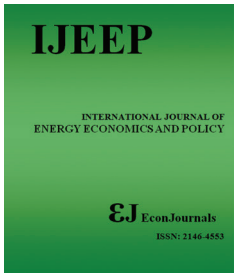

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The Impact of Crude Oil Price Fluctuation on Revenue Generation in the Oil Dependent Economy: Nigeria

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ABSTRACT

This study explores the dynamic relationship between crude oil price volatility and revenue generation in Nigeria over a 41-year period from 1981 to 2021. It encompasses an analysis of key variables, including total revenue (REV), oil price (OPV), oil revenue (ORV), non-oil revenue (NRV), and exchange rate (EXCHR). The study employs the Auto Regressive Distributed Lags model to examine the long-term and short-term impacts of oil price volatility on revenue generation. This study reveals that crude oil price volatility (OPV) failed to exert a strong impact on total revenue (REV) in Nigeria in the distance period. Oil revenue (ORV) exhibits a strong and positive influence on total revenue, highlighting its pivotal role in revenue generation. Non-oil revenue (NRV) also significantly contributes to total revenue, emphasizing the importance of diversifying revenue sources. Exchange rate (EXCHR) fluctuations do not significantly predict changes in total revenue. Based on the findings, policy recommendations include diversifying revenue sources, enhancing non-oil revenue collection, effective oil revenue management, promoting economic diversification, strengthening tax infrastructure, and adopting prudent budgeting practices.

Keyword: Crude Oil Price, Oil Revenue, Non-Oil Revenue, Exchange Rate, Auto Regressive Distributed Lags Approach
JEL Classifications: E3; E61; C22

1. INTRODUCTION

Energy is a crucial factor in the progress of nations across the world and serves as a significant source of government revenue, thereby directly impacting the revenue generation and invariably economic growth of countries, particularly developing nations of which Nigeria is one. However, due to its high demand, the oil market is often influenced by the market forces of supply and demand, which are usually determined by the global price index (Alekhina and Yoshino, 2018). The fluctuation of oil prices on a global level is referred to as volatility. This indicates that the prices are exogenous and determined by external factors that are beyond Nigeria's control, ultimately affecting the stability of the Naira.

Ujunwa (2015) attributes the recent oil price fluctuation (a significant up and drop in oil prices) to various factors, including an unexpectedly high supply of oil, weakened global demand for oil due to advances in the technology used in the production processes such as shale production techniques in the United States, a continuous increase in oil production from non-OPEC economies, and the rapid way recovering from the stress that was confronting oil production in some OPEC producers (for example, Iran). Additionally, OPEC's decision in November 2014 to keep oil production levels constant despite the substantial drop in prices suggests that this trend may persist in the foreseeable future.

Changes in energy prices can also affect aggregate demand, of which investment is a significant component (Bjørnland, 2019). When oil prices rise, income is usually transferred from oil- importing economies to their counterparts who export oil, leading to reduced revenue for oil importers. As a result, rational consumers in oil- importing countries may cut back on their consumption spending and investment, reducing overall demand and output. However, if the increase in revenue for oil exporters

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leads to greater demand from the additional revenue transferred to them from oil importers, the global effect may be minimized.

Particularly in a one- sided economy such as Nigeria, oil price uncertainty makes it difficult to ascertain the direction of the economy as a result of its perceived consequences of depleting the oil revenue coupled with the perceived improper allocation/mismanagement associated with the revenue in question. Argument abound as to why an oil- producing economy like Nigeria should import refined petroleum instead of refining it locally for consumption in the domestic economy. Studies such as Akinleye and Ekpo (2013) posit the importation of refined petroleum plays a significant role in declining in revenue generation resulting from value addition, thus making the domestic oil price higher compared to the price that would have been set by the local market if the refine locally. This has caused the devaluation of the revenue of the affected Nation. In contrast, Budina and Van Wijnbergen (2008) are of the opinion that the challenges are associated with inappropriate management of the proceeds from oil achieved, viewing the role played by fiscal policy in an attempt to control the fluctuation of oil wealth and its perceived implications for debt and development of the nation.

Consequently, the lesson learned from the oil price fall in the most recent period particularly in 2019 when oil price decline from $114 a barrel to below $50, with a further declined to below $35 a barrel in 2021 by IMF is evidence that continuous and persistent fall in oil prices exerts a more significant effect on the revenue generation of oil dominant economy like Nigeria relative to the importation of refined petroleum (Adugbo, 2016).

Particularly from 2021 to date, the global economy has been rocked by a sudden and sharp decrease in crude oil prices, which seems to exert an effect on the Nigerian economy. This has been particularly hard hit in several areas, including a decline in foreign reserves, a currency crisis, a reduction in government revenue, and a potential threat to meeting financial obligations in a timely manner.

The implications of these challenges have not gone unnoticed, and both policymakers and academics have been working hard to come up with solutions to mitigate the negative impacts. This has led to the implementation of a wide range of policies, such as the promotion of diversification in the economy, the reinvigoration of once viable sectors, subsidy removal, the anti-corruption campaign, and a cut in government fiscal responsibility and its cost implication.

Nigerian economy, as we all know has been heavily dependent on revenue generated from the production and export of crude oil. As a result, the successive fall in oil prices has significantly impacted the country's foreign exchange earnings. This has had a ripple effect on various sectors of the economy, causing them to suffer and slow down.

