# OIL PRICES AND INFLATION IN NIGERIA: AN EMPIRICAL ANALYSIS OF NONLINEAR RESPONSES TO OIL PRICE CHANGES

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## ABSTRACT
This study examines the nonlinear relationship between oil prices and inflation in Nigeria from 1981 to 2024, using the Nonlinear Autoregressive Distributed Lag (NARDL) model. It investigates the asymmetric effects of positive and negative oil price shocks on inflation while accounting for factors such as reserves, money supply, GDP growth, and monetary policy rates. The results show that past inflation significantly impacts current inflation, with a 1% increase in past inflation leading to a 0.63% rise in current inflation. Positive oil price shocks initially have short-term negative effects on inflation but create a significant positive relationship in the long run, particularly with lagged periods. Conversely, negative oil price shocks initially raise inflation, but later periods show a deflationary impact. Changes in total reserves significantly reduce inflation, and past money supply growth notably influences inflation dynamics. The Broad Money Supply (LM2) initially reduces inflation but later raises it, with a negative effect at -66.8034 and a positive effect at 40.1919. GDP growth shows no immediate impact on inflation but has a positive effect after three periods. The Monetary Policy Rate (MPR) has a varying effect, with a positive relationship suggesting that higher interest rates initially increase inflation. The error correction term reveals that inflation adjusts quickly to its long-run equilibrium. Based on these findings, the study recommends targeted monetary policies, strategic reserve management, and economic diversification to mitigate the impact of oil price fluctuations on inflation.

**Keywords: Inflation, Oil Prices, NARDL, Total Reserves, Money Supply.**
**JEL Codes: E31**: **Q43**: **C22**: **F31**: **E51**

## 1 INTRODUCTION
Oil price fluctuations have long been a critical determinant of economic stability, particularly in oil-dependent economies like Nigeria, where fiscal stability and macroeconomic performance are heavily influenced by global oil prices (Ezechukwu, 2024). While higher oil prices boost government revenue, they often lead to inflationary pressures, driving up consumer prices and straining economic stability. Conversely, lower oil prices may ease inflation but exacerbate fiscal challenges due to reduced export earnings (Ahmed et al., 2023). The relationship between oil prices and inflation is especially significant for Nigeria, which relies heavily on oil for foreign exchange and government revenue. High oil prices stabilize the naira, easing inflation, while low prices deplete reserves, leading to depreciation and rising import costs that fuel inflation. The 2016 oil price crash, which saw inflation surge to over 18%, is a notable example of the lasting impact of oil price fluctuations on Nigeria's economy. Even in 2024, inflation remains persistent, driven by ongoing naira depreciation and external price shocks (Ezechukwu, 2024).

These fluctuations have significant implications for inflation, fiscal health, and economic growth. Higher oil prices can trigger cost-push inflation, reducing disposable income and

slowing economic activity (Pettinger, 2021). On the other hand, lower oil prices may temporarily relieve inflation but undermine government revenues, leading to budget deficits and macroeconomic instability. This complex relationship highlights the dual-edged impact of oil prices on Nigeria's economy, where short-term benefits of low prices are often overshadowed by long-term costs. Additionally, long-term oil price movements shape investment patterns, with high oil prices spurring investments in oil exploration and alternative energy sources, like electric vehicles (Pettinger, 2021). For Nigeria, where oil constitutes a significant portion of national income, understanding the nonlinear effects of oil price shocks on inflation is vital for effective policy-making.

While many studies have explored the relationship between oil prices and inflation (Kudabayeva et al., 2024; Okeke et al., 2024), none to our knowledge account for asymmetric effects in Nigeria's economy. Traditional models assume a symmetric relationship between oil prices and inflation, which empirical evidence suggests is inaccurate; rising oil prices tend to have a greater inflationary impact than falling prices. This study aims to address this gap by employing the Nonlinear Autoregressive Distributed Lag (NARDL) model to analyse the asymmetric effects of oil price changes on inflation in Nigeria from 1981 to 2024. By distinguishing between the effects of price increases and decreases, the NARDL model offers a more accurate representation of how oil price fluctuations affect Nigeria's inflation dynamics.

The objective of this study is to provide policy-relevant insights to manage inflation amid oil price volatility and offer recommendations for sustainable economic management in Nigeria's oil-dependent economy. We have structured the paper as follows: Section 2 reviews relevant literature, Section 3 outlines the methodology, Section 4 presents and discusses the results, and Section 5 concludes with key findings, policy implications, and recommendations for future research.

## 2 LITERATURE REVIEW

### 2.1 Theoretical Literature

The impact of oil price changes on inflation in Nigeria is grounded in several economic theories that explain the oil price fluctuations effect on general price levels and economic stability. This study employs various economic theories, such as the cost-push inflation theory, exchange rate pass-through theory, monetary theory of inflation, and the asymmetric effects hypothesis, to comprehend the correlation between oil prices and macroeconomic stability.

**Cost-Push Inflation Theory:** The cost-push inflation theory suggests that rising production costs, especially in essential commodities like oil, result in higher overall prices. This is because oil is a crucial input in industrial production, transportation, and energy generation, and as businesses pass these higher costs onto consumers, inflation rises (Pettinger, 2022). This mechanism is particularly important in Nigeria, where energy costs are heavily linked to oil prices.

**Exchange-rate pass-through (ERPT):** Exchange-rate pass-through (ERPT) is a measure of international prices' responsiveness to exchange rate changes. It is the elasticity of local-currency import prices compared to foreign currency prices. It is often measured as the percentage change in local currency resulting from a one percent exchange rate change between exporting and importing countries. The law of one price and purchasing power parity relate to a greater ERPT, which results in more inflation transmission between countries (Menon, 1996). ERPT suggests that oil price fluctuations can impact inflation in Nigeria, as the country relies heavily on oil exports for foreign exchange earnings. A decline in oil prices reduces foreign currency inflow, leading to the depreciation of the naira and increased costs of imported goods and services, resulting in inflation exceeding 15% during the 2016 recession.

