Asymmetric Effect of Oil Revenue on Economic Performance in Nigeria: A Non-linear ARDL Approach

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ABSTRACT

Depending on the prevailing global or local economic situations, the instability in income from crude oil sales dictate the state of oil exporting economy, such as Nigeria. This is anchored to the fact that considerable proportion of the country's total revenue comes from the oil sector. Thus, rise (positive change) and fall (negative change) in oil revenue may exert unequal influence on the Nigeria's economic performance. Based on the foregoing, this research work investigates the asymmetric effect of income from oil on Nigeria's economic performance between the period 1981 and 2020. The objective is to examine how economic performance reacts severally to rise and fall in oil revenue. Using time series analysis methodology, the study utilizes datasets on real GDP (a proxy for economic performance), oil revenue, exchange rate and inflation rate. The data were sourced from CBN Statistical Bulletin and World Development Indicators. The data analysis process includes stationarity test (using ADF test), bounds cointegration test, technique of estimation, using non-linear autoregressive distributed lag (NADRL) and post estimation tests. The findings reveal that positive change (increase) and negative change (decrease) in oil revenue exert the same direction (positive) but different magnitudes of impact on Nigerian economic performance in the long run. In other words, positive oil revenue change exerts positive impact on economic performance while negative oil revenue change exerts negative impact on economic performance. Essentially, both positive and negative oil revenue changes are real GDP inelastic, however, economic performance responds more to negative change (decrease) in oil revenue than the positive change (increase) in the long-run. Therefore, the study submits that the Nigerian government, through its concerned agencies in the oil sector, should design necessary strategies to curb oil theft such as adopting proactive measures against vandalism. Also, massive diversification into other sectors of the economy must be the government's paramount consideration.

JEL Classification: H50, O40, Q43

Keywords: Economic Performance, Oil revenue, Nigeria, NARDL**.**

INTRODUCTION

Predominantly, agricultural sector was the centre of attention of the Nigerian economy before the discovery of crude oil in Nigeria. Prior to emergence of oil in Nigeria, the agriculture sector used to generate approximately 85% of the earnings from foreign exchange, constituting about 60% of the employment capacity as well as contributing about 52% to the gross domestic output of Nigeria (Efanga, Ugwuanyi & Ogochukwu, 2020). However, since the emergence of oil, the oil sector has surpassed the agricultural sector as regards foreign exchange generation and contribution to gross domestic product (GDP). The world Bank data (as cited in Asagunla & Agbede, 2018) reported that revenue generated approximately 90% of the Nigeria's foreign exchange earnings, constituting about 80% of Nigerian total revenue. Ogechukwu and Azubike (2016) also stressed that 82% of the Nigeria's total revenue was generated from the hydrocarbon sector.

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This further emphasizes that Nigeria deeply depends on the oil sector in the provision of infrastructure and funding other economic and social activities.

The neglect of the agricultural sector in the 1970s could be ascribed to the discovery and mass oil exploration leading to over dependence on crude oil extraction and refinery as the major source of the revenue generation in Nigeria (Olojede & Michael, 2020). The term “resource curse” is a typical example of the idiom “too much of good thing”. This is mostly concerned with the oil-producing and exporting countries such as Kuwait, Nigeria, Qatar, and Saudi Arabia among others. Recently, Saudi Arabia declared a novel economic plan referred to Saudi Vision 2030 which is aimed at diversifying into other essential areas of the economy and thus, breaking its resource curse on oil exploration (Ilori & Akinwunmi, 2020). A number of the members of the Organisation of Petroleum Exporting Countries (OPEC) such as Saudi Arabia and United Arab Emirate (U.A.E), among others, have witnessed a sustainable economic growth. However, Nigeria’s economy continues to witness growth retardation despite the huge oil revenue generation over the years.

The unrealistic Nigeria’s dependency on the oil sector as well as the insignificant contributions of other sectors to the growth of the economy and revenue generation is very worrisome (Olojede & Michael 2020). The efforts of the previous administrations to improve the productivity of the non-oil sectors as revenue-driven sources through series of policy formulations and economic plans yielded little or no significant results. This could be attributed to weak policy implementations, lack of political will as well as the unremitting conviction that revenue from oil is of course always certain (Efanga, et al., 2020). The overdependence on crude oil in Nigeria has put the non-oil sectors in very vulnerable positions resulting in low revenue growth.

The emergence of any socio-economic turbulence or shock (such as the Covid-19 pandemic) grossly affect the international oil market operations which results in the unfavourable fluctuations in oil prices. Consequently, the unfavourable fluctuations in the crude oil prices affect the revenue generation capacity of Nigeria, which may invariably have adverse effect on economic performance, especially as Nigerian government uses global oil price as a yardstick in preparing its national budget to avoid shortfall of funds.

