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Oil Price Shocks and Economic Growth in Oil Exporting Countries: A Case Study of a Small Open Economy

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ABSTRACT

This study investigates the relationship between oil price shocks and economic growth in a small open economy which is also a prominent oil-exporting economy. The research employs annual time series data from 1996 to 2022 and error correction method (ECM) to analyze the impact of variations in oil prices on Nigeria's economic performance. The study unraveled the nuanced mechanisms driving the interaction between oil price volatility and economic performance in our case, small open economy, Nigeria. In addition, the research explores the mechanisms through which oil price shocks transmit to the broader economy, considering factors such as government policies, institutional frameworks, and the structure of Nigeria's oil-dependent economy. Findings revealed that in the short-run as well as long-run, oil price volatilities, investments, and oil revenues have a negative effect on economic growth. Indeed investments, whether lagged by 1-year or not lagged at all, has a negative effect on economic growth in Nigeria. The study will equip policymakers and other stakeholders' valuable knowledge to formulate more robust policies aimed at mitigating the adverse impacts of oil price volatility on Nigeria's economic growth prospects and foster sustainable economic development strategy in Nigeria.

Keyword: Oil Price Shocks, Economic Growth, Vector Autoregression, ARDL, ECM
JEL Classifications: C22, E64, F43

1. INTRODUCTION

Multiple sources, including Udosen et al. (2009), and Kadafa (2012) agree that crude oil was first discovered in commercial quantity in Oloibiri, in Nigeria's Bayelsa State, in 1956. Prior to the discovery of crude oil, agriculture was the main source of government revenue (Saidu et al., 2016). From Nigeria's first crude oil export from Oloibiri in February 1958, Nigeria has grown increasingly dependent on crude oil revenues. Despite the emphasis on economic diversification by the Nigerian government, crude oil remains the dominant exported product in Nigeria (Nigerian Economic Summit Group, 2019). Nigerian Economic Summit Group (2019) reported that "like in previous years, crude oil continues to dominate exports, accounting for 82% of total exports in 2018. This implies that the Nigerian economy is still reliant on crude oil for foreign exchange earnings and by extension, government revenue" (p.1).

The economy's focus on exporting its oil almost entirely in its crude form not only prevents the economy from deriving benefits from the value addition from crude oil refinement but also makes it constantly "susceptible to energy prices" (CIA, 2024). With its growing dependence on crude exports, oil revenues and foreign exchange, the country continues to experience oil shocks resulting from the vagaries of the global oil markets. Some of the more major disturbances included the Arab-Israeli War which led to the OPEC oil embargo of 1973–1974, the Iranian revolution of 1978-1979, the Iran-Iraq War of 1980, the Persian Gulf War of 1990–1991, and the oil price spike of 2007-2008 (Hamilton, 2011). To varying extents, these oil shocks have always negatively impacted Nigeria's economy through recessions, escalation in the rates of unemployment and inflation, aggravation in the budget deficit problems (Soile and Babajide, 2015).

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Depending on the source, current estimates of the impact of petroleum on the country's revenues range for example, from 80% (Imandojemu, Akinlosotui, and Odigie, 2018) to upwards of 95% (Okotie, 2018). In 2019, over 80 percent of Nigeria's export value was generated by the mineral fuels, oils, and distillation products' sector, accounting for approximately 47 billion U.S. dollars. However, due to the lower demand related to the pandemic, oil production and exports dropped. Data for 2020 shows, indeed, a considerable decrease in the export value derived from oil. At the beginning of 2020, Nigeria's daily oil production exceeded two million barrels. Afterwards, production decreased and reached 1.14 million barrels per day during January 2021, the lowest value recorded in the last years. Overall, the lowest daily production of oil in Nigeria was recorded during the first three months of 2021.

More interesting is the impact of Nigeria's oil sector on the country's real GDP. According to data from the Nigeria Bureau of Statistics, prior to the outbreak of coronavirus pandemic, Nigeria's oil sector accounted for about nine percent of the country's GDP. Between October and December 2020, the oil industry contributed 5.9% to the real GDP, a decrease of approximately three percent compared to the previous quarter. In the second quarter of 2023, the contribution of the oil sector to the country's GDP reached 5.34 percent.

Several studies have examined the effects of global oil price shocks on developed countries and emerging economies. See Hamilton (1983), Blanchard and Gali (2007), Cunado and Pérez de Gracia (2003), IMF Report (2017), and Van Eyden et al. (2019) among others. Despite the continuous occurrence of the global oil price shocks and the relatively large negative ripple effects, not a lot of research has been done in this area on Nigeria. Though these few studies on Nigeria have made useful contributions towards an understanding of the effects of global oil price shocks on the economy, however, findings from these few studies are mixed and cannot be generalized. Thus, there is a need for more studies on the subject matter to shed more light on the debate and allow for improved policies.

In addition, to bridging of the gap in literature as it relates to oil price shocks and economic growth in small open, oil exporting economies, this study will explore the relationship between oil price shocks and economic growth in Nigeria, taking cognizance of other variables such as government policies, institutional frameworks, and other related structure of Nigeria's economy.

2. LITERATURE REVIEW

The relationship between oil price shocks and economic growth in oil-exporting countries has been a subject of debate and counter debate, with a range of findings depending on the context, methodology, and time considered.

