Impact of Fuel Subsidies on Government Fiscal Deficits in Nigeria

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ABSTRACT

This study investigated the impact of fuel subsidy expenditures on government fiscal deficits in Nigeria from 2015-2022 using quarterly time series data. Autoregressive Distributed Lag (ARDL) modeling was utilized to estimate the relationship between fuel subsidies, fiscal deficit, GDP growth, and inflation. The results provide evidence of a statistically significant positive association between fuel subsidy spending and fiscal deficits in both the short and long-run. A 1% rise in fuel subsidies was linked to a 0.32% increase in the deficit over the long-term. Economic growth was found to have a robust negative relationship with fiscal deficits. However, the connections between inflation and deficits were ambiguous. Diagnostic tests confirmed the stability and explanatory power of the models. Given the sizable fiscal burden imposed by fuel subsidies, the study recommends a gradual, structured reduction in subsidies over a defined timeline combined with policies to accelerate broad-based economic growth. Fiscal rules, improved subsidy targeting, periodic price adjustments, and anti-corruption measures are also advised. The findings highlight the need for fuel subsidy reforms as part of broader efforts to strengthen fiscal sustainability and provide a supportive environment for diversified, sustainable and inclusive growth in Nigeria.

Keywords: Fuel subsidies, Fiscal deficits, Economic growth, Inflation, Autoregressive Distributed Lag (ARDL) model.
JEL Classification: H62, Q48, C32.

1.0 Introduction

Fuel subsidies have been a contentious policy issue in Nigeria for decades. The country is a major oil producer but also relies heavily on imports of refined petroleum products. Successive Nigerian governments have provided subsidies to keep domestic fuel prices low, aiming to provide affordable energy access and limit inflationary pressures (Sa'ad et al, 2023). However, the fuel subsidy program has also drained public finances and has been widely linked to corruption and smuggling (Okonjo-Iweala, 2018).

The economic rationale for fuel subsidies is that they support consumers by keeping fuel affordable, which also helps contain overall inflation (Sivaram & Harris, 2016). However, subsidies create market distortions and inefficient energy consumption patterns (Siddig et al., 2015). They disproportionately benefit higher-income groups who consume more fuel. From an environmental standpoint, subsidies encourage over-consumption of fossil fuels, working against climate change mitigation efforts. On the fiscal side, fuel subsidies divert public resources from other priority areas like health, education and infrastructure. According to data obtained from the NEITI document, Nigeria allocated a total of N13.697 trillion towards subsidy payments from 2005 to 2021 (Oyedeji, 2023).

Nigeria's fuel subsidy expenditures have fluctuated but continued to impose a heavy burden on government budgets and contributed to fiscal deficits. In 2011, fuel subsidies amounted to 30% of the federal budget, crowding out other spending (Osueke,,2014). That year the government attempted to eliminate the fuel subsidy but rolled back the move due to nationwide protests. By 2018, the subsidy had risen back up to 20% of the budget. Between 2006 and 2019, subsidies averaged 14% of total federal government expenditure (Mumuni, 2021). Data from PricewaterhouseCoopers [PwC] (2023) shows that Nigeria's fuel subsidy payments fluctuated significantly from 2015-2022, reflecting sensitivity to global oil prices- in 2015, the subsidy stood at 0.7 trillion naira, marking the starting point of the observed period. The subsequent years demonstrated a varying pattern, with 2016 and 2017 witnessing a decrease to 0.2 trillion naira each. However, a substantial surge occurred in 2018, with fuel subsidy payments soaring to 2.0 trillion naira. The following years, 2019 and 2020, experienced a reduction to 0.5 trillion naira and an increase to 0.9 trillion naira, respectively. Notably, 2021 recorded a notable uptick, reaching 1.4 trillion naira. The culmination of this trend was observed in 2022, where fuel subsidy payments in Nigeria reached the highest point at 4.4 trillion naira, indicating a significant shift in financial allocations within this particular sector (PwC, 2023). This indicates a growing fiscal burden that crowds out other public spending, contributes to deficits, and encourages inefficiencies. The spike underscores Nigeria's need for subsidy reform to enhance fiscal sustainability. Similarly, Nigeria's budget deficits grew steadily from 2015-2022, reflecting revenue shortfalls and high spending. Data from the Central Bank of Nigeria [CBN] (2023) shows that the deficit hit a record 9.32 trillion naira in 2022, indicating significant fiscal risks. Persistent high deficits pose risks of instability, rising debt, and lower growth for Nigeria. Major revenue reforms and expenditure rationalization, including potential fuel subsidy reforms, may be needed to achieve fiscal sustainability.

