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# Asymmetric Analysis of the Impact of Oil Price Shock on Output Growth in Nigeria

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## Abstract

Nigeria's economy is heavily dependent on crude oil, which contributes 35% of GDP, over 90% of exports, and 80% of government revenues. Ranked 11th in crude oil production and 7th in exports, Nigeria's reliance on oil makes it vulnerable to price volatility, causing economic instability. Despite extensive research on oil dependency, few studies have explored how nonlinear oil price changes affect Nigeria's output growth. Hence, this study investigates the relationship between oil price fluctuations and output growth using a Nonlinear Autoregressive Distributed Lag (NARDL) model. The findings show that asymmetric changes in oil prices significantly impact output. A 1% oil price increase raises output by 45% in the short run, while a 1% decrease leads to a 0.6% rise. Both positive and negative oil price changes influence government expenditure, underscoring the direct impact of oil price volatility on fiscal policy and economic performance. This implies that an increase in oil prices affects output differently than a decrease, highlighting the asymmetric and nonlinear relationship between oil prices and economic performance. Fluctuations in oil prices significantly influence production levels, costs, and overall economic activity, particularly in oil-dependent economies. Policymakers must address these effects, employing strategies tailored to oil price increases (e.g., inflation control) and decreases (e.g., boosting investment). The study emphasizes the need for Nigeria to diversify its economy, reducing reliance on oil to ensure long-term stability. By strengthening non-oil sectors and enhancing fiscal management, Nigeria can better withstand global oil price shocks and foster sustainable economic resilience.

Keywords: Asymmetric Oil price shock Output Growth NARDL

JEL Classification: D82, O47, R15

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#### 1. Introduction

Nigeria is richly endowed with natural resources, with crude oil exports playing a pivotal role in its economy. Ranked 11th in global crude oil production and 7th in exports, oil contributes 35% to Nigeria's GDP, over 90% to exports, and 80% to government revenues (Rotimi, Ngalawa & Kutu, 2022; Ogbonna & Appah, 2012). Additionally, 85% of government revenue and 95% of foreign exchange earnings stem from oil exports. This heavy reliance on oil revenue, coupled with price volatility, has led to economic instability (Odulara, 2008). While previous studies (e.g., Ayadi, 2005; Olomola & Adejumo, 2006; Adeniyi et al., 2011) have analyzed Nigeria's dependence on crude oil sales, none have examined how oil price nonlinearity has impacted output growth up to 2022 (Rotimi, Olaoluwa, Kolawole, Atsana, Famoroti, Rotimi & Ogunsola, 2023; Rotimi, Ngalawa & Kutu, 2022). The windfall gains from the petroleum sector in the 1970s led to a significant decline in agricultural exports as oil exports surged (Olomola & Adejumo, 2006). However, the global oil market crash of 1981 triggered an economic crisis in Nigeria due to its heavy reliance on crude oil exports, causing a major economic shock and marking a critical turning point that frames the starting period for this research.

Given that Nigeria's economy remains heavily reliant on oil exports, fluctuations in oil prices significantly impact its primary source of income (Ufoeze et al., 2018). On May 29, 2007, crude oil was priced at \$67.2 per barrel, and foreign exchange reserves, which stood at \$4.72 billion in 1999, had grown to \$43 billion, indicating a robust economy (NNPC, 2009). However, during the global economic crisis, Nigeria's external reserves began to decline, falling from \$40 billion in April 2010 to a low of \$31.74 billion by September 2011 (https://www.economywatch.com/worldeconomy-2014).

In July 2014, fluctuations in global crude oil prices adversely impacted Nigeria's foreign reserves, triggered a currency crisis, reduced government revenue, and significantly affected output. Oil prices fell from a peak of \$108.66 in 2013 to \$43.73 in 2016, further dropping to \$37.35 (OPEC, 2016), representing a 64.5% decline. Government revenue plummeted from N10,068.9 billion in January 2014 to N5,616.4 billion by June 2016 due to over a 70% drop in oil prices. Meanwhile, government spending rose from N4,587.4 billion in 2014 to N5,858.6 billion in 2016, widening the fiscal deficit (CBN, 2016). The asymmetry of oil price effects on Nigeria's revenue and output growth forced the country to rely on borrowing while neglecting diversification of its revenue base, exacerbating macroeconomic challenges like inflation, exchange rate instability, and interest rate fluctuations (Abdullah & Omaku, 2018).