**Monetary inflation:** The monetary theory of inflation, based on the Quantity Theory of Money, suggests that inflation arises from excessive money supply growth relative to economic output (Pettinger, 2017). In oil-dependent economies like Nigeria, high oil prices can lead to increased government revenues, fueling public spending. However, if this spending isn't matched by economic output, inflationary pressures arise. Conversely, low oil prices can limit money supply growth, easing inflation but potentially slowing economic growth.

**Asymmetric Effects Hypothesis:** The Asymmetric Effects Hypothesis suggests that certain phenomena or relationships do not respond symmetrically to changes in underlying factors, meaning that the impact of a positive shock on a system is not necessarily the same as the impact of a negative shock of the same magnitude (Apostolakis and Giannellis, 2024). Hamilton (2009) suggests that businesses and consumers adjust prices rapidly due to rising costs, but may not decrease prices at the same rate when oil prices fall. In Nigeria, energy pricing mechanisms, domestic price adjustments rigidities, and structural inefficiencies contribute to the asymmetric transmission of oil price shocks to inflation.

The theoretical framework suggests that oil price changes impact inflation through various channels, including direct cost, exchange rate, monetary policy, and asymmetric transmission. Higher oil prices increase production and transportation costs, leading to cost-push inflation. Exchange rate volatility affects foreign exchange earnings, affecting the naira and import costs. Government revenue fluctuations from oil affect money supply and fiscal policy, influencing inflationary trends.

Putting these different theories together gives us a full picture of the complicated link between oil prices and inflation in Nigeria. It also shows how important asymmetric and nonlinear effects are.

## 2.2 Empirical Review

The relationship between oil prices and inflation has been widely studied, with some studies highlighting the complexity of this connection. Bouchouev (2021) explores how frequent regime changes complicate the relationship between oil prices and inflation. His study reveals that short-term price changes affect inflation measures, while long-term market expectations influence the financial demand for petroleum futures. This underscores the nuanced nature of the oil price-inflation relationship. In contrast, Kilian and Zhou (2020) challenge the traditional view that oil or gasoline prices directly influence inflation expectations. They show that gasoline price shocks significantly affect one-year household inflation expectations, particularly between 2009 and 2013. However, these shocks account for only 39% of the variation in inflation expectations since 1981, calling into question the conventional wisdom that price fluctuations alone drive inflation expectations.

The impact of oil price shocks on inflation also varies by region and economic structure. In South Africa, Balcilar, Uwilingiye, and Gupta (2018) found a positive but weak correlation between oil prices and inflation from 1922 to 2013. They attribute this weak relationship to the South African Reserve Bank's efforts to stabilize inflation expectations despite external oil price shocks. Similarly, Sek et al. (2015) examined the effects of oil price changes in both high and low oil dependency countries. Their study found that oil price changes directly affect inflation in low-dependent countries, while in high-dependent countries, the effect is transmitted indirectly through exporters' production costs. They suggest that policymakers should use monetary policy to mitigate these inflationary impacts.

The role of oil prices in shaping inflation dynamics in different economic contexts is also evident in studies examining broader geographic areas. Choi et al. (2018) analyzed the effects of oil price fluctuations on inflation in 72 advanced and developing economies from 1970 to 2015. Their findings suggest that a 10% increase in oil prices raises domestic inflation by 0.4 percentage points, but the effect dissipates after two years. They also highlight that transport and energy subsidies are key factors influencing how countries experience oil price shocks. The study by Amoke et al. (2022), titled Assessment of Oil Price, Exchange Rate, and Economic Development in Nigeria, found that while the oil price and exchange rate targets were achievable, the Human Development Index target was unattainable. The authors recommended that the Nigerian government increase oil exploration, revamp refineries, diversify the economy, and develop a more pragmatic exchange rate regime. Adebayo (2020) used wavelet coherence techniques alongside Granger and Toda-Yamamoto causality tests to examine the relationship between oil prices and inflation in Nigeria. The findings revealed a positive co-movement between oil prices and inflation, with evidence of causality running from oil prices to inflation. The study also offers recommendations for future research in Nigeria.

In more specific contexts, such as in Azerbaijan, Mukhtarov, Mammadov, and Ahmadov (2019) found a long-term relationship between oil prices, exchange rates, and inflation. Their study, covering the period from 1995 to 2017, revealed that inflationary pressures persist during both high and low oil price periods, with the exchange rate acting as a transmission channel. This finding reinforces the idea that oil price shocks can have a lasting impact on inflation, with the exchange rate playing a key role in how these effects are transmitted. Wang et al. (2022) took a broader approach, examining the role of oil price volatility in influencing inflation rates and economic growth in both oil-importing and oil-exporting countries. Using 30 years of panel data, their study found that oil price volatility significantly impacts financial development and economic growth, with the effects being stronger in oil-exporting countries like Norway and Canada. This emphasizes the critical role that oil market dynamics play in shaping the economic trajectories of both oil-importing and oil-exporting nations.

In Southeast Asia, Aharon et al. (2023) examined how oil price shocks affect inflation in the ASEAN5+3 countries from 1987 to 2022. They found that the COVID-19 pandemic significantly altered inflation dynamics, particularly in Malaysia, Singapore, Thailand, the Philippines, and Japan. The study also noted that inflation responds asymmetrically to oil price shocks, with different responses to positive and negative price shocks. These findings provide important policy implications for managing inflation in these countries in response to global oil price fluctuations.

Lastly, focusing on Nigeria, Okeowo et al. (2023) analyzed the impact of exchange rates, oil prices, and wage structures on the country's economic growth from 1991 to 2022. Their study found a positive relationship between inflation and wage structure, while exchange rates and oil prices were found to negatively affect economic growth. They recommend policies such as effective wage management, exchange rate adjustments, and economic diversification to mitigate these challenges and promote growth. Kpagih et al. (2022) investigated the impact of fluctuating energy prices on inflation in Nigeria during the COVID-19 pandemic. Using the ARDL method, their study found that, although there was no long-term impact, short-term oil and gas price lags significantly influenced inflation between 1985 and 2018. Okeke et al. (2024) further explored the effects of crude oil price shocks on inflation and exchange rates in Nigeria from 1990 to 2022. Their findings indicated that these shocks negatively impacted both inflation and exchange rates, largely due to the ongoing devaluation of the Naira relative to the US Dollar. To mitigate excessive cost-push inflation, the study recommends that the

government increase allocations to the excess crude account and implement contractionary monetary and fiscal policies to reduce overall demand and control inflationary pressures.