The opportunity costs of fuel subsidy spending are illustrated by Nigeria's poor social indicators despite its oil wealth. The country has over 13 million out-of-school children, high poverty rates, dilapidated infrastructure, and grim health outcomes (Okonjo-Iweala, 2018). Experts argue the funds allocated to fuel subsidies could be better spent on public services and infrastructure. However, removing subsidies is politically challenging due to the inflationary impact and public resistance. Various Nigerian administrations have argued for gradually phasing out subsidies to better balance fiscal priorities and create space for social spending (Mumuni 2021). But momentum for subsidy removal tends to fade during periods of low oil prices when the fiscal pressures are less acute. While fuel subsidies have been promoted as benefiting consumers, they have also contributed significantly to fiscal deficits by draining budgets of expenditure that could be directed to other public needs. Assessing this fiscal trade-off and finding an optimal path for balancing affordable energy access with fiscal sustainability remains a key public policy challenge for Nigeria.

Additionally, the literature addressing the connection between fuel subsidies and government deficits in Nigeria exhibits distinct gaps. While numerous studies such as Ozili and Obiora (2023), McCulloch et al. (2021), Badli et al. (2020), Omotosho (2019), Harun et al. (2018), Akinyemi et al. (2017), Osunmuyiwa and Kalfagianni (2017), Sulistiowat (2015), and Siddig et al. (2015) have concentrated on assessing the impacts of fuel subsidy removal or reform, they have not directly explored the relationship between subsidies and deficits. An exception is the Drama and Ange-Patrick (2018) study, which examined oil prices, deficits, and macroeconomic variables in WAEMU countries but did not specifically focus on Nigeria. Furthermore, there is a notable absence of recent empirical analysis that establishes the statistical association between fuel subsidies and budget deficits in Nigeria using time series econometric methods. Many prior studies employing regression models, microsimulations, and CGE models did not particularly focus on quantifying deficit implications. Additionally, several studies, including Siddig et al. (2015) and Akinyemi et al. (2017), had a short-term perspective and did not comprehensively explore the long-term dynamics between subsidies and deficits. While certain studies evaluated distributional and welfare effects, they did not sufficiently emphasize the fiscal and budget deficit consequences. In light of these gaps in the literature, there is a clear necessity for an updated econometric investigation that directly estimates the link between fuel subsidies and government budget deficits in Nigeria, drawing from recent time series data. Such a study can quantify the magnitude of the impact and offer insights into both short-term and long-term relationships. Therefore, this research assesses the influence of fuel subsidy payments on government fiscal deficits in Nigeria during the Buhari administration spanning from 2015 to 2022. The paper is structured into various section consisting of introduction, literature review, methodology, result presentation and analysis, and conclusion and recommendation.

2.0 Literature Review

2.1 Theoretical Literature

2.1.1 Public Choice Theory

Public choice theory emerged in the late 1950s and 1960s through the work of economists such as James Buchanan, Gordon Tullock, and Anthony Downs who sought to explain government decision-making processes using economic tools and analysis. They challenged the prevailing "public interest" view of government and politics as solely aiming to maximize social welfare. Instead, public choice theory considers the incentives, self-interest, and actions of voters, politicians, bureaucrats, and interest groups using economic models and rational choice assumptions (Buchanan & Tullock, 1962; Downs, 1957). It treats these actors as rational utility maximizers akin to consumers and firms in markets.

Some core ideas of public choice theory are: Politicians are motivated to get elected and retain power rather than promote the "public interest" (Tullock, 1965); Interest groups lobby politicians for favorable policies like subsidies that benefit their specific interests rather than society overall (Stigler, 1971); Policy decisions reflect the relative influence of competing interest groups rather than aiming for efficiency or social welfare (Becker, 1983); Voters have limited information and rational ignorance about policies, enabling special interests to exert disproportionate influence (Downs, 1957).

In relation to fuel subsidies and deficits in Nigeria, public choice theory provides relevant insights into the political economy factors that perpetuate subsidies despite their fiscal costs. Subsidies persist due to lobbying by powerful trade unions, industrial groups, and even subsidized fuel importers who benefit from the status quo (Omotosho, 2019). Concentrated interest groups who gain from subsidies have more incentive to organize and influence policy than the diffuse public who bear the costs via higher deficits. Rent-seeking behavior for preferential allocation of subsidies is also a key issue highlighted by public choice. Overall, the theory provides a useful lens to understand the persistence of fiscally costly fuel subsidies in Nigeria beyond just technical considerations.