During the COVID-19 pandemic in 2020, an oil price crisis emerged following a disagreement between Russia and OPEC over production cuts. Combined with global lockdowns, Nigeria experienced significant economic setbacks. Oil prices fell sharply from \$57/barrel in January 2019 to \$15/barrel in 2020 (Statista, 2022), resulting in an estimated \$15.8 billion economic loss. GDP contracted by 6.1% in the second quarter and 3.62% in the third guarter of 2020 (Olujobi et al., 2022). This shock underscored the urgent need for political and diplomatic measures to stabilize oil markets and for Nigeria to prioritize developmental policies aimed at boosting nonoil sector production to achieve economic resilience.

Government expenditure in Nigeria has consistently risen over the years due to numerous infrastructure projects, programs, and other initiatives aimed at fostering rapid economic development. This ambition has largely contributed to persistent budget deficits in the national accounts (Adelegan and Out). However, the impact of these fiscal deficits has not translated into significant economic progress. Budget deficits often reduce national savings, which adversely affects economic development. Additionally, the economy's heavy reliance on oil revenue has left it external shocks. vulnerable to further exacerbating its challenges (Kilishi et al., 2010).

In light of the above, establishing a longrun relationship between oil prices and output growth is crucial for identifying any persistent Nigeria's imbalances in economic performance. To achieve this, the study employs the Nonlinear Autoregressive Distributed Lag (NARDL) model to examine both the short-run and long-run asymmetric effects of oil price fluctuations on output growth in Nigeria. The study is structured into five sections: Section 1 introduces the research context; Section 2 revviews relevant literature; Section 3 details the methodology; Section 4 provides an empirical analysis of the results and key findings; and Section 5 concludes with recommendations.

## 2. Literature review

# 2.1. Theory of Economic Growth output Asymmetry-in-Effects

This theory is largely associated with the works of Mork, Olsen, and Mysen (1994). They investigated the asymmetric relationship between oil price volatility and economic development, focusing on how oil price increases and decreases affect economic growth in different ways. Their work emphasized that oil price increases tend to have a more negative impact on GDP growth than decreases, highlighting the non-linear or asymmetric nature of the relationship between oil prices and economic output. In context, the relationship between crude oil prices and economic growth, as observed in the U.S. economy, diminishes over time until it becomes negligible. A recent study conducted in select African countries by Mork, Olsen, and Mysen (1994) corroborates the asymmetric nature of the impact of oil price volatility on economic development. According to their findings, an increase in oil prices negatively affects future GDP growth. However, the consequences of a decline in oil prices remain uncertain.

# 2.2. The Linear and Symmetric Relationship Theory of Growth

The Linear and Symmetric Relationship Theory of Growth was proposed by Hamilton

(1983). Hamilton's work argued that changes in oil prices (both increases and decreases) have a direct and proportional effect on economic growth. According to this theory, the relationship between oil price fluctuations and economic output is linear and symmetric, meaning that oil price increases and decreases influence economic growth in similar, predictable ways. This theory is based on the assumption that oil price volatility does not have asymmetric effects and that both price rises and falls affect the economy in a similar manner. Supporting this theory, Gisser and Godwin (1986), Hooker (1996), and Laser (1987) argued that the volatility in the price of oil is the main factor causing instability in the growth rate of output." They formulated their judgments based on "the events in the oil market between 1948 and 1972 and how they affected the economies of oil-exporting and importing countries. respectively." Furthermore, Hooker (2002) came to the conclusion that between 1948 and 1972, the level of "the oil price and its volatility had a significant influence on the pace of rise in output. This was the result of extensive empirical study.

## 2.3. Renaissance growth model

This theory, developed by a subset of scholars examining symmetric and asymmetric effects, was notably advanced by Lee et al. (1995). Their theoretical work aimed to differentiate between oil price movements and oil price volatility, using standard deviation over a specific time period to measure volatility. They argued that both factors negatively affect economic development, but in distinct ways: while volatility has an immediate and significant impact, the effects of oil price changes take about a year to materialize. They concluded that it is not the level of oil prices, but rather the volatility or changes in crude oil prices that exert a greater influence on economic growth.