Numerous studies have been conducted on the relationship between oil revenue and economic performance in Nigeria. There have been several conflicting or inconsistent findings regarding the impact of oil revenue on economic growth in Nigeria. This majorly depends on the methodology employed. For instance, Olojede and Michael (2020) found that oil revenue had no significant impact on economic growth in Nigeria, whereas studies such as Asagunla and Agbede (2018), Efanga, et al. (2020) found otherwise. However, Ilori and Akinwunmi (2020) in their study found that oil and non-oil revenue exerted significantly adverse effects on economic development in Nigeria. These studies utilized the conventional estimation methods such as ordinary least square (OLS), error correction mechanism and the symmetric autoregressive distributed lag (ARDL) model. Unrealistically, these estimation methods assume that positive changes (increase) and negative changes (decrease) in a policy variable exert symmetric (equal) magnitude of impact on the response or target variable. However, the magnitude or size of oil revenue fluctuates from time to time depending on the prevailing local and global economic conditions. Thus, these fluctuations dictate the state of economic performance. This implies that positive changes (increase) and negative changes (decrease) in oil revenue may exert different impacts on the economic performance. In light of this, this study seeks to examine existence of asymmetric impacts of oil revenue on economic performance in Nigeria using non-linear autoregressive distributed lag (NARDL) methodology, the causal relationship between them and to further substantiate the findings of the previous related empirical studies

LITERATURE REVIEW

Olojede and Michael (2020) explored the nexus between oil revenue and Nigerian economic performance

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for period from1981-2018. The study ordinary least squares (OLS) estimation technique and the Wiener-Granger causality test. Aside from the oil revenue as the core explanatory variables, other variables utilized are agricultural revenue, manufacturing revenue and building and construction revenue. Meanwhile, real GDP was used as a proxy for economic performance. The empirical result from the study revealed that the response of real GDP to oil revenue changes was negative and statistically significant, while other variables failed to have statistically significant effect on economic performance. Thus, the study established that oil revenue is a resource curse for Nigeria. The study opined that the over-dependence on oil revenue and the adversely resultant impact on the Nigerian economic performance hampers other sectors in the country from improving.

Ilori and Akinwunmi (2020) analysed the effect of oil and non-oil revenues on Nigerian economic development, employing error correction model (ECM) to evaluate time series data from 1989 -2018. The variables used in the study were oil revenue, non-oil revenue, real GDP (a proxy for economic development), debt and exchange. The ECM results showed that both oil and non-oil revenue exerted significantly adverse effects on economic development in Nigeria. This implies that economic development responded negatively to the changes in both oil and non-oil revenue in Nigeria. However, the study found that exchange rate significantly promotes economic development. Subsequently, the study concluded that the adverse effects of oil and non-oil revenues could be attributable to the persistent fall in the worldwide crude oil prices and other socio-economic crises retarding the phase of the Nigerian economic development.

Efanga, Ugwuanyi and Ogochukwu (2020) evaluated the influence of oil revenue on Nigerian economic performance for the period between 1981 and 2018, using ARDL estimation technique. Real GDP was regressed on oil revenue, exchange rate and foreign direct investment (FDI). The ARDL results indicated that oil revenue have positive and significant influence on economic performance. This suggests that economic performance responded positively and significantly to oil revenue. Meanwhile, exchange rate was found to have significantly negative influence on economic performance. Furthermore, FDI exerted positive and insignificant impact on economic real GDP. consequently, the study recommended that government should boost oil exploration and enhance the productivity capacity of non-oil sector such as agriculture, among others.

In another study by Asagunla and Agbede (2018), employing ECM to investigate the linkage between oil revenue and Nigerian economic performance for the period covering between 1981 and 2014. The study used real GDP (a proxy for economic performance), oil revenue, public domestic investment, inflation rate, unemployment rate and per capita income. The study's model specification was underpinned by the model specified in Beghebo and Atima (2013). As found in Asagunla and Agbede (2018), oil revenue exerted positive and significant impact on economic performance. However, economic performance responded negatively and significantly to inflation and unemployment rates over the chosen sample period. Thus, the study suggested that the authority in charge of the affairs of economy should ensure that a more effective system is designed in channelling oil revenue into critical areas of the economy, thereby enhancing the core values of development.