Early research by Hamilton (1983) laid the groundwork by examining the macroeconomic effects of oil price shocks, albeit primarily focusing on the U.S. economy. Hamilton's findings suggested that oil price increases were significant contributors to economic recessions during the post-World War II period. Although his study was centered on the U.S., it provided a foundation for understanding how oil price fluctuations could influence economies, including those of oil-exporting nations. Sachs and Warner (1995) expanded the scope by examining the broader implications of natural resource abundance, including oil, on economic growth. Their research introduced the concept of the "resource curse," where countries rich in natural resources, like oil, often experience slower economic growth compared to their less resource-endowed counterparts. They argued that oil price volatility exacerbates economic instability in oil-exporting countries, making it challenging to achieve sustainable long-term growth.

Cunado and Pérez de Gracia (2003) examined the impact of oil price shocks on the economic activity of several Asian economies, including oil-exporting countries. They found that oil price shocks have a significant and negative impact on economic growth, especially in the short run, with the effects varying across countries. Blanchard and Gali (2007) research explored the macroeconomic effects of oil price shocks, focusing on developed economies but providing insights relevant to oil exporters. The study found that the impact of oil price shocks on economic growth has diminished over time, partly due to better monetary policy frameworks and structural changes in economies. Jiménez-Rodríguez and Sánchez (2005) analyzed the asymmetric effects of oil price changes on economic growth in a sample of OECD and OPEC countries. They concluded that oil price increases tend to have a stronger negative impact on economic growth compared to the positive effects of oil price decreases, particularly in oil-exporting countries.

Moving into the 21st century, Bjørnland (2009) provided a more nuanced analysis by focusing on Norway, an oil-exporting country, to study the effects of oil price shocks. Using a structural VAR model, Bjørnland (2009) differentiated between supply-driven and demand-driven oil price shocks, finding that demand-driven oil price increases generally had a positive effect on economic growth in oil-exporting countries. However, supply-driven shocks were more complex, sometimes leading to slower economic growth. Rafiq et al. (2009) investigated the dynamic relationship between oil prices and economic growth in key oil-exporting countries using a panel data approach. The study found a strong positive relationship between oil price increases and economic growth, but also highlighted the risks of dependency on oil revenue. Aloui and Jammazi (2009) analyzed the asymmetric effects of oil price shocks on the economic activity of oil-exporting countries using a non-linear approach. They found that the impact of oil price shocks is non-linear, with negative shocks having a more pronounced effect on economic growth than positive ones.

The impact of oil price shocks on specific regions was further explored by Berument et al. (2010), who studied Middle Eastern and North African (MENA) countries. Their research employed a VAR model to assess both the short-term and long-term impacts of oil price fluctuations. They concluded that oil price shocks tend to boost GDP growth in the short term for these countries but can lead to long-term challenges due to an over-reliance on oil revenues. Korhonen and Ledyaeva (2010) explored the spillover effects of oil price shocks from oil-exporting countries to their trading partners. Their findings revealed that oil price shocks in exporting countries can have significant spillover effects, influencing economic growth in both the exporting and importing nations. Iwayemi and Fowowe (2011) analyzed the impact of oil price shocks on economic growth in Nigeria, one of Africa's largest oil exporters. Their study revealed that oil price shocks significantly affect Nigeria's economic growth, but the impact is moderated by the country's exchange rate regime and fiscal policy. Farzanegan and Markwardt (2009) explored the impact of oil price shocks on the Iranian economy, using a VAR model to capture the short-term effects. They concluded that oil price shocks have a significant impact on Iran's economic growth, with the effects being more pronounced during periods of international sanctions.

El-Anshasy et al. (2011) examined the relationship between oil price volatility and economic growth in major oil-exporting countries. They found that increased oil price volatility is associated with lower economic growth, emphasizing the importance of stable oil revenues for sustained economic performance. Cavalcanti et al. (2011) looked into the effects of oil price shocks on the economies of oil-exporting countries, particularly focusing on their fiscal responses. They concluded that the oil-exporting countries with prudent fiscal policies are better equipped to mitigate the adverse effects of oil price shocks on economic growth.

In a different vein, Arezki and Brückner (2012) explored the political economic aspects of oil price shocks, particularly how such shocks influence government spending and investment in oil-exporting countries. They found that high oil prices often lead to increased public spending, which can stimulate short-term economic growth. However, this increase in spending can also lead to inefficiencies and vulnerabilities, particularly when oil prices decline, highlighting the need for prudent fiscal management. Ghosh and Kanjilal (2014) examined the long-term relationship between oil prices and economic growth in oil-exporting countries, considering structural breaks. They observed that there is a significant long-term relationship between oil prices and economic growth, with structural breaks often corresponding to major oil price shocks. Moshiri (2015) focused on the effects of oil price uncertainty on economic growth in oil-exporting countries. Higher oil price uncertainty is associated with lower economic growth, highlighting the need for policies to manage oil price volatility. Rahman and Serletis (2010) examined the relationship between oil prices and economic growth using a multivariate GARCH model to account for volatility. The study found that oil price volatility has a significant and negative impact on economic growth, with the effects varying across different time periods.