This study adopts Keynesian theory, which advocates for state intervention in economic management to achieve full employment and mitigate cyclical recessions or depressions. This contrasts with classical economic theory, which supports Say's Law. Keynes' theory posits that individual and firm-level microeconomic actions can lead to macroeconomic outcomes where the economy operates below its potential output growth (Keynes, 1939). The Keynesian school recommends several measures to end recessions, including large borrowing and infrastructure spending, tax cuts and incentives, acceptance of the natural rate of inflation, countercyclical spending and investment, accommodating monetary policy, and providing bailouts. Keynes advocates for injecting money into the economy during a recession to boost aggregate demand and prevent depression (Jhingan, 2005).

# 2.4. *Empirical review*

The relationship between oil price changes and economic activity has been the subject of extensive research using various estimation methods. For instance, Chuku (2012) explored the linear and asymmetric effects of oil price shocks on the Nigerian economy from 1970 Q1 to 2008 Q4, employing the VAR model and Granger causality test. The study concluded that oil price changes did not have a significant impact on macroeconomic activity. Furthermore, the nonlinear model results revealed that the effects of oil price fluctuations on Nigeria's economy were asymmetric. The linear model suggested that oil price shocks were not a major determinant of Nigeria's performance. macroeconomic Similarly, Rotimi, Ngalawa, and Kutu (2022) investigated the asymmetric behavior of oil price shocks and output performance across Africa, while Rotimi. Olaoluwa, Kolawole, Atsana, Famoroti, Rotimi, and Ogunsola (2023) analyzed the relationship between oil price fluctuations and output growth in Nigeria using the ARDL approach.

Oriakhi and Iyoha (2013) analyzed the impact of oil price volatility (OPV) on Nigeria's economic growth from 1970 to 2010. Their findings indicated that OPV had a direct influence on real government expenditure, real exchange rates, and real imports, while also indirectly affecting real GDP, money supply, and inflation through government spending. The study concluded that oil price fluctuations determined government expenditure, which in turn affected the rate of Nigeria's economic growth.

Similarly, Apere and Eniekezimene (2016) observed that changes in oil prices significantly influenced real exchange rates but had no effect on the country's balance of payments or human capital development. Their study also highlighted that oil price shocks had a considerable impact on Nigeria's economic growth and government expenditure.

Mgbame, Donwa, and Onyeokweni (2015) identified a positive and significant correlation between oil price volatility and Nigeria's economic development in their empirical review. They concluded that changes in oil prices influenced government expenditure, inflation, and unemployment, all of which contributed to the growth of the Nigerian economy.

Nwanna and Eyedayi (2016) investigated the effects of crude oil price variations on Nigeria's economic growth between 1980 and 2014. Their findings revealed a significant relationship between oil price changes and Nigeria's economic growth, though they noted that oil price volatility did not produce any positive economic outcomes.

Benramdane (2017) studied the effect of OPV on Algeria's economic growth using annual data from 1970 to 2012. The study revealed that the negative effects of oil price volatility overshadowed the positive impacts of the oil boom.

Some recent studies indicate a clear trend that oil price fluctuations have an asymmetric effect on economic growth. In general, increases in oil prices tend to have a larger negative impact on economic growth than decreases, particularly in oil-exporting countries. These findings suggest that oildependent economies should adopt strategies to mitigate the risks associated with oil price volatility, such as diversification and fiscal stabilization measures.

Hassan, Gupta, and Parida (2023) study the effect of oil price shocks on economic growth in emerging markets, using a sample of 12 emerging economies over the period 2000-2022. The study utilizes a Structural Vector Autoregressive (SVAR) model to capture the dynamic relationships. The findings suggest that oil price increases negatively affect economic growth in oil-importing countries, while oil-exporting economies show a positive relationship with oil price increases, although with diminishing returns. The authors highlight the asymmetric nature of the impact, with oil price increases causing more significant downturns than oil price decreases contributing to growth recovery. The study concludes that oil-importing economies should reduce their dependency on oil while oil-exporting countries need to focus on economic diversification.

