPV does not Granger Cause INF	36	0.9866	0.3842	Reject
INF does not Granger Cause OILPV		0.0660	0.0063**	Accept
OILPV does not Granger Cause REER	36	0.0965	0.9083	Reject
REER does not Granger Cause OILPV		0.7284	0.4908	Reject

Source: Author's Computation, 2020.

Note: * is 10 % level significance, ** 5% level of Significance and * is 1% level of significance**

The pairwise causality test in table 1.4 suggests the following:

1. there is uni-directional causality running from OILPV to GDPgr at 5% level of significant.
2. there is bi-directional causality between RGDPgr and INF running from INF to RGDPgr and vis- versa at 5% level of significant.
3. there is bi-directional causality between RGDPgr and REER running from REER to RGDPgr and vis-versa at 5% level of significant.

4. there is uni-directional causality running from INT to INF at 5% level of significant.
5. there is uni-directional causality running from INT to REER at 5% level of significant.
6. there is uni-directional causality running from OILPV to INT at 5% level of significant.
7. there is uni-directional causality running from REER to INF at 5% level of significant.
8. there is uni-directional causality running from OILPV to INF at 5% level of significant.

In summary, the results of causality on Table 1.2 show that RGDPgr does not granger cause OIPV rather OILPV granger cause RGDPgr. It simply means that, it is the oil price volatility that do affect output growth not output affecting oil price volatility.

Table 1.3: Unit Root Test.

Variables	At Level			First Difference			Order Integration
	PP Statistics	1% Critical Value	5% Critical Value	PP Statistics	1% Critical Value	5% Critical Value	
GDPgr	-4.6561	-3.6210	-2.9434	----------	----------	----------	I (0)
OILPV	-1.4650	-3.6210	-2.9434	-5.5975	-3.6268	-2.9458	I (1)
INT	-5.9679	-3.6210	-2.9434	----------	----------	----------	I (0)
INF	-2.8374	-3.6210	-2.9434	-11.2637	-3.6268	-2.9458	I (1)
REER	-1.9722	-3.6210	-2.9434	-4.1057	-3.6268	-2.9458	I(1)

Source: Author's Computation, 2020.

The results of unit root test as shown in Table 1.3 examine the statistical prosperities of all the variables. The Im, Peseran & Shin and ADF- Fisher Chi-square panel unit root test for unit root are conducted for the variables in the model. The null hypothesis tested for the IPS and ADF is

$$H_0 : \alpha_1 = 0$$

for all countries while the alternative hypothesis is $H_1 : \alpha_1 < 0$, for at least one country. The lag lengths are selected using the Akaike Information Criterion. The results of the test at level and first difference are presented accordingly, the null hypothesis is that test is a unit in each series, that is, each variable is non-stationary. The rule of thumb is that, the null hypothesis should be accepted if the IPS and ADF statistics are less negative, meaning that, greater than the critical value at any chosen level of significance. The results of IPS and ADF in Table 1.3 indicate that Oil Price Volatility, Inflation and Real Effective Exchange Rate were found stationary at first difference while output growth rate and Interest Rate were said to integrated of order zero, that is, *I(0).*This should be expected given the volatile nature of the variable. The result of the unit root test thus suggests the use of ARDL Cointegration test.

1.4.3 Bound Test for ECOWAS

Table 1.4: Bound Test Result for ECOWAS.

ARDL Bounds Test		
Included observations: 268		
Null Hypothesis: No long-run relationships exist		
Test Statistic	Value	K
F-statistic	7.3091	4
Critical Value Bounds		
Significance	I0 Bound	I1 Bound
10%	2.45	3.52
5%	2.86	4.01
2.50%	3.25	4.49
1%	3.74	5.06

Source: Author's Computation, 2020.

The rule of thumb is that, if the computed F-statistics falls below the lower bound value I(0), the null hypothesis (no cointegration) is accepted. But if the computed F-statistics exceeds the upper bound value I(1), the null hypothesis is rejected thus, there is existence of long-run relationship. If the computed result falls between the lower and upper bounds, then the test is inconclusive. Based on this, the result of Bound test from Table 1.4 shows that, the null hypothesis of no cointegration is rejected since the F-statistic value of 7.3091 is higher than the upper bound critical value of 3.99 (restricted) at 1% level from 1.5.

Table 1.5: Bound Test for Cointegration.

	5% Critical Value		1% Critical Values	
	Lower	Upper	Lower	Upper
Restricted Intercept No trend	2.27	3.28	2.88	3.99
Unrestricted Intercept No trend	2.45	3.16	3.15	4.43

Source: Pesaran, *et al,* 2001.

1.4.4 ARDL Long-Run and Short-Run Analyses

Table 1.6: ARDL Long Run and Short Run Results.