THEORETICAL FRAMEWORK

This study is built on the Harrod (1939) and Domar (1947) growth model. Together, they are referred to Hrrod-Domar growth model. This model lays emphasis on savings and investments in enhancing economic performance. Capital accumulation is considered as essential factor in the process of economic growth. For an economy to grow, it must save a substantial proportion of its income in order to promote investment in capital goods. Thus, new investments generate additional capital stock necessary to improve economic

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performance via output growth. However, the new investments which represent capital accumulation (net addition to capital stock) depend on the average propensity to save or net saving ratio. An economy with a high net saving ratio may have an increase in stock of capital in the form of new investments leading to increase in output growth. Apart from the net saving ratio, Harrod-Domar growth model also stresses on the efficiency of the available capital stock. The efficiency of capital stock is measured by capital-output ratio. Thus, the rate of growth of output depends on net savings ratio and capital-output ratio. The focal point of the Harrod-Domar growth model is the growth of output of an economy depends directly on national savings ratio and inversely on capital-output ratio. That is, the higher the saving ratio, the larger the volume of investments which in turns leads to greater growth of output. However, the lower the capital-output ratio, the higher the growth of output and vice versa. Nevertheless, the major constraint on economic growth, according to Harrod-Domar theory of growth, is the low level of capital formation (that is, low savings leading to low investments) in most developing or poor countries.

Based on the foregoing, in the context of Nigeria, oil revenue is an essential element for capital accumulation. Substantial savings from oil revenue (such as excess crude oil account) can boost investment in capital stock, thereby leading to increase in economic performance via output growth (growth of real GDP). Therefore, substantial savings from oil revenue for infrastructural development will enhance economic performance in Nigeria.

METHODOLOGY

Data Source

The focus of this study is time series methodology. Thus, annual time series datasets on real GDP (as proxy for economic performance), oil revenue, exchange rate and inflation rate were sourced from the CBN statistical bulletin (2021) and World Bank's World Development Indicators (WDI, 2021) for the period of 40 years (1981 – 2020). Thus, datasets on real GDP, oil revenue, exchange rate were extracted from the CBN statistical bulletin (2021) while dataset on inflation rate (*INF*) was sourced from World Bank's WDI (2021).

Estimation Techniques

The data analysis includes preliminary analysis such as (descriptive analysis, pre-estimation test), the model estimation and post-estimation tests. The pre-estimation tests include unit root test and bound co-integration test. As regards the estimation stage, Nonlinear Autoregressive Distribution Lag (NADRL) model, developed by Shin, Yu and Greenwood-Nimmo (2014), was employed to examine asymmetric short run and the long-run relationships between oil revenue and economic performance. Thus, since the independent variable, oil revenue, is the core variable, thus, it is considered as an asymmetric variable. Therefore, NARDL model examines the asymmetric (positive changes and negative changes) impacts of oil revenue on economic performance. The control variables such as exchange rate and inflation rate are considered to have symmetric impacts on economic performance. Like the standard ARDL model, using NARDL model requires all the variables to integrated of order one that is, to be *I(1)* processes or mixture of *I(0)* and *I(1)* processes.

Using bounds test to co-integration, there is existence of long run relationships if the computed F-statistics exceeds the upper bound critical values. However, the null hypothesis of no co- integration may have to be considered if the F-statistic is below the lower bound or the result will be considered inconclusive for a value within bounds.

Post estimation diagnostic tests such as serial correlation and structural stability CUSUM test were conducted to examine the reliability and adequacy of specified model.

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Besides, Granger causality test were used to evaluate the causality between oil revenue and real GDP.

Model Specification for NARDL

Employing NARDL model for the estimation in this study assumes that the response variable (that is, real GDP [*GGDP*] as a proxy for economic performance) responds to the changes in oil revenue asymmetrically. In other words, economic performance is expected to react differently to the positive changes and negative changes in oil revenue.

Partial Sum Processes of the asymmetric variable (*OREV*)

To analyse the impacts of the positive changes and negative changes in oil revenue (*OREV*) on real *GDP*, *NARDL* decomposes oil revenue (*OREV*) into partial sums given as follows:

- Partial sum of positive change in *OREV* = $OREV_t^+$
- Partial sum of negative change in *OREV* = $OREV_t^-$

Thus, *OREV* is decomposed as $OREV = OREV_t^+ + OREV_t^-$, where $OREV_t^+$ and $OREV_t^-$ are the partial sum processes of positive and negative changes in *OREV* respectively.

In line with Shin et al (2014), the two partial sums (positive changes and negative changes) for *OREV* are defined as follows:

Positive change partial sum of *OREV*

Negative change partial sum of *OREV*

Positive change partial sum of *OREV*

$$OREV_t^+ = \sum_{j=1}^{t} \Delta OREV_j^+ = \sum_{j=i}^{t} \max(\Delta OREV_j, 0) \qquad (1a)$$

Negative change partial sum of *OREV*

$$OREV_t^- = \sum_{j=1}^{t} \Delta OREV_j^- = \sum_{j=i}^{t} \min(\Delta OREV_j, 0) \qquad (1b)$$

Specification of the NARDL Model

The linear or symmetric functional form of the model is given as follows:

$$RGDP_t = f(OREV_t, EXR_t, INF_t) \qquad (2)$$

However, given the positive and negative changes in the given asymmetric independent variable (*OREV*), the nonlinear or asymmetrically functional form of the model, as proposed by Shin, et al. (2014), is specified as follows:

$$RGDP_t = f(OREV_t^+ t, OREV_t^-, EXR^t, INF^t) \qquad (3)$$

Recall: *OREV* = oil revenue

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$OREV_t^+$= partial sum of positive change in *OILR*

$OREV_t^-$ = partial sum of negative change in *OILR*

EXR = exchange rate

INF = inflation rate

The core explanatory variables (that is, *OREV*) is considered as the asymmetric variables while the control variables (*EXR* and *INF*) are the symmetric variables.

