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Nigeria's Volatile Oil Revenue: Is There a Cause for Concern?

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ABSTRACT

This study, unlike previous studies, investigates the impact of volatile oil revenue on economic growth in Nigeria from 1986 to 2020. The study adopts the Auto-Regressive Distributed Lag technique (ARDL) to analyze the data. The results show that in the short-run, oil revenue volatility significantly depressed economic growth. In the long-run, however, oil revenue volatility improves economic growth in the country. The study therefore recommends that governments and policymakers in Nigeria should vigorously pursue policies that would reduce the reliance on oil revenue through greater economic diversification; otherwise economic growth may worsen in the short-run.

Keywords: Oil Revenue Volatility, ARDL, Short-run, Long-run, Nigeria
JEL Classifications: F43, Q40, Q43

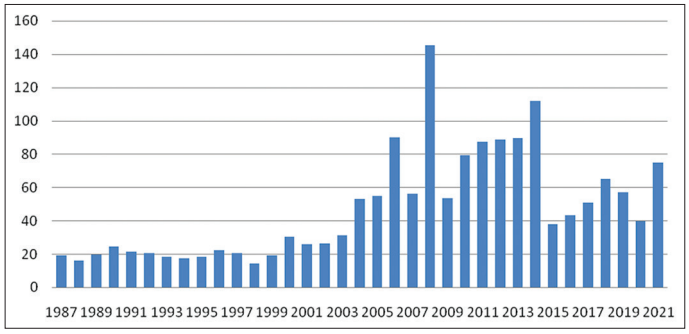
1. INTRODUCTION

The majority of Nigeria's mineral resources are non-renewable, with oil being the most abundant. Nigeria is now one of Africa's top oil exporters as a result of this. Oil export earnings provide for more than 90% of the government's revenue (see Dada and Abanikanda, 2019; Ogunjumo et al., 2023). Nigeria has reaped significant benefits from the oil industry. However, changes in the price of oil on the global market have had a negative impact on government revenue, spending, and economic expansion. According to Efanga et al. (2020), the Nigerian economy is strongly dependent on large amounts of oil revenue to meet important macroeconomic policy objectives, therefore changes or shocks in oil revenue will have an impact on government initiatives. In fact, oil revenue appears to be the most erratic of all non-renewable energy sources. Any change in oil price lowers anticipated government revenue and spending for the fiscal year. According to Olayungbo (2019), Nigeria's economy is extremely susceptible to external shocks because of its substantial reliance on crude oil export.

As shown in Figure 1, in 1987, oil price stood at US$ 19.20 per barrel and in 1988 and 1989, oil prices dwindled to US$ 15.97 and US$ 19.64 respectively but increased slightly to US$ 24.53 per barrel in 1990. It further increased to US$ 56.64 per barrel in 2005 and in 2007; it declined to US$ 55.8 per barrel. In 2008, there was an unprecedented rise in oil price, the price rose to US$ 145.29 per barrel as against US$ 55.8 per barrel in the previous years. In 2009 crude oil price dropped to US$ 53.4 per barrel probably as a result of the global financial downturn within that year. In 2010, it rose to US$ 79.48, $94.88 in 2011, US$ 112 in 2014 and slumped to US$ 38.5 in 2015. In 2016, it increased slightly to US$ 43.29 and in 2017 the price rose to US$ 50.8 and then to US$ 65.23 in 2018. Following COVID -19 Pandemic, crude oil price dropped to US$ 56.99 and US$ 39.65 between 2019 and 2020 and increased to US$ 74.99 per barrel in 2021. The incessant oil price fluctuation has adversely affected government anticipated revenue, expenditure and economic growth.