Lee, Yang, and Chen (2023) examine the asymmetric effects of oil price shocks on the economic growth of both oil-importing and oilexporting countries. They use a non-linear autoregressive distributed lag (NARDL) model with data spanning from 1995 to 2021. The study reveals that oil price increases result in more significant negative effects on economic growth in oil-importing countries, whereas oilexporting countries exhibit a weaker, but still positive, response to oil price increases. The research emphasizes the asymmetric transmission mechanism, particularly noting that the negative effects of oil price increases on economic growth are stronger in the short run but tend to diminish over time.

Bello and Olowokere (2023) analyze the asymmetric effects of oil price fluctuations on Nigeria's economic growth, utilizing an ARDL model for the period 1995 to 2022. The study finds that oil price shocks have a significant asymmetric effect on Nigeria's GDP, with oil price increases leading to a larger negative impact on economic growth than oil price decreases. The authors conclude that Nigeria's over-reliance on oil revenue makes it vulnerable to global oil price shocks, and they recommend diversification of the economy as a key policy strategy to reduce the negative impacts of price volatility on economic performance.

Tariq and Kiani (2023) provide an empirical analysis of the asymmetric effects of oil price shocks on economic growth across both developed and developing economies. Using a dynamic panel data model and data from 30 countries from 1990 to 2022, the study finds that the effects of oil price fluctuations differ significantly between developed and developing countries. In developed economies, oil price increases have a small negative effect, while in developing economies, the effects are more pronounced, with oil price increases leading to substantial economic slowdowns. The paper also highlights that oil price decreases have a less significant effect on both groups, suggesting an asymmetric impact.

Nguyen, Tran, and Pham (2023) focus on the ASEAN region to analyze the asymmetric impact of oil price shocks on economic growth. Using a panel data model covering 10 ASEAN countries from 2000 to 2021, the study finds that oil price increases negatively affect economic growth in net oil-importing countries, while the effects on oil-exporting ASEAN countries are more muted. The study also identifies that the relationship between oil prices and economic growth is asymmetric, with the negative effects of oil price increases being more significant and longer-lasting than the benefits of oil price decreases.

While most studies on the impact of oil price shocks on the Nigerian economy have assumed symmetrical volatility in oil prices, few have explicitly tested for asymmetric effects on output, as seen in Nwanna & Eyedayi (2016) and Oriakhi & Iyoha (2013). This study aims to address this gap.

# 3. Methodology

## 3.1 Data

The study utilized secondary data, including government revenue, government expenditure, and real gross domestic product (RGDP), sourced from the Central Bank of Nigeria (CBN, 2023). Data on the exchange rate and inflation rate were retrieved from the World Bank (2024). The analysis covered annual data series spanning 41 years, from 1981 to 2022. The variables were defined and measured as follows: OP represents the annual Brent Crude oil price, expressed in US dollars; RGDP refers to the real gross domestic product, calculated as a percentage of GDP; EXCH indicates the exchange rate, measured as the conversion rate from US dollars to Nigerian naira; and INF denotes the inflation rate, measured using the consumer price index (CPI) in local currency.

Similar to Rotimi et al. (2022), the research model could be expressed as:

$$RGDP - f(OP, EXCH, INF)$$
 1

where *OP*, *RGDP*, *EXCH*, and *INF* respectively denotes oil price, real gross domestic product, Exchange rate and Inflation. The econometric form of the function is stated as follows:

$$RGDP_t = \alpha_0 + \alpha_1 OP_t + \alpha_2 EXCH_t + \alpha_3 INF_t + \mu_t$$
 2

#### 3.2 Nonlinear ARDL

To capture the nonlinear and asymmetric cointegration between the variables used in this study, the Nonlinear Autoregressive Distributed Lag (NARDL) bounds testing approach, developed by Shin et al. (2014), was employed. The NARDL method distinguishes between short-term and long-term effects of the independent variables on the dependent variable. It accommodates variables with different integration orders and incorporates the possibility of asymmetric effects, where positive and negative changes in the independent variables may impact the dependent variable differently. This feature sets it apart from the standard ARDL model.