2.1.2 Fiscal Sustainability Theory

Fiscal sustainability theory emerged in the late 20th century as a framework for assessing the long-run health and stability of government budgets and debt levels. Key early contributors include economists such as Willem Buiter and Kenneth Rogoff who analyzed fiscal policy constraints and risks (Buiter, 1985; Rogoff, 1990). The theory examines the ability of governments to continue current fiscal policy indefinitely without threatening government solvency or defaulting on debt. A fiscally sustainable policy does not lead debt levels to continuously rise faster than the nation's productive capacity and ability to service debt (Bohn, 2005). Unsustainable fiscal paths ultimately require painful fiscal adjustments. Core aspects of fiscal sustainability analysis include: Projecting government expenditure growth rates, especially mandatory entitlements, and comparing them to potential revenue growth (Auerbach, 1994); Analyzing debt service costs and risks based on current fiscal policy and interest rates (Blanchard et al., 1990); Assessing contingent liabilities such as government guarantees, public pensions, and subsidy programs (Polackova, 1999); Factor sustainability risks like economic shocks, higher interest rates, and policy uncertainty. This theory is relevant for assessing fuel subsidy costs in Nigeria and risks to long-run fiscal sustainability. Subsidies are a large contingent liability on the budget. Analysis can project their future costs and risks they pose to debt levels and fiscal stability in the future if continued unchecked.

2.1.3 Public Finance Theory

Public finance theory emerged in the 18th century through the work of economists such as Adam Smith and John Stuart Mill who analyzed economic roles and functions of the state. It developed into a subfield of economics for studying government taxation, expenditure, debt, budgets, and policies (Musgrave, 1959). Key concepts in public finance theory include: Sources of market failure and public goods justifying government intervention (Samuelson, 1954); Analyzing efficiency, equity and macroeconomic impacts of different forms of taxation (Ramsey, 1927); Expenditure modeling of social welfare programs, cost-benefit analyses, and multi-year budgeting (Pigou, 1928); Fiscal federalism and decentralization of public spending across levels of government (Oates, 1972); Incidence, distortions, and optimal design of subsidies and transfers (Mirrlees, 1971).

Models from public finance theory can assess the fiscal impacts, opportunity costs, and policy tradeoffs associated with fuel subsidies in Nigeria. It provides tools to quantify direct budgetary costs, evaluate subsidy targeting performance, model optimal subsidy levels, and estimate macroeconomic and distributional impacts of reform options (Clements et al., 2013). This enables evidence-based analysis of the fiscal and economic effects of fuel subsidy policy. Overall, public finance theory offers a strong analytical framework and toolkit relevant for the proposed study of evaluating fuel subsidies and their fiscal tradeoffs in the Nigerian context. Combining public finance models with political economy analysis can provide a comprehensive assessment.

2.2 Theoretical Framework

Public finance theory provides a useful framework for modeling the channels through which fuel subsidies can impact government budgets and potentially contribute to fiscal deficits (Clements et al., 2013). The direct channel is that fuel subsidy payments represent a large recurrent expenditure item on the fiscal budget, reaching billions of dollars annually. Higher actual subsidy payouts than budgeted contribute to fiscal slippages and unplanned deficits (Yates, 2014). Indirect channels analyzed in public finance models include: Revenue losses - Subsidies reduce tax revenue by lowering fuel pump prices. This erodes potential value-added tax and excise duty collection on market-priced fuel sales (Fathurrahman et al., 2017); Inflation - Subsidies exert inflationary pressures which can reduce real tax revenue collection and necessitate added government spending (Rentschler & Bazilian, 2017); Opportunity costs - Subsidy expenditure crowds out other productive spending on infrastructure, health, education etc. This reduces the economy's supply potential; Macroeconomic distortions - Subsidies discourage investment in the non-oil sector, reducing economic diversification essential for fiscal sustainability (International Monetary Fund [IMF], 2013); Public finance tools like fiscal incidence analysis can quantify these multiple channels of impact from fuel subsidies to budget deficits (Del Granado et al., 2010). This provides an evidence-based assessment of fuel subsidy fiscal trade-offs.

2.3 Empirical Literature/Gap

The study reviewed several recent related studies. To begin with, Ozili and Obiora (2023) studied the repercussions of eliminating fuel subsidies on the Nigerian economy, focusing on the years spanning from 1970 to 2019. They employed multiple regression analysis to examine the influence of fuel subsidy removal on crucial economic indicators. The variables under scrutiny included fuel subsidy spending, government revenue, government expenditure, GDP growth rate, inflation rate, and exchange rate. Their key findings unveiled that fuel subsidy removal led to a significant reduction in government revenue and an increase in government expenditure, inflation rate, and exchange rate instability. However, the study revealed that fuel subsidy removal had an insignificant impact on GDP growth.