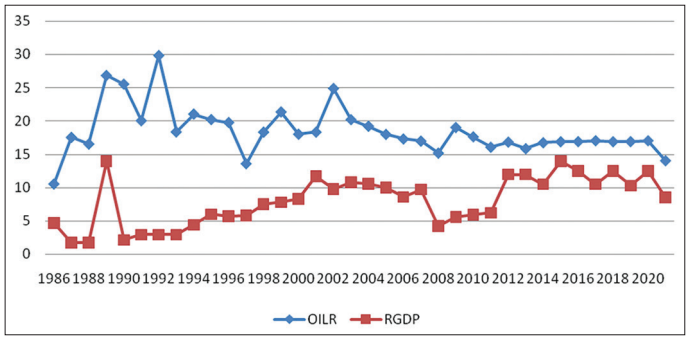
As shown in Figure 2, in 1986, oil price dwindled, leading to fall in oil revenue. Similarly, in 2009, during global oil crisis, oil revenue deteriorated, and the growth also declined to an abysmal

Figure 1: Trends of Oil Prices in Nigeria, 1987-2021 (in US$)



Source: CBN, 2023

Figure 2: Oil Revenue and GDP, 1986-2021



Source: CBN, 2023

level, crashing and crumbling along with the dwindling oil prices. RGDP was consistently below oil revenue, suggesting that slump in oil prices precipitated decline in oil revenue with a spillover effect on the general economy proxy by real RGDP.

Nigeria has a significant oil riches potential, but its economy has not grown to the necessary level. Does erratic oil revenue hurt the expansion of the economy? Although there have been several efforts to demonstrate how oil revenue influences economic growth in Nigeria (see, for example, Akinyele et al., 2021; Alarudeen and Isiaka, 2019; Dada and Abanikanda, 2019; Ogbonna and Appah, 2012; Omodero and Ehikioya, 2020; Olayungbo, 2019; Ugwo et al., 2019), the empirical findings presented display a notable restriction. The impact of oil revenue on economic growth has been the only focus of these earlier researches which may be too limiting in the empirical research, as Karim and Mehdi (2012) note that the effect of oil revenue on economic growth does not rely only on levels of revenue but also on revenue volatility. By examining the impact of oil income volatility on economic growth in Nigeria, this study contributes to the understanding of the relationship between oil revenue and growth.

The findings of this study indicate that in the short-run, oil revenue volatility significantly depressed economic growth. The study, on the contrary, found that oil revenue volatility improves growth in the long-run. The results challenge upfront the common believe that oil revenue volatility is harmful, and has a more adverse effect on growth in all periods. The remainder of the paper is structured as follows: Section two provides a brief review of literature. This is followed by methodology which is contained in section three. The fourth segment deals with data presentation and discussion and the last part is concluding remarks.

2. EMPIRICAL LITERATURE: A BRIEF REVIEW

Appah (2022) used data from 1990 to 2019 to do a research on oil revenue. The data were analyzed using OLS regression. He found that domestic oil sales had a negative impact on real GDP by using variables including RGDP, domestic crude oil sales (DCOIL), oil licensing fees (OLF), petroleum profit tax, and crude oil export. In order to determine the degree of connection between oil revenue (OILR) and Nigeria's growth from 1981 to 2018, Akinyele et al. (2021) also did a research. Using ARDL, it was determined that the GDP was inversely related to the petroleum profit tax (PPTX), the inflation rate (INFLR), and the exchange rate (EXHR). On the other hand, Jabir et al. (2020) found that oil revenue positively and significantly affected GDP growth rate using panel data on 83 oil-producing nations from 1990 to 2015. Using data from 1981 to 2018, Efanga et al. (2020) carried out a similar investigation and used the ARDL approach. Their results concur with those of Jabir et al. (2020). Similar to this, Akinlolu and Nejo (2020) and Ilori and Akinwunmi (2020) found that GDP was negatively impacted by both oil and non-oil revenue using ECM. Nigeria's economic growth was considerably impacted by oil revenue, according to Dada and Agbanika (2019), who used threshold regression analysis on a data set spanning the years 1980–2017. Using the period from 1981 to 2016, Alarudeen and Isiaka (2019) looked at whether there was an unbalanced link between oil revenue and economic growth in Nigeria. They identified a significant correlation between oil revenue and GDP. Olawunmi, et al. (2018) also find a high correlation between oil price and oil revenue and economic growth. This conclusion is consistent with earlier work by Nweze and Edame (2016), Olayungbo and Kazeem (2017), Brown and Nnamaka (2019), Olayungbo (2019), and Jabir et al. (2020). The outcome in Saudi Arabia is consistent with those of other academics. Al- Rasasi et al. (2019) employed granger causality and the error-correction model to identify a long-term association between oil revenue and GDP. Using the structural vector auto-regression (SVAR) model, Karim and Mehdi (2012) discovered that the volatility of oil revenue has a detrimental impact on Iran's economic growth.