The NARDL methodology is ideal for this study as it captures both short- and long-run asymmetric relationships between oil price changes and economic output. It distinguishes between positive and negative oil price changes, addressing the nonlinear impacts typical in oil-dependent economies like Nigeria. Additionally, NARDL handles variables of mixed integration orders (I(0) and I(1)), ensuring robust analysis of oil price asymmetry on economic growth.

The NARDL approach also selects an appropriate lag order for the variables, effectively addressing the issue of multicollinearity. Furthermore, the method provides cumulative dynamic multiplier graphs, which are useful for tracing the adjustment patterns in response to positive and negative shocks in the explanatory variables. Budding from equation (2) above, the model can be modified and extended into an asymmetric long-run equation as follows:

$$RGDP_t = \alpha_0 + \alpha_1 POS_t + \alpha_2 NEG_t + \alpha_3 OP_t + \alpha_4 EXCH_t + \alpha_5 INF_t + \mu_t 3$$

where:  $\alpha_0$ ,  $\alpha_1$ ,  $\alpha_2$ ,  $\alpha_3$ ,  $\alpha_4$  and  $\alpha_5$  are long run parameters to be estimated and  $\mu_t$  is the stochastic error term. The constant term,  $\alpha_0$ , captures all the exogenous factors such as a constant term, linear trend and dummy variable for structural breaks, if any. In equation (3), POS and NEG represent the element of asymmetry in ARDL model. The values of POS and NEG are generated by computing,

$$POS = \Sigma_{i=1}^{k} \Delta OP_{i}^{+} = \max(\Delta OP_{i}, 0)$$
 4

and

$$NEG = \sum_{i=1}^{k} \Delta OP_i^- = \min(\Delta OP_i, 0) \qquad 5$$

In this framework, POS represents the partial sum of positive changes in oil prices (OP), while NEG represents the partial sum of negative changes in OP. The potential asymmetric impact of oil prices on fiscal policy can be assessed by analyzing the coefficients  $\alpha_1$  and  $\alpha_2$  in equations (4) and (5), which measure the effects of oil price increases and decreases, respectively, on fiscal policy. If  $\alpha_1 \neq \alpha_2$ , it suggests no asymmetry exists between oil prices and fiscal policy. Conversely, if  $\alpha_1 \neq \alpha_2$ , it indicates the presence of a nonlinear relationship. Following Shin et al. (2011), the equation can be formulated in an ARDL framework, consistent with the methodologies outlined by Pesaran, Shin and Smith (1999) and Pesaran, Shin, & Smith et al. (2001), as follows:

$$\Delta In(RGDP)_{t} = \alpha_{0} + \alpha_{1}In(RGDP)_{t-1} + \alpha_{2}\ln(OP)_{t-1} + \alpha_{3}\ln(EXCH)_{t-1} + \alpha_{4}\ln(INF)_{t-1} + \Sigma_{i=1}^{s}\theta_{0i}\Delta RGDP_{t-i} + \Sigma_{i=1}^{s}\theta_{1i}\Delta OP_{t-i} + \Sigma_{i=1}^{s}\theta_{2i}\Delta EXCH_{t-i} + \Sigma_{i=1}^{s}\theta_{3i}\Delta INF_{t-i} + \Sigma_{i=1}^{s}\theta_{0i}\Delta RGDP_{t-1} + \Sigma_{i=1}^{s}\theta_{j}^{+}\Delta OP_{j}^{+}OP_{j}^{-}\Delta OP_{j}^{-} \qquad 6$$

In the equation 6, all variables are as previously defined, including the lag orders. The long-run effects of both increases and decreases in crude oil prices on output are explicitly represented. Specifically,  $\Sigma_{i=1}^{s} \theta_{j}^{+}$  measures the short-run impact of an increase in oil prices on fiscal policy.  $\Sigma_{i=1}^{s} \theta_{j}^{-}$  captures the short-run effects of a reduction in oil prices on economic output. Thus, the model not only reflects the asymmetric long-run relationship between oil price changes and output but also incorporates

the asymmetric short-run impacts of oil price fluctuations on output.

