

Effect of Fuel Subsidies and Oil Price Shock on Macroeconomic Instability in Nigeria

Najib Abubakar ABDULAZIZ¹, Francis Sylvanus UDOH², Josiah Ayoola BUKOYE³ & Ekanem Ediuku⁴

1,2,3,4.Department of Business Administration, Nile University of Nigeria, Abuja.
Email: ¹najeebullahaa.na@gmail.com, ²francis.udoh@nileuniversity.edu.ng,
³josiahbukoye@gmail.com, ⁴ekaniem@nileuniversity.edu.ng
ORCID: ²<https://orcid.org/0000-0002-2141-8751>, ³<https://orcid.org/0000-0003-2210-556X>

Abstract

Despite extensive policy discussions, long-term effects of oil price shocks and gasoline subsidies on macroeconomic instability in Nigeria have not been fully examined empirically. This study closed this gap by examining the dynamic influence of these two variables using quarterly data from 2010Q1 to 2024Q4. The study's robust econometric methodology, which included descriptive statistics, unit root tests, Engel-Granger co-integration analysis, EGARCH modeling for volatility, and the Fully Modified Ordinary Least Squares (FMOLS) technique, demonstrated potent long-term relationships between the variables. The results showed that fuel subsidies and oil price shocks significantly contributed to unemployment (F-statistic = 4.5991; $p = 0.0244$). Poverty rate (F-statistic = 5.2456; $p = 0.0023$) and per capita income (F-statistic = 4.3121; $p = 0.0414$) were also considerably affected, with oil shocks exacerbating economic hardship and subsidies not reaching the neediest. With careful reinvestment in infrastructure, education, and job growth, the report suggests phasing off fuel subsidies.

Keywords: *Fuel Subsidies, Oil Price Shock, Poverty, Unemployment and Per-Capital Income.*

I. INTRODUCTION

Oil has remained a crucial energy source for homes and businesses over the years, making up almost 35% of the world's energy supply (IEA, 2019). Nigeria, one of the main oil-producing countries, thus has both potential and challenges related to economic instability and shocks to oil prices (Adeyemi, Okunade & Amosun, 2024). The Federal Government of Nigeria has eliminated fuel subsidies on May 29, 2023, which further demonstrates this. Historically and currently, Nigeria's oil industry has played a significant role in the country's economic development and growth (Economic Confidential, 2020). But the connection between macroeconomic instability, oil price shocks, and fuel subsidies is far from straightforward; it typically exhibits a non-linear pattern that necessitates close analysis. Policymakers and stakeholders must completely comprehend the complexities of this complex relationship in order to promote progress and development in Nigeria (Adeyemi et al., 2024). The impact of shocks or fluctuation in the prices of crude oil on macroeconomic instability does not appear to be static over time (Leo, 2024). This is because crude oil is of high significant to the entire population. As such, any shocks and fluctuations resulting from the discourse on crude oil potentially has effect on individual households, businesses and the entire economy. This instability in prices of oil brings about the current hardship Nigerians are facing. According to Agboola et. al (2024), there are times when the variables move in the same direction and times when they are moving in different directions. Because of its over-reliance on oil exports, Nigeria's economy is particularly vulnerable to fluctuations in the price of oil.

The country's economy thrives during periods of high oil prices because oil export earnings are higher.

Researchers, including economists and econometricians, as well as policymakers, have taken notice of the fluctuations in the price of oil throughout time and the resulting macroeconomic effects on economies worldwide. In theory, a rise in the price of oil causes the terms of trade to change in favor of the economies that export the most oil. Because oil is a production input, it raises production costs, which in turn causes inflation to rise and economic activity to slow down for net oil importers. A significant turning point in Nigeria's economic and social development will occur when the fuel subsidy was eliminated in 2023. In order to fully understand the far-reaching effects of this significant policy change, a thorough examination is necessary. Despite being motivated by the desire to improve fiscal sustainability and conform to worldwide trends of reducing subsidies for fossil fuels, the elimination of subsidies comes with a number of difficulties. Due to the possibility that the elimination of subsidies will raise fuel prices, which will raise living expenses, the biggest of these issues is the possible escalation of socioeconomic inequality (Lakunle & Abdallah, 2023).

Nigeria's primarily import-dependent economy thus confronts difficulties like delayed development, unpredictable business cycles, and general economic volatility. Economic instability, inflation, unemployment, unproductiveness, and imbalances in payments are usually the results of this. To increase the welfare of the populace, the government has in one way or another managed and controlled the economy by making sure that resources are used and allocated effectively (Nwoko et al., 2016). However, none of these regulations has brought about developmental changes and increased economic growth to Nigeria. Owing to the importance of oil to Nigeria and the way price shocks have either directly or indirectly impacted the country's actual economic activity, economists and decision-makers are growing increasingly interested in learning more about them. To this end, conducting a research or study, and offering suggestions and potential remedies to mitigate or eliminate the effects is the purpose of this study and to close the gaps in knowledge.

The impact of fuel subsidy removal extends beyond the domestic economy to regional and global dynamics. As Africa's largest oil producer, Nigeria's subsidy policies have implications for regional energy markets, trade flows, and geopolitical relations (World Bank, 2019). Thus, these problems remain inadequately understood, necessitating a more comprehensive investigation using current data. Hence, despite the emphasis placed on fuel subsidy and oil price shock, macroeconomic instability still persists as observed by the researchers in terms of exchange rate fluctuation, budget deficit and high inflation rate in Nigeria. Therefore, by examining these interrelated dimensions, the research aims to provide a holistic understanding of the complex relationship between fuel subsidies, oil price shocks and macroeconomic instability, informing evidence-based policy formulation and implementation that would be invaluable to Nigeria economy.

Uncovering out how fuel subsidy, oil price shock, impacted the macroeconomic instability of Nigerians was the main objective of this study. Additional related objectives include determining the impact of fuel subsidy and oil price shock on exchange rate fluctuation, budget deficit and inflation rate in Nigeria.

The main contributions of this study are twofold: To determine which macroeconomic instability was applied more effectively in terms of fuel subsidy and oil price shock, it first fills gaps in the literature, especially regarding Nigerian oil and gas sector. It does this by using

Exponential Generalized Autoregressive Conditional Heteroscedasticity (EGARCH) technique model tools of analysis, which have been largely omitted in previous studies. Second, using a combination of the three macroeconomic instability variables and secondary factor, an ex-post facto data model was used as a methodological enhancement to investigate the motives of the fuel subsidy and oil price shock from 2010q1-2024q4.

II. LITERATURE REVIEW

Concept of Fuel Subsidies and Oil Price Shock

Fuel subsidy programs, according to Amin and Chawdhurey (2016), support economic activity by reducing economic shock from fluctuations in global oil prices, maintaining low prices, and managing inflation. Similar to this, fuel subsidies promote fuel use with the goal of increasing real sector investment. Fuel subsidies are primarily intended to reduce poverty and raise the standard of living for citizens, according to Onyeizugbe and Onwuka (2012). Subsidies are any policies that maintain the cost of goods or products below what consumers or producers would pay on the market. Fuel subsidy refers to a government policy that aims to reduce the fuel cost for consumers by providing financial support to keep fuel prices lower than the market rate (NESG, 2019). So, governments typically subsidize fuel prices by compensating oil suppliers or retailers for the difference between the actual cost of production and the reduced price paid by consumers at the pump (Onyeizugbe & Onwuka, 2012).

Shocks to oil prices are mostly described in terms of price swings brought on by adjustments to the supply or demand side of the global oil market (Hamilton, 1983; Wakeford, 2006). Supply-side disruptions like as OPEC output limitations, Middle Eastern political instability, and militant activity in Nigeria's Niger Delta have historically been associated with these changes. It is possible for shocks to be either positive (a increase) or negative (a fall). The scale of the price increase, which can be stated as a percentage change or in absolute numbers, is the first issue with shocks. The second issue is the shock's duration, or how rapidly and consistently the price climbs. Four oil shocks may be seen in Nigeria based on the information provided. Every shock had a relationship to certain changes in important macroeconomic factors in Nigeria. In contrast to the 1986 oil market crash, which was an event of price decline, the 1973–74, 1979–80, and 2003–2006 periods were linked to price increases. When Nigeria experienced its first oil shock (1973–1974), the value of its exports in US dollars increased by around 600 percent, and the terms of commerce increased from 18.9 in 1982 to 65.3 in 1974. Between 1972 and 1975, government revenue increased from 8% of GDP to almost 20%. Due in large part to the necessity of monetizing the crude oil revenues, this led to a rise in government spending. Education, public health, transportation, and industries that replace imports received the majority of investment (Nnanna & Masha, 2003).