There is no doubt that oil dominates the national economy of Nigeria, considering its significant role in adding to the revenue-based at national. Take, for example, the statistical bulletin of CBN (2011) records that proceeds from oil contributed about 85.1%, 87% and 90% to the earning from the foreign exchange of the national economy in 2017, 2018, and 2019 respectively, in 2021 this has increased to 98.21%. In like manner, the total export revenue generated for the national economy amounted to US$70,579 million, in 2019, out of which US$61,804 million which is about 87.6% was contributed by revenue generated from petroleum.

The empirical underpinning posits that the price of oil generally is one of the highly unstable prices that normally exerts a strong influence on the aggregate economies of many developed and developing nations, as opined by Guo and Kliesen (2005) and closely backed by Ferderer (1996). Other studies that subscribed to this conclusion include (Mehrara, 2008; Salisu and Fasanya, 2013). The work of further, Mork et al. (1994), Guo and Kliesen (2005), Narayan and Narayan (2007) Mandal and Datta (2024) further lent their support to the ongoing argument.

Though, in the quest to reduce the influence of this fluctuation, the Nigerian government was left with no option but to reduce the projected oil revenue from an expert of the year 2016 to N820 billion based on a price pegged at $38/barrel relative to the initial projected oil earnings of N3.9 trillion pegged at a price prediction of $53/b in 2015 (Adugbo, 2016). Consequently, the issue turned out to be worse rather than lubricating the economy to a point of stability. This raised serious concern and a question that is begging for answers as follows: what will turn out to be the fate of the average Nigerian whose minimum take home pay is just <N30,000.00 (US $ 665.2996) after tax deduction?

The effect of the fall in oil price eventually distorted revenue generation which in turn affected the government budget, as a result the economy was engulfed with serious economic distress as evidently seen in capacity underutilization of local refineries, poor infrastructural facilities, high rate of poverty and unemployment coupled with a surge of instability in the political sphere and corruption, thereby undermining the overall performance of the national economy through the multiplier effect (Akinlo, 2012; Udoh, 2014 and Adugbo, 2016).

Hence, the effect of the price of crude oil instability on revenue generation in Nigeria is a critical research problem that requires further investigation knowing that Nigeria is a resource-rich country that is heavily reliant on crude oil exports as its primary source of revenue. However, the volatile nature of oil price seems to have resulted in a significant fluctuation in revenue generation, which has had severe implications for the country's economy. Despite numerous studies on this topic, there is still a gap in knowledge regarding the extent of the problem and its long-term effects on Nigeria's economic development. Therefore, this study is necessary to examine the impact of crude oil price volatility on revenue generation in Nigeria from 1981 to 2021. Also, this study aims to recommend practical strategies to mitigate the negative effects of crude oil price volatility on revenue generation and promote sustainable economic growth.

2. THE RESOURCE CURSE THEORY AND EMPIRICAL REVIEW

The Nigerian economy regarded oil revenue as both a blessing and a curse. It was considered a significant source of wealth

for the country, but at the same time, it resulted in the neglect of other sectors (Agbaeze and Ukoha, 2018). The concept of the resource curse was introduced by Richard Auty in 1993. It describes how countries with an abundance of natural resources often fail to benefit fully from their wealth and experience slow economic development compared to resource-poor countries. This phenomenon is also known as the paradox of plenty (Ogunbiyi and Abina, 2019). The theory is based on a surprising finding that natural resource abundance can be detrimental to economic growth. Sachs and Warner's research on resource-rich countries from 1970 to 1989 sparked a surge in studies on this topic. They found a correlation between the intensity of the resource curse and economic performance (Toyon, 2021).

Resource-rich economies mostly tend to be overwhelmed with higher rates of conflict and authoritarianism and lower rates of economic stability and advancement relative to their non-resource-rich counterparts. Despite the expectation of better development outcomes after the discovery of natural resources, the resource curse theory suggests that governments in these countries are often unable to respond effectively to public welfare needs (Akinleye et al., 2021).

The resource curse theory also postulates that resource-rich countries fail to develop their infrastructure and other economic sectors, leading to financial problems. Instead, they are forced to rely on other nations for goods and services, which they end up losing revenue. This is because the revenue generated from exported products to other countries is used to purchase finished products at a high cost (Ogunbiyi and Abina, 2019).

Hardin (1986) observed that when natural resources are freely accessible, they tend to be overexploited, leading to socio-political and interstate conflicts. This, in turn, hinders the government's ability to provide essential services to its citizens.

Several scholars have tried to explain the connection between crude oil price fluctuation and revenue generation in Nigeria. Hence this section discusses the review of pertinent and related literature studies on the influence of the price of crude oil instability on revenue generation. In their study, Manasseh et al. (2021) employed the Vector Error Correction model to examine the relationship between oil revenue and the welfare of Nigerians. Their findings indicate that oil price fluctuations do not significantly affect well-being. The researchers suggest the establishment of a savings plan for crude oil revenue during boom times and propose delegating responsibility for managing excess crude oil accounts to Nigeria's central bank.

Ahmed and Habiba (2022) conducted a study to investigate the impact of oil price and oil production on Nigeria's economic growth from 1989 to 2020 using the Autoregressive Distributed Lag (ARDL) model. The ARDL bounds test results indicated the existence of co-integration among the variables. The ARDL model estimates revealed a positive relationship between oil price and economic growth, both in the short and long term. However, the study found that oil production has a negative impact on real GDP in the short term, while its effect in the long term is statistically insignificant.