Thus, the nonlinear ARDL(p,q_1^+,q_1^-,q^2,q^3) model is given as follows:

$$RGDP_t = \psi + \sum_{i=1}^{p} \alpha_i RGDP_{t-i} + \sum_{i=0}^{q_1^+} \beta_{1i}^+ OREV_{t-i}^+ + \sum_{i=0}^{q_1^-} \beta_{1i}^- OREV_{t-i}^- + \sum_{i=0}^{q_2} \beta_{2i} EXR_{t-i} + \sum_{i=0}^{q_3} \beta_{3i} INF_{t-i} + \varepsilon_t \quad (4)$$

The NARDL error correction mechanism (ECM) similar to the standard ARDL proposed by Pesaran *et al* (2001) is given as:

$$RGDP_t = \psi + \sum_{i=1}^{p} \alpha_i \Delta RGDP_{t-i} + \sum_{i=0}^{q_1^+} \beta_{1i}^+ \Delta REV_{t-1}^+ + \sum_{i=0}^{q_1^-} \beta_{1i}^- \Delta REV_{t-1}^- + \sum_{i=0}^{q_2} \beta_{2i} \Delta EXR_{t-i} + \sum_{i=0}^{q_3} \beta_{3i} \Delta INF_{t-i} + \emptyset ECM_{t-i} + \varepsilon_t \quad (5)$$

Equation (5) states the NARDL ECM (error correction model) which bridges the gap between the short run disequilibrium and long run equilibrium. The coefficient, , of the ECM term called the speed of adjustment is expected to be negative in order to establish an equilibrium, *i.e.* .

Similar to the linear ARDL model proposed by Pesaran *et al* (2001), the NARDL bounds test for co-integration specification is given as:

$$RGDP_t = \psi + \sum_{i=1}^{p} \alpha_i \Delta RGDP_{t-i} + \sum_{i=0}^{q_1^+} \beta_{1i}^+ \Delta OREV_{t-i}^+ + \sum_{i=0}^{q_1^-} \beta_{1i}^- \Delta OREV_{t-i}^- + + \sum_{i=0}^{q_2} \beta_{2i} \Delta EXR_{t-i} + \sum_{i=0}^{q_3} \beta_{3i} \Delta INF_{t-i} + \lambda RGDP_{t-1} + \delta_1^+ OREV_{t-1}^+ + \delta_1^- OREV_{t-1}^- + \delta_2 EXR_{t-1} + \delta_3 INF_{t-1} + \varepsilon_t \quad (6)$$

NARDL short-run coefficients: $\alpha_i, \beta_{1i}^+, \beta_{1i}^-, \beta_{2i}, \beta_{3i}$ at various lags

NARDL long-run coefficients: $\lambda, \delta_1^+, \delta_1^-, \delta_2, \delta_3$

Equation (6) is the specification for the short-run and long-run asymmetric relationship between economic performance (*RGDP*) and oil revenue. The coefficients and are the asymmetric short-run impacts of *OREV* on economic performance (*RGDP*) at various lags while the coefficients. Meanwhile, the coefficients and are the symmetric short-run impacts of the control variables; *EXR* and *INF* respectively on *RGDP*.

Bounds Test for Co-integration

Similar to the ARDL bounds test, the NARDL bounds test is also a joint test (F-test) of all the long-run coefficients. Given equation (3.6), thus, testing for co-integration requires the null hypothesis given as:

$$H_0: \lambda = \delta_1^+ = \delta_1^- = \delta_2^+ = \delta_2^- = \delta_3 = \delta_4 = \delta_5 = 0$$

H_1:Not all the long-run coefficients are equal to zero

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The rejection of the null hypothesis implies the existence of long-run relationship among the variables in the presence of asymmetry.

Long-run Model

From the specification of the NARDL bounds test for co-integration (equation 3.6), the asymmetric long-run model is specified as:

$$RGDP_t = \phi_0 + \phi_1^+ OREV_t^+ + \phi_1^- OREV_t^- + \phi_2 EXR_t + \phi_3 INF_t \qquad (7)$$

The long-run coefficients are defined are defined as follows:

$$\phi_1^+ = \frac{-\delta_1^+}{\lambda},\ \phi_1^- = \frac{-\delta_1^-}{\lambda},\ \phi_2 = \frac{-\delta_2}{\lambda},\ \phi_3 = \frac{-\delta_3}{\lambda}$$

$$\phi_1^+ > 0,\ \phi_1^- < 0,\ \phi_2 < 0,\ \phi_3 < 0 \qquad (8)$$

Using equations (7) and (8), the coefficients and give the asymmetric (nonlinear) long-run (positive and negative) impacts of *OREV* on *RGDP* (economic performance). Meanwhile, the coefficients , and are the symmetric long-run impacts of *EXR* and *INF* respectively on *RGDP*.