3. DATA AND METHODOLOGY

3.1. Data

The World Development Indicators (WDI), which is the World Bank's online database and the Central Bank of Nigeria's (CBN) online database were used to gather all the data, with the exception of the volatility of oil revenue. The information was in yearly form. Since the volatility of oil earnings cannot be seen, the Generalized Auto-Regressive Conditional Heteroscedasticity (GARCH (1, 1)) method was used to calculate the data. To achieve volatility clustering, the GARCH (1, 1) is adequate. According to the GARCH (1, 1) model, big variances in the past will result into future larger variances (see Bollerslev, 1986; Zang et al., 2019). The main view is that some of the volatility depends on historical data from a previous age. As a result, the volatility may be forecast using past changes in oil revenue. Following Fang and Zhiquan (2022) and Musa (2021) a GARCH (1, 1) model entails

$$or = \phi_0 + \phi_1 or_{t-1} + \mu_t \quad (1)$$

Where or donates monthly oil revenue return series; $\mu_t \sim N(0,h_t)$ and the conditional variance is:

$$\sigma_t^2 = \varphi_0 + \varphi_1 \mu_{t-1}^2 + \varphi \sigma_{t-1}^2 \quad (2)$$

Where represents σ_{t-1}^2 the GARCH term

3.2. Methodology

We outline a model that links economic growth, oil revenue volatility, and other growth-affecting factors in the manner of Karim and Mehdi (2012).

$$Economic\ growth = f(OILRV, NOILR, GOVEXP, INFL, EXR) \quad (3)$$

The econometric specification of the model could be written as follows:

$$Economic\ growth = \lambda_0 + \lambda_1 OILRV + \lambda_2 NOILR + \lambda_3 GOVEXP + \lambda_4 INFL + \lambda_4 EXR + \mathcal{E} \quad (4)$$

Real GDP is used to measure economic growth; NOILR stands for non-oil revenue; GOVEXP is for total government spending; and OILRV stands for oil revenue volatility. The yearly percentage of consumer prices is used to calculate the inflation rate, or INFL; Exchange rate proxy by real exchange rate is called EXR, and error term is ε. The study adopts the Auto Regressive Distributed Lag (ARDL) technique to estimate Equation (4). We specify

$$\begin{aligned}\Delta Economic\ growth_t &= \alpha_0 + \delta_1 Economic\ growth_{t-1} \\ &+ \delta_2 OILRV_{t-1} + \delta_3 NOILR_{t-1} + \delta_4 GOVEXP_{t-1} \\ &+ \delta_5 INFL_{t-1} + \delta_6 EXR_{t-1} + \sum_{i=1}^{p} \delta_i \Delta Economic\ growth_{t-i} + \\ &\sum_{i=0}^{p} \gamma_i \Delta OILRV_{t-i} + \sum_{i=0}^{p} \lambda_i \Delta NOILR_{t-i} + \sum_{i=0}^{p} \sigma_i \Delta GOVEXP_{t-i} \\ &+ \sum_{i=0}^{p} \xi_i \Delta INFL_{t-i} + \sum_{i=0}^{p} \xi_i \Delta EXR_{t-i} + \varepsilon_t\end{aligned} \quad (5)$$

The ARDL method may be used to calculate the short and long-term implications of oil revenue volatility on economic growth. The fact that the ARDL approach may take into account I(0) and I(1) variables makes it superior to other estimate strategies (Onabote et al., 2023)