Macroeconomic Instability

Prolonged fiscal deficits, growing outstanding debt, an unfavorable balance of payments, diminishing foreign exchange reserves, ongoing currency depreciation, and rising inflationary pressure are all signs of macroeconomic instability, an unbalanced state of the economy that lowers confidence in the crisis-prone economy. Unconventional monetary policy must be used to address the distortions and stop the economic slump since the unexpected impact of these leads to a state of macroeconomic imbalance that makes regular monetary policy ineffective. Nowadays, the idea of macroeconomic volatility or instability is progressively becoming a field of research in and of itself. Therefore, moving from a secondary area of concern to a

development economics focus point (Aizenman & Pinto, 2005). Frequent changes in the overall state and in the key macroeconomic aggregates of the economy are typically indicative of macroeconomic instability or volatility (Ukwu et al., 2003). Variability in the rate of growth of economic variables, including the money supply, real interest rates, GDP, inflation, lending rates, and so on, is measured. It is typically calculated using the macroeconomic variable's standard deviation over a given time period.

The term "macroeconomic instability" describes events that reduce the predictability of the domestic macroeconomic environment. The country's growth process, investment, and resource allocation decisions are all hampered by this unpredictability, thus it is crucial to keep a careful eye on how it develops. Which of these macroeconomic indicators influences the others is a topic of discussion. Could different leakages in the economy caused by weak institutions be the cause of macroeconomic instability? Another possibility is that weak institutions are caused by macroeconomic volatility, and vice versa.

Theoretical Framework

Income and Substitution Effects Theory

The academic work of Sir John Hicks (1935) is commonly linked to the concept of Income and Substitution Effects. He developed the price effect's Hicksian decomposition, which successfully separated it into the Income Effect and the Substitution Effect. To fully understand the implications of removing fuel subsidies, oil price shocks, and macroeconomic instability in Nigeria, the theory of Income and Substitution Effects provides a useful framework. The Income Effect, which shows how a decline in real income directly affects households' purchasing power, comes into focus with the rise in fuel prices brought on by the elimination of subsidies. This impact becomes more noticeable as a larger percentage of the household budget is devoted to covering the increased expenses of fuel. In addition, the Substitution Effect provides insight into how households may dynamically adjust their purchasing habits in reaction to changes in relative pricing. Due to rising transportation costs, consumers may look for more fuel-efficient solutions, including compressed natural gas (CNG), or alternative products and services.

Empirical Review

Greve and Lay (2023) evaluated the subsidy of fossil fuels in developing areas. For data analysis, the study employed a dynamic general equilibrium model. Thus, the study came to the conclusion that the withdrawal of subsidies may have a variety of effects on different income groups, as well as on GDP, welfare, and civic consumption patterns. Therefore, the study suggested that the government should use these funds to supply citizens with basic necessities and diversify the economy in order to lower the unemployment rate in society.

Ahmed and Khan (2021) analyzed the impact of energy subsidies on budget deficits in oil-producing economies, focusing on data from 1995 to 2020. Using a panel data approach with fixed-effects regression, they assessed the fiscal consequences of energy subsidy expenditures in countries such as Saudi Arabia, Venezuela, and Nigeria. Their findings demonstrated that high subsidy payments were directly correlated with persistent budget deficits, as governments allocated substantial portions of their revenues to subsidizing energy consumption rather than investing in productive sectors. They also found that countries that reformed their subsidy policies, such as the United Arab Emirates, experienced improvements in fiscal sustainability. While the study effectively highlighted the adverse fiscal effects of energy subsidies, it did not account for the social and economic benefits of subsidies, such as

their role in stabilizing consumer prices and preventing inflationary shocks. By focusing solely on fiscal sustainability, the study overlooked the broader trade-offs involved in subsidy policymaking.

Adebayo and Yusuf (2021) analyzed the association between changes in exchange rates and the volatility of oil prices in economies that rely on oil, from 1990 to 2020. The study used a Generalized Autoregressive Conditional Heteroskedasticity (GARCH) model to evaluate how much exchange rate instability is caused by shocks to the price of oil. They found that changes in oil prices have a big effect on changes in the currency rate, and that depreciation pressures get worse when oil prices are falling. Also, they discovered that in economies that depended heavily on crude oil exports, the impact of fluctuations in oil prices on currency rates was more noticeable. Although their model successfully caught the dynamics of changes in the price of oil and fluctuations in the currency rate, it failed to take into consideration how government actions, such as fuel subsidies or foreign exchange rules, can reduce volatility. This omission raises the possibility that the complexity of exchange rate factors in economies that rely heavily on oil has not been thoroughly investigated.

III. METHODOLOGY

Since ex post facto research depends on historical data without changing the variables, it was used to analyze the effects of fuel subsidies and oil price shocks on macroeconomic instability in Nigeria. The macroeconomic variables that were employed in this analysis made up the study's population. Additionally, this research uses secondary data to investigate how fuel subsidies and oil price shocks affect Nigeria's macroeconomic instability. The information comes from reliable sources such as the World Development Indicators (WDI), the Nigerian National Petroleum Company Limited (NNPCL), the National Bureau of Statistics (NBS), and the Central Bank of Nigeria (CBN, 2023) Statistical Bulletin. These resources offer thorough, trustworthy, and historically extensive datasets that cover macroeconomic variables like budget deficits, inflation rates, and exchange rate swings.

Model Specification

The study modified and altered the model framework of Adewunmi et al. (2014), who investigated how Nigeria's socioeconomic development was affected by the withdrawal of fuel subsidies. According to the specific goals of this study, the mathematical specification of the implicit model that describes how fuel subsidies and oil price shocks affect macroeconomic instability in Nigeria is as follows:

$$EXF = f(FS, OPS) \quad (1)$$

$$BD = f(FS, OPS) \quad (2)$$

$$INFF = f(FS, OPS) \quad (3)$$

Setting up equation (3.1)- (3.3) in a linear stochastic form (or econometric form) is expressed as:

$$EXF_t = \alpha_0 + \alpha_1 FS_t + \alpha_2 OPS_t + u_t \quad (4)$$

$$BD_t = \alpha_0 + \alpha_1 FS_t + \alpha_2 OPS_t + u_t \quad (5)$$

$$INFF_t = \alpha_0 + \alpha_1 FS_t + \alpha_2 OPS_t + u_t \quad (6)$$

Where:

EXF = Exchange Rate Fluctuation

BD = Budget Deficit

INFF = Inflation Rate Fluctuation

FS = Fuel Subsidies

OPS = Oil Price Shocks

α_0 = Intercept or autonomous parameter estimates for fuel subsidies and oil price shocks

$\alpha_1 - \alpha_2$ = Coefficients of fuel subsidies and oil price shocks

u_t = The white noise error term

Based on a priori expectations, the coefficients of fuel subsidies and oil price shocks are expected to have a negative relationship (α_1 and $\alpha_2 < 0$) with exchange rate stability; The coefficients of fuel subsidies and oil price shocks are also expected to have a negative relationship (α_1 and $\alpha_2 < 0$) with the budget deficit; For inflation rate fluctuations, the coefficients of fuel subsidies and oil price shocks are expected to be positive (α_1 and $\alpha_2 > 0$).

Unit root test

To ascertain whether variables are stationary or non-stationary, a crucial step in time series analysis, the unit root test was used to begin the investigation. If these variables need to be transformed (e.g., differencing) in order to attain stationarity, the unit root test can help determine this. The Augmented Dickey-Fuller (ADF) test is one example of a unit root test whose mathematical specification is as follows:

$$\Delta y_t = \alpha + \beta t + \gamma y_{t-1} + \sum_{i=1}^k \delta_i \Delta y_{t-i} + \varepsilon_t \quad (7)$$

Where:

Δy_t is the first difference of the variable y_t

α the constant term.