Wald test for Short-run and Long-run Asymmetry

Recall that the asymmetric variable is oil revenue (*OREV*). Thus, short-run and long-run asymmetric impacts of *OREV* can be examined using Wald test. This test indicates whether the impacts of the positive changes (increase) and negative changes (decrease) in *OREV* on *RGDP* (economic performance) are statistically different in both short-run and long-run.

Using equation (6), short-run asymmetry tests have the null and alternative hypotheses that:

$$H_0: \sum_{i=0}^{q_j^+} \beta_i^+ = \sum_{i=0}^{q_j^-} \beta_i^- \ \ and\ \ H_1: \sum_{i=0}^{q_j^+} \beta_i^+ \neq \sum_{i=0}^{q_j^-} \beta_i^-$$

If the null hypothesis is rejected, then, there is presence of asymmetry impacts in the long-run. This implies that there is existence of short-run asymmetric impacts of *OREV* on *RGDP*.

The long-run asymmetry tests have the null and alternative hypotheses that:

$$H_0: \frac{-\delta_j^+}{\lambda} = \frac{-\delta_j^-}{\lambda}\ \ and\ \ H_1: \frac{-\delta_j^+}{\lambda} \neq \frac{-\delta_j^-}{\lambda}$$

If the null hypothesis is rejected, then, there is presence of asymmetry impact in the long-run. This implies that *OREV* has long-run asymmetric impacts on *GGDP*.

Model Specification for Causality Test

The model specification is based on granger methodology to examine the predictive causality between oil revenue and real GDP. In other words, using granger causality test approach, the objective is to investigate whether oil revenue causes or predicts real GDP (that is,) or real GDP causes or predicts oil revenue (that is,).

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Thus, the granger causality test is based on the following specifications:

$$RGDP_t = \sum_{j=1}^{P} \theta_{1j}\, RGDP_{t-j} + \sum_{j=1}^{p} \theta_{2j}\, OREV_{t-j} + u_{it} \qquad (9)$$

$$OREV_t = \sum_{j=1}^{P} \varphi_{1j}\, RGDP_{t-j} + \sum_{j=1}^{P} \varphi_{2j}\, OREV_{t-j} + u_{2t} \qquad (10)$$

In testing for causality, the null hypothesis is that either *FDB* or *GGDP* does not Granger-cause the other. Thus, following equations (9) and (10), the hypotheses are stated as follows:

- H_0: , that is, *OREV* does not Granger-cause *RGDP*. The rejection of the null hypothesis suggests that *OREV* Granger-causes or predicts *RGDP*.
- H_0: , that is, *RGDP* does not Granger-cause *OREV*. The rejection of the null hypothesis suggests that *GGDP* Granger-causes or predicts *OREV*.

Based on the foregoing hypotheses, if only one of the hypotheses yields significant result (that is, rejection of H_0, then, there is existence of unidirectional causality, *i.e*. either *OREV* or *RGDP* causes the other. However, if both hypotheses are statistically significant, then, there is bilateral causality between *OREV* and *RGDP*. This implies that *OREV* and *RGDP* granger-cause each other, that is, there is presence feedback mechanism between *OREV* and *RGDP*.

RESULTS AND DISCUSSION

Descriptive Statistics

Table 1 reports the summary statistics of the variables in the study. Reiterating the measurement units of the variables. The mean values or averages recorded for *RGDP*, *OREV*, *INF* and *EXR* are ?36843.4 billion, ?2487.90 billion, 19.07% and ?100.87/$ respectively for the given sample period. Thus, on average, oil revenue (*OREV*) accounts for about 6.75% over the period of 40 years for the given sample period.
Interestingly, oil revenue (*OREV*) appears to be volatile for the considered sample period having its standard deviation above the average. Naturally, the forgoing may be attributed to fluctuations in the global oil prices in the event of global economic challenges. Meanwhile, all the variables appear to be positively skewed (long right tail) having positive coefficients of skewness. Series such as *RGDP* and *OREV* appear to have flat-topped distributions (platykurtic) relative to the normal distribution, having coefficients of kurtosis less than the threshold level of 3 in the case of moment distribution. On the contrary, *INF* appears to have a peaked distribution (leptokurtic) having coefficient of kurtosis greater threshold level of 3. However, *EXR* appears to have a moderately peaked distribution (mesokurtic) having kurtosis coefficient (2.9875) approximately equal to the threshold level of 3. In summary, the Jarque-Bera statistics for the normality test indicate that the series *RGDP*, *OREV* and *EXR* appear to be approximately normally distributed having their respective p-values above the 5% level of significance. However, *INF* seems not to follow a normal distribution having its p-value below the 5% level of significance.