The global interconnectedness of economies and the transmission of oil price shocks were examined by Mohaddes and Pesaran (2016) using a Global VAR (GVAR) model. Their study emphasized the significant impact of global oil price fluctuations on oil-exporting countries, noting that these countries are particularly susceptible to economic volatility. They also underscored the importance of sound fiscal policies in mitigating the adverse effects of oil price shocks. An IMF Report (2017) provided further insights into the macroeconomic impact of oil price shocks on oil-exporting countries, with a particular focus on their fiscal policies and economic diversification strategies. The report highlighted the critical role of economic diversification in reducing the negative effects of oil price shocks, noting that countries with more diversified economies were better able to withstand oil price volatility. The asymmetric effects of oil price shocks were explored by Apergis and Miller (2019), who used a non-linear ARDL model to analyze how positive and negative oil price shocks differently affect economic growth in oil-exporting countries. They found that while positive oil price shocks generally lead to higher economic growth, negative shocks have a disproportionately large negative impact, underscoring the vulnerability of these economies to price fluctuations.

In the same year, Van Eyden et al. (2019) investigated the role of financial development in moderating the impact of oil price shocks on economic growth in oil-exporting countries. Their study revealed that financial development plays a crucial role in reducing the negative impact of oil price shocks, suggesting that countries with more developed financial systems are better positioned to manage oil price volatility. Finally, Nwosa (2021) focused on African oil-exporting countries, particularly Nigeria, to analyze the impact of oil price shocks on economic growth. Nwosa found that while oil price shocks significantly impact economic growth, the effects are moderated by the country's fiscal policy and the degree of economic diversification.

Li et al. (2022) investigated the impact of oil price shocks on economic growth in major oil-exporting countries, focusing on the role of renewable energy development as a moderating factor. The authors found that while oil price shocks continue to significantly affect economic growth, the expansion of renewable energy infrastructure in these countries helps mitigate the negative impacts. This highlighted the importance of diversifying energy sources to stabilize economic growth amidst oil price volatility. Zhang and Wang (2022) examined the asymmetric effects of oil price shocks on the economic growth of oil-exporting countries, emphasizing the role of financial development in these economies. The study concluded that oil price increases tend to have a positive impact on economic growth, particularly in countries with more developed financial sectors. However, the negative impacts of oil price declines are more pronounced in countries with less financial development, suggesting that financial sector development can cushion the adverse effects of oil price drops.

Ahmed and Sharma (2023) investigated the long-term effects of oil price shocks on economic growth in the Gulf Cooperation Council (GCC) countries, considering the recent economic diversification efforts in the region. The research found that while oil price shocks still significantly impact economic growth in GCC countries, the ongoing diversification efforts have started to reduce their vulnerability. Countries that have made more progress in diversifying their economies show greater resilience to oil price fluctuations. Elshamy and Kassem (2023) examined the effects of oil price shocks on the macroeconomic stability of Middle Eastern oil-exporting countries, focusing on the interplay between oil revenues and public debt. The research concluded that high levels of public debt exacerbate the negative impact of oil price shocks on economic growth. Countries with lower debt levels are better able to manage oil price volatility, while those with high debt levels face greater economic instability. Abdulrahman and Musa (2023) explored the relationship between oil price shocks and inflation in oil-exporting countries, with a focus on the Middle East and North Africa (MENA) region. The research found that oil price shocks have a strong impact on inflation, which in turn affects economic growth. Countries with better inflation management policies are better able to sustain economic growth despite oil price fluctuations.

In summary, the literature revealed that while oil price shocks can stimulate short-term economic growth in oil-exporting countries, they also introduce significant volatility and long-term risks, especially in economies heavily dependent on oil revenues. Also, it highlighted the ongoing complexities and challenges faced by oil-exporting countries in managing the economic impacts of oil price shocks. The extent of these effects is influenced by various factors, including the nature of the oil price shock, the country's level of economic diversification, fiscal policies, and the development of its financial systems.

3. METHODOOGY

This study investigates the relationship between oil price shocks and economic growth in Nigeria, a prominent oil-exporting nation. The research employs annual time series data from 1996 to 2022. The main sources of data for this study are from the Central Bank of Nigeria statistical bulletin and the World Bank World Governance Indicators. Specifically, the study sourced real GDP, Annual Oil Revenue, Government Expenditure, and Gross Capital Formation data from the most recent Central Bank of Nigeria Statistical Bulletin. Data for Annual Average Crude Oil prices, and Annual Crude Oil Price Volatility were sourced from the National Bureau of Statistics. As already stated, Institutional Quality data was sourced from the World Bank Worldwide Governance Indicators database. The Table 1 summarises the data and data sources used in this study discussed.

3.1. Method of Analyses

In a linear model, a set of explanatory variables are used to model some dependent variable Y in the form:

$$Y_i = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \ldots + \beta_k X_{ki} + e_i \quad (1)$$

Where Y_i is the dependent variable, β_0 is the intercept, β_1 to β_k are the vectors of coefficients, X_{1i} to X_{ki} are the vectors of explanatory variables of i at a point in time and e_i in the model is the stochastic term which captures any variations in the model that cannot be attributed to independent variables used in the model. Note that control variables are included in the linear model in the same way as other explanatory variables.

For a set of dependent and independent variables, Cohen et al. (2003) explained that the relationship between the factors may be depicted by anyone of a straight line, a curved line, or be indeterminable on a graph, depending on the effects of independent variables on the dependent variable (p. 8). Thus, while multiple regressions are indeed linear, their use is not only restricted to the study of straight-line relationships (p. 9).