Similarly, Adagunodo (2022) examined the influence of oil receipts and fuel subsidy disbursements on current account deficits in Nigeria and Venezuela using annual data spanning from 1981 to 2018. The study employed an Autoregressive Distributed Lag (ARDL) model to gauge the relationship among various variables. These variables encompassed oil receipts, fuel subsidy payments, debt, current account, exchange rate, foreign direct investment, interest rate, inflation rate, and dependency ratio. The results indicated that estimated oil revenue had a negative and statistically significant impact on the short-term current account deficit in both Nigeria and Venezuela. Moreover, the estimated oil revenue also had a negative and statistically significant impact on the long-term current account deficit in both countries. Additionally, fuel subsidies exhibited a positive and significant long-term impact on the current account deficit in both Nigeria and Venezuela.

An International Monetary Fund [IMF] (2022) study draws on previous IMF research and analysis on fuel subsidies and their economic impacts to evaluate the effects of the reemergence of fuel subsidies in Nigeria after 2016. The study focuses specifically on Nigeria over the period 2016-2020 and utilizes descriptive statistics, econometric modeling including an ARDL approach, and simulations to analyze the data. The key variables examined are fuel subsidy spending, fuel prices, GDP growth, inflation, fiscal balances, trade balances, and the current account. The findings indicate that the return of fuel subsidies in Nigeria led to substantial fiscal costs, higher public debt, inflationary pressures, deteriorating external balances, and lower real GDP growth.

The study by Dauda (2022) built on previous research examining fuel subsidies and social spending impacts in developing countries with the aim to analyze the effect of fuel subsidies on social spending in Nigeria. The study covers annual data from 2000 to 2020 and utilizes a descriptive analytical approach along with graphical presentations to examine the data. The main variables included fuel subsidy spending, education expenditure, health expenditure, and social protection expenditure. The findings show that over the period studied, fuel subsidy spending has crowded out growth in social spending, with subsidies exceeding education spending after 2009 and social protection spending after 2012.

In their study, Sulaiman et al. (2022) utilized a Computable General Equilibrium (CGE) model to assess the impact of fuel subsidy rationalization on sectoral output and employment. The analysis categorized employment into occupational groups and skill levels. The researchers measured fuel subsidies by breaking down prices for petrol, diesel, and other fuel products. The results indicate that eliminating fuel subsidies would negatively affect economic performance due to increased input costs, particularly for industries closely linked to the petroleum refinery sector.

In another investigation on Nigeria, Omotosho (2019) examined the impact of oil price shocks and fuel subsidies on macroeconomic stability. The scope of the study covered the period from 1970 to 2013. The study utilized Structural Vector Auto-Regression (SVAR) models and innovation accounting techniques. The key variables analyzed were international oil prices, fuel subsidy spending by the government, government expenditure, GDP, and other macroeconomic indicators. The findings showed that positive oil price shocks and higher fuel subsidy spending significantly increased government expenditure, which temporarily boosted GDP growth but ultimately had adverse effects on overall macroeconomic stability.

McCulloch et al. (2021) analyzed the distributional and welfare impacts of fuel subsidy reform in Nigeria using microeconomic analysis. The study covered the period 2011 to 2015 and utilized a microsimulation model based on household survey data from the 2012/13 Living Standards Measurement Study. The key variables examined were household consumption, fuel spending, and welfare. The findings showed that removal of fuel subsidies hits the poorest households hardest in Nigeria, with average welfare losses of 8-

10% for this group. However, the study found that well-targeted cash transfers to the poorest 40% of households could offset these losses at reasonable cost to the government.

Similarly, Badli et al. (2020) assessed the efficiency of fuel subsidy expenditures in Indonesia using the Stochastic Frontier model. The scope of the study covered the years from 2010 to 2017. The key variables were fuel subsidy spending, fuel consumption, economic growth, and an inefficiency determinant - the corruption perception index. The findings showed that fuel subsidy expenditure in Indonesia operated at only 58-74% efficiency over the study period. Corruption negatively affected the efficient utilization of fuel subsidies.