Ben Salem et al. (2024) provide a comparative perspective by examining the sectoral impact of oil price fluctuations on inflation in 10 oil-importing and exporting nations. Using the Nonlinear Autoregressive Distributed Lag (NARDL) model and Hansen's threshold model, they analyze monthly data to assess asymmetric effects. Their findings reveal that oil price effects vary across sectors, with energy-intensive sectors experiencing the strongest inflationary effects. Additionally, they find that the inflationary impact of oil price changes is more pronounced in oil-importing nations than in oil-exporting ones. While Ben Salem et al. (2024) provide valuable cross-country insights, their study does not focus specifically on Nigeria, nor does it examine the role of structural changes or policy interventions in shaping inflation responses to oil price shocks.

Despite extensive research on the oil price-inflation nexus, there is a significant gap in understanding how structural changes and asymmetric oil price movements affect inflation in Nigeria, often overlooking structural breaks and policy shifts. This study intends to fill this gap by providing a detailed, country-specific, and time-sensitive empirical analysis of how nonlinear oil price changes affect inflation in Nigeria, using the latest data up to 2024. This will provide a more accurate understanding of the inflationary transmission mechanism and policy implications for managing oil price shocks and inflation in Nigeria's evolving economic landscape.

## 3 METHODOLOGY

### 3.1 Theoretical Framework

In order to understand the complex relationship between oil price fluctuations and inflation in Nigeria, this study adopts the Asymmetric Effects Hypothesis as its primary theoretical framework. The Asymmetric Effects Hypothesis posits that the impact of oil price changes on inflation is not symmetric—meaning that the inflationary effects of rising oil prices differ from the effects of falling oil prices. This theory is particularly relevant for Nigeria, where oil is a key driver of government revenues, foreign exchange, and inflation dynamics. According to Hamilton (2009), price adjustments in response to oil price increases occur more swiftly, but when prices fall, the deflationary effect is not always equally rapid or pronounced. This is due to factors such as energy price rigidity and exchange rate dynamics, which contribute to asymmetric inflationary effects. The nonlinear autoregressive distributed lag (NARDL) model employed in this study is particularly suited to capturing these asymmetric responses to oil price shocks, as it allows for distinct modeling of the positive and negative effects of oil price changes on inflation.

### 3.2 Research Design

The study uses a quantitative research design to analyze the nonlinear relationship between oil prices and inflation in Nigeria from 1981 to 2024, using time-series econometric analysis to assess both short-term and long-term effects.

### 3.3 Data Description

The study uses data from 1981–2024 from the Central Bank of Nigeria and the World Development Indicators to analyze the nonlinear relationship between oil prices and inflation in Nigeria. Table 1 provides detailed information on the variables, their measurement, expected relationships, and the data sources.

**Table 1: Measurement of Variables and Data Sources**

| Variable | Measurement | Expected Relationship with Inflation | Data Source |
|---|---|---|---|
| Inflation Rate (INF) | Annual percentage change in the Consumer Price Index (CPI) | Dependent Variable | https://data.worldbank.org/indicator/FP.CPI.TOTL.ZG?locations=NG and the Central Bank of Nigeria (CBN) |
| Oil Price (OP) | Brent crude oil price (USD per barrel) | Positive (+): Higher oil prices increase production costs and fuel cost-push inflation. Negative (-): Lower oil prices reduce inflationary pressures. | www.statista.com (1981-1986) and macrotrends.net (1987-2024) |
| Total Reserves (TR) | Total reserves (includes gold, US$) | Predominantly Negative (-): Higher reserves should help lower inflation in Nigeria by stabilizing the exchange rate and providing economic confidence. | https://data.worldbank.org/indicator/FI.RES.TOTL.CD?locations=NG |
| Broad Money Supply (M2) | M2 in current US$ | Strong Positive (+) Relationship: In most cases, a higher Broad Money Supply (M2) leads to higher inflation. | https://data.worldbank.org/indicator/FM.LBL.BMNY.CN?locations=NG |
| Gross Domestic Product (GDP) | Annual real GDP growth rate (%) | Negative (-): Higher economic growth stabilizes inflation by improving supply conditions. | https://data.worldbank.org/indicator/NY.GDP.MKTP.KD.ZG?locations=NG&most_recent_value_desc=true |
| Monetary policy rate | Central Bank policy rate | Negative (-): Higher interest rates reduce inflation by discouraging borrowing and spending. Positive (+): In some cases, high interest rates increase cost-push inflation. | CBN Statistical Bulletin, 2023, A.11 |

## 3.4 Model Specification

The study uses the Nonlinear Autoregressive Distributed Lag (NARDL) model, following the framework of Shin, Yu, & Greenwood-Nimmo (2014) to examine the asymmetric impact of oil price changes on inflation, breaking down changes into positive and negative components. The model is specified as:

$$\Delta INF_t = \alpha + \sum_{i=1}^{\rho} \beta_i \Delta INF_{t-i} + \sum_{j=0}^{q} \gamma_j^{+} \Delta PCOP_t^{+} + \sum_{j=0}^{q} \gamma_t^{-} \Delta NCOP_t^{-} + \sum_{k=0}^{q} \delta_k Z_{t-k} + \phi_1 INF_{t-1} +$$

$$\phi_2 PCOP_t^{+} + \phi_3 NCOP_t^{-} + \phi_4 Z_t + \varepsilon_t \qquad (1)$$

Where:

$\Delta INF_t$ = Change in inflation at time $t$ (dependent variable).

$PCOP_t^{+}$ *and* $NCOP_t^{-}$ = Positive and negative changes in Brent crude oil price (USD per barrel) (independent variable): Oil prices directly impact Nigeria's economy due to its heavy reliance on oil exports and government revenues.

$Z_t$ = Control variables, including:

Total Reserves (TR): Total reserves influence the country's ability to buffer against oil price volatility, impacting inflation and foreign exchange stability.