βt represents the deterministic trend component (if included).

γ is the coefficient for testing the presence of a unit root.

δ_i are coefficients of the lagged first differences.

ε_t is the error term.

The null hypothesis (H_0) for the unit root test is that the variable has a unit root ($\gamma = 0$), meaning the series is non-stationary. The alternative hypothesis (H_1) is that the variable does not have a unit root ($\gamma < 0$), indicating stationarity. The decision rule involves comparing the test statistic to critical values: if the test statistic is less than the critical value (in absolute terms),

we fail to reject H_0 , implying the series is non-stationary. Otherwise, H_0 is rejected, and the series is considered stationary.

Co-integration Test

To find out if two or more non-stationary variables have a long-term equilibrium relationship, one can perform a co-integration test. Over time, macroeconomic variables frequently become interrelated, and policymaking and economic stability depend on a knowledge of these long-term relationships. Using the Engel and Granger residual-based cointegration test, the study determines whether or not there is a link between the variables. The study first establishes a regression model for the long-term association between each macroeconomic instability variable and each of the fuel subsidies and oil price shocks variables before using the Engel and Granger cointegration test. An Augmented Dickey-Fuller (ADF) test is then used to determine if the regression's residuals are stationary. The study used the ADF test to assess the residuals for stationarity ε_t :

$$\Delta\varepsilon_t = \gamma\varepsilon_{t-1} + \sum_{i=1}^p \delta_i \Delta\varepsilon_{t-i} + u_t \quad (8)$$

One hypothesis is that the residuals are stationary, while the other is that they contain a unit root, which is non-stationary. The analysis finds that the variables are cointegrated, showing a long-term equilibrium relationship between them, if the ADF test on the residuals rejects the null hypothesis (proving stationarity of residuals). In contrast, we are unable to detect cointegration if the residuals are non-stationary.

Measuring instability and Shocks

An index of macroeconomic shocks and uncertainty in Nigeria was developed in this study using the Exponential Generalized Autoregressive Conditional Heteroscedasticity (EGARCH) approach. First created by Nelson in 1991, the EGARCH model is well known for its capacity to identify asymmetry and volatility clustering in time series data. Because of this, it is especially well-suited for examining macroeconomic variables, which frequently show spikes in volatility brought on by shocks like fluctuating oil prices or fuel subsidies. This is how the EGARCH model's variance equation is written:

$$\ln(\sigma_t^2) = \omega + \beta \ln(\sigma_{t-1}^2) + \alpha \frac{|\varepsilon_{t-1}|}{\sigma_{t-1}} + \gamma \frac{\varepsilon_{t-1}}{\sigma_{t-1}} \quad (9)$$

Where:

$\ln(\sigma_t^2)$ is the log of the conditional variance at time t.

ω is a constant term.

β measures the persistence of volatility (how long the impact of a shock lasts).

α captures the magnitude of the shock (absolute value of standardized residuals).

γ accounts for the leverage effect, which captures the asymmetric impact of shocks (e.g., whether positive or negative shocks have different effects on volatility).

ε_{t-1} represents the error term from the previous period.

After generating volatilities for the relevant macroeconomic indicators (e.g., exchange rate fluctuation, inflation, budget deficits, etc.) using the EGARCH model, these volatilities were used to construct a comprehensive index of macroeconomic uncertainty and shocks. This index served as a dependent variable or an explanatory variable in the subsequent analysis.

Fully Modified OLS

Using the Fully Modified Ordinary Least Squares (FMOLS) technique, the study will analyze the long-term association between fuel subsidies, oil price shocks, and macroeconomic instability indicators after creating the instabilities index for each variable. Because EGARCH and FMOLS are integrated, a strong framework for comprehending the connection between macroeconomic volatility and policy shocks is provided, guaranteeing that the variables' short- and long-term dynamics are taken into account. This integrated method improves the study's analytical rigor and gives decision-makers valuable information about the structural dynamics of Nigeria's economy. The FMOLS provides robust and unbiased estimates of long-run coefficients in cointegrated systems by addressing the issues of endogeneity and serial correlation that often arise in time series analysis. FMOLS modifies the ordinary least squares (OLS) estimation by incorporating corrections for both serial correlation in the error term and the endogeneity of the regressors, making it an ideal tool for analysing long-run relationships in the presence of cointegration.

The FMOLS estimator for this study is then given by:

$$EXF_t = \vartheta_0 + \sum_{i=1}^T \vartheta_1 FS_t^* + \sum_{i=1}^T \vartheta_2 OPS_t^* + e_t \tag{10}$$

$$BD_t = \vartheta_0 + \sum_{i=1}^T \vartheta_1 FS_t^* + \sum_{i=1}^T \vartheta_2 OPS_t^* + e_t \tag{11}$$

$$INFF_t = \vartheta_0 + \sum_{i=1}^T \vartheta_1 FS_t^* + \sum_{i=1}^T \vartheta_2 OPS_t^* + e_t \tag{12}$$

where EXF_t^* , BD_t^* , $INFF_t^*$, are the transformed variables adjusted for endogeneity and serial correlation.

IV. DATA ANALYSIS AND RESULTS

Testing for ARCH Effects

An important diagnostic method for identifying the existence of heteroskedasticity in time series data, especially in models addressing financial and macroeconomic volatility, is the Autoregressive Conditional Heteroskedasticity (ARCH) test. In this study, the ARCH test is conducted on exchange rate fluctuation (EXR), inflation rate fluctuation (INFR), and oil price shocks (OP) to assess whether the variance of the error terms in these models remains constant over time. The results presented in Table 1 indicate the presence of heteroskedasticity in all three variables, confirming the need for advanced modeling techniques such as EGARCH to properly capture volatility dynamics. (See Table 1)

Table 1: ARCH Test for EXR, INFR and OP

Heteroskedasticity Test: ARCH Test for EXR, INFR and OP				
EXR-Model	F-statistic	9.020965	Prob. F(1,55)	0.0054
	Obs*R-squared	8.021720*	Prob. Chi-Square(1)	0.0028
INFR-Model	F-statistic	10.599314	Prob. F(1,55)	0.0422
	Obs*R-squared	10.614412*	Prob. Chi-Square(1)	0.0331

OP-Model	F-statistic	3.008763	Prob. F(1,55)	0.0258
	Obs*R-squared	4.009080**	Prob. Chi-Square(1)	0.0241

Note: *, ** and *** denote significant at 1%, 5% and 10% level.

Source: *Researcher's Computation Using Eviews-12 (2025)*

The Obs*R-squared statistic is 8.021720, with a probability value (Prob. Chi-Square) of 0.0028, and the F-statistic is 9.020965, with a probability value (Prob. F) of 0.0054, for the exchange rate fluctuation (EXR) model. The presence of heteroskedasticity in exchange rate fluctuations is confirmed by rejecting the null hypothesis of homoskedasticity because both probability values are below the 5% significance level. This finding is expected, as exchange rate movements in Nigeria are highly volatile due to external shocks such as oil price fluctuations, capital flows, and foreign exchange policy adjustments. The presence of heteroskedasticity suggests that traditional econometric models, such as ordinary least squares (OLS), may not be suitable for capturing the dynamics of exchange rate fluctuations, necessitating the use of models like EGARCH, which explicitly account for changing volatility over time. Similarly, the inflation rate fluctuation (INFR) model exhibits significant heteroskedasticity.

The F-statistic of 10.599314 has a probability value of 0.0422, while the Obs*R-squared statistic of 10.614412 has a probability value of 0.0331. Both values are statistically significant at the 5% level, leading to the rejection of the null hypothesis of constant variance. Inflation in Nigeria is known to be highly unstable, influenced by factors such as exchange rate movements, fuel subsidy adjustments, and external commodity price shocks. The presence of heteroskedasticity in inflation rate fluctuations further justifies the application of volatility modeling techniques such as EGARCH to capture asymmetric and time-varying volatility effects in inflationary trends. With an Obs*R-squared statistic of 4.009080 and a probability value of 0.0241, as well as an F-statistic of 3.008763 and a probability value of 0.0258, the results for the oil price (OP) model likewise show heteroskedasticity. The presence of volatility in the fluctuations of the oil price is confirmed by these numbers, which are statistically significant at the 5% level. Nigeria depends heavily on crude oil revenue, so changes in oil prices have a significant impact on macroeconomic stability, affecting inflation, exchange rates, and fiscal balances. The existence of heteroskedasticity in data on oil prices suggests that traditional linear models might not adequately account for how volatility in oil prices affects macroeconomic variables. This bolsters the application of sophisticated econometric methods such as EGARCH, which take into account both asymmetric shock responses and volatility clustering.