Table 1-: Summary Statistics

Statistics	Variables:			
	RGDP	*OREV*	*INF*	*EXR*
Mean	36843.40	2487.904	19.0728	100.8726
Median	25914.08	1411.264	12.7158	107.0243
Maximum	71387.83	8878.970	72.8355	358.8108
Minimum	16048.31	7.253000	5.3880	0.6100
Std. Dev.	19785.11	2712.810	16.8491	100.7597

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Skewness	0.631816	0.716173	1.8174	0.8854
Kurtosis	1.794414	2.204572	5.1501	2.9875
Jarque-Bera	5.0837	4.4739	29.7240	5.2255
***p*-value**	0.0787	0.1068	0.0000	0.0733
Obs.	40	40	40	40

Source: Author's computation (2022).

Unit Root Tests

The Augmented Dickey-Fuller (ADF) test was employed to evaluate the stationarity of the series based on the fact that it is a reliable choice for unit root testing (Aritova & Fedorova, 2016). Table 2 presents the results of the unit test using result. As revealed in the table, *INF* appear to be integrated of order zero, that is, it is an *I(0)* process. This also implies that it is stationary in its level form, thereby having a mean reverting attribute. However, other competing series such as *RGDP*, *OREV* and *EXR* are integrated of order one, that is, they are *I(1)* processes. This suggests that the series had to be differenced once in order to become stationary. Thus, the combinations of *I(0)* and *I(1)*) orders of integration of the variables validate the use of bounds co-integration test to examine the existence of linear combination among the variables as suggested by Pesaran, Shin and Smith (2001).

Table 2-: Unit Root Test Results

Variable	Test form	ADF-Test Statistics			I(d)
		Constant	Constant & Trend	None	
RGDP	**Level**	-1.0540	-1.7654	3.0603	**I(1)**
	ΔRGDP	-3.7731***	-3.5505**	-2.2650**	
OREV	**Level**	-1.5699	-0.6454	1.7625	**I(1)**
	ΔOREV	-6.1540***	-5.4840***	-5.3021***	
INF	**Level**	-3.4598**	-4.4359***	-0.8180	**I(0)**
EXR	**Level**	-2.1121	-1.3653	1.9054	**I(1)**
	ΔEXR	-5.2996***	-5.6777***	-4.2592***	

Source: Author's computation (2022).
Note: *** and ** denote statistical significance at 1% and 5% respectively.

Co-integration Test

Since the variables under consideration have different orders of integration, it is therefore essential to test for possible linear combination or long-run relationship among the variables. Thus, having different orders of integration suggests the use of bounds co-integration test (the ARDL bounds test) to examine the existence of long-run equilibrium among the variables.

Table 3-: Bounds Co-Integration Test Result

F – Statistic:	6.4578	
Level of significance	**Lower bounds – I(0)**	**Upper bounds – I(1)**
1%	4.4	5.72
5%	3.47	4.57
10%	3.03	4.06

Source: Author's computation (2022).

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The table 3 presents the results of the bounds co-integration test using the ARDL approach proposed by Pesaran, Shin and Smith (2001). The F-statistic (6.4578) exceeds all the upper critical value bounds, I(1), at all the 1%, 5% and 10% levels of significance. This suggests that there is a strong evidence of long run relationship or linear combination among the variables. In other words, *RGDP*, *OREV*, *INF* and *EXR* appear to have a long-run relationship, regardless of the different orders of integration among the variables. This also implies that problem of spurious relationship is non-existent among the variables.

Asymmetric Short Run Estimation Result

With the evidence of cointegration among the variables, the estimation provides both asymmetric long-run and short-run coefficients using non-linear ARDL. All the variables are expressed in natural logs for the estimation. Table 4 presents the result of the short run coefficients (error correction model) of the ARDL. The coefficient (-0.4225) of the ECT term (error correction term) which is the speed of adjustment is negative and statistically significant (*p*-value = 0.0001) at 1% level of significance. Thus, this suggests that *RGDP* adjusts to $OREV^{+}$, $OREV^{-}$, *INF* and *EXR* in the long run. In other words, the system corrects its disequilibrium in the previous period at a speed of 42.25%, thereby restoring to equilibrium in the current period.