Broad Money Supply (M2) and Gross Domestic Product growth rate (GDPGR): influence inflation dynamics in the context of Nigeria's reliance on public spending, oil revenues, and the need for economic diversification

Monetary policy rate (MPR): Monetary policy rates (MPR) are important because Nigeria's central bank often adjusts interest rates in response to inflationary pressures, which are influenced by oil prices.

$\phi_1, \phi_2, \phi_3, \phi_4 =$ Long-run coefficients.

$\beta_i, \gamma_j^+, \gamma_j^- =$ Short-run coefficients.

$\varepsilon_t$ = Error term

### 3.5 Estimation Procedure

Stationarity Test: The Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests check to see if the variables stay the same at level I(0), first difference I(1), or higher. The NARDL approach can accommodate variables integrated at I(0) or I(1) but not I(2).

Decomposition of Brent crude oil price: crude oil price (COP) is decomposed into its positive $(PCOP^+)$ and negative $(NCOP^-)$ components using partial sum decomposition:

$$COP_t^+ = \sum_{i=1}^{t} \max(\Delta COP_i, 0), COP_t^- = \sum_{i=1}^{t} \min(\Delta COP_i, 0)$$

Bounds Testing for Cointegration: The F-Bounds test will be applied to determine the existence of a long-run relationship among the variables.

Estimation of NARDL Model:

Long-run and short-run asymmetries in the relationship between inflation and agricultural GDP will be estimated.

The coefficients of $PCOP^+$ and $NCOP^-$ will reveal whether inflation has an asymmetric effect on agricultural Inflation (INF).

Diagnostic Tests: The robustness of the model will be verified using:

Breusch-Godfrey LM Test: Tests for serial correlation.

Breusch-Pagan-Godfrey Test: Checks for heteroscedasticity.

Jarque-Bera Test: Assesses residual normality.

CUSUM and CUSUMSQ Tests: Evaluate model stability.

### 3.6 Justification for Methodology

The study uses the NARDL Model to analyze the asymmetric impact of oil price fluctuations on Nigerian inflation from 1981 to 2024, justified by various factors.

### 1 Addressing Nonlinear and Asymmetric Relationships

Traditional linear models assume symmetric effects of oil price increases and decreases on inflation, but economic theory and empirical evidence suggest asymmetric effects due to the following factors:

Rising oil prices may have a stronger impact on inflation than declining prices due to rigidities in price adjustments.

Currency depreciation increases inflationary pressures during oil price increases, but may weaken its effects during oil price declines.

Nigeria's reliance on oil revenues could lead to structural rigidities, causing potential disproportionate fiscal and monetary impacts from oil price crashes.

The NARDL model, developed by Shin et al. (2014), decomposes oil price changes into positive and negative components, enabling the examination of inflation's response to rising and falling oil prices.

**2 Suitability for Mixed Order of Integration (I(0)) and I(1))**

The NARDL model, unlike traditional cointegration techniques, is suitable for variables with different integration orders, offering flexibility in handling stationarity issues without requiring all variables to be I(1), as macroeconomic time series often exhibit unit roots.

**3 Short-run and Long-run Dynamics**

The NARDL approach effectively identifies short-term and long-term equilibrium relationships between oil prices and inflation, crucial for policy recommendations, as it allows us to distinguish between:

The immediate inflationary effects following oil price shocks.

The long-term structural adjustments in the economy.

**4 Robustness to Structural Breaks and Policy Shocks**

Nigeria's economy has undergone structural changes, such as subsidy removals, exchange rate devaluations, and monetary policy shifts. The NARDL bounds testing approach is more reliable than conventional cointegration tests due to its robustness.

**5 Policy Relevance**

This methodology helps policymakers understand the symmetric or asymmetric effects of oil price increases and decreases on inflation. It provides insights for policymakers on:

Inflation targeting strategies: Understanding inflation dynamics is crucial for formulating effective monetary policies.

Total reserve and fiscal policies: Countries with high reserves can implement counter-cyclical fiscal policies, like Nigeria, without worrying about external imbalances. Conversely, low reserves limit fiscal space, leading to increased external borrowing, currency depreciation, and austerity measures, such as cutting social spending and subsidies.

Energy subsidy and diversification policies: The findings can inform policies for managing external shocks and stabilizing inflation through energy subsidy and diversification policies.

**3.7 Expected Outcomes**

This study aims to advance empirical literature on the oil price-inflation relationship in Nigeria by applying the Nonlinear ARDL (NARDL) model to capture asymmetric effects and distinguish between oil price increases and decreases on inflation. The findings will help policymakers identify whether oil price increases have a stronger impact on inflation than decreases, and help assess the impact of fuel subsidy removals and exchange rate adjustments on inflation. The study also contributes to understanding asymmetric price transmission mechanisms, such as exchange rate pass-through effects, cost-push inflation dynamics, and policy inertia in price adjustments. The findings will inform structural and fiscal policy reforms, such as designing exchange rate policies to mitigate oil price volatility, formulating fiscal policies to cushion inflationary effects, and reducing Nigeria's dependence on oil revenues.

## 4 RESULTS AND THE DIAGNOSTIC TESTS

### 4.1 Unit Root Test

The unit root tests are used to determine the stationarity of variables in time series analysis. Stationary data ensures constant statistical properties over time, preventing spurious results. The results will guide the choice of an appropriate econometric model, using the NARDL model, which can accommodate variables at level I(0), I(1), or a combination of both.

The results of the unit root test, presented in Table 2

**Table 2: Unit Root Tests Result of all Variables**

| Variables | ADF Test Statistic | | PP Test Statistic | |
|---|---|---|---|---|
| | **Level** | **1st Diff** | **Level** | **1st Diff** |
| Inflation (INF) | -3.05* | -5.99* | -2.91 | -10.36* |
| Positive Oil Price Change (PCOP) | -4.98* | -8.63* | -4.93* | -18.23* |
| Negative Oil Price Change (NCOP) | -6.56* | -6.94* | -6.59* | -26.79* |
| Exchange Rate (EXR) | 2.19 | 4.71 | 4.36 | 5.83 |
| Total Reserve (TR) | -0.87 | -5.96* | -0.75 | -6.74* |
| Broad Money (M2) | -1.53 | 3.59* | -1.41 | -3.50* |
| GDP Growth Rate (GDPGR) | -3.28* | 10.81* | -4.44* | -11.23* |
| Monetary Policy Rate (MPR) | -2.30 | -7.19* | -2.14 | -7.20* |

Source: Authors computation using Eviews 12, 2025

Before proceeding with the model estimation, we tested the stationarity of the variables using the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests. The results presented in Table 2, indicate that INF, PCOP, NCOP, and GDPGR are stationary at level, requiring no differencing. TR, M2 and MPR, become stationary at first difference, indicating an I(1) process.