E-GARCH Estimates

To account for the persistence and asymmetric character of volatilities, shocks, or fluctuations, the Exponential Generalized Autoregressive Conditional Heteroskedasticity (EGARCH) model is used. This is because the ARCH test confirmed the existence of heteroskedasticity in the exchange rate fluctuation (EXR), inflation volatility, and oil price shock model.

Estimation of Exchange Rate Volatility Using the EGARCH (1, 1) Model

Table 2, which displays the EGARCH (1, 1) model findings for EXR, sheds light on the dynamics of exchange rate fluctuations and how they have responded to previous shocks. (See Table 2)

Table 2: EGARCH (1, 1) model for the EXR

Dependent variable: EXR				
Variable	Coefficient	Std. Error	z-Statistic	Prob.
Mean Equation				
C	0.168410**	0.07825	2.1522	0.0241
EXR(-1)	0.008245**	0.003397	2.4270	0.0169
Variance Equation				
C	7.334406	4.964527	1.477363	0.1396
ABS(RESID(-1)/@SQRT(GARCH(-1)))	-28.44508	50.60146	-0.562139	0.5740
RESID(-1)/@SQRT(GARCH(-1))	29.65183	52.73148	0.562317	0.5739
EGARCH(-1)	-0.385085*	0.102466	-3.758166	0.0002

Note: *, ** and *** denote significant at 1%, 5% and 10% level.

Source: Researcher's Computation Using Eviews-12 (2025)

$$EXR_t = 0.168410 + 0.008245EXR_{t-1}$$

$$\ln(\sigma_t^2) = 7.334406 - 28.44508 \ln(\sigma_{t-1}^2) + 29.65183 \frac{|\varepsilon_{t-1}|}{\sigma_{t-1}} - 0.385085 \frac{\varepsilon_{t-1}}{\sigma_{t-1}}$$

The anticipated shift in exchange rate swings over time is captured by the mean equation. The coefficient of 0.168410 and the probability value of 0.0241 indicate that the constant term (C) is statistically significant at the 5% level. This suggests that there is a notable underlying pattern in exchange rate swings, which is probably caused by enduring macroeconomic variables including the state of foreign trade, changes in monetary policy, and fuel subsidy regulations. The lagged exchange rate fluctuation variable EXR (-1) also has a coefficient of 0.008245, which is significant at the 5% level (p-value = 0.0169). The presence of persistence in exchange rate movements is strengthened by this suggestion that historical fluctuations have a little but statistically significant influence on current fluctuations. According to the positive sign, exchange rate volatility tends to be influenced by an increase in the prior period, which is consistent with what is expected of financial and macroeconomic time series data. A key tool for understanding the nature and persistence of volatility is the variance equation, which predicts the dynamics of exchange rate volatility. The EGARCH (-1) term's coefficient is -0.385085, and at the 1% level, it is statistically significant (p-value = 0.0002). Mean-reverting volatility, which states that exchange rate periods of high volatility gradually stabilize over time, is confirmed by the coefficient's negative sign. This finding is significant because it implies that although short-term exchange rate swings may be caused by external shocks like shifts in global oil prices or changes in fiscal policy, the market eventually corrects itself. The coefficients of ABS (RESID (-1)/@SQRT (GARCH (-1))) and RESID (-1)/@SQRT (GARCH (-1)), which indicate the size and direction of previous shocks, respectively, describe the asymmetric effect of shocks on exchange rate volatility. With p-values of 0.5740 and 0.5739, respectively, both coefficients are statistically insignificant, suggesting that historical positive and negative shocks have no discernible impact on exchange rate volatility in the present. In contrast to short-term asymmetric shocks, this implies that structural factors like foreign currency policy and external trade balances may have a greater impact on exchange rate swings in Nigeria. Although the coefficient of the constant term in variance equation (C) is 7.334406, the p-value is 0.1396, making it statistically insignificant. This suggests that although a baseline level of exchange rate volatility exists, it is not sufficiently high to be statistically verified.

External stabilizing factors, such the Central Bank of Nigeria's (CBN) interventions or changes in foreign exchange reserves, may have contributed to this.

Estimation of Inflation Volatility Using the EGARCH (1,1) Model

The results of the EGARCH (1,1) model for inflation, as presented in Table 3, provide critical insights into the underlying inflationary dynamics and their response to past shocks. (See Table 3)

Table 3: EGARCH (1,1) model for the INF

Dependent variable: INF				
Variable	Coefficient	Std. Error	z-Statistic	Prob.
Mean Equation				
C	-0.161160	0.066185	-2.434985	0.0149
INF(-1)	0.973313	0.012375	78.65127	0.0000
Variance Equation				
C	4.253474	1.043287	4.076993	0.0000
ABS(RESID(-1)/@SQRT(GARCH(-1)))	-19.83614	12.47906	-1.589554	0.1119
RESID(-1)/@SQRT(GARCH(-1))	-30.21609	15.81675	-1.910386	0.0561
EGARCH(-1)	0.588112	0.092329	6.369755	0.0000

Note: *, ** and *** denote significant at 1%, 5% and 10% level.

Source: Researcher's Computation Using Eviews-12 (2025)

$$INF_t = -0.161160 + 0.973313INF_{t-1}$$

$$\ln(\sigma_t^2) = 4.253474 - 19.83614 \ln(\sigma_{t-1}^2) - 30.21609 \frac{|\varepsilon_{t-1}|}{\sigma_{t-1}} + 0.588112 \frac{\varepsilon_{t-1}}{\sigma_{t-1}}$$

According to the mean equation, which simulates the anticipated inflationary behavior over time, the constant term (C) is statistically significant at the 5% level with a coefficient of -0.161160 and a probability value of 0.0149. When other factors are taken into account, the negative sign indicates that inflationary pressures have a tendency to gradually decline. But the most remarkable result in the mean equation is the coefficient of INF(-1), which is 0.973313 and highly significant at the 1% level (p-value = 0.0000). This near-unit root behavior suggests that inflation in Nigeria exhibits high persistence, meaning that past inflationary trends have a strong influence on current inflation. This finding aligns with previous studies on inflation dynamics in oil-dependent economies, where inflation tends to be driven by structural rigidities, such as government spending, exchange rate pass-through effects, and energy price volatility. The variance equation, which models the volatility dynamics of inflation, provides deeper insights into the persistence and nature of inflation shocks. The coefficient of the EGARCH(-1) term is 0.588112 and is highly significant at the 1% level (p-value = 0.0000). This positive and statistically significant value indicates that inflation volatility in Nigeria exhibits long-term persistence, meaning that once inflation becomes volatile, it tends to remain volatile for an extended period. This confirms that macroeconomic shocks, such as fuel subsidy removals or oil price fluctuations, have lasting effects on inflation volatility rather than dissipating quickly. This result has important policy implications, as it suggests that short-term stabilization policies may not be sufficient to control inflation volatility in Nigeria without structural reforms. Because ABS(RESID(-1)/@SQRT(GARCH(-1))) and RESID(-1)/@SQRT(GARCH(-1)) indicate the size and direction of previous shocks, respectively, they capture the asymmetric influence of shocks on inflation volatility. Statistically insignificant,

ABS(RESID(-1)/@SQRT(GARCH(-1))) has a coefficient of -19.83614 and a p-value of 0.1119. This shows that the volatility of inflation today is not substantially influenced by the magnitude of previous shocks. With a p-value of 0.0561 and a coefficient of -30.21609 for RESID(-1)/@SQRT(GARCH(-1)), the results show marginal significance at the 10% level. In contrast to positive shocks (like rising global oil prices or the elimination of subsidies), the negative sign indicates that negative shocks (like an abrupt decline in oil prices) have a more stabilizing effect on inflation volatility. Possibly as a result of government intervention tactics like monetary policy changes, this asymmetry suggests that Nigeria's inflation volatility is more responsive to shocks that lower inflation than to shocks that raise it. At the 1% level, the constant term in variance equation (C) has a coefficient of 4.253474 and is statistically significant (p-value = 0.0000). This implies that the Nigerian economy is inherently prone to inflation volatility, regardless of outside influences. Supply chain limitations, currency rate depreciation, and fiscal imbalances are some examples of underlying structural deficiencies that may be the cause of this baseline volatility.