In their study, Babuga and Ahmad (2022) analyzed the interplay between the volatile nature of crude oil prices and economic expansion in Sub-Saharan African (SSA) countries from 1990 to 2018. The authors used a dynamic heterogeneous panel PMG estimation to analyze the data, and found that a threshold level links oil price increases with economic expansion in these countries. Specifically, the results showed a non-linear, inverted U-shaped relationship between oil prices and real GDP, whereby an increase in oil prices above a certain threshold level is associated with a decrease in real GDP.

Olujobi et al. (2022) examined how oil price shocks affect Nigeria's economy and explored legal solutions to enhance economic resilience and reduce future risks. To analyze the data, the researchers utilized a Vector Error Correction model. The study highlights the potential of existing laws as a proactive measure to mitigate the impact of oil price shocks on the economy. The key findings suggest that crude oil production and prices contribute positively to real growth. However, they also have a negative impact on growth, which cannot be sustained in the long term.

Onodje et al. (2022) investigated the effect of crude oil prices on the exchange rate in Nigeria, focusing on distinguishing the influence of favourable and unfavourable changes in oil prices on the exchange rate. The study utilized a monthly flow of data from 1996:1 to 2019:6 and adopted a non-linear ARDL (NARDL) model with duo oil price proxies, Brent crude as well as West Texas Intermediary prices, and Wald tests to determine co-integration and asymmetric effects. The finding indicated that both favourable and inverse changes in Brent crude prices had a strong influence on exchange rates in the immediate and future terms, with differences only observed in the magnitude of the effect as the exchange rate declined for both positive and negative oil price changes.

The influence of Oil Price instability on economic progress in Nigeria from 1984 to 2017 was examined by Ifeonyemetalu et al. (2020). The study utilized the Generalized Auto-Regressive Conditional Heteroscedasticity (GARCH) (1, 1) model to estimate the influence of oil price fluctuations on economic progress in Nigeria. The results indicate that oil prices have a favourable and strong effect on economic progress in Nigeria. Additionally, although instability in oil prices has favourable effects on economic progress, they are not significant.

Baba (2020) conducted a vector autoregressive analysis of oil price instability and economic expansion in Nigeria spanning from 1997 to 2017. According to the study, the initial lag in GDP growth exerts a favourable and strong influence on current GDP expansion, while it has an inverse and strong effect on current oil price instability. Additionally, the second lag in GDP growth has an a unfavourable and significant influence on oil price volatility.

Musa et al. (2020) employed the use of the autoregressive distributed lag (ARDL) model to examine the effect of crude oil prices on exchange rates in Nigeria from 1983 to 2017. The finding shows that crude oil price exerts a strong inverse effect on exchange rates, both in the immediate and future terms.

Additionally, oil revenue and GDP exerts a strong favourable effect on exchange rates in both the immediate and future term.

Akinsola and Odhiambo (2020) conducted a literature review on the possible connection between oil prices and economic expansion in oil-importing economies, covering developed, emerging, and developing nations. There was significant evidence supporting an inverse link between oil prices and economic expansion, particularly in developed economies. While a rise in oil price was consistently associated with reduced economic expansion, a decrease in oil price had little effect on economic growth in developing countries.

Agu and Nyatanga (2020) examined how changes in oil prices affect economic expansion in Nigeria using Quarterly flow of data spanning between 1980 Q1 and 2018 Q4. The researchers used the new Hamilton Index within the Structural Vector Autoregressive (SVAR) framework to analyze how macroeconomic variables respond to sudden oil price fluctuations. The study revealed that negative changes in oil prices exert a greater influence on economic expansion than other types of oil price movements. In addition, the study found that macroeconomic policies such as rates of interest and money supply can effectively drive economic output in Nigeria. Overall, the research concludes that the exchange rate, money supply, and interest rate are channels through which oil prices are transmitted to economic output.

Akinsola and Odhiambo (2020) investigated the effect of oil prices on economic expansion in seven low-income oil-importing SSA countries, using Panel-ARLD within the time frame which span between 1990 and 2018. The finding revealed that, while the short-term impact of oil prices on economic expansion in these countries was mixed, the long-term impact was negative and significant. To further explore this relationship, the study adopted NARDL model and the there was evidence that decline in oil prices exerts a favourable and strong effect on economic expansion, whereas a rise in oil prices exerts a strong inverse effect.

Manasseh et al. (20191) examine the effect of oil price instability and changes in the exchange rate on the performance of economic activities using multi-regression analysis and generalized autoregressive conditional heteroscedastic (EGARCH) model. Finding revealed evidence of link between the variable under studiedFindings revealed evidence of a link between the variable under variables under study. Particularly, a 10% rise in oil price resulted to in a 19% surge in the real exchange rate in the future term.

Adeleke et al. (2019) understudied the empirical connection between crude oil price instability and macroeconomic performance in some oil- dependent economies in Africa with the period 1980 to 2016, using the panel structural vector-regressive model, and Hamiton index (1996. Findings from the estimated model shows that oil production naturally responds to drastic instability in oil prices in differ. It was also discovered that a fall in oil prices has the capacity to cause a structural inflation in the national economy.