With ARDL models, Oxera (2010) explained that the variable of interest is assumed to be a function of the past values of itself (auto regressive) and the current and past values of a function of other exogeneous variables (distributed lag). As already discussed, unlike other models, the autoregressive distributed lag (ARDL) model is more efficient in the case of relatively small or finite sample data sizes; the technique also gives unbiased long-run estimates (Nkoro and Uko, 2016). The ARDL model is therefore of the following generalized form:

$$Y_t = \mu_{0i} + \sum_{I=0}^{p} \delta_i Y_{t-1} + \sum_{I=0}^{q} \beta_i X_{t-1} + + e_{it} \quad (2)$$

Where Y is a vector and dependent variable. X are the explanatory variables. μ is the constant while δ *and* β are coefficients. p, q are optimal lag orders, with p the lag orders for the dependent variables while q the lag order for the explanatory variables representing the regressors. e_{it} is a vector of the error term.

Given current estimates of the impact of petroleum on the country's revenues, export value, and foreign exchange earnings, we propose an economic model where real GDP growth (RGDPG) is a function of crude oil prices (COP), oil price volatility (OPV), annual oil revenue (OREV), total government expenditure (TGE), gross capital formation (GCF), and institutional quality variables represented by the rule of law (ROL), control of corruption (COC), and regulatory quality (REQ).

$$RGDPG_t = f\,(COP_t, OPV_t, OREV_t, TGE_t, GCF_t, ROL_t, COC_t, REQ_t,) \quad (3)$$

We express equation (3) in econometric form:

$$RGDPG_t = \alpha + \beta COP_t + \gamma OPV_t + \delta OREV_t + \eta TGE_{t\,+}\, \theta GCF_t + \phi ROL_t + \pi COC_t, + \zeta REQ_t + \varepsilon \quad (4)$$

Table 1: Variables and sources

	Variable	Data Source	Comments
1	Real GDP Growth Rate (RGDPG)	CBN Statistical Bulletin	
2	Annual Average Crude Oil Price (COP)	National Bureau of Statistics	
3	Annual Crude Oil Price Volatility (OPV)	National Bureau of Statistics	Measured as the change in annual average crude oil prices.
4	Annual Oil Revenue (OREV)	CBN Statistical Bulletin	
5	Total Government Expenditure (TGE)	CBN Statistical Bulletin	Proxy for government policy.
6	Gross Capital Formation (GCF)	CBN Statistical Bulletin	Proxy for aggregate investments.
7	Control of Corruption (COC)	World Governance Indicators	Proxy for Institutional Framework
8	Rule of Law (ROL)	World Governance Indicators	
9	Regulatory Quality (REQ)	World Governance Indicators	

For ease of interpretation, and to avoid TGF, GCF, and OREV (which are non-percentages) being non-stationary, we convert them from their raw numbers into log-linear form:

$$RGDP_t = \alpha + \beta \text{InCOP}_t + \gamma \text{InOPV}_t + \delta \ln OREV_t + \eta \ln TGE_t + \theta \ln GCF_{t+} \delta ROL_t + \pi COC_t + \zeta REQ_t + \varepsilon \quad (5)$$

We started with the use of the Vector Autoregression (VAR) model, then introduced the linear Autoregression Distributed Lag (ARDL) regression model. Shrestha and Bhatta (2018) advised that the main method of selection of time series analysis should be by using the results of unit root tests as the test results determine the stationarity of the variable (p. 3). As a result, Shrestha and Bhatta (2018) maintained that the ARDL methodology is the best methodology because unlike the use of OLS or VAR (in which either one of the two methods can be used if all the variables of interest are stationary), if variables of interest in the analysis are of a mixed type, i.e., some are stationery and others are non-stationery, ARDL models are the most appropriate.

With ARDL models, Oxera (2010) explained that the variable of interest is assumed to be a function of the past values of itself (auto regressive) and the current and past values of a function of other exogeneous variables (distributed lag). As already discussed, unlike other models, the autoregressive distributed lag (ARDL) model is more efficient in the case of relatively small or finite sample data sizes; the technique also gives unbiased long-run estimates (Nkoro and Uko, 2016).

The ARDL model is therefore of the following generalized form:

$$Y_t = \mu_{0i} + \underset{I=0}{\Sigma^p} \delta_i Y_{t-1} + \underset{I=0}{\Sigma^q} \beta_i X_{t-1} + + e_{it} \quad (6)$$

Where Y is a vector and dependent variable. X are the explanatory variables. μ is the constant while δ and β are coefficients. p, q are optimal lag orders, with p the lag orders for the dependent variables while q the lag order for the explanatory variables representing the regressors. eit is a vector of the error term.

4. RESULTS

This section provides informational coefficients that summarize the set of data used in this research.

4.1. Description Statistics

The descriptive statistics of the data are as presented in Table 2.

As earlier discussed, total data used in this research ranges from 1996–2022, a total of 27 years, thus the total observations as stated here is 27. In addition, section 3.3 also discussed the characteristics of the dataset. While economic growth rate (RGDPG), annual crude oil price volatility (COP), rule of law (ROL), control of corruption (COC), and regulatory quality (REQ) were all specified in rates, annual average Crude Oil Price (COP), annual oil revenue (OREV), toral government expenditure (TGE), and gross capital formation (GCF) were originally obtained in their raw numbers and subsequently converted to natural logarithm to better interpret growth rates.