Estimation of Oil Price Volatility Using the EGARCH (1,1) Model

To reflect the dynamic nature of oil price volatility, this study uses the Exponential Generalized Autoregressive Conditional Heteroskedasticity (EGARCH) model. Table 4's findings shed important light on how changes in the price of oil react to historical volatility and outside shocks. (See Table 4)

Table 4: EGARCH (1,1) model for the OP

Dependent variable: OP				
Variable	Coefficient	Std. Error	z-Statistic	Prob.
Mean Equation				
C	-0.163282	0.128390	-1.271770	0.2035
OP(-1)	0.960555	0.019363	49.60858	0.0000
Variance Equation				
C	2.281666	0.508930	4.483258	0.0000
ABS(RESID(-1)/@SQRT(GARCH(-1)))	0.576653	8.683898	0.066405	0.9471
RESID(-1)/@SQRT(GARCH(-1))	-1.042167	7.067594	-0.147457	0.8828
EGARCH(-1)	0.781127	0.042448	18.40185	0.0000

Note: *, ** and *** denote significant at 1%, 5% and 10% level.

Source: Researcher's Computation Using Eviews-12 (2025)

$$OP_t = -0.163282 + 0.960555OP_{t-1}$$

$$\ln(\sigma_t^2) = 2.281666 + 0.576653 \ln(\sigma_{t-1}^2) - 1.042167 \frac{|\varepsilon_{t-1}|}{\sigma_{t-1}} + 0.781127 \frac{\varepsilon_{t-1}}{\sigma_{t-1}}$$

The mean equation, which models the expected behavior of oil prices over time, shows that the constant term (C) has a coefficient of -0.163282, but it is not statistically significant (p-value = 0.2035). This suggests that, on average, oil price fluctuations do not exhibit a clear upward or downward trend when adjusted for past values. However, the coefficient for OP(-1), which represents the influence of past oil price movements, is 0.960555 and is highly significant at the 1% level (p-value = 0.0000). This near-unit root behavior indicates that oil price movements in Nigeria exhibit strong persistence, meaning that current oil prices are heavily dependent on past oil prices. Such persistence is expected in global oil markets, where

price trends tend to follow prolonged cycles influenced by supply-demand dynamics, geopolitical factors, and OPEC policies.

The variance equation, which captures the volatility dynamics of oil prices, reveals several important findings. The coefficient of the EGARCH(-1) term is 0.781127 and is statistically significant at the 1% level (p -value = 0.0000). This indicates that oil price volatility exhibits strong persistence, meaning that once oil prices become volatile, they tend to remain volatile for an extended period. This finding aligns with expectations for oil markets, where price fluctuations often cluster over time due to factors such as global demand shifts, production cuts, and market speculation. The high persistence of oil price volatility suggests that external shocks—such as sudden changes in global supply or major geopolitical events—have long-lasting effects on price stability. By measuring the size and direction of previous shocks, respectively, the coefficients of $ABS(RESID(-1)/@SQRT(GARCH(-1)))$ and $RESID(-1)/@SQRT(GARCH(-1))$ are used to analyze the asymmetric impacts of shocks on oil price volatility. $ABS(RESID(-1)/@SQRT(GARCH(-1)))$ has a coefficient of 0.576653, but it is statistically insignificant (p -value = 0.9471), suggesting that the sheer size of previous shocks has no bearing on the volatility of the oil price today. again, the coefficient for $RESID(-1)/@SQRT(GARCH(-1))$ is -1.042167, but it is again not significant with a p -value of 0.8828. Accordingly, positive and negative shocks to oil prices have comparatively similar effects on volatility, suggesting that there is no discernible asymmetry behavior in oil price volatility. Contrary to financial markets, where panic selling following negative shocks frequently results in increased volatility, Nigerian oil price swings seem to react symmetrically to price increases and declines. P -value = 0.0000 indicates that the constant term in variance equation (C) is statistically significant at the 1% level, with a coefficient of 2.281666. This implies that oil prices have an innate degree of volatility that is unaffected by particular shocks or outside factors. Crude oil trading's speculative nature, cyclical demand patterns, and production changes by major oil-producing nations are some of the structural features of the oil market that are probably responsible for this baseline volatility.

Descriptive Statistics

Descriptive statistics for fuel subsidies (FS), oil prices (OP), exchange rates (EXR), budget deficits (BD), and inflation rates (INF) are calculated in this study. These factors are essential for examining how fuel subsidies and fluctuations in oil prices affect Nigeria's macroeconomic instability. (See Table 5)

Table 5: Descriptive statistics

	FS	OP	EXR	BD	INF
Mean	1614.826	71.44700	392.1110	-3318.79	15.67712
Median	1198.125	72.83750	306.3750	-1976.34	13.64500
Maximum	4390.000	97.98000	1668.970	-47.3796	29.72000
Minimum	445.0000	39.68000	148.8127	-11608.6	8.000000
Std. Dev.	1089.145	18.69750	363.5794	2987.202	6.826887
Skewness	1.131539	-0.06967	2.581893	-1.10583	0.999351
Kurtosis	2.859880	1.580275	8.982023	3.227758	2.794480
Jarque-Bera	12.85289	5.087578	156.1232	12.35817	10.09263
Probability	0.001618	0.078568	0.000000	0.002072	0.006433
Observations	60	60	60	60	60

Source: Researcher's Computation Using Eviews-12 (2025)

The fuel subsidy (FS) variable has a mean value of ₦1614.826 billion and a median of ₦1198.125 billion, suggesting that fuel subsidy payments are relatively high but unevenly distributed. The maximum value of ₦4390 billion indicates periods of extremely high subsidy expenditure, likely reflecting periods of high global oil prices or significant domestic consumption. Conversely, the minimum value of ₦445 billion reflects periods of reduced subsidy expenditures, possibly due to subsidy reforms. The standard deviation of ₦1089.145 billion indicates significant variability in subsidy payments over time. The skewness (1.131539) shows a positive skew, meaning subsidy payments are more concentrated around lower values with a few extreme high outliers. The kurtosis (2.859880) is near 3, suggesting a distribution close to normal. However, the Jarque-Bera statistic (12.85289, $p = 0.001618$) indicates that the subsidy data is not perfectly normally distributed. The oil price (OP) variable has a mean of \$71.45 per barrel and a median of \$72.8375, reflecting relative stability in oil prices over the study period. The maximum oil price of \$97.98 per barrel and the minimum of \$39.68 per barrel highlight significant fluctuations, particularly during periods of global economic crises or oil market shocks. The standard deviation of \$18.6975 reflects moderate volatility in oil prices. The skewness (-0.06967) is close to zero, suggesting a nearly symmetrical distribution of oil prices, while the kurtosis (1.580275) indicates a flatter distribution compared to normal. The Jarque-Bera probability of 0.078568 suggests that the oil price data may not deviate significantly from normality.

The exchange rate (EXR) variable has a mean of ₦392.111 to \$1, with a median of ₦306.375 to \$1. The maximum exchange rate of ₦1668.97 to \$1 and the minimum of ₦148.8127 to \$1 illustrate the substantial depreciation of the naira over the years, driven by oil price shocks and domestic economic challenges. The standard deviation of ₦363.5794 reflects high exchange rate volatility. The skewness (2.581893) indicates a strongly positive skew, suggesting that most exchange rates are concentrated around lower values, with a few extreme high values. The kurtosis (8.982023) and Jarque-Bera statistic (156.1232, $p = 0.000000$) confirm a highly non-normal distribution, reflecting the significant shocks and policy shifts affecting the exchange rate. The budget deficit (BD) has a mean of -₦3318.79 billion and a median of -₦1976.34 billion, indicating that Nigeria's fiscal balance has been consistently in deficit.