Adeniran et al. (2014) subscribed to the stand point that instability inin the exchange rate will exerts a strong favourable effect on economic expansion, while Akpan and Atan (2015) by adopting a quarterly flow of data for the period 1986 to 2016 submit a no evidence of the direct link between instability in the exchange rate and productivity expansion in Nigeria. Akhmedov (2019) examined the topic under consideration and lent support to favourable influence of oil price instability on macroeconomic variables in Kazakhstan.

The study of Bulimu (2019) examines the effect of oil price instability on the tax revenue and government expenditure in Kenya by adopting a data set from 1980 to 2018, while using the VARM method. Findings shows that oil price instability exerts a negative influence on tax revenue, and recurrent and capital expenditure of the nation's economy during the under- studied period. The work of Hem and Kamal (2015) examined the effect of oil price instability on productivity, inflation, and real exchange rate in selected ASEAN economies by adopting the Structural VAR model. Findings shows an evidence of cointegration, while the impulse response function revealed an evidence of no future effect of oil price uncertainty on the economies of the studied area. Consequently, price instability does not account for a strong change in the variable under studied study, as supported by (See: Akpan and Atan 20112, Ogunkanmi et al., 2014) as well as Adeniran et al. (2014). Oriakhi and Osaze (2010) examine the subject matter in the case of Nigeria, and the result proved that oil price volatility exerts a strongly favourable effect on government expenditure. Oluwatoyin and Adegboye (2014) found that instability from oil prices exerts strong effects on economic expansion in Nigeria as supported by the study of Englama et al. (2010).

3. RESEARCH METHODOLOGY

This section will deal with the description of the approach to be used in the estimation of the model of this study. The choice of method of estimation may be a challenge at times because the adoption of a wrong method can lead to a spurious regression.

3.1. Model Specification

This study is modeled after the Linear/Symmetry Relationship Theory and empirically takes after the work of Ifeonyemetalu et al. (2020) and Musa et al. (2020) and with a slight modification. Specifically, these works by Musa et al. (2020) make use of oil price, oil revenue, and exchange rate as there major independent variabletheir major independent variables. However, this study takes after their work by including non-oil revenue to in the model.

For the purpose of this study, the relationship between the dependent and independent variables is specified as follows:

$$Rev = f(OPV, ORV, NRV, Exchr) \quad 1$$

Where;
REV – Total Revenue Generated
OPV – Crude Oil Price
ORV – Oil Revenue
NRV – Non-oil Revenue
Exchr - Exchange rate

The exact form of the above linear function (equation 2) expressed in econometric form can be rewritten as:

$$REV = \alpha_0 + \beta_1 OPV_t + \beta_2 ORV_t + \beta_3 NRV_t + \beta_4 Exchr_t + \mu_t \quad 2$$

To ensure unison in the measurement of the variables in this model the variables employed in this model are logged except exchange rate. Hence, the logged model specification is given as:

$$LNREV = \alpha_0 + \beta_1 LNOPV_t + \beta_2 LNORV_t + \beta_3 LNNRV_t + \beta_4 Exchr_t + \mu_t \quad 3$$

Where, ln is natural logarithm and μ_t is error term.

3.3.1. A priori expectation

$\beta_1 > 1, \beta_2 > 1, \beta_3 > 1$ and $\beta_4 < 1$: Specifically, this implies that, oil prices will contribute to revenue generation.

3.2. Stationarity Tests

The first important test to conduct while analyzing a time series data is the Unit root test. A unit root test is done to test if the variables under consideration are stationary or non- stationary, and to discover the order of integration. A variable is stationary when shock fades away gradually overtime but, a variable is non-stationary when shock are permanents.

Augmented Dickey Fully (ADF) is one of the most popular unit root test. It tests the null hypothesis that a variable has a unit root (non-stationary) against the alternative hypothesis that a variable does not have a unit root (stationary). The ADF test relies on estimating the test regression:

$$\Delta Y_t = \alpha_0 + p_1 Y_{t-1} + \sum_{i=1}^{k} \alpha_i \Delta Y_{t-1} + \mu_t \quad 4$$

Where:

ΔY_t is change in Y_t, ΔY_{t-1} captures serial correlation, μ_t is error term, t is lag trend, k is lagged value of ΔY. The unit root test is then carried out under the null hypothesis $\gamma = 0$ p = 0 against the alternative hypothesis of $p < 0$.

Decision rule:

If ADF statistics > critical value - Variable is Stationary.

If ADF statistics < critical value - Variable is non-stationary.

At Significant level of 5% level.

3.3. ARDL Co-integration Test

The ARDL Long-run and bound test is used to test the long-run interaction between crude oil price instability and revenue generation in Nigeria. It tests the null hypothesis that there is no co-integration among the variables. This relationship is detected using the F-Statistics. The F statistics is are compared with two asymptotically sets of critical values: the lower bound I(0) and the upper bound I(1).

If the F-statistics is greater than the upper bound critical value, there exists a long- run relationship among the variables, but if the F-statistics falls below the lower bound critical value there exists no long- run relationship between the variables, and, if the value of the F-statistics falls between the lower bound and upper bound critical value then the state of the long run relationship is inconclusive Yakubu et al (2015).