## 4. **Results and Discussion**

## 4.1 Unit Root Test

As presented in Table 1, the results of the Augmented Dickey-Fuller (ADF) test indicate that the variables are stationary at levels I(0)and at first differences I(1). No variable is found to be integrated at the second order I(2). This satisfies the prerequisite conditions for conducting the bounds test for cointegration. The Augmented Dickey-Fuller (ADF) test results shown in Table 4.1 indicate the following: the LNRGD- at level, the ADF statistic (-0.867876) is higher than the 5% critical value (-2.938987), so it is not stationary. At first differencing, the ADF statistic (-4.041604) is lower than the critical value (-2.936942), making it stationary, order of integration is I(1). LNOP: at level, the ADF statistic (-0.897119) exceeds the critical value (-2.935001), so it is not stationary.

		At Level		At 1 <sup>st</sup> Differencing			
Variables	ADF	5% Critical	Remarks	ADF	5% Critic	Remarks	Order of
	Statistics	Value		Statistics	Value		Integration
			Not				
LNRGDP	-0.867876	-2.938987	Stationary	-4.041604	-2.936942	Stationary	I(1)
			Not				
LNOP	-0.897119	-2.935001	Stationary	-5.157748	-2.938987	Stationary	I(1)
			Not				
EXCH	3.369341	-2.935001	Stationary	-3.821809	-2.936942	Stationary	I(1)
INF	-3.050406	-2.935001	Stationary	-	-	Stationary	I(0)

**Table 1. ADF Unit Root Results** 

Source: Authors computation using E-views10 (2024).

At first differencing, the ADF statistic (-5.157748) is lower than the critical value (-2.938987), making it stationary, order of integration is I(1). EXCH: at level, the ADF statistic (3.369341) exceeds the critical value (-2.935001), so it is not stationary. At first differencing, the ADF statistic (-3.821809) is lower than the critical value (-2.936942), making it stationary. Order of integration is I(1). INF (Inflation): at level, the ADF statistic (-3.050406) is lower than the critical value (-2.935001), so it is stationary. Order of integration is I(0). The implications is that LNRGDP, LNOP, and EXCH are I(1), while INF is I(0). Mixed integration supports the use of ARDL modeling to capture short-run and long-run dynamics. Inflation's stationarity at level suggests inherent stability, while the other

variables required differencing for trend removal. The results justify ARDL bounds testing for analyzing relationships between these variables.

## 4,2 NARDL Bound Test

As shown in Table 2, the F-statistic value of 16.59 exceeds the upper bound critical value of 2.39 at the 5% significance level. This confirms the presence of cointegration, indicating a long-run relationship between oil prices and output in Nigeria.

**Table 2. NARDL Bound Test** 

OPRGDP	<b>F-Statistics</b>	Lower bound	Upper bound	Conclusion	
(I)	16.59419	2.39	3.38	Conintegration	
0 1		10 (2024)			

Source: Authors computation using E-views10 (2024).

The adjusted R-squared (Adj R<sup>2</sup>) value of 0.879574 suggests that the independent variables collectively explain approximately 87.96% of the variations in the dependent variable. This indicates a strong explanatory power of the model, implying that the changes in oil price (positive and negative), exchange rate, and inflation adequately account for fluctuations in the dependent variable (output or fiscal policy). A high R<sup>2</sup> is consistent with studies like Oriakhi and Iyoha (2013), which emphasize the significant role of macroeconomic variables in influencing economic outcomes.

The Durbin-Watson statistic is 2.433465, which is close to the ideal value of 2. This suggests that there is no evidence of serial correlation in the residuals of the model, ensuring the reliability of the parameter estimates. The absence of autocorrelation reinforces the validity of the model over the study period.

# 4.3 Result of Nonlinear ARDL Estimation

For the analysis of the individual coefficients, the coefficient of oil price given as 0.452938(significant at p<0.01) and 0.069893(significant at p<0.01) reveals that oil price has a significant positive effect on the dependent variable, consistent with economic theories that link oil price increases to government revenue and expenditure growth in oildependent economies like Nigeria. The coefficient of exchange rate (EXCH) (-0.000492) (significant at p=0.0306) reveals a negative relationship which implies that as the exchange rate depreciates (Naira weakens against the Dollar), the dependent variable decreases. This aligns with findings in Apere and Eniekezimene (2016), where exchange rate volatility significantly impacted fiscal stability. For inflation (INF), the coefficient, 0.001947 (significant at p<0.01) reveals that inflation positively affects the dependent variable, possibly due to price adjustments in government expenditure and revenue during inflationary periods.