As a result, the minimum and maximum crude oil prices for the period were 12.28 and 109.45 respectively, while the minimum and maximum oil price volatility are −0.458 and 0.6079. This is indicative of significant changes in crude oil prices and volatilities over the years. As the skewness (measure of symmetry) for ROL, COC, and REQ are negative, this indicates that their dataset is skewed left (the left tail is long relative to the right tail) while all other variables have positive values for the skewness which indicates data that are skewed right (the right tail is long relative to the left tail).

4.2. Pre-Estimation Tests

4.2.1. Correlation analyses

Table 3 displays the correlation coefficients between all the possible pairs of values. It highlights a few interesting positions. For example, it shows that there is a negative relationship between (i) oil price volatilities and gross capital formation, (ii) oil price volatilities and total government expenditure, (iii) oil price volatilities and all specified components of institutional quality, (iv) total government expenditure and real GDP, real GDP and all institutional variables. These observations are consistent with economic theory as negative changes in oil prices and oil price volatilities are expected to negatively affect growth in real GDP, increases in government expenditure and gross capital formation (investments).

On positive relationships, we noted positive relationships between (i) oil revenues and real GDP, (ii) crude oil prices and real GDP, and (iii) oil price volatilities and real GDP. These observations are also consistent with economic theory as positive (negative) changes in oil prices and oil price volatilities are expected to positively (negatively) affect growth in real ad in oil revenues GDP. It is however important to note that several of the relationships are not significant. In addition, notwithstanding the results of the correlation analysis, it is important to note that in general, descriptive statistics only show the direction and strength of relationships and not causality.

4.2.2. Test for stationarity (unit root test)

This study employed the Augmented Dickey-Fuller (ADF) test to confirm the unit root properties of variables used in our models i.e. whether all the variables in the series are stationary at level or at first difference. The ADF test is particularly important because the ADF test checks if the mean of the time series is constant over time. According to Arltova and Fedorova (2016), the ADF test achieves better and more reliable results than other tests of stationarity and is more suitable when the sample period is more than 25 but less than 50.

We used the following hypothesis to interpret the results displayed in Table 4:

H_0: Variable has a unit root (Variable is non-Stationary)
H_1: Variable has no unit root (Variable is Stationary).

The result in Table 4 shows the stationarity level of the variables. RGDPG, COP, LNGCF, LNOREV, COC, ROL, and REQ are

Table 2: Descriptive Statistics

Statistic	RGDP	COP	OPV	LNTGE	LNGCF	LNOREV	COC	ROL	REQ
Mean	4.764874	56.94815	0.107630	3.424756	2.653846	3.491528	−1.173333	−1.161111	−0.914231
Median	5.015900	60.86000	0.131803	510655	3.015000	3.613810	−1.160000	−1.160000	−0.920000
Maximum	15.32920	109.4500	0.607923	4.300270	3.230000	4.387945	−0.900000	−0.840000	−0.680000
Minimum	−1.794300	12.28000	−0.458303	2.527910	1.770000	2.510947	−1.500000	−1.510000	−1.290000
Std. Dev.	3.548327	30.38175	0.300467	0.497906	0.546041	0.442641	0.142235	0.199409	0.149858
Skewness	0.562190	0.230431	−0.176626	0.015160	−0.666878	-0.715097	−0.275713	−0.254199	−0.761430
Kurtosis	4.388560	1.885522	2.070562	2.148727	1.618943	3.194371	2.891125	2.035081	3.579690
Jarque-Bera	3.591370	1.636261	1.112221	0.816283	3.993406	2.343638	0.355414	1.338229	2.876403
Probability	0.166014	0.441256	0.573435	0.664885	0.135782	0.309803	0.837188	0.512162	0.237354
Sum	128.6516	1537.600	2.906015	92.46842	69.00000	94.27126	−31.68000	−31.35000	−23.77000
Sum Sq. Dev.	327.3562	23999.32	2.347286	6.445677	7.454015	5.094204	0.526000	1.033867	0.561435

Source: Authors' computation

Table 3: Correlation matrix

Correlation probability	RGDP	COP	OPV	LNTGE	LNGCF	LNOREV	COC	ROL	REQ
RGDP	1.000000								

COP	0.076149	1.000000							
	0.7116	-----							
OPV	0.159359	0.121204	1.000000						
	0.4368	0.5553	-----						
LNTGE	−0.323058	0.636074	−0.063552	1.000000					
	0.1074	0.0005	0.7578	-----					
LNGCF	−0.226068	0.797445	−0.085854	0.871228	1.000000				
	0.2668	0.0000	0.6767	0.0000	-----				
LNOREV	0.085429	0.858738	0.132663	0.774416	0.841786	1.000000			
	0.6782	0.0000	0.5182	0.0000	0.0000	-----			
COC	−0.423650	0.455798	−0.084333	0.522251	0.698121	0.400574	1.000000		
	0.0310	0.0193	0.6821	0.0062	0.0001	0.0426	-----		
ROL	−0.534367	0.512772	−0.089074	0.793040	0.789005	0.525713	0.740032	1.000000	
	0.0049	0.0074	0.6652	0.0000	0.0000	0.0058	0.0000	-----	
REQ	−0.160576	0.674435	−0.003236	0.289233	0.503063	0.415296	0.572473	0.412502	1.000000
	0.4333	0.0002	0.9875	0.1518	0.0088	0.0349	0.0022	0.0362	-----