To perform the bound test for co-integration, the model employed for this study is specified as:

$$\Delta lnREV_t = \alpha_{01} + \beta_{11} lnREV_{t-i} + \beta_{21} lnOPV_{t-i} + \beta_{31} lnORV_{t-1} + \beta_{41} lnNRV_{t-1} + \beta_{51} Exchr_{t-1} + \sum_{i=1}^{p} \alpha_{1i} \Delta lnREV_{t-1} + \sum_{i=1}^{q} \alpha_{2i} \Delta lnOPV_{t-1} + \sum_{i=1}^{q} \alpha_{3i} \Delta lnORV_{t-1} + \sum_{i=1}^{q} \alpha_{4i} \Delta lnNRV_{t-1} + \sum_{i=1}^{q} \alpha_{5i} \Delta Exchr_{t-1} + \mu_{1t} \quad 5$$

Hypotheses:

H_0 *(longrun relationship does not exsits)*: $\beta_{1i} = \beta_{2i} = \beta_{3i} = \beta_{4i}$ H_1 (*longrun relationship does exsits*): $\beta_{1i} \neq \beta_{2i} \neq \beta_{3i} \neq \beta_{4i}$ (i = 1, 2)

Hence, lack of co-integration shows that a variable has no long-run relationship.

3.4. Error Correction Mechanism (ECM)

The ECM is used to reveal the speed of adjustment from the immediate period equilibrium to the future equilibrium state. After conducting the co-integration test, it is important to estimate the ECM to ensure the variables would converge to long-run equilibrium. To ensure convergence, the coefficient of the lagged ECT_{t-1} must be negative and >10%. A positive coefficient would indicate a divergenence from the long-run equilibrium and any coefficient <10% would indicate a very slow speed of adjustment or no adjustment, which means the long-run relationship would no longer makes sense.

The error correction model for the estimation of the short-run relationship is given as:

$$\Delta lnREV_t = \alpha_{02} + \sum_{i=1}^{p} \alpha_{1i} \Delta lnREV_{t-1} + \sum_{i=1}^{q} \alpha_{2i} \Delta lnOPV_{t-1} + \sum_{i=1}^{q} \alpha_{3i} \Delta lnORV_{t-1} + \sum_{i=1}^{q} \alpha_{4i} \Delta lnNRV_{t-1} + \sum_{i=1}^{q} \alpha_{5i} \Delta Exchr_{t-1} + \lambda ECT_{t-1} + \mu_{2t} \quad 6$$

Where; α_{1i}, α_{2i}, α_{3i}, α_{4i}, are the short-run dynamic coefficients. $\lambda = (1 - \sum_{i=1}^{p} \delta_i)$ which is the speed of adjustment parameter with a negative sign. $ECT = (lnREV_{t-i} - \theta X_t)$ where θ is the long-run parameter.

4. EMPIRICAL RESULTS AND DISCUSSION

This section unveils the outcomes of this study analysis. We start by providing a snapshot of key numbers summarizing specific variables: Total revenue (REV), oil price volatility (OPV), oil

revenue (ORV), non-oil revenue (NRV), and exchange rate (EXCHr). We examine trends in these variables, assess their stationarity through unit root tests, perform co-integration tests using ARDL, estimate the models, conduct diagnostic tests post-estimation, assess Granger causality, and finally, engage in a detailed discussion of the results. Table 1 displays a summary of the key findings from our research study, providing an overview of various factors from 1981 to 2021 in Nigeria. We used the original (raw) data to calculate these descriptive statistics. It's important to note that apart from OPV (measured in USD) and EXCHR (measured in %), all other variables are expressed in billions of Naira (₦).

In terms of oil revenue (ORV), the average earnings from oil stood at ₦2.5 trillion, with a range spanning from a modest ₦7.3 billion to a substantial ₦8.9 trillion. This variation underscores the disparities in the revenue generated from the production, sale, and export of oil. Looking at non-oil revenue (NRV), the average earnings from non-oil stood at ₦1.2 trillion, with a range spanning from a modest ₦2.98 billion to a substantial ₦6.4 trillion. This variation underscores the disparities in the revenue generated from taxes (such as income tax, corporate tax, and value-added tax), customs duties, fees, fines, and income from non-oil industries and sectors like manufacturing, services, and agriculture. The exchange rate (EXCHR) averaged ₦108/USD, with the lowest EXCHR recorded at N0.62/USD and the highest at N401.2/USD. This variance in EXCHR highlights the fluctuation of the Nigerian Naira in relation to the US dollar throughout the study period, reflecting changes in currency value.

Furthermore, this study employed skewness to assess the distribution of these variables around their mean. Positive skewness suggests that there is a tendency for values to be higher than the mean, while negative skewness implies the opposite. Notably, all variables exhibited positive skewness, indicating a prevalence of higher values compared to the mean.

We also utilized kurtosis and the Jarque-Bera test to evaluate the tail behavior and distribution normality of the variables. A variable would be considered normally distributed if the Jarque-Bera probability exceeded the standard 5% significance level. In this study, all variables were found to be normally distributed. Interestingly, all variables displayed Kurtosis values <3 except NRV and exchr, indicating that the majority of their values fell below their respective sample means.

In this study, we conducted unit root tests on the variables of interest to determine their stationary properties and ensure they do not exceed order one (I [1]). To achieve this, we employed both the Philip-Perron (PP) Test and the Augmented Dickey-Fuller (ADF) unit root test. Our conclusions and interpretations are based on the commonly accepted rule of thumb, which states that if the P-value is less than or equal to the 5%° of freedom, then the variable is considered stationary.