EXCH POSEXCH For the and EXCH NEGEXCH, the results reveal that positive changes (EXCH POSEXCH) have a effect significant positive (0.000994, p=0.0221). Negative changes (EXCH NEGEXCH) are not statistically significant (p=0.5563), implying that positive shocks in the exchange rate (appreciation) have a more significant effect than negative shocks but the EXCH POSEXCH has a significant positive effect (0.000994, p=0.0221). Negative changes (EXCH NEGEXCH) are not statistically significant (p=0.5563), implying that positive shocks in the exchange rate (appreciation) have a more significant effect than negative shocks.

Variable	Coefficient	Std. Error	t-Statistic	Prob.	
С	8.068510	0.447111	18.04586	0.0000	
LNOP	0.452938	0.143150	3.164079	0.0090	
LNOP	0.069893	0.016686	4.188652	0.0015	
D(EXCH)	-0.000492	0.000198	-2.479629	0.0306	
D(INF)	0.001947	0.000286	6.802905	0.0000	
EXCH POS	0.000994	0.000373	2.662954	0.0221	
EXCH NEG	0.007930	0.013069	0.606782	0.5563	
INF POS	-0.011327	0.003822	-2.964067	0.0129	
INF NEG	-0.017041	0.004556	-3.740271	0.0033	
LNOP POS	0.051312	0.029767	1.723771	0.0947	
LNOP POS(-1)	0.016872	0.046059	0.366318	0.7166	
LNOP POS(-2)	0.073593	0.039758	1.851038	0.0737	
LNOP NEG	0.033062	0.012848	2.573256	0.0151	
CointEq(-1)*	-0.230443	0.017199	-13.39847	0.0000	
Adj R	0.879574				
Durbin-Watson	2.433465				

 Table 3. Nonlinear Autoregressive Distributed Lag (NARDL) Estimation Results.

Source: Authors computation using E-views10 (2024).

For INF POSINF and INF NEGINF, the positive inflation shocks reveal a significant negative effect (-0.011327, p=0.0129) while the negative inflation shocks (INF NEGINF) have an even larger negative effect (-0.017041, p=0.0033). This implies that inflation shocks (positive or negative) adversely affect economic stability, aligning with findings from Mgbame et al. (2015). The coefficient of lagged LNOP POSLNOP are significant at lags of 1 and 2, indicating the persistence of positive oil price effects on the dependent variable while the coefficient of LNOP NEGLNOP is 0.033062 and p-value (p=0.0151), implying that a negative variation in oil price changes significantly impact the dependent variable, reinforcing the asymmetric effect of oil price volatility.

Furthering this analysis, the empirical findings in Table 4.4 highlight a significant and asymmetric impact of oil price changes on economic output and government expenditure in both the short and long run.

In the shortrun, a 1% increase in oil prices results in a 45% increase in output, indicating a strong positive effect of rising oil prices on economic performance. Conversely, a 1% decrease in oil prices leads to a 0.6% increase in output, albeit at a much smaller magnitude, suggesting an asymmetric relationship where positive oil price shocks have a greater influence than negative shocks. In the longrun, positive oil price changes maintain a significant positive relationship with government expenditure, where a 1% increase in oil prices causes a 0.05% increase in output. This reflects the role of rising oil revenues in boosting government fiscal capacity and expenditures. Similarly, negative oil price changes also have a significant positive association with government expenditure, with a 1% decrease in oil prices contributing to a 0.03% rise in output. This suggests that even during periods of declining oil prices, government expenditure remains adaptive, potentially through counter-cyclical fiscal measures or reserves.

These findings underscore the asymmetric nature of oil price effects, with positive shocks exerting a more pronounced influence on economic outcomes compared to negative shocks. This dynamic aligns with the broader literature on oil-exporting economies, where fluctuations in oil prices significantly shape fiscal policy and economic performance.

For the cointEq(-1) (Error Correction Term), the coefficient of -0.230443 is negative and significant (p<0.01), indicating that approximately 23% of deviations from the long-run equilibrium are corrected annually. This highlights the speed of adjustment in the system, showing that the model effectively captures long-term dynamics. The F-statistic is significant at the 5% level, underscoring the overall validity and robustness of the model.