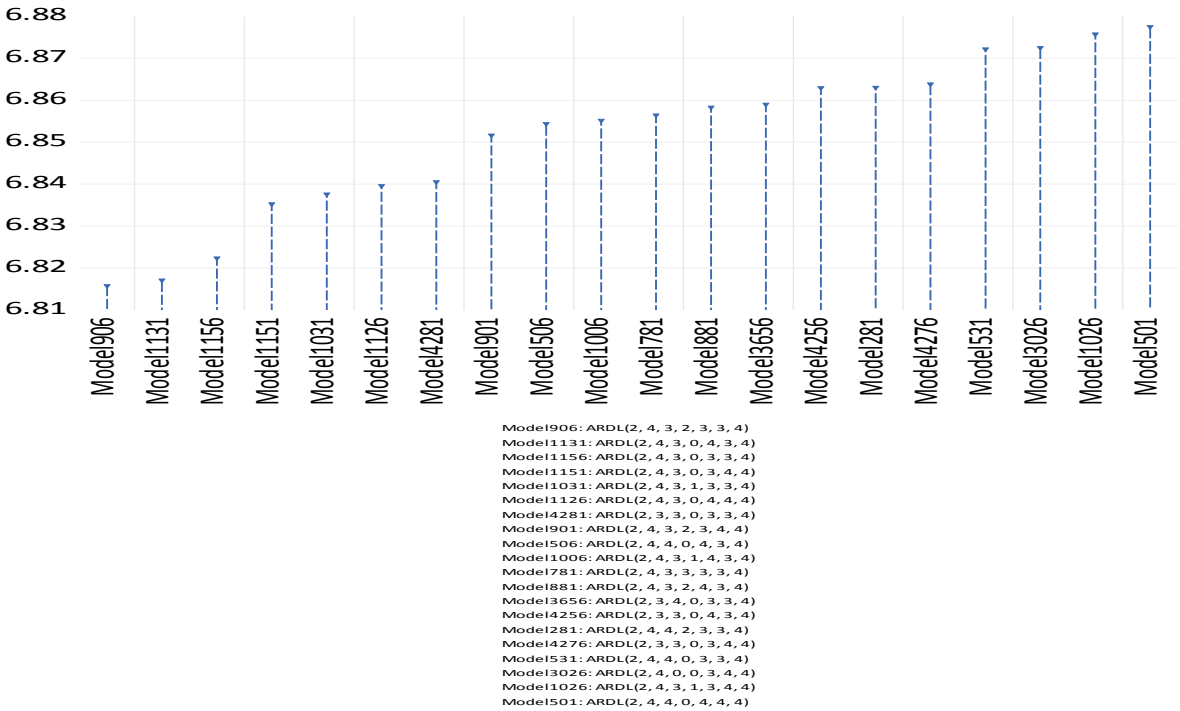
The study included Exchange Rate (EXR) as an independent variable to measure inflation in Nigeria. However, the unit root test showed EXR was not stationary, making it unsuitable for econometric modeling without further transformation. Total Reserves (TR) was introduced as a substitute variable to address this challenge.

Total Reserves (TR) and Exchange Rate (EXR) are closely linked, with foreign exchange reserves serving as a buffer for exchange rate stability. Higher reserves reduce volatility and inflationary pressures. Low reserves increase the likelihood of currency depreciation, raising import costs and fueling inflation. Countries with higher reserves have greater capacity to manage external shocks, support fiscal stability, and finance trade imbalances. The exchange rate (EXR) is non-stationary, potentially leading to spurious regression results. Total Reserves (TR) provides a stable proxy for external economic conditions and improves model estimation due to its better stationarity properties. TR is a critical monetary tool used by policymakers to intervene in the foreign exchange market and affect inflation dynamics. High reserves help stabilize the economy by managing external debt and supporting the exchange rate, reducing inflationary pressures.

## 4.2 Model Selection Process

Figure 1 presents the summary of the top-ranked models based on Akaike Information Criterion (AIC). The model selected, ARDL (2, 4, 3, 2, 3, 3, 4) with the lowest AIC value of 6.815702, efficiently captures variable relationships without overfitting. The model will be used for further analysis, estimating both short-term and long-term relationships.

Figure 1: Akaike Information Criteria (top 20 models)




## 4.3 Bounds Testing for Cointegration

**Table 3: F-Bounds Test** **Null Hypothesis: No levels relationship**

| Test Statistic | Value | Signif. | I(0) | I(1) |
|---|---|---|---|---|
| | | | Asymptotic: n=1000 | |
| F-statistic | 4.325536 | 10% | 1.99 | 2.94 |
| k | 6 | 5% | 2.27 | 3.28 |
| | | 2.5% | 2.55 | 3.61 |
| | | 1% | 2.88 | 3.99 |
| | | | Finite Sample: n=40 | |
| Actual Sample Size | 40 | | | |
| | | 10% | 2.218 | 3.314 |
| | | 5% | 2.618 | 3.863 |
| | | 1% | 3.505 | 5.121 |

The F-statistic (4.325536) is greater than the upper bound (I(1)) at 5% and 10% significance levels, rejecting the null hypothesis and confirming a long-run cointegrating relationship between oil prices, inflation, and other explanatory variables, confirming the appropriateness of an ARDL or NARDL model.

### 4.4 Estimation of NARDL Model

The NARDL Model is a statistical technique used to analyze asymmetric relationships between variables, dividing independent variables like oil prices into positive and negative impacts on inflation.

#### 4.4.1 Long-run asymmetries

Table 3 presents the results of the Conditional Error Correction Regression from an ARDL model, which aids in analyzing long-term relationships among variables.