According to Table 3 below, the results of the Bounds test shows that the estimated F-statistics (33.55) is greater than the lower and upper bounds presented in (table 4) bounds at 5% significance (2.56 and 3.49 respectively). This means that there is evidence of at least one significant co-integrating equation among the series, further implying that there is a significant long-run relationship among them.

Therefore, our findings indicate a mixed order of integration among these variables. This observation guides our decision to use the Auto Regressive Distributed Lags (ARDL) model to estimate the relationship between oil revenue and its determinants, as this model is suitable for situations where variables have different orders of integration.

Accordingly, the ARDL Bounds test is the most suitable technique for determining co-integration among the variables.

According to Table 3 below, the results of the Bounds test shows that the estimated F-statistics (33.55) is greater than the lower and

Table 1: Summary statistics of specified variables

Summary Stat.	REV (N)	OPV (USD)	ORV (N)	NRV (N)	EXCHR (%)
Mean	3780.098	38.93146	2533.522	1255.918	108.0868
Maximum	11,116.85	99.67000	8878.970	6397.140	401.1520
Minimum	10.50870	0.000000	7.250000	2.980000	0.617708
SD	4044.960	30.56514	2694.565	1647.051	109.9700
Skewness	0.564117	0.588652	0.669365	1.330335	0.978891
Kurtosis	1.734546	2.219724	2.165181	3.925352	3.189257
Jarque-Bera	4.910238	3.407912	4.252251	1.355638	4.609079
Probability	0.085853	0.181962	0.119299	0.711138	0.066716
Observations	41	41	41	41	41

Source: Researcher's compilation from E-views 10. SD: Standard deviation, REV: Revenue, OPV: Oil price volatility, NRV: Nonoil revenue, EXCHR: Exchange rate, ORV: Oil revenue

Table 2: Stationary unit root test

Variables	PP test		ADF		Decision	
	Level, P	First difference, P	Level, P	First difference, P	Stationarity	Integration
LNREV	0.5142	0.0000	0.5538	0.0000	1st difference	I (1)
LNOPV	0.7018	0.0001	0.6415	0.0001	1st difference	I (1)
LNORV	0.3866	0.0000	0.4421	0.0000	1st difference	I (1)
LNNRV	0.2831	0.0000	0.0000	0.7121	Level	I (0)
EXCHr	1.0000	0.0043	1.0000	0.0032	1st difference	1 (1)

Source: Author's compilation. PP: Philip-Perron, ADF: Augmented dicky fuller, EXCHr: Exchange rate

upper bounds presented in (Table 4) bounds at 5% significance (2.56 and 3.49 respectively). This means that there is an evidence of at least one significant co-integrating equation among the series, further implying that there is a significant long-run relationship among them.

Table 4 provides insights into the estimated coefficients of the short-term relationship and the error correction term (ECT). According to the table, the estimated model demonstrates statistical significance, as evidenced by the P-value of the F-statistic (0.0000 < 0.05). This indicates that at least one of the regressors exerts a significant effect on the target variable, REV (total revenue). Additionally, the adjusted R-Squared value suggests that approximately 80% of the variations in total revenue between 1981 and 2021 can be attributed to the specified explanatory variables, namely oil price, oil revenue, non-oil revenue, and exchange rate.

Upon closer examination of the short-run probability values of the variables, it becomes clear that all the regressors are significant in the short run. Specifically, the short-term impact of oil price (OPV), oil revenue (ORV), non-oil revenue (NRV), and exchange rate (EXCHr) on total revenue is as follows:

Oil price (OPV) exhibits a positive coefficient and a p-value of ($\beta = 0.101848$, $P = 0.0249 < 0.05$), signifying a strong favourable effect on REV in the short run. In practical terms, a 1% increase in OPV will lead to a 10% rise in the current year's REV in the immediate period, assuming all other factors remain constant. This aligns with prior expectations as further supported by the findings of Olujobi et al. (2022), Ifeonyemetalu et al. (2020) and Akinsola and Odhiambo (2020).

The relationship between Rev and oil revenue (ORV) indicates that given a 1% rise in ORV will turn out to cause a 72% rise in revenue in the short run, with a statistically significant coefficient ($P = 0.000 < 0.05$). Likewise, a 1% rise in non-oil revenue will result to a significant improvement of 19% in REV. This result conforms to the a priori expectation. Empirically, this finding corroborates with the work of Musa et al. (2020).

Similarly, the connection between REV and exchange rate (Exchr) reveals a statistically significant and positive result. It suggests that a 1% rise in exchange rate will lead to a 0.07% increase in Rev in the short run, all else being equal. The ECT, representing long-run coefficients, is also statistically significant ($0.0000 < 0.05$) with a negative coefficient of −0.939. This implies that deviations of oil revenue in the future period will be corrected at a rate of 94%. In other words, any deviation of REV from its equilibrium will be adjusted at an annual rate of 94%. Furthermore, the Durbin-Watson statistic is 1.8985, which is approximately 2, indicating the absence of serial correlation.

Analyzing the results in Table 5, we find that the probability value associated with oil price (OPV) is 0.4339, indicating its statistical insignificance at the 5% level. In contrast to the short run, a negative and insignificant relationship emerges between oil prices and total revenue in the future period. Specifically, a 1% increase in OPV results in a 1.9% decline in Rev in the long run, assuming all other factors remain constant. This finding aligns with the Linear/Symmetry Relationship Theory, which posits a linear negative connection between oil prices Cumulative Sum of Squares (CUSUM) in tests and economic expansion. In practical terms, as oil prices rise over the long term, there is greater pressure on inflation, leading to reduced demand for oil and consequently lower revenue and economic growth. This empirical result is supported by the findings of Baba (2020) and Akinsola and Odhiambo (2020).