Source: Authors' computation

Table 4: Stationary test result

Variable	Count	t-Statistic	Prob.*	Status
RGDPG	27	−7.037260	0.0000	I (1)
COP	27	−4.255527	0.0030	I (1)
OPV	27	−4.932011	0.0006	I (0)
LNTGE	27	−3.473470	0.0195	I (0)
LNGCF	27	−5.772577	0.0001	I (1)
LNOREV	27	−3.597633	0.0133	I (1)
COC	27	−5.527580	0.0001	I (1)
ROL	27	−3.722796	0.0115	I (1)
REQ	27	−5.833113	0.0001	I (1)

Source: Authors Computation (I (0) is level stationarity, and I (1) is first difference

stationary of order 1 (i.e. they attain stationarity at first difference) (I(1)) with P-values of 0.0000, 0.0030, 0.0001, 0.0133, 0.0001, 0.0115 and 0.0001 respectively, while OPV, and LNTGE attain stationarity at level i.e. I(0) with P-value of 0.0006 and 0.0195 respectively.

4.2.3. VAR lag order selection criteria

The VAR Lag Order Selection result on Table 5 shows that most of the criterion selected lag (1) as the optimum leg for estimating the long run relationship.

4.2.4. Co-integration bounds test

The ARDL bounds testing approach tests for the existence of a long-run relationship among the variables by conducting an F-test for the joint significance of the coefficients of the lagged levels of the variables. Irrespective of the chosen significance level. Two critical values bound (a lower and an upper value) are subsequently obtained and provide a test for cointegration. The lower value assumes that the regressors are I(0), while the upper value assuming purely I(1) regressors (Frimpong and Oteng-Abayie, 2006).

The decision rule is that:

(i). If the F-statistic is above the upper critical value, the null hypothesis of no long-run relationship can be rejected irrespective of the orders of integration for the time series. This implies that if the F-statistic value is greater than the I(1) value, cointegration is established and the Error Correction Model (ECM) for the dependent variable should be estimated as it is indicative of the presence of a long run relationship among the variables.

(ii). If the F-statistic falls below the lower critical value, the null hypothesis of no level relationship cannot be rejected but we estimate the short-run ARDL model.

Table 5: VAR Lag Order Selection Criteria

Endogenous variables: RGDP						
Exogenous variables: C COP OPV LNTGE LNGCF LNOREV						
Sample: 1996 2022						
Included observations: 22						
Lag	**LogL**	**LR**	**FPE**	**AIC**	**SC**	**HQ**
0	−51.595	NA*	11.159	5.235949	5.533506	5.306045
1	−49.603	2.716627	10.29*	5.145750*	5.492900*	5.227528*
2	−49.025	0.735600	10.817	5.184116	5.580859	5.277577
3	−47.969	1.247174	10.936	5.179089	5.625424	5.284232
4	−47.604	0.399502	11.829	5.236706	5.732634	5.353532

*Indicates lag order selected by the criterion. LR: Sequential modified LR test statistic (each test at 5% level), FPE: Final prediction error, AIC: Akaike information criterion, SC: Schwarz information criterion, HQ: Hannan-Quinn information criterion

Table 6: Bound test (test for long or short run relationship)

Model	F-Statistic	Significance	I (0)	I (1)	Decision
ARDL	2.924678	5%	2.	3.39	Undefined, Estimate ARDL and ECM. Short and Long Run Model

Source: Authors' computation (I (0) is lower bound, and I (1) is upper bound)

(iii).If the F-statistic falls between the lower and upper critical values, the result is inconclusive.

Table 6 reveals the bounds test results for the model of the study. The values of the F-statistics and the t-statistics are given as 2.924678 and1.578639 respectively at a 5% level of significance.

4.3. Regression Results

4.3.1. Vector autoregression (VAR)

For VAR modelling, we based the variables used in the model on the decision from the VAR lag order selection criteria (Table 5). Table 5 shows that the optimal lag order is lag (1) as the optimum leg for estimating the long run relationship. However, to make use of VAR modelling, certain criteria must be met:

(a) All the variables in the model must be stationary at the same level (Shrestha and Bhatta, 2018). The results from Table 4 show that RGDPG, COP, LNGCF, LNOREV, COC, ROL, and REQ are stationary at first difference, while OPV, and LNTGE attains stationarity at level.

(b) VAR is only used to investigate short-run relationships. If there is co-integration among the investigated variables, then there is no requirement to use VAR modelling as it is indicative of long-run relationships. The results from the bounds test in Table 6 show that there is a long-run relationship among the investigated variables.

4.3.2. Autoregression distributed lag (ARDL) short-run estimation

ARDL regression model was used to evaluate the relationship between oil price shocks and economic growth in Nigeria, and ARDL(1, 0, 1, 0, 1, 1, 1, 0, 0) was selected to be the best model to test the relationship between real GDP and the regressors COP, GCF, OREV, COC, ROL, REQ, OPV, and TGE. The ARDL short run model that was estimated is shown in Table 7.