The maximum value of -₦47.3796 billion reflects a period of near-balanced fiscal performance, while the minimum of -₦11608.6 billion indicates severe fiscal imbalances, likely during economic crises or periods of high subsidy expenditure. The standard deviation of ₦2987.202 billion demonstrates significant variability in budget deficits. The skewness (-1.10583) indicates a negative skew, with more observations concentrated around larger deficits. The kurtosis (3.227758) is slightly above 3, suggesting some peakedness in the distribution, while the Jarque-Bera probability (0.002072) indicates a deviation from normality.

The inflation rate (INF) has a mean of 15.67712% and a median of 13.645%, indicating relatively high inflation in Nigeria over the study period. The maximum inflation rate of 29.72% and the minimum of 8% highlight significant variability, likely influenced by exchange rate fluctuations and subsidy reforms. The standard deviation of 6.826887% reflects moderate volatility in inflation. The skewness (0.999351) shows a positive skew, meaning inflation rates are concentrated at lower values with occasional high spikes. The kurtosis (2.794480) is near 3, suggesting a distribution close to normal, though the Jarque-Bera probability (0.006433) indicates some deviation from normality.

Unit Root Test

The stationarity of variables like fuel subsidies (FS), oil price shocks (OPS), exchange rate fluctuation (EXRF), budget deficit (BD), and inflation rate fluctuation (INFF) is examined in this study using the Augmented Dickey-Fuller (ADF) test. After first differencing, all variables become stationary, indicating that they are integrated of order one, or I(1), according to the data in Table 6. (See Table 6)

Table 6: Unit Root Test Results

Variable	ADF Test Statistics	Critical ADF Test Statistics	Order of Integration
FS	-3.901121**	-3.489228	I(1)
OPS	-7.797968*	-4.127338	I(1)
EXRF	-4.216959*	-4.156734	I(1)
BD	-3.188149***	-3.173114	I(1)
INFF	-7.506725*	-4.127338	I(1)

*Note: The tests include intercept with trend; *, ** and *** significant at 1, 5 and 10 percent.*

Source: Researcher's Computation Using EViews-12 (2025)

In contrast to the crucial value of -3.489228, the results indicate that fuel subsidies (FS) are stationary at the first difference, with an ADF test statistic of -3.901121 that is significant at the 5% level. This suggests that variations in fuel subsidies, which are impacted by shifts in policy and trends in the price of oil globally, level out in their first variation. Because of its stationarity at I(1), FS's link to other macroeconomic variables can be properly examined within the framework of long-term equilibrium models.

The ADF test statistic of -7.797968 for oil price shocks (OPS) is significant at the 1% level, exceeding the crucial value of -4.127338. This demonstrates that shocks to the price of oil, which are naturally erratic due to the dynamics of the global market, become stationary following first differencing. Although it is expected that oil prices will show long-term trends, the I(1) integration of OPS shows that volatility analysis can accurately simulate short-term variations.

The exchange rate fluctuation (EXRF) variable has an ADF test statistic of -4.216959 that is significant at the 1% level in comparison to the crucial value of -4.156734, indicating that it is also stationary at I(1). In Nigeria, where trends in currency depreciation are mostly caused by external shocks like fluctuations in the price of oil and international capital flows, this outcome illustrates the durability of exchange rate swings. Following differencing, the exchange rate data stabilizes, enabling thorough analysis when combined with other factors. At the 10% level, the ADF test statistic for the budget deficit (BD) of -3.188149 is substantial, above the critical threshold of -3.173114.

This shows that Nigeria's fiscal imbalances, which are frequently made worse by subsidy spending and falling oil income, are non-stationary at initially but eventually become stationary. Because of its integration at I(1), BD can be included in cointegration models to investigate its relationship to indicators of macroeconomic instability. When compared to the crucial value of -4.127338, the ADF test statistic of -7.506725 indicates that the inflation rate fluctuation (INFF) is stationary at I(1). Global commodity prices, policies aimed at eliminating subsidies, and currency rate depreciation all have an impact on Nigeria's inflation, which fluctuates in value. Nonetheless, it is appropriate for long-term equilibrium modeling since its first-differenced form is stationary.

Co-integration Results

When analyzing whether non-stationary variables that are integrated of the same order, usually I(1), have a long-term equilibrium relationship, cointegration analysis is an essential step. The study uses the Engel and Granger cointegration test to assess whether explanatory variables like fuel subsidies and oil price shocks have a stable long-term relationship with variables like inflation rate fluctuation (INFF), budget deficit (BD), and exchange rate fluctuation (EXRF). By determining whether the long-run regression's residuals are stationary, the test verifies cointegration. The results are shown in Table 7, which focuses on the models' significance levels. (See Table 7)

Table 7: Engel & Granger Co-integration Result

Augmented Dickey-Fuller test statistic			
Residual	t-Statistic (Critical value)	Prob.*	Decision
EXRF-Model	-6.833535*(-2.606163)	0.0000	Co-integrated
BD-Model	-2.124678**(-1.946764)	0.0334	Co-integrated
INFF-Model	-7.621422*(-2.606163)	0.0000	Co-integrated

Note: * $p < 0.01$; ** $p < 0.01$; *** $p < 0.10$

Source: Researcher's Computation Using EViews-12 (2025)

At the one percent significance level, the Augmented Dickey-Fuller (ADF) test statistic for the exchange rate fluctuation (EXRF) model is -6.833535 (critical value = -2.606163, p-value = 0.0000). This demonstrates a strong correlation over the long term between exchange rate swings and explanatory factors such as fuel subsidies and shocks to the price of oil.

This outcome is anticipated given Nigeria's reliance on oil exports for foreign exchange revenues, as volatility in the world oil market and domestic subsidy policies have a significant impact on exchange rate stability. When cointegration is present, it indicates that these variables adapt to preserve a steady long-term equilibrium in spite of short-term oscillations.

At the 5% level, the budget deficit (BD) model's ADF test statistic of -2.124678 is significant (critical value = -1.946764, p-value = 0.0334). This suggests that the budget deficit and the explanatory factors have a long-term equilibrium connection.

The fiscal effects of fluctuating oil prices and subsidy spending, two major causes of Nigeria's fiscal imbalances, are reflected in the relevance of cointegration. The finding implies that although shocks may cause short-term fluctuations in budget deficits, structural variables such as government revenue from oil and subsidy spending ultimately determine them.

At the 1% level, the inflation rate fluctuation (INFF) model exhibits excellent cointegration, as evidenced by its ADF test statistic of -7.621422 (critical value = -2.606163, p-value = 0.0000). This suggests a close relationship between Nigerian inflation trends and fuel subsidies, oil price shocks, and associated macroeconomic issues.

Through energy costs and currency rate pass-through effects, the outcome is in line with the knowledge that changes in oil prices and subsidies have a direct impact on inflation. Despite short-term volatility, cointegration shows that inflationary pressures are rooted in a long-term link with these explanatory factors.

Test of Hypotheses

Exchange Rate Fluctuation Model

Table 8 presents the findings, which show how important fuel subsidies and oil price shocks are in explaining exchange rate swings in Nigeria, a nation that depends mostly on oil exports for its foreign exchange earnings. (See Table 8)

Table 8: Fully Modified Least Squares (FMOLS) Result

Dependent Variable: EXFR				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
FS	0.002694	0.001170	2.301542	0.0252
OPS	-0.798018	0.249346	-3.200440	0.0023
C	-0.198367	2.321324	-0.085454	0.9322
Reliability estimates				
R-squared	0.568003			
Adjusted R-squared	0.537189			
Wald-F-Statistic	6.4589			
Wald-F-Statistic (p-value)	0.0093			
Long-run variance	93.18773			

Source: Researcher's Computation Using EViews-12 (2025)