Therefore, equilibrium or long-run relationship has been restored among the variables. Meanwhile, aside from the short-run coefficients of the second period lag of *EXR*, all other short-run coefficients exert statistically significant impacts on economic performance (*RGDP*) in the short-run. More importantly, the present positive oil revenue changes ($OREV^{+}$) appear to exert positive and significant impact on economic performance in the short-run. Similarly, present negative oil revenue changes ($OREV^{-}$) appears to have positive and statistically significant impact on economic performance in the short-run. Although both positive and negative oil revenue changes are real GDP inelastic, economic performance responds more to $OREV^{+}$ than $OREV^{-}$ in the short-run. The explanatory power (adjusted R-squared) of the short-run model is considerably higher (87.27%) and thus, suggests that $OREV^{+}$, $OREV^{-}$, *INF* and *EXR* are good predictors or determinants of economic performance in the short-run. However, the short-run asymmetric test seems not to support the existence of asymmetric short run impact of the oil revenue on economic performance judging by the statistical insignificance of the Wald test.

Table 4-: Estimated Asymmetric Short Run Coefficients

Independent Variable	Dependent Variable: *RGDP*			
	Coefficient	S.E	t-stat.	*p*-value
c	4.6860	0.6960	6.7323	0.0001
t	-0.0503	0.0074	-6.7781	0.0000
	-0.4001	0.1722	-2.3236	0.0425
	0.4001	0.0994	4.0265	0.0024
	0.1376	0.0247	5.5820	0.0002
	-0.0382	0.0180	-2.1250	0.0595
	-0.0757	0.0175	-4.3238	0.0015
	-0.0637	0.0162	-3.9323	0.0028
	0.0833	0.0243	3.4325	0.0064
	0.0964	0.0330	2.9216	0.0153
	0.0708	0.0239	2.9610	0.0143
	0.1294	0.0295	4.3940	0.0013
	-0.0198	0.0087	-2.2809	0.0457

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	0.1294	0.0295	4.3940	0.0013
	-0.0198	0.0087	-2.2809	0.0457
	0.0242	0.0098	2.4724	0.0330
	0.0454	0.0160	2.8302	0.0178
	-0.0424	0.0089	-4.7348	0.0008
	-0.1440	0.0160	-8.9717	0.0000
	-0.1657	0.0343	-4.8351	0.0007
	0.0050	0.0188	0.2647	0.7966
	0.0783	0.0153	5.1053	0.0005
	-0.4225	0.0628	-6.7234	0.0001
R-squared	0.9476			
Adjusted R-squared	0.8727			
Asymmetric Test (Wald Test)				
t-stat.	-1.5365			
F-stat.	2.3608			
$\chi 2$	2.3608			

Source: Author's computation (2022)

Asymmetric Long Run Estimation Result

Table 5 reports the result of the estimated asymmetric long run coefficients for the given sample period. In the long run, positive oil revenue changes ($OREV^{+}$) tend to have positive and significant impact (p-value = 0.0001 < 0.01) on *RGDP*. Similarly, negative oil revenue changes ($OREV^{-}$) exert positive impact on *RGDP*. In other words, a 1 percent rise ($OREV^{+}$) in oil revenue, will on average, result in 0.47% rise in *RGDP* while a 1 percent decline ($OREV^{-}$) in oil revenue, will on average, result in 0.58% fall in *RGDP*. In terms of magnitude, though both positive and negative oil revenue changes are real GDP inelastic, economic performance responds more to $OREV^{-}$ than $OREV^{+}$ in the long-run

Table 5-: Estimated Asymmetric long run coefficients

Independent Variable	**Dependent Variable: RGDP**			
	Coefficient	**S.E**	**t-stat.**	**p-value**
$OREV^{+}$	0.4746^{***}	0.0776	6.1188	0.0001
$OREV^{-}$	0.5755^{***}	0.1381	4.1684	0.0019
INF	-0.2364^{**}	0.0905	-2.6130	0.0259
EXR	-0.1634^{***}	0.0478	-3.4197	0.0066
Asymmetric Test (Wald Test)				
t-stat.	5.0930^{***}			
F-stat.	25.9323^{***}			
$\chi 2$	25.9383^{***}			

Source: Author's computation (2022).

Note: ***, ** and * denote statistical significance at 1%, 5% and 10% respectively

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More evidently, the long-run asymmetric test supports the existence of asymmetric long run impact of the oil revenue on economic performance judging by the statistical significance of the Wald test.

Post Estimation tests (Residual Diagnostic Tests)

The post estimation tests include serial correlation test, Heteroscedasticity test, normality test, linearity or specification error test (Ramsey RESET test) and stability test (CUSUM test).

Table 7-: Results of Post Estimation tests

Serial correlation test:		p-value
F-statistic	**3.1058**	0.4900
LM Statistic	**33.2175**	0.0954
Heteroscedasticity test:		**p-value**
F-statistic	**0.9245**	0.5869
LM Statistic	**29.9164**	0.4544
Normality Test:		**p-value**
Jarque-Bera	**1.4919**	0.4743
Linearity Test		**p-value**
t-statistic	0.3185	0.7573
F-statistic	0.1015	0.7573

Source: Authors' computation (2022).