The result in Table 7 show that the equation is statistically significant at 99% confidence interval. Also, the R-square is high at 79.6%. This means that approximately 80% of the variation of a dependent variable (RGDP) is explained by the independent variables in the regression model. In addition, oil revenues lagged by one year is the most significant independent variable. Also, the results revealed that crude oil price volatility has negative effects on economic growth while oil revenue has positive effect on economic growth in Nigeria. Further, government expenditure and capital formation has positive effect on economic growth in Nigeria.

Table 7: Short Run Model (Autoregressive Distributed Leg)

Dependent Variable: RGDP				
Method: ARDL				
Selected Model: ARDL (1, 0, 1, 0, 1, 1, 1, 0, 0)				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.***
RGDP(-1)	0.456903	0.344029	1.328095	0.2110
COP	0.058661	0.052397	1.119541	0.2868
OPV	8.049545	3.812971	2.111095	0.0585
OPV(-1)	−2.792558	2.786179	−1.002290	0.3377
LNTGE	2.098375	4.679256	0.448442	0.6625
LNGCF	−3.780667	4.038942	−0.936054	0.3693
LNGCF(-1)	13.88743	7.510130	−1.849160	0.0915
LNOREV	−12.82836	8.706020	−1.473505	0.1686
LNOREV(-1)	22.97366	6.825227	3.365992	0.0063
COC	1.199097	9.236041	0.129828	0.8990
COC(-1)	12.77135	7.232687	1.765783	0.1051
ROL	3.336069	8.430468	0.395716	0.6999
REQ	4.392725	8.717282	0.503910	0.6243
C	28.17445	24.43304	1.153129	0.2733
R-squared	0.795980	Mean dependent var		4.848160
Adjusted R-squared	0.554866	S.D. dependent var		3.677462
S.E. of regression	2.453542	Akaike info criterion		4.931962
Sum squared resid	66.21853	Schwarz criterion		5.614532
Log likelihood	−47.64952	Hannan-Quinn criter.		5.121278
F-statistic	3.301260	Durbin-Watson stat		2.238814
Prob (F-statistic)	0.027490			

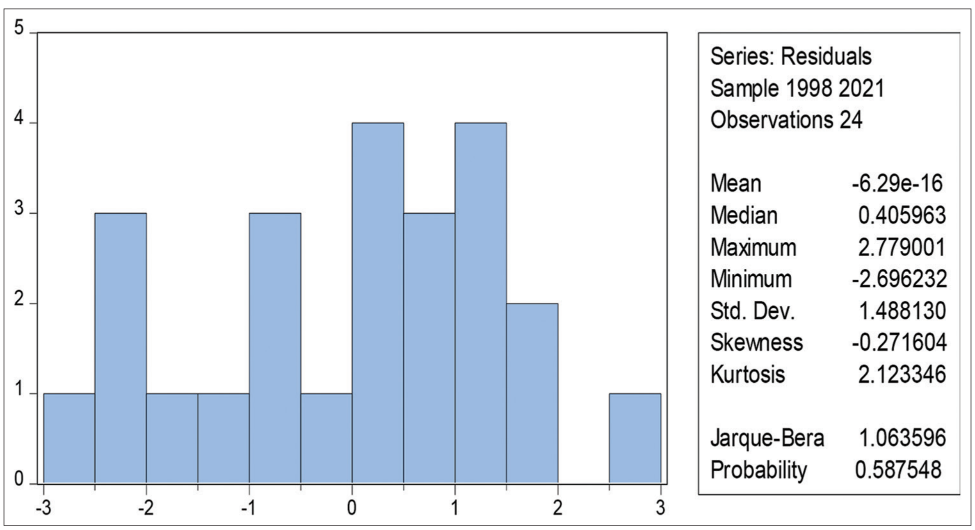
*P values and any subsequent tests do not account for model selection

The result in Table 8 shows that the equation is statistically significant at 99% confidence interval. Also, the R-square is high at 77.25%. This means that approximately 77% of the variation of a dependent variable (RGDP) is explained by the independent variables in the regression model with a probability (F-Statistics)

Table 8: ARDL Error Correction Regression (Long-run Model)

Dependent variable: D (RGDP)				
Method: Least Squares				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
C	−0.644339	1.000320	−0.644134	0.5356
D (RGDP(-1))	0.539054	0.371022	1.452888	0.1802
D (COP)	0.040162	0.051465	0.780386	0.4552
D (OPV)	8.086891	3.954441	2.045015	0.0001
D (OPV(-1))	−3.770988	2.253531	−1.673369	0.1286
D (LNTGE)	6.936205	9.227743	0.751669	0.4714
D (LNGCF)	−1.929623	3.698950	−0.521668	0.6145
D (LNGCF(-1))	−9.471036	8.579103	−1.103966	0.2982
D (LNOREV)	−13.49963	6.882133	−1.961547	0.0814
D (LNOREV(-1))	23.21329	7.717113	3.008028	0.0148
D (COC)	−5.634142	9.314817	−0.604858	0.5602
D (COC(-1))	6.301210	8.888887	0.708886	0.4963
D (ROL)	7.461840	6.568650	1.135978	0.2853
D (REQ)	2.923554	8.225838	0.355411	0.7305
ECM(-1)	−1.230312	0.370503	−3.320657	0.0089
R-squared	0.772446	Mean dependent var		-0.021948
Adjusted R-squared	0.712564	S.D. dependent var		3.482107
S.E. of regression	1.866865	Akaike info criterion		4.291962
Sum squared resid	66.21853	Schwarz criterion		4.584492
Log likelihood	−47.64952	Hannan-Quinn criter.		4.373097
F-statistic	12.89935	Durbin-Watson stat		2.238814
Prob (F-statistic)	0.000015			

Figure 1: Normality test



Source: Authors' Computation

of 0.000015. In addition, oil revenues lagged by one year is the most significant independent variable.