4. EMPIRICAL RESULTS AND DISCUSSION

The result of the GARCH (1, 1) model and its diagnostic test report are presented in Table 1. Before computing GARCH (1, 1), we calculate oil revenue return series (*or*), which is given as the first difference of the logarithm of the oil revenue. The oil revenue return series is then tested for stationarity. We observed that the oil revenue return series is stationary in its level form (the ADF and PP test results are available upon request) thus, there is no need to difference the oil revenue return series when computing GARCH (1, 1). As indicated in Table 1, the fact that the sum of the ARCH and GARCH coefficients is close to 1 suggests that Nigeria's oil revenue volatility is persistent (Figure 1 for evidence). The diagnostic procedures of the GARCH (1, 1) are also included in Table 1. The mean and variance equations are correctly written, and there is no serial connection, as evidenced by the fact that all Q-statistics are negligible. Furthermore, the LM test demonstrates the non-significance of the Obs. R-squared's coefficient, demonstrating the null hypothesis of no ARCH error. Figure 3 plots the monthly volatility series generated via GARCH (1, 1). The oil revenue volatility series over this time prove that changes in oil revenue are persistent.

Table 1: Results of GARCH (1, 1)

Variable	Coeff.	Std. Error	z-Statistic	Prob.
Mean Equation	−0.000289	4.46E-05	−6.488794	0.0000
*C***				
or(−1)***	0.971273	0.001529	635.1908	0.0000
Variance Equation				
*C**	1.07E-06	5.94E-07	1.808917	0.0705
ARCH*	0.012691	0.007259	1.748207	0.0804
GARCH(−1)***	0.815865	0.040145	20.32308	0.0000
Diagnostic Test				
ARCH-LM				
Obs. R^2	0.229702			0.6317
Q & Q2 (1-36)				Not Sig

*, ** and *** explain 10%, 5% and 1% significance levels respectively
Source: Author's computation (2023)

All of the variables in Table 2's descriptive statistics demonstrate a high degree of stability, with mean and median values that fall between the lowest and maximum ranges. The fact that all variables' Jarque-Bera values are greater than their Kurtosis values in Table 2 further demonstrates that all variables are regularly distributed. The similarity between the median and mean of all variables serves as additional evidence of this normalcy.

In addition, Table 3's results for stationarity show that the series *RGDP, INFL, NOILR,* and *GOVEXP* are stationary at first difference, or I(1), whereas *OILRV* and *EXR* are stationary at level, or I(0). This meant that the variables' levels of integration varied, as demonstrated by the results of the ADF and PP unit root tests. Given the uneven order of integration in this instance, ARDL is preferable. We generate lag durations for the ARDL model using this knowledge.

Table 4 demonstrates that the desired lag duration, as stated by AIC, SIC, and HQ, is 3. Now that we are aware of the lag times, we can determine whether the variables used in this study have any long-term relationships. The established F-statistic is considerable and exceeds Pesaran et al. (2001)'s critical domain, as shown in Table 5. We have developed co-integration connections between the variables as a result.

The estimated ARDL model's findings are presented in Table 6. The short-run outcomes demonstrate that initially and in the early term, the volatility of oil revenue and economic growth are unrelated. However, in the third lag, the instability of oil revenue sharply

Table 2: Results of Descriptive Statistics

	RGDP	*OILRV*	*NOILR*	*GOVEXP*	*INFL*	*EXR*
Mean	31.19	−11.07	5.83	1.10	3.43	4.61
Median	31.13	−11.21	6.26	0.76	3.81	4.60
Maximum	31.90	−19.16	8.46	2.24	5.71	5.60
Minimum	30.47	−11.06	1.50	−0.09	−0.14	3.90
Std. Dev.	0.50	0.73	2.14	0.82	1.70	0.40
Skewness	0.16	0.79	−0.53	0.02	−0.69	0.88
Kurtosis	1.45	2.94	2.01	1.41	2.35	3.57
Jarque-Bera	3.62	3.69	3.09	3.66	3.38	5.01