Conversely, there exists a favourable and statistically strong connection between oil revenue (ORV) and total revenue in the long run. The probability value associated with ORV is 0.0000, demonstrating its statistical significance at the 5% significance level. The coefficient for ORV indicates that a 1% increase in ORV results in a substantial 76% increase in total revenue in the long run, all else being equal. This outcome supports the prior expectation that higher oil revenue levels stimulate revenue generation. Similarly, a 1% increase in NRV results in a substantial 20% increase in total revenue in the long run, all else being equal.

Lastly, the probability value for the exchange rate is 0.0000, indicating its statistical significance at the 5% significance level. The coefficient associated with the exchange rate suggests a negative relationship with total revenue in the long run. Specifically, a 1% increase in the exchange rate (Exchr) leads to

Table 3: Bounds test co-integration

F-bounds test		Null hypothesis: No levels relationship		
Test statistic	Value	Significance (%)	Asymptotic: n=1000	
			I (0)	I (1)
F-statistic	33.55302	10	2.2	3.09
K	4	5	2.56	3.49
		2.5	2.88	3.87
		1	3.29	4.37

Source: Authors compilation

Table 4: Short run coefficients

Explanatory variables	Coefficient	SE	t-statistic	P	Remark
LNOPV	0.101848	0.042693	2.385626	0.0249	Significant
LNORV	0.717871	0.028637	25.06809	0.0000	Significant
LNNRV	0.190740	0.020475	9.315758	0.0000	Significant
EXCHR	0.000732	0.000146	5.023498	0.0000	Significant
ECT_{t-1}*	−0.939034	0.019105	−49.15096	0.0000	Significant
Adjusted R^2	0.799569	R^2	0.899663		
F-statistic	10592.44	Durbin-Watson stat		1.898509	
P (F-statistic)	0.000000				

Source: Author's compilation from E-views 10. EXCHR: Exchange rate, SE: Standard error, ECT: Error correction term

Figure 1: CUSUM and CUSUM-square

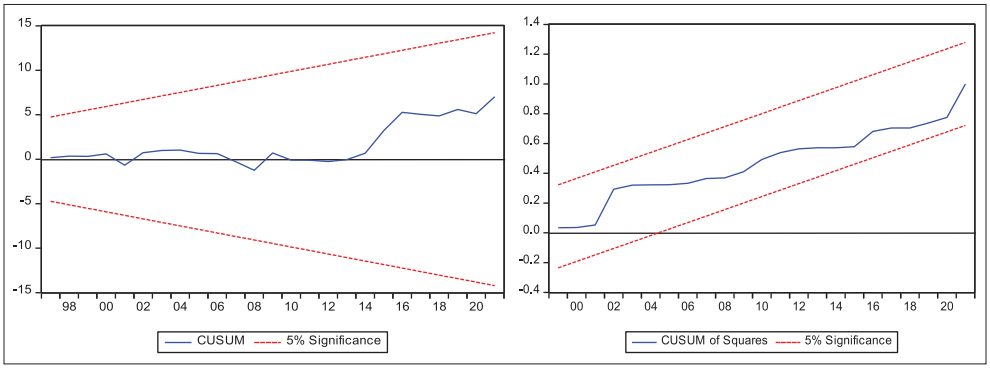

Table 5: Long-run relationship

Cointegrating Eq	Coefficient	SE	t-statistic	P
LNOPV	−0.017921	0.022531	−0.795383	0.4339
LNORV	0.764478	0.019673	38.85874	0.0000
LNNRV	0.203124	0.020728	9.799643	0.0000
EXCHR	−0.000779	0.000152	−5.118115	0.0000

Source: Author's compilation. SE: Standard error, EXCHR: Exchange rate

Table 6: Results for diagnostics tests

Tests	Statistic	P	Decision
Normality	0.31809	0.853	Residuals are normal (normally distributed)
Serial correlation	0.001588	0.9984	No serial correlation
Heteroscedasticity	1.976196	0.0992	No case of heteroskedasticity
Ramsey reset	1.378904	0.1806	Model is well specified

Source: Researcher's compilation from E-views 10

Table 7: Granger causality result

Null hypothesis	Obs	F-statistic	P
LNOPV failed to granger cause LNREV	33	1.74166	0.1937
LNREV failed granger cause LNOPV		1.14885	0.3315
LNORV failed granger cause LNREV	39	3.77765	0.0353
LNREV failed granger cause LNORV		0.00287	0.9971
LNNRV failed granger cause LNREV	39	5.75320	0.0081
LNREV failed granger cause LNNRV		2.35090	0.1106
EXCHR failed granger cause LNREV	39	1.94696	0.1583
LNREV failed granger cause EXCHR		1.90524	0.1643

Source: Researcher's compilation from E-views 10. EXCHR: Exchange rate

a significant 0.08% decrease in REV over the long term, all else being equal.

Following the estimations of the ARDL model, five (5) diagnostic tests were run to verify the accuracy, reliability and stability of the model as presented in Table 6.