The t-statistic for fuel subsidies (FS) is 2.301542, the p-value is 0.0252, and the coefficient is 0.002694, making it statistically significant at the 5% level. According to this positive correlation, there are more exchange rate fluctuations when fuel subsidy payments rise. Since large subsidy payments put strain on government finances, lowering foreign reserves and causing instability in the foreign exchange market, this finding is in line with economic theory and empirical data. Such fiscal strain increases exchange rate volatility for an oil-dependent economy like Nigeria, especially when oil revenue is low. The oil price shocks (OPS) coefficient, on the other hand, is -0.798018, which has a t-statistic of -3.200440 and a p-value of 0.0023, making it statistically significant at the 1% level. By raising foreign exchange revenues and external reserves, higher oil prices are likely to lessen exchange rate swings, according to the negative relationship. The characteristics of oil-exporting economies, where higher oil prices tend to strengthen the domestic currency and lessen exchange rate volatility, are consistent with this outcome. However, as a result of Nigeria's foreign exchange market's heavy reliance on oil revenue, falling oil prices frequently cause currency depreciation and increased volatility. A t-statistic of -0.085454 and a p-value of 0.9322 indicate that the constant term (C), despite having a coefficient of -0.198367, is statistically insignificant. This suggests there is no innate pattern in long-term exchange rate changes despite taking into consideration the impact of fuel subsidies and oil price shocks. The robustness of the model is further demonstrated by its reliability estimations. Fuel subsidies and oil price shocks account for almost 57% of the variation in exchange rate movements, according to the R-squared value of 0.568003, indicating a moderately significant explanatory power. The general dependability of the model is confirmed by the modified R-squared value of 0.537189, which takes into consideration the number of explanatory factors. The joint importance of the explanatory factors is confirmed at the 1% level by the Wald-F-statistic of 6.4589 and the associated p-value of 0.0093. As a result, exchange rate changes are greatly impacted over time by both fuel subsidies and oil price shocks. Nigeria's foreign currency market faces structural issues, as evidenced by the long-run variance of 93.18773, which shows that exchange rate fluctuations are persistently volatile over time.

Budget Deficit Model

In light of Nigeria's substantial fuel subsidy expenditures and reliance on oil earnings, this analysis offers important new information about the structural factors influencing the nation's budget deficit. The FMOLS method addresses possible endogeneity and serial correlation concerns while guaranteeing reliable estimation of long-run coefficients. (See Table 9)

Table 9: Fully Modified Least Squares (FMOLS) Result

Dependent Variable: BD				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
FS	-2.381819	0.385526	-6.178101	0.0000
OPS	8.191413	82.13589	0.099730	0.9209
C	430.1043	764.6550	0.562481	0.5761
Reliability estimates				
R-squared	0.645931			
Adjusted R-squared	0.632818			
Wald-F-Statistic	5.2644			
Wald-F-Statistic (p-value)	0.0232			
Long-run variance	10111566			

Source: Researcher's Computation Using EViews-12 (2025)

At the 1% level, the fuel subsidies (FS) coefficient of -2.381819 is highly significant, with a t-statistic of -6.178101 and a p-value of 0.0000. This inverse link suggests that Nigeria's fiscal deficit is made worse by rising fuel subsidy expenses. A significant financial burden, subsidies take funds away from debt reduction or other worthwhile endeavors. The research emphasizes how excessive subsidy payments contribute to growing fiscal imbalances, especially when oil revenue is low. Fuel subsidies' detrimental effects on the budget deficit draw attention to the necessity of measures in order to lower this unsustainable spending and enhance fiscal stability.

In comparison, the coefficient for oil price shocks (OPS) is 8.191413, but the t-statistic and p-value are 0.099730 and 0.9209, respectively, making it statistically negligible. This implies that the budget deficit in Nigeria is not much impacted in the long run by changes in oil prices. The lack of significance may be due to ineffective revenue management or an over-reliance on oil income, which may not result in appreciable improvements in fiscal balances, even when increases in oil prices are anticipated to enhance government revenues. It might also mean that short-term fluctuations in oil prices have a greater influence on budgetary outcomes than long-term patterns.

A t-statistic of 0.562481 and a p-value of 0.5761 indicate that the constant component (C), which has a coefficient of 430.1043, is statistically insignificant. This suggests that there is no long-term trend in the budget deficit once the effects of fuel subsidies and oil price shocks have been taken into consideration. The model's robustness and explanatory capacity are demonstrated by its reliability estimations. Oil price shocks and fuel subsidies account for about 65% of the variance in the budget deficit, according to the R-squared value of 0.645931. Even after controlling for the number of explanatory variables, the model's reliability is confirmed by the adjusted R-squared value of 0.632818.

A p-value of 0.0232 and a Wald-F-statistic of 5.2644 support the joint importance of the explanatory factors at the 5% level. This underlines the general usefulness of the model in describing long-term budgetary developments in Nigeria. Given the ongoing unpredictability

in fiscal deficits, the long-run variance of 10,111,566 highlights the inherent difficulties in overseeing Nigeria's fiscal policy.

Inflation fluctuation Model

A long-term association between inflation variability and the explanatory variables, fuel subsidies (FS) and oil price shocks (OPS), is examined by the Fully Modified Ordinary Least Squares (FMOLS) regression result for the inflation fluctuation (INFF) model. (See Table 10)

Table 10: Fully Modified Least Squares (FMOLS) Result

Dependent Variable: INFF				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
FS	-0.000123	0.00000	-2.217007	0.0290
OPS	-0.072009	0.02774	-2.595762	0.0138
C	0.431236	1.125246	0.383237	0.7030
Reliability estimates				
R-squared	0.506383			
Adjusted R-squared	0.430417			
Wald-F-Statistic	6.8577			
Wald-F-Statistic (p-value)	0.0066			
Long-run variance	21.89689			

Source: Researcher's Computation Using EViews-12 (2025)

A t-statistic of -2.217007 and a p-value of 0.0290 indicate that the fuel subsidies (FS) coefficient, which is -0.000123, is statistically significant at the 5% level. This inverse relationship implies that, over time, larger fuel subsidy payments are linked to less changes in inflation. This outcome is explained by the price-stabilizing effect of subsidies, which lessen the upward pressure on overall price levels by maintaining artificially low energy costs. Nevertheless, as the results of the budget deficit model show, subsidies frequently have a large fiscal cost even though they may temporarily reduce inflation volatility. The findings show Nigeria's trade-offs between attaining budgetary sustainability and preserving inflation stability. The t-statistic for oil price shocks (OPS) is -2.595762, the p-value is 0.0138, and the coefficient is -0.072009, which is statistically significant at the 5% level. The inverse association suggests a relationship between lower inflation volatility in Nigeria and higher oil prices. This aligns with the idea that rising oil prices boost government revenue, which improves fiscal space and lessens the need for inflationary financing strategies like money printing and excessive borrowing. On the other hand, falling oil prices can decrease foreign exchange reserves, devalue the currency, and raise the price of imported products, all of which can make inflationary swings worse. A t-statistic of 0.383237 and a p-value of 0.7030 indicate that the constant term (C), despite having a coefficient of 0.431236, is statistically insignificant. According to this, there is no intrinsic long-term pattern in inflation volatility once the effects of fuel subsidies and oil price shocks have been taken into consideration. The overall robustness of the model is indicated by its reliability estimates. The R-squared value of 0.506383 indicates that fuel subsidies and shocks to the price of oil account for around 51% of the variation in inflation swings. Once the number of explanatory variables has been adjusted, the model's reliability is confirmed by the updated R-squared value of 0.430417. The model is relevant in capturing the factors that influence inflation volatility, as evidenced by the Wald-F-statistic of 6.8577 and associated p-value of 0.0066, which show the joint significance of the explanatory variables at the 1% level. Nigeria continues to experience inflation unpredictability, as

evidenced by the long-run variance of 21.89689, which highlights the inherent difficulties in maintaining price stability in an economy that depends heavily on oil.