**Table 3: Long-Run Estimates**

| Variable | Coefficient | Std. Error | t-Statistic | Prob.* |
|---|---|---|---|---|
| INF(-1) | 0.634678 | 0.192010 | 3.305437 | 0.0063 |
| INF(-2) | -0.400519 | 0.155507 | -2.575568 | 0.0243 |
| PCOP | 0.044917 | 0.201694 | 0.222700 | 0.8275 |
| PCOP(-1) | 0.337481 | 0.199904 | 1.688215 | 0.1172 |
| PCOP(-2) | 0.542987 | 0.224215 | 2.421724 | 0.0322 |
| PCOP(-3) | 0.802994 | 0.332381 | 2.415888 | 0.0326 |
| PCOP(-4) | 0.364519 | 0.284898 | 1.279473 | 0.2249 |
| NCOP | 0.295712 | 0.206361 | 1.432985 | 0.1774 |
| NCOP(-1) | 0.170410 | 0.199451 | 0.854394 | 0.4096 |
| NCOP(-2) | 0.166744 | 0.176014 | 0.947338 | 0.3622 |
| NCOP(-3) | 0.341545 | 0.217313 | 1.571675 | 0.1420 |
| LTR | -20.17654 | 3.881943 | -5.197536 | 0.0002 |
| LTR(-1) | 5.286783 | 6.339966 | 0.833882 | 0.4206 |
| LTR(-2) | -6.475875 | 6.850587 | -0.945302 | 0.3632 |
| LM2 | -9.931894 | 16.82735 | -0.590223 | 0.5660 |
| LM2(-1) | 41.52197 | 22.14393 | 1.875095 | 0.0853 |
| LM2(-2) | -66.80340 | 27.46128 | -2.432639 | 0.0316 |
| LM2(-3) | 40.19199 | 18.34985 | 2.190317 | 0.0490 |
| GDPGR | 0.089402 | 0.518467 | 0.172434 | 0.8660 |
| GDPGR(-1) | -0.470047 | 0.485538 | -0.968094 | 0.3521 |
| GDPGR(-2) | -0.341115 | 0.353116 | -0.966014 | 0.3531 |
| GDPGR(-3) | 1.214894 | 0.400935 | 3.030155 | 0.0105 |
| MPR | -0.647700 | 0.468433 | -1.382694 | 0.1919 |

| | | | | |
|---|---|---|---|---|
| MPR(-1) | -0.437850 | 0.548250 | -0.798631 | 0.4400 |
| MPR(-2) | 2.215918 | 0.614059 | 3.608642 | 0.0036 |
| MPR(-3) | -0.421848 | 0.585725 | -0.720216 | 0.4852 |
| MPR(-4) | 0.881757 | 0.550946 | 1.600443 | 0.1355 |
| C | 337.9213 | 92.54621 | 3.651380 | 0.0033 |
| R-squared | 0.952919 | | | |

Inflation is highly persistent, with a 1% increase in past inflation leading to a 0.63% increase in the current period. The second lag of inflation has a negative effect, meaning inflationary shocks dissipate over time. Inflation is persistent but mean-reverting in the long run. Positive crude oil prices (PCOP) have a significant impact on inflation after a delay of 2-3 periods. PCOP (current) = 0.0449, PCOP(-1) = 0.3375, PCOP(-2) = 0.5429, PCOP(-3) = 0.8029, and PCOP(-4) = 0.3645. These increases raise inflation after a delay of 2-3 periods. The model shows that negative crude oil prices do not significantly impact inflation, with NCOP values of -1, -2, and -3 not significant.

The result shows that higher total reserves significantly reduce inflation in the short run, with a highly significant negative effect on inflation. However, the effect varied between -1 and -6.4758, suggesting no effect. The Broad Money Supply (LM2) has mixed effects, initially reducing inflation and later increasing it. It has varying degrees of positive and negative effects, with a significant negative effect occurring at -66.8034 and a significant positive effect at 40.1919. The GDP Growth Rate (GDPGR) has no effect on inflation, but it increases after three periods, with a significant positive effect observed at 1.2149 (p = 0.0105). The Monetary Policy Rate (MPR) has varying effects, with a significant positive effect observed at a rate of 2.2159, suggesting that higher interest rates initially increase inflation. The model, with a R-squared of 0.9529, effectively explains 95.29% of the variation in inflation, demonstrating its strong explanatory power.

### 4.4.2 Short-run Asymmetries

Table 4 presents the short-run results of the NARDL model, highlighting the immediate and lagged effects of independent variables on Nigerian inflation.

**Table 4: Short-Run Results**

ECM Regression

Case 2: Restricted Constant and No Trend

| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|---|---|---|---|---|
| D(INF(-1)) | 0.400519 | 0.108003 | 3.708416 | 0.0030 |
| D(PCOP) | 0.044917 | 0.143030 | 0.314041 | 0.7589 |
| D(PCOP(-1)) | -1.710501 | 0.303774 | -5.630837 | 0.0001 |

| | | | | |
|---|---|---|---|---|
| D(PCOP(-2)) | -1.167513 | 0.276480 | -4.222769 | 0.0012 |
| D(PCOP(-3)) | -0.364519 | 0.168776 | -2.159781 | 0.0517 |
| D(NCOP) | 0.295712 | 0.104958 | 2.817417 | 0.0155 |
| D(NCOP(-1)) | -0.508289 | 0.125890 | -4.037573 | 0.0016 |
| D(NCOP(-2)) | -0.341545 | 0.113967 | -2.996888 | 0.0111 |
| D(LTR) | -20.17654 | 2.253893 | -8.951860 | 0.0000 |
| D(LTR(-1)) | 6.475875 | 4.026023 | 1.608504 | 0.1337 |
| D(LM2) | -9.931894 | 8.349050 | -1.189584 | 0.2572 |
| D(LM2(-1)) | 26.61141 | 9.298712 | 2.861838 | 0.0143 |
| D(LM2(-2)) | -40.19199 | 8.002896 | -5.022181 | 0.0003 |
| D(GDPGR) | 0.089402 | 0.270495 | 0.330511 | 0.7467 |
| D(GDPGR(-1)) | -0.873779 | 0.287809 | -3.035962 | 0.0104 |
| D(GDPGR(-2)) | -1.214894 | 0.246153 | -4.935532 | 0.0003 |
| D(MPR) | -0.647700 | 0.332033 | -1.950707 | 0.0748 |
| D(MPR(-1)) | -2.675827 | 0.448585 | -5.965034 | 0.0001 |
| D(MPR(-2)) | -0.459909 | 0.418462 | -1.099045 | 0.2933 |
| D(MPR(-3)) | -0.881757 | 0.331200 | -2.662312 | 0.0207 |
| ECT(-1)* | -0.765841 | 0.103464 | -7.402035 | 0.0000 |
| R-squared | 0.935892 | | | |