As shown in Table 6, the residual normality test examines whether the residuals of the dependent variable adhere to a normal distribution. In this instance, the table indicates that the probability of the residuals following a normal distribution is 0.85, which is higher than 0.05. This implies that we do not have sufficient evidence to reject the null hypothesis, indicating that the residuals indeed exhibit a normal pattern. In simpler terms, it appears that the residuals conform to a normal distribution.

Likewise, the results of the Breusch-Godfrey LM test demonstrate the absence of serial correlation in the estimated model, as the P-value (0.998) exceeds 0.05. This suggests that the model is reliable because there is no indication of serial correlation, which could compromise the validity of the results.

The Heteroscedasticity Test indicates no evidence of heteroscedasticity in the model, as the P-value (0.0992) is >0.05. This implies that the model is homoscedastic, meaning that the variance of the residuals remains relatively consistent across different levels of the independent variables. This is a desirable characteristic for a reliable model. Furthermore, the Ramsey Regression Specification Error Test (RESET) implies that the model is stable, well-fitted, and adequately specified. The P-value (0.1806) surpasses 0.05, indicating that the existing model does not require additional independent variables to significantly explain changes in total revenue (Rev). In other words, the current model is sufficient for elucidating variations in oil revenue.

Lastly, the Cumulative Sum of Squares (CUSUM) in tests in Figure 1 confirms the model's stability. This conclusion is evident as the parameters of the estimated model (represented by the thin blue line in Figure 1) fall within the 5% critical level (represented by the red lines).

The Granger Causality test helps us understand if one variable, let's say X, is causing changes in another variable, Y. In simpler terms, it checks if changes in Y can be predicted by looking at the history of X. Here are the key findings from the Granger Causality Tests, focusing on the relationship between total revenue (REV) and other variables, as presented in Table 7: There is a one- way causal effect running from oil revenue to total revenue, and from non-oil revenue to total revenue. Other relationship could not be established. In summary, the Granger Causality test results provide valuable insights into the relationships between these key variables. Oil price and oil revenue do not significantly influence each other, while oil revenue and non-oil revenue appear to significantly impact total revenue. However, exchange rate changes do not significantly predict changes in total revenue.

5. CONCLUSION AND POLICY GUIDES

The primary objective of this research was to assess the impact of crude oil price volatility on total revenue in Nigeria. The estimation

results from the study indicate that oil price, oil revenue, non-oil revenue, and exchange rate exert a strong effect on total revenue in the national economy of Nigeria within the immediate period. However, in the future period, only oil and non-oil revenue exhibit a positive impact on total revenue. This means that as oil and non-oil revenue increases, there is a corresponding increase in total revenue. On the other hand, the influence of oil price and exchange rate on total revenue in the long run is not positive; this study found that they have a negative effect on total revenue over the long term.

This research has shed light on the intricate interaction between oil price volatility and total revenue in Nigeria over the past four decades. The findings suggest that oil revenue, non-oil revenue, and exchange rate play pivotal roles in influencing total revenue. This information can be invaluable for policymakers, economists, and stakeholders seeking a deeper understanding of Nigeria's oil sector dynamics.

Basically, the findings of this study carry profound implications for Nigeria's economic stability and policy formulation. First and foremost, the revelation that oil price volatility does not significantly impact total revenue in the long run underscores the need for diversified revenue sources. While oil revenue remains a critical component, the study emphasizes the importance of developing and nurturing non-oil revenue streams. This diversification can mitigate the country's vulnerability to the inherently volatile nature of oil markets.

The significant relationship observed between oil revenue and total revenue reaffirms the pivotal role of prudent oil revenue management. It emphasizes the urgency of effective mechanisms for saving and investing oil revenue, safeguarding against the fluctuations in oil prices, and ensuring sustainable economic development.

In addition to the above the following strong policy recommendations are proposed:

First, given the volatility of oil prices, it is imperative for Nigeria to exercise fiscal discipline. Establishing a robust sovereign wealth fund that saves excess revenue during periods of high prices and provides a buffer during price downturns is essential. This fund can be used for critical infrastructure development and economic diversification projects.

Secondly, the Nigeria's overreliance on oil revenue makes the country vulnerable to the effects of crude oil price volatility. Therefore, it is recommended that the government should prioritize economic diversification policies that would promote growth in other sectors of the economy, such as agriculture and manufacturing, to reduce the reliance on oil revenue.

Thirdly, the government should enhance the efficiency and effectiveness of non-oil revenue collection mechanisms. Implement modern tax collection methods, improve compliance, and broaden the tax base to increase revenue from income tax, corporate tax, value-added tax (VAT), and customs duties.

Fourthly, despite the limited direct impact of oil price volatility on total revenue, it remains vital to manage oil revenue effectively. Establish an Oil Revenue Stabilization Fund to save excess oil revenue during periods of high prices and use it to cushion budget deficits during low-price periods.

Finally, the study findings suggest that exchange rate fluctuations have a positive significant effect on total revenue in the short run but become negative and significant in the long run. As such, it is recommended that the government should strengthen its exchange rate policies to promote stability in the currency, which would reduce the impact of exchange rate fluctuations on revenue. Effective exchange rate policies are critical to support the oil industry's long-term sustainability. Policymakers should consider strategies to mitigate exchange rate fluctuations' negative impact on oil revenue, such as hedging mechanisms or foreign exchange reserves management.

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