Source: Authors' computation, 2023

Table 3: Unit root test

Variable	ADF	Remark	PP	Remark
RGDP	−3.39*	I (1)	−3.24*	I (1)
OILRV	−4.51***	I (0)	−4.55***	I (0)
NOILR	−6.21***	I (1)	−18.86***	I (1)
GOVEXP	−5.74***	I (1)	−5.76***	I (1)
INFL	−3.91**	I (1)	−3.53**	I (1)
EXR	−3.66**	I (0)	−3.75**	I (0)

*, ** and *** explain 10%, 5% and 1% significance levels respectively
Source: Authors' computation, 2023

Table 4: Lag lengths results

Model (F (RGDP|OILRV NOILR GOVEXP INFL EXR))						
Lag	**LogL**	**LR**	**FPE**	**AIC**	**SC**	**HQ**
0	−108.5	NA	5.17e-05	7.1	7.4	7.2
1	93.6	315.8	1.67e-09	−3.2	−1.3	−2.5
2	141.5	56.8	1.02e-09	−3.9	−0.3	−2.7
3	221.9	65.3*	1.39e-10*	−6.7*	−1.5*	−5*

*implies lag order selected by the criterion
Source: Authors' computation, 2023

Table 5: Bound Tests Results

Model	K	Computed F-statistic	Remarks
(F (RGDP|OILRV NOILR GOVEXP INFL EXR))***	5	69.6	reject H_0

*** show 1% significance level
Source: Authors' computations, 2023

Critical Value Bounds						
K	**10%**		**5%**		**1%**	
5	I (0)	I (1)	I (0)	I (1)	I (0)	I (1)
	2.33	3.41	2.80	4.01	3.90	5.41

Source: Pesaran et al. (2001)

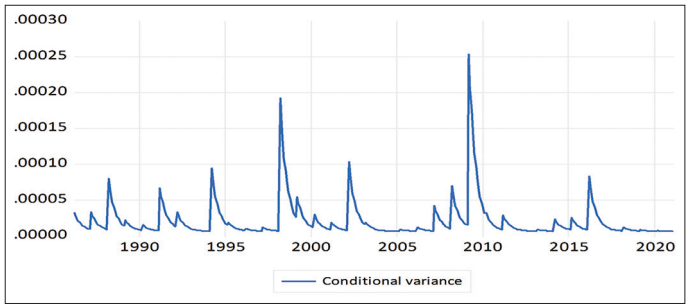
slowed economic expansion. Karim and Mehdi (2012) back this conclusion. This study has the consequence that oil revenue volatility has the potential to slow economic development in the short term. The data also shows that non-oil revenue has a positive and statistically significant influence. The findings also suggested that Nigeria's economic growth is not influenced by government spending. In contrast, the inflation rate and economic expansion were inversely related. The correlation between exchange rate and economic growth was also supported by Jabir et al. (2020). The error correction term's estimate of -0.06 coefficient was significant at the 5 percent level, indicating that around 6 percent of any disequilibrium would be easily corrected in a short period of time. The long-term effects of oil revenue volatility, however, were far better than in the short-run. In the long-term, oil revenue

Table 6: Estimated ARDL model

Dependent Variable: RGDP			
Variable	**Coeff.**	**t-Statistic**	**Prob.**
Short-run			
D (OILRV)	0.004987	1.245635	0.2320
D (OILRV(−1))	0.003969	0.871880	0.3970
D (OILRV(−2))**	−0.010044	−2.156997	0.0476
D (NOILR)***	0.081230	6.470690	0.0000
D (GOVEXP)	0.007778	0.949796	0.3573
D (INFL)***	−0.401231	−10.68830	0.0000
D (INFL(−1))***	0.471040	7.474045	0.0000
D (INFL(−2))***	−0.288780	−7.909604	0.0000
D (EXR)***	0.070315	4.864421	0.0002
D (EXR(−1))	0.005633	0.389391	0.7025
D (EXR(−2))***	0.052984	5.927015	0.0000
ECT***	−0.061336	−3.903361	0.0014
Long-run			
OILRV*	0.327482	1.923607	0.0736
NOILR***	1.324333	3.675379	0.0022
GOVEXP**	−0.391420	−2.114200	0.0517
INFL***	−1.512724	−3.316240	0.0047
EXR**	−0.502009	−2.391070	0.0303
C***	36.83247	13.18156	0.0000
Diagnostic Test			
Serial Correlation	0.49[ρ]		
Heteroscedasticity	0.75[ρ]		
Specification Form	0.86[ρ]		
Normality	0.24[δ]		