The coefficient for lagged inflation (INF(-1)) is 0.4005, indicating a positive relationship between past inflation and current inflation, with a 1-unit increase in the previous period leading to a 0.4005 increase in current inflation. The current positive crude oil price D(PCOP) has a positive but insignificant effect on inflation, suggesting that it does not have a statistically significant effect in the short run. The lagged effects of positive crude oil prices on inflation are represented by D(PCOP(-1)), D(PCOP(-2)), and D(PCOP(-3). The strong negative effect of positive oil prices from the previous period on inflation is indicated by a coefficient of -1.7105, while the negative effect of positive oil prices from two periods ago is indicated by a coefficient of -1.1675. The coefficient for negative crude oil prices D(NCOP) is 0.2957, indicating a positive relationship between current prices and inflation. However, the lagged effects of negative crude oil prices are -0.5083 (p-value = 0.0016) and -0.3415 (p-value = 0.0111), indicating a negative impact of previous negative oil prices on inflation. This suggests that inflation tends to increase when negative oil prices occur in the short-run.

Table 4 reveals a significant negative relationship between changes in total reserves and inflation, with an increase in reserves reducing inflation significantly. However, the coefficient for lagged reserves, 6.4759, is not statistically significant, suggesting that reserves do not significantly impact inflation in the short-run. The money supply (LM2) coefficient is -9.9319, not significantly influencing inflation in the current period. The first lag of LM2(-1) has a strong positive effect on inflation, suggesting that an increase in the previous period leads to

higher inflation. The second lag, LM2 (-2), has a strong negative effect from money supply changes two periods ago on inflation.
The model's coefficient for GDP growth (GDPGR) is 0.0894, not significant, suggesting current GDP growth doesn't significantly affect inflation. However, both lagged GDP growth values have significant negative effects on inflation, suggesting that past negative GDP growth (recessions) has a deflationary effect on inflation. The monetary policy rate (MPR) has a marginally significant negative effect on inflation, suggesting that increases in the rate might slightly reduce it. The first lag of the MPR has a significant negative effect on inflation, suggesting that an increase in the policy rate from the previous period can reduce it. The second and third lags of the MPR have no significant effect on inflation, as indicated by their p-values greater than 0.05.

The error correction term in ECT(-1) has a significant coefficient of -0.7658, indicating that inflation will correct itself by 76.58% each period towards long-run equilibrium, driven by any deviations from equilibrium. The model, with an R-squared of 0.9359, effectively explains 93.6% of the variation in inflation, demonstrating a strong fit.

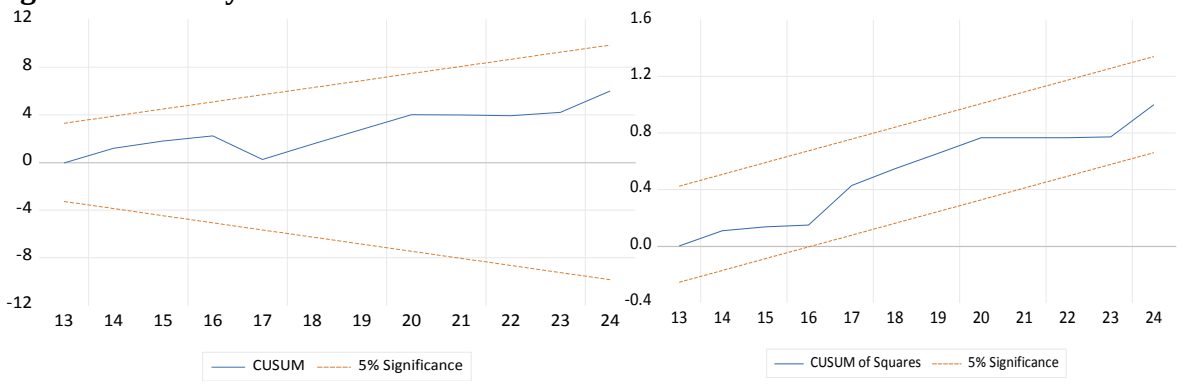
### 4.5 Diagnostic Tests

**Table 6: Summary of Diagnostic Test Results**

| Test | Test Statistic | p-Value | Decision | Remark |
|---|---|---|---|---|
| Breusch-Godfrey LM Test | F = 0.216444 | 0.8091 | Accept null hypothesis of no autocorrelation | Indicates non residual autocorrelation. |
| Heteroskedasticity Test (Breusch-Pagan-Godfrey) | F = 0.241990 | 0.9989 | Fail to reject null hypothesis of homoscedasticity | No heteroskedasticity detected. |
| Normality Test (Jarque-Bera) | JB=1.950018 | 0.377189 | Fail to reject null hypothesis | Residuals are normally distributed. |
| Stability (CUSUM) | Within bounds | N/A | Model is stable | No structural instability detected. |
| CUSUM of Squares Test | Within bounds | N/A | Model is stable | No structural instability detected. |

Source: Author's calculations, 2025

**Figure 3: Stability Result**



### 4.6 Discussion of Findings

The cost-push inflation theory suggests that rising oil prices increase production costs, which businesses then transfer to consumers, leading to inflation. Our findings support this theory, showing significant positive coefficients at different lags for oil price changes (PCOP(-2) and PCOP(-3) are statistically significant at the 5% level). This aligns with previous research in Nigeria, where crude oil price shocks significantly influence inflation, as supported by Okeke et al. (2024) and Okeowo et al. (2023). However, our findings also reveal that the short-term effects of oil prices on inflation in Nigeria are not statistically significant (e.g., PCOP at lag 0 and NCOP at various lags), suggesting that transmission may be delayed or dependent on other economic conditions. This aligns with Kpagih et al.'s (2022) finding that while oil prices significantly influence inflation in the short term, their long-term effects may not always be sustained.