Table 7 presents the results of the serial correlation test, Heteroscedasticity test, normality test and linearity test. All the post estimation test results appear to be satisfactory (statistically insignificant), thereby fulfilling the assumptions required for the application OLS technique.

Meanwhile, the CUSUM test result is presented as figure1 below:

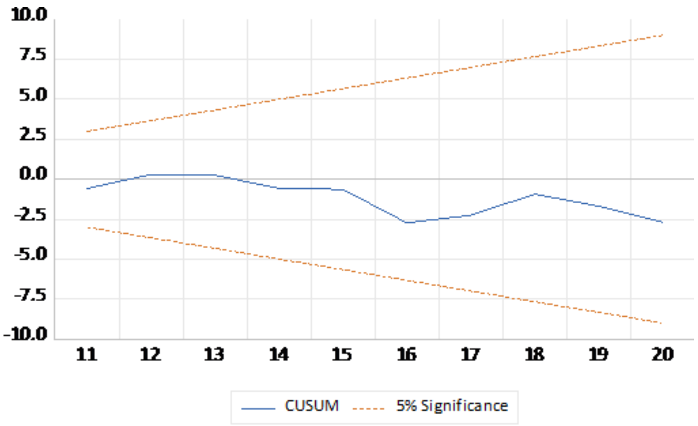

Figure 4.1-: Plot of Cumulative Sum (CUSUM) of Recursive Residuals

Figure 1 presents the result of stability test using CUSUM measure. Since the plot remains within the critical bounds at 5% level of significant, thus, the model is structurally stable. In other words, the estimated NARDL coefficients are stable and suitable for long run policy making. Therefore, all the post estimation test results suggest that the short-run and long-run estimates from the estimated NARDL model are valid and reliable for forecasting and policy making.

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Estimation Result for Causality

Table 8-: Granger-Causality Test Results

H_0	F-Statistic	p-value
	2.9597	0.0657
	0.4887	0.6178

Source: Authors' computation (2022).

Table 8 reports the granger-causality test result. It appears that *OREV* does not Granger-cause *RGDP*. The rejection of the null hypothesis suggests that *OREV* Granger-causes or predicts *RGDP*

DISCUSSION OF FINDINGS

Oil revenue changes appear to have asymmetric long run impact on economic performance. Positive changes (increase) in oil revenue exerts positive and significant impact on economic performance. This implies that a rise (positive change) in oil revenue results in improvement in economic performance. The finding matches that of Asagunla and Agbede (2018), and Efanga, et al. (2020) which revealed that oil revenue exerted positive and significant impact on economic growth. Likewise, negative changes (decrease) in oil revenue is found to have positive impact on economic performance. This suggests that a fall (negative change) in oil revenue is accompanied by a growth retardation in the Nigerian economy. Correspondingly, Olojede and Michael (2020) and Ilori and Akinwunmi (2020) had similar finding that oil revenue exerted insignificant impact on economic growth. More importantly, the study's finding corroborate the proposition of the Harrod-Domar growth model that substantial savings from oil revenue can enhance economic performance via growth of GDP across the different sectors of the economy.

CONCLUSION AND RECOMMENDATIONS

This study deals with the analysis of the asymmetric impact of oil revenue on economic performance. The study utilizes non-linear autoregressive distributed lag (NARDL) methodology using annual time series datasets spanning 40 years (1981-2020). In the context of Nigeria, the oil sector is the major source of revenue. Thus, Nigerian economy is susceptible to fluctuations in the global oil market transactions. Fundamentally, fluctuations in the global oil price alongside the production quota set by the Organisation of Petroleum Exporting Countries (OPEC) determine the oil revenue generation in Nigeria (as an oil exporting country) which in turn dictates the Nigerian economic performance.

Empirically, this study finds that positive changes (increase) and negative changes (decrease) in oil revenue exert distinct magnitudes, but the same direction (positive) of impact on economic performance in the long run in Nigeria. That is, increase in oil revenue results in improvement in economic performance, while decrease in oil revenue exerts negative impact on economic performance. However, the fall in oil revenue exerts greater adverse effect on the Nigerian economy compared with the significant positive impact the rise in oil revenue exerts on economic performance. In other words, economic performance responds more to the negative oil revenue change (decrease) than the positive change (increase). Although the fluctuations in the global oil prices and the OPEC production quota are practically beyond the control of the Nigerian government, the fall in oil revenue may still be attributed to oil theft through pipeline vandalism.

Consequently, the study recommends that the Nigerian government through its concerned agencies in the oil sector should design necessary strategies to curb oil theft such as adopting proactive measures against vandalism. In addition, diversifying into non-oil sectors of the economy should be government's paramount consideration.

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