*, ** and ***explain 10%, 5% and 1% significance levels respectively. [ρ]indicates F-Statistic Probability. [δ]indicates Jarque-Bera Probability.
Source: Author's Computation, 2023

Figure 3: Oil Revenue Volatility Series Via GARCH (1, 1)



Source: Author's Computation, 2023

volatility improved economic expansion in Nigeria. This outcome contrast Karim and Mehdi (2012). The long-term impact of non-oil revenue on economic growth was nevertheless favorable. The link between government spending and economic growth was unfavorable. This suggested that longer-term economic growth was severely adversely affected by higher government spending. Economic growth was significantly and negatively impacted by the inflation rate. This result implies that inflation slows growth over the long term. Additionally, the exchange rate had a detrimental effect on Nigeria's economic expansion. This suggested that over time, exchange rate depreciation slows economic development.

Furthermore, the model does not have an autocorrelation problem, according to the post estimation test findings in Table 6, where the probability value of the serial correlation LM test is reported as 0.49 and is higher than 0.05. The model also does not have a heteroskedasticity issue. We get the conclusion that the model is not biased towards

Figure 4: CUSUM

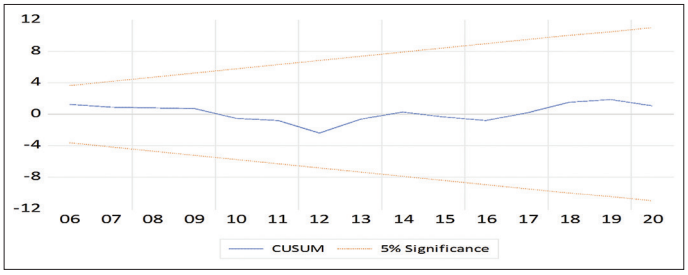
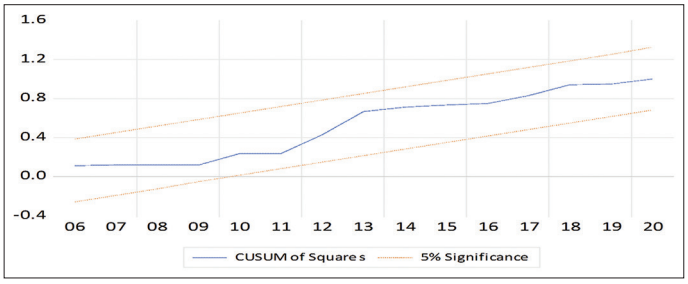


Figure 5: CUSUM of Squares



misspecification. We ran the CUSUM and CUSUMSQ in order to more thoroughly confirm the model's stability. Figures 4 and 5 illustrate the results. The stability of the model is shown by the graph of CUSUM and CUSUMSQ. None of the recursive residuals were outside the two critical lines and are all inside the 5% critical boundaries.

5. CONCLUSION AND POLICY IMPLICATIONS

The impact of oil revenue volatility on Nigeria's economic growth between 1986 and 2020 was examined. We used the GARCH (1, 1) model to calculate the volatility of oil revenue and the ARDL method to analyze the growth model. According to this study, the short-term impact of oil revenue volatility on economic growth was negative and significant. However, in the long run, fluctuating oil revenue boosts the nation's economic expansion.

This report advises Nigerian governments and policymakers to strongly promote measures that would lessen the country's dependency on oil revenue through increased economic diversification; else, the country's economic growth may deteriorate temporarily.

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