The exchange rate pass-through theory (ERPT) suggests that oil price fluctuations impact inflation by influencing exchange rates. When oil prices fall, Nigeria's foreign reserves decline, leading to currency depreciation and inflation. The results partly support this theory, but because the exchange rate variable is not stationary, the role of changes in the exchange rate is not directly tested. Previous studies have highlighted the importance of exchange rates in transmitting oil price shocks, as seen in Mukhtarov et al. (2019). However, the study suggests that future research should include exchange rate variables to confirm the ERPT mechanism, as oil price changes influence inflation.

The monetary theory of inflation suggests that excessive money supply growth relative to economic output leads to inflation. The results show that broad money supply significantly influences inflation, especially at lag 2, suggesting that past increases may reduce inflation in later periods due to fiscal adjustments or policy interventions. The result is in support of Pettinger (2017), who posited that the impact of increased oil revenue on inflation is influenced by fiscal and monetary policy management.

Also, LM2(-3), which has a positive coefficient that is significant at the 5% level, shows that money supply growth can sometimes cause inflationary pressures. This is in line with Kpagih et al. (2022), who found Nigeria's monetary policies impact inflationary trends due to energy price shocks. Our findings suggest that monetary policy can either mitigate or amplify inflationary effects depending on time and implementation.

The findings reveals that the inflationary impact of oil price increases is stronger than the deflationary effect of price decreases. Positive oil price shocks significantly impact inflation at certain lags, while negative shocks do not consistently have a significant impact. This suggests an asymmetric transmission of oil price shocks. This result supports Hamilton (2009) and Aharon et al. (2023), who found that inflation reacts asymmetrically to oil price changes. Ben Salem et al. (2024) also noted that inflation responses to oil price shocks vary across sectors, with energy-intensive industries experiencing the strongest effects. We could attribute this asymmetry in Nigeria to structural inefficiencies, slow price adjustments, and rigid energy pricing mechanisms.

The result reveals significant relationships between inflation and monetary policy variables. The Monetary Policy Rate (MPR) at lag 2 has a positive effect on inflation, suggesting that higher interest rates in previous periods might have contributed to inflationary pressures. This suggests weak monetary policy transmission in Nigeria, possibly due to poor banking sector responses or government fiscal dominance. In line with what Wang et al. (2022) found, GDP

growth at lag 3 is significantly positive. This suggests that past economic growth causes inflation by raising aggregate demand.

## 5 CONCLUSION AND POLICY RECOMMENDATIONS

### 1 Conclusion

The study explores the nonlinear relationship between oil price changes and inflation in Nigeria, revealing a complex and multifaceted relationship influenced by various economic factors, in line with theoretical expectations and previous empirical literature. In the short run, results show a substantial level of inflation persistence, as indicated by the positive coefficient of lagged inflation (0.4005). This shows that past inflationary trends significantly impact current inflation levels, with current oil price increases having minimal direct impact. However, positive oil price changes' lagged effects have a strong negative influence, as shown by coefficients -1.7105 and -1.1675. This result indicates that inflation does not immediately respond to oil price shocks but rather adjusts over time.

Conversely, the impact of negative oil price shocks has a positive short-run effect on inflation (0.2957), but past changes tend to reduce inflation over time (-0.5083 and -0.3415). The asymmetric response suggests that Nigeria's inflation does not decrease proportionally with oil price decreases, possibly due to structural inefficiencies, price stickiness, and exchange rate volatility.

Additional macroeconomic factors also influence inflation trends. The pronounced adverse impact of total reserves on inflation indicates that increased foreign reserves contribute to price stabilisation by bolstering exchange rate stability. However, the lagged reserves variable is not statistically significant, indicating that reserves do not strongly influence inflation in the short run. Similarly, the money supply (LM2) does not have an immediate impact on inflation; past increases in the money supply exhibit both inflationary and deflationary effects, depending on the period analyzed. GDP growth (GDPGR) has an insignificant effect in the current period, but its past values exert a significant negative influence, reinforcing the idea that economic slowdowns tend to have a deflationary impact.

The monetary policy rate (MPR) has a slight negative impact on inflation, with its first lag causing a stronger deflationary effect. Adjustments take time to affect inflation, and the error correction term (ECT) is highly significant, indicating that 76.58% of deviations from long-run equilibrium are corrected each period. This emphasizes the robust self-adjusting mechanism of inflation in Nigeria.

The analysis demonstrates that oil price variations in Nigeria exert a nonlinear and asymmetric influence on inflation, with short-term impacts often delayed. Prolonged adjustments are essential for stabilizing inflationary patterns. It underscores the necessity for prudent monetary and fiscal policies, the stabilization of currency rates, and the strategic management of foreign reserves.

In the future, researchers should look into how Nigeria's inflationary response to changes in oil prices is affected by structural reforms, fiscal policies, and the state of the world economy as a whole. They should also use sectoral analysis to see how different industries react to these shocks in different ways.

### 2 Policy Recommendations

Based on the findings, the study recommends the following:

1. The Central Bank of Nigeria (CBN) should focus on enhancing exchange rate stability to counteract the impact of oil price shocks on inflation. This can be achieved by

increasing foreign exchange reserves, improving exchange rate management through clear policies, and diversifying foreign exchange sources beyond oil exports to reduce vulnerability to oil price shocks and stabilize the naira.

2. The CBN should adopt a data-driven approach to monetary policy adjustments, strengthen inflation-targeting frameworks, and maintain a balanced liquidity management to effectively control inflation by preventing excessive money supply expansion.
3. The government should use countercyclical fiscal policies, make public spending more efficient, and lower fiscal deficits by bringing in more money from sources other than oil, such as tax reforms and strategies for economic diversification.
4. The government should strengthen energy and fuel price policies, consider targeted fuel subsidies, and encourage investments in alternative energy sources like solar and renewables to reduce reliance on oil-based energy.
5. Policymakers should invest in non-oil sectors, strengthen industrialization policies, and develop value-added industries, while implementing advanced econometric models, establishing an independent monitoring agency, and improving statistical agency data collection and analysis.

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