Statistical Test of Hypotheses

In this study, the hypotheses were assessed using the t-test and its associated p-value. The two-tailed test was set at a significance level of 5%. The individual significance of the coefficients of each explanatory variable was evaluated using the t-test, which was obtained from the FMOLS regression results. This test assessed the statistical significance of the effects of fuel subsidies and oil price shocks on macroeconomic instability indicators, including budget deficits, inflation, and exchange rate fluctuations. The probability value (PV), which served as the foundation for acceptance or rejection, was used to evaluate the null hypothesis. At the five percent significance level, the independent variable was considered statistically significant if the PV was less than five percent (i.e., $PV < 0.05$); if not, it was regarded as inconsequential. (See Table 11)

Table 11: Summary of FMOLS Statistical Test of Hypotheses Result

Variable	F-Statistic	Prob.
EXRF-Model	6.4589	0.0093
BD-Model	4.5991	0.0244
INFF-Model	6.8577	0.0066

Source: Researcher's Computation Using EViews-12 (2025)

With a probability value of 0.0093 and a Wald F-statistic of 6.4589, we find that the first null hypothesis - that fuel subsidies and oil price shocks have no discernible effect on exchange rate fluctuations in Nigeria is correct. Given that the p-value is less than the significance level of 0.05, the null hypothesis is rejected. This suggests that fluctuations in Nigeria's exchange rate are statistically significantly impacted by fuel subsidies and oil price shocks. We also obtain a Wald F-statistic of 4.5991 with a probability value of 0.0244 for the second, which asserts that fuel subsidies and oil price shocks have no discernible impact on Nigeria's budget deficit. The null hypothesis is rejected since the p-value is less than 0.05. This suggests that shocks to oil prices and gasoline subsidies have a statistically significant impact on Nigeria's budget deficit. Lastly, the third's Wald F-statistic is 6.8577 with a probability value of 0.0066, indicating that fuel subsidies and oil price shocks have no discernible impact on Nigeria's inflation rate fluctuations. The null hypothesis is rejected since the p-value is significantly below the 0.05 cutoff. This shows that shocks to the price of oil and fuel subsidies are major factors influencing Nigeria's inflation.

V. DISCUSSION OF FINDINGS

According to the study's findings, Nigeria's inflation rate, budget deficit, and exchange rate fluctuate significantly in response to fuel subsidies and oil price shocks. A drop-in oil prices results in fewer dollar inflows, which devalues the naira and raises exchange rate volatility because Nigeria's foreign exchange revenues are primarily derived from oil exports. In terms of the budget deficit, falling oil prices result in lower government income, which exacerbates the deficit because of the fixed costs of subsidy payments. On the other hand, removing or reducing subsidies causes gasoline prices to rise, which raises the cost of products and services and propels inflation. These results are consistent with research by Ahmed et al. (2021), who examined the effect of energy subsidies on budget deficits in oil-producing economies and found that they had a positive effect, and Adebayo et al. (2021), who looked at

the relationship between exchange rate fluctuations and oil price volatility in oil-dependent economies and also found that they had a positive effect.

VI. CONCLUSION AND RECOMMENDATIONS

The study concluded that the finding from the result were positively related. The three macroeconomic variables exchange rate, inflation rate and budget deficit were positively related. In conclusion, the study showed that fuel subsidies and oil price shocks play a critical role in Nigeria's macroeconomic stability. The findings emphasize the need for policy reforms that promote economic diversification, reduce fiscal dependency on oil revenues, and ensure efficient public spending to mitigate macroeconomic instability. With this, the study recommends that to address the issue of exchange rate fluctuation caused by fuel subsidies and oil price shocks, the Central Bank of Nigeria (CBN) should implement policies that enhance foreign exchange stability by reducing excessive government dependence on crude oil earnings. This can be achieved through effective forex reserve management, encouraging non-oil exports, and promoting a diversified economy to reduce pressure on the naira. Also, to mitigate budget deficits exacerbated by fuel subsidy expenditures, the Federal Ministry of Finance, Budget, and National Planning should prioritize fiscal consolidation by phasing out subsidies and redirecting the funds into more productive sectors such as infrastructure, healthcare, and education. The National Assembly should pass legislation that limits unsustainable government borrowing while ensuring transparency in oil revenue management. Finally, to manage inflation fluctuations caused by subsidy policies and oil price shocks, the CBN should adopt a combination of monetary policy tools, such as inflation-targeting frameworks and interest rate adjustments, to control price stability. The Federal Competition and Consumer Protection Commission (FCCPC) should regulate fuel pricing to prevent artificial price hikes and market exploitation following subsidy reforms

References

- 1) Adebayo, T., & Yusuf, M. (2021). Oil price volatility and exchange rate fluctuations in oil-dependent economies. *Energy Economics*, 94, 105062.
- 2) Adewumi, M., Remi, H., & Iyewumi, T. D. (2014). The impact of fuel subsidy removal on socio-economic development in Nigeria an econometric investigation. *International Journal of Economics, Commerce and Management*, 2(12), 1-14
- 3) Adeyemi, O.J., Okunade, S.O., & Amosun, O.O. (2024). Nonlinear relationship between oil price shocks and sustainable development in Nigeria. *Economic Insights - Trends and Challenges*, 13(3), 73-89. doi.org/10.51865/EITC.2024.03.05
- 4) Agboola, E., Chowdhury, R., & Yang, B. (2024). Oil price fluctuations and their impact on oil- exporting emerging economies. *Economic Modelling*, 132, Article 106665. <https://doi.org/10.1016/j.econmod.2024.106665>
- 5) Ahmed, H., & Khan, Z. (2021). The impact of energy subsidies on budget deficits: Evidence from oil-producing economies. *International Journal of Public Economics*, 45(1), 33-51.
- 6) Aizenman, J. & Pinto, B. (2005). Overview. In Aizenmann, J. & Pinto, B. eds. *Managing Economic Volatility and Crises*. Cambridge, United Kingdom: Cambridge University Press.

- 7) Amin, S., & Chawdhurey, A. (2016). Fuel subsidy measures and economic activities. *Journal of Economic Policy Research*, 14(3), 145-169.
- 8) CBN (2023). Central Bank of Nigeria Statistical Bulletin various issues.
- 9) Economic Confidential, (2020). Nigeria's economy already fragile before COVID-19 Pandemic - Minister <https://economicconfidential.com/2020/03/nigeria-economy-fragile-covid19-pandemic/>
- 10) Greve, P., & Lay, J. (2023). Fossil fuel subsidies in developing countries: Consumption patterns and economic implications. *Global Energy Economics*, 10(3), 55-78.
- 11) Hamilton, J. D. (1983). Oil and the macro economy since World War 11, *The Journal of Political Economy* 91, 228-248.
- 12) Hicks, J. R. (1935). A suggestion for simplifying the theory of money. *Economica*, New Series, 2(5), 1-19.
- 13) International Energy Agency (2019). World energy outlook 2019 - Analysis
- 14) Lakunle, O. I., & Abdallah, D. (2023). An assessment of Fuel subsidy removal and its effects on Nigerians. An unpublished Dissertation Presented to the Faculty of social sciences, Department of Sociology University of Abuja.
- 15) Leo, J. G. (2024). The macroeconomic impact of crude oil price fluctuations in Nigeria. *Futurity of Social Sciences*, 2(3), 147-181. <https://doi.org/10.57125/FS.2024.09.20.09>
- 16) Nigerian Economic Summit Group (NESG), (2019). Citizen education/engagement strategy report: Understanding fuel subsidy removal and its economic and social impact.
- 17) Nnnanna, O. J., & Masha, I. (2003). Oil price fluctuation, macroeconomic behaviour and Policy Response in Nigeria: A VAR Specification. *West African Journal of Monetary and Economic Integration*, 3(1), 85-113.
- 18) Nwoko, C., et al. (2016). The Fisherian equation of exchange and monetary stability. *Journal of Economic Studies*, 19(3), 200-223
- 19) Onyeizugbe, C., & Onwuka, O. (2012). Fuel subsidies and economic stability. *Journal of African Economic Studies*, 14(3), 155-180.
- 20) Ukwu, I. U., Obi, A. W., & Ukeje, S. (2003). Policy options for managing macroeconomic volatility. A publication of the *African Institute for Applied Economics Publication*, pp. 1-44.
- 21) Wakeford J. (2006). The impact of oil price shocks on the South African macro-economy: History and prospects, in accelerated and shared growth in South Africa: Determinants, constraints and opportunities. 18-20 October, 2006.
- 22) World Bank (2019). Subsidies in the Energy Sector. An Overview. *The World Bank Group Available online at <http://worldbank.org/EXTESC/Resources/SubsidyBackgroundPaper> Pdf Accessed Tuesday 12th August 2023.*
- 23) World Bank. (2020). Monitoring global poverty. World Bank Group. https://doi.org/10.1596/978-14648-1602-4_ch1.