4.4. Post-Estimation Tests

4.4.1. Test for heteroskedasticity

We used the following hypothesis to interpret the results displayed in Table 9:

H_0: Heteroskedasticity

H_1: Homoskedasticity.

The result in Table 9 shows that null hypothesis cannot be rejected with p-value of 0.7616 which is greater 0.05 level of significant at 95% confidence interval for rejecting the null hypothesis, which implies that the model is free from Heteroskedasticity (i.e. it is homoscedastic).

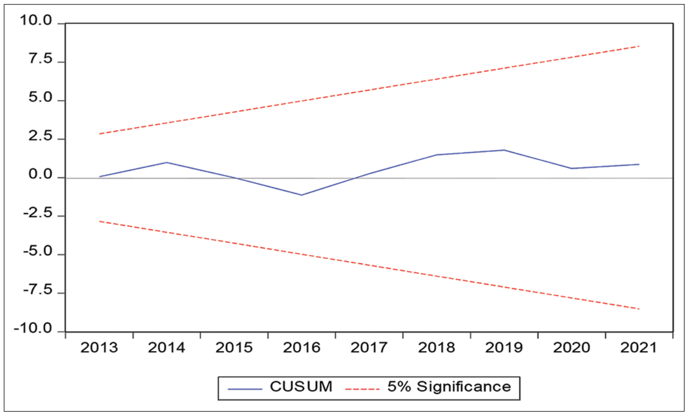
4.4.2. Normality test

From the normality test result in Figure 1, we cannot reject the null hypothesis that the residuals are normally distributed with its P-value of 0.587548 which is greater than 0.05 at 95% confidence interval. Therefore, we conclude that that the residual is normally distributed.

4.4.3. Stability test

The CUSUM (cumulative sum) test is used to test the constancy of the coefficients in a model so see if there are times when the

Figure 2: CUSUM test



Source: Authors' computation

Table 9: Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	0.665309	Prob. F (14,9)	0.7616
Obs*R-squared	12.20595	Prob. Chi-Square (14)	0.5898
Scaled explained SS	0.964091	Prob. Chi-Square (14)	1.0000

Table 10: Breusch-Godfrey Serial Correlation LM Test

F-statistic	0.142060	Prob. F (1,8)	0.7160
Obs*R-squared	0.418744	Prob. Chi-Square (1)	0.5176

Source: Author's computation

probability distribution of a time series changes. This is because if there are unexpected changes in the parameters of regression models, over time, it may cause structural breaks which can lead to forecasting errors and unreliability of models. Figure 2 shows that the model is within the 5% level of significant, which implies that the model is stable.

4.4.4. Serial correlation test

We used the following hypothesis to interpret the results displayed in Table 10:

H_0: No Serial Correlation

H_1: Presence of Serial Correlation.

The result on Table 10 shows that null hypothesis cannot be rejected with P-value of 0.7160 which is greater 0.05 level of significant at 95% confidence interval for rejecting the null hypothesis, which implies that the ECM is a good fit.

5. CONCLUSION AND POLICY IMPLICATIONS

This study investigates the relationship between oil price shocks and economic growth in Nigeria, a prominent oil-exporting nation. The research employed annual time series data from 1996 to 2022 and error correction method (ECM) to analyze the impact of fluctuations in oil prices on Nigeria's economic performance. The study reveals the intricate relationship between oil price fluctuations and the broader economic landscape. Nigeria, heavily reliant on oil exports for revenue, experiences significant economic volatility due to the unpredictability of global oil prices. Periods of high oil prices have historically led to economic booms, characterized by increased government revenue, higher investment in infrastructure, and improved social services. Conversely, sharp declines in oil prices have precipitated economic downturns, leading to budget deficits, reduced public spending, and economic contraction. The cyclical nature of these price shocks has underscored the vulnerability of Nigeria's economy to external factors, highlighting the need for a more diversified economic base.

The results revealed that crude oil price volatility has negative effects on economic growth while oil revenue, government expenditure and capital formation have positive effect on economic growth in Nigeria. The findings suggest that while oil revenues have the potential to spur economic growth, over-reliance on this single commodity exposes the economy to significant risks. The impact of oil price volatility on Nigeria's economic growth is negative. The results revealed the importance of institutional quality in mitigating the adverse effects of oil price shocks. Countries with strong institutions are better positioned to cushion the effects of oil price volatility.

To mitigate the adverse effects of oil price shocks on Nigeria's economy, it is imperative for Nigeria to intensify efforts towards economic diversification. Reducing dependency on oil by developing other sectors such as agriculture, manufacturing, and services will help stabilize the economy and reduce vulnerability to external shocks. This can be achieved through targeted investments, policy incentives, and creating an enabling environment for private sector growth.

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