The implications of the findings:

- *i.* Oil Dependency and Asymmetry: The results underscore Nigeria's dependence on oil prices, with both positive and negative changes exerting significant effects. The asymmetric impact suggests a nonlinear relationship, consistent with the findings of Shin et al. (2014).
- *ii. Exchange Rate Sensitivity*: The significant negative effect of exchange rate depreciation implies that currency stability is critical for mitigating adverse effects on the economy. This corroborates Nwanna and Eyedayi (2016), who highlighted exchange rate stability as a key determinant of economic performance.

- *iii. Inflation Management*: The dual negative effects of inflation shocks emphasize the need for effective inflation control measures to sustain economic growth.
- *iv. Adjustment Mechanism*: The error correction term highlights a moderate adjustment speed, suggesting that economic policies need time to address oil price-induced shocks.

The results align with broader literature emphasizing the critical role of macroeconomic stability in fostering sustainable growth in oil-dependent economies.

## 4.4 Diagnostic Test

The residual diagnostic tests in Table 4. applied to the model indicate the following results: the Jarque-Bera statistic, 0.32354, exceeds the 5% significance level, confirming that the residuals of the model are normally distributed; the probability value for serial correlation, 0.0677, which is greater than 5%, indicating that there is no evidence of serial correlation in the model's residuals; and the probability value for heteroskedasticity, 0.7010, which is also above the 5% threshold, suggesting that the residuals are homoskedastic. Overall, these results demonstrate that both models successfully pass all residual diagnostic tests, ensuring the robustness and reliability of the model estimates.

Table 4. Residual Diagnostic Test				
Jarque-bera = 0.323534				
Serial autocorrelation $= 0.0677$				
Heteroskedasticity =0.7010				

Source: Authors computation using E-views 10 (2024).

## 4.5 Wald Test for Asymmetry

Table 4.5 presents the Wald test. In the table, the F-statistic value is 111.2705, and its probability value is 0.0089, which is less than the 5% significance level. This indicates that the null hypothesis of no joint significance of the coefficients is rejected. Therefore, there is a statistically significant relationship between the independent and dependent variables. The Chi-square value is 1223.975, with a probability value of 0.0000, which is also less than the 5% significance level. This confirms the rejection of the null hypothesis, reinforcing the evidence that the independent variables collectively have a significant impact on the dependent variable. These results indicate a strong asymmetric relationship between oil price changes and the output level in Nigeria. The significant probabilities suggest that both positive and negative changes in oil prices have measurable effects on economic growth.

Test Statistic	Value	Df	Probability	
F-statistic	111.2705	(7, 2)	0.0089	
Chi-square	1223.975	7	0.0000	

## Table 4.5: Wald Test Result

Source: Authors computation using E-views 10 (2024).

This supports the hypothesis that oil price movements exert asymmetric impacts on the Nigerian economy, which aligns with findings in the literature that resource-dependent economies, such as Nigeria's, are highly sensitive to oil price fluctuations, suggesting that policymakers should consider these asymmetries in oil price effects when formulating fiscal and economic policies to mitigate potential adverse impacts and leverage favorable conditions effectively.

# 5. Conclusion

The study reveals the existence of asymmetry in both short-run and long-run oil price effects on output. Positive oil price shocks significantly and positively influence output, with a larger magnitude compared to negative shocks. Conversely, a reduction in oil prices also increases output but at a slower rate of adjustment. Additionally, the study finds that exchange rate and inflation exhibit a positive and statistically significant relationship with output. The exchange rate, in particular, has a notable impact on influencing output levels.

Given these findings, it is recommended that the government take proactive measures to mitigate the adverse effects of unpredictable oil price shocks. Specifically, steps should be taken to diversify the economy to reduce overreliance on oil revenue. This would ensure that government expenditures are financed by internally generated revenue rather than through borrowing or dependence on foreign aid, promoting economic stability and resilience. The study also recommends Strengthening monetary and fiscal policies to manage exchange rate and inflation shocks effectively and lastly utilization of forwardlooking mechanisms like sovereign wealth funds to stabilize fiscal outcomes during oil price fluctuations.

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