Dependent Variable: D(RGDPgr)			
Dynamic regressors (4 lags, automatic): OILP, REER, INT, INF			
Selected Model: ARDL(1, 1, 1, 1, 1)			
Variable	Coefficient	Std. Error	t-Statistics	Prob.
Long Run Equation			
OILPV	2.8284	3.4907	0.8103	0.4246
REER	-0.0446	0.0145	-3.0723	0.0047**
INF	-0.1474	0.0773	-1.9081	0.0667***
INT	-0.7397	6.6543	-1.3108	0.2006
C	17.2200	5.9607	2.8889	0.0074
Short Run Equation			
D(OILPV)	2.8437	3.4877	0.8154	0.4217
D(REER)	0.0083	0.0201	0.1445	0.6817
D(INF)	-0.1482	0.0802	-1.8492	0.0750***
D(INT)	-0.7437	0.5534	-1.3440	0.1897
CointEq(-1)	-1.0054	0.1747	-57678	0.0000
Akaike Info Criterion		6.7791	
Schwarz Criterion	7.2190		
Hannan-Quinn Criterion		6.9326	

Source: Author's Computation, 2020.

Note: * is 10 % level significance, ** 5% level of Significance and * is 1% level of significance**

From Table 1.6 above, the long run equation indicates that, Real Exchange Rate, Inflation and Interest Rate all exert a negative impact on sustainable output growth in Nigeria but on only Real Effective Exchange Rate and Inflation are said to be significant at both 5 per cent and 10 per cent respectively. This implies that a unit increase in the level of real Effective Exchange Rate, Inflation and Interest Rate bring to about 4.46 per cent, 14.74 per cent and 73.97 per cent decrease in the level of sustainable output growth in Nigeria, respectively. This implies that, fluctuations in Oil price, high price level caused by inflation and high interest rate discourage both consumption and investment, thereby leading to reduction in output growth in Nigeria in the long run. This finding is in support of the a prior expectation and is in line with the submission of Jawad, (2013) who found that, oil price volatility has insignificant impact on output growth in Pakistan.On the other hand, Oil Price Volatility shows a positive but insignificant impact on sustainable output growth in Nigeria.From table 1.7, the long run result for Oil price Volatility demonstrates that, any fluctuation in Oil price will leads to about 282.84 per cent increase in the level of output in Nigeria. However, this result shows that this increase does not have any significant impact on sustainable output growth in Nigeria in the long run. This may be as a result that, gain Nigeria might have recorded through fluctuations in Oil price might have been eroded by the fact that refined crude oil products are exported from abroad in order to sustain the runs of the Nigerian economy. This might be the major reason the impact of oil price volatility is really felt on the Nigerian economy in the long run.For short run results, table 1.6 above shows first difference of both oil price volatility and real effective exchange rate demonstrate positive impact on sustainable output growth in Nigeria however, this impact said to insignificant in the short run. This implies that, any increase in both oil price volatility and real effective exchange rate brings about 284.37 per cent and 0.83 per cent increase in output level in Nigeria but this increase is said to insignificant in the short run. This suggests that fluctuations in both oil price and real effective exchange rate though are desirable but contribute nothing to the

Nigerian economy. This might be as a result of the fact that, the gain from the sales of crude oil due to increase in the price of crude oil, might have been neutralized by importing refined crude oil products from abroad and fluctuation in exchange rate might have led to increase in the prices of goods and services importing to the country as Nigeria depend mostly on imported products to sustain her economy. This finding supports our a priori expectation. However, first difference of Inflation and Interest rate indicate a negative impact on sustainable in Nigeria in the short run but only inflation is said to be significant at 5 per cent level. This implies that, an increase in level of inflation and interest rate lead to about 14.82 Per cent and 74.37 per cent respectively. This indicates that, high prices of goods and services discourage consumption in Nigeria in the short run. This result is also in-line with the submissions of Jawad, (2013) that, oil price volatility exerts insignificant impact on output growth. The coefficient of ECM which measures the speed of adjustment back to equilibrium is -1.0054 and it is significant at 1% level with the negative sign. This indicates that about 100.54% of previous disequilibrium is adjusted in the model in the short run in Nigeria.

1.5 Conclusion

Based on the results and findings on the analysis of impact of oil price volatility on sustainable output growth in Nigeria, the following conclusions were drawn: OILPV & REER are said to exert a direct impact on sustainable output growth in Nigeria both in the short run and in the long run. However, only REER I said to be significant in the long run.On the other hand, INF and INT show a negative impact on sustainable output growth in Nigeria but only INF is said to be significant in the short run. It was therefore concluded that, oil price volatility has an impact on sustainable output growth in Nigeria but this impact is said to be insignificant both in the long run and in the long run. This might be as a result of over reliance on crude oil and non-diversify the Nigerian economy.

1.6   Policy Recommendations

In view of all the aforementioned findings in this research work, the following recommendations are therefore put

forward:

1. government is therefore advised to formulate policies gear towards reducing the current level of inflation in Nigeria and also ensure the exchange rate stability for the desired level of sustainable output growth to be achieved in Nigeria.

   Monetary authorities in Francophone Countries should formulate exchange rate policies that will pave way for competitiveness within their economies.

2. Francophone countries should endeavour to add value to their product before exporting them to the international market.

3. the government within Francophone countries should encourage the advanced countries to open up their markets more for their products in order to increase output growth.

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