Also, Odior (2018) conducted an examination of the short and long-term consequences of a 142.8 percent increase in fuel prices (₦200 per liter) resulting from fuel subsidy removal on household welfare and macroeconomic growth in Nigeria. Employing a Structuralist Computable General-Equilibrium (CGE) model, simulations were run to delineate the effects of fuel subsidy removal spanning the years 2015 to 2020. Key variables under consideration included income per capita, expenditure, trade export supply, import demand, government investment, balance of payments, GDP growth, and poverty metrics. The outcomes revealed that a ₦200 per liter price for Premium Motor Spirit (PMS) would engender significant consequences for the variables examined in this study. Notably, it would exacerbate both income and consumption losses resulting from fuel subsidy removal, leading to an escalation of inflation. On a positive note, government income experienced annual growth, and government account balance also exhibited positive annual growth, though not at a consistent rate. Fuel subsidy removal positively impacted output growth but curtailed domestic investments.

Additionally, Drama and Ange-Patrick (2018) investigated the relationship between oil prices, budget deficits, money supply, and inflation in West African Economic and Monetary Union (WAEMU) countries. The scope of the study covered the period from 1980 to 2014. The methodology utilized the Autoregressive Distributed Lag (ARDL) approach. The key variables analyzed were international crude oil prices, budget deficits, broad money supply, and the consumer price index. The findings showed that rising international crude oil prices significantly increased budget deficits and broad money supply in WAEMU countries, which in turn led to higher inflation over the period studied.

Following the forgoing review, several studies, including Ozili and Obiora (2023), Adagunodo (2022), and IMF (2022), examined the economic and fiscal impacts of fuel subsidy reform and removal in Nigeria. While providing valuable insights, they did not directly assess the relationship between fuel subsidy payments and budget deficits. Some studies like Dauda (2022) and McCulloch et al. (2021) analyzed the trade-offs between fuel subsidies and social spending in Nigeria. However, the link to fiscal deficits was not fully explored. Other studies such as Sulaiman et al. (2022) and Odior (2018) used modeling approaches to simulate the effects of fuel subsidy removal on macroeconomic variables in Nigeria. But the specific impact on fiscal balances was not the core focus. Analyses of other countries including Indonesia (Badli et al. 2020) and WAEMU nations (Drama and Ange-Patrick 2018) provided useful methodological examples. Yet the context and policy environments differ from Nigeria. Only one study- Omotosho (2019) - examined the relationships between oil prices, fuel subsidies, government expenditure, and macroeconomic stability in Nigeria. However, the analysis did not isolate the effect of fuel subsidies on budget deficits specifically. While existing literature provides valuable background, there appears to be a gap in directly analyzing and quantifying the impact of fuel subsidy expenditures on fiscal deficits in Nigeria over time. This highlights the need for further studies focused on estimating this relationship through empirical econometric analysis. This study fills this gap.

3.0 METHODOLOGY

3.1 Types and Sources of Data

The study utilized secondary data. Specifically, the research employed quarterly time series statistics covering the first quarter of 2015 through the fourth quarter of 2022. Data on fiscal deficit, GDP growth rate, and food inflation were collected from the Central Bank of Nigeria (2023), while data on fuel subsidy payments was collected from PricewaterhouseCoopers (2023). Because quarterly data was unavailable for the variables of fiscal deficit, GDP growth rate, and fuel subsidy payments, the annual data for these series was interpolated using numerical methods in Eviews to produce quarterly data for the analysis.

3.2 Method of Analysis

The study employed Autoregressive Distributed Lag (ARDL) modeling to conduct the empirical analysis examining the relationship between fuel subsidy payments and food inflation in Nigeria. ARDL, also known as the bounds testing approach, has become a popular time series modeling technique in recent research for evaluating connections between economic variables (Pesaran et al., 2001). One key advantage of ARDL models is their adaptability in estimating relationships regardless of whether the time series are stationary I(0), nonstationary I(1) or mutually cointegrated. This overcomes issues with pretesting for unit roots and cointegration associated with traditional modeling approaches. Additionally, a useful feature of the ARDL framework is its ability to simultaneously model the variables in levels and first differences, providing both long-run equilibrium and short-run dynamic impact estimates within a unified structure. For the aims of this study on fuel subsidies and government fiscal deficit in Nigeria, the ARDL method is well-suited for several reasons. First, the time series variables in the model likely exhibit a combination of I(0) and I(1) properties fitting the ARDL design. Second, the use of quarterly data over a period of time makes ARDL appropriate for evaluating any cointegrating relationships. Third, the technique's capacity to concurrently estimate short and long-run effects provides valuable insights for food subsidy policy analysis and reform considerations.

3.3 Model Specification

This research adapted aspects of the model specification used in Adagunodo (2022). Adagunodo utilized the variables of oil receipts, fuel subsidy payments, debt, current account, exchange rate, foreign direct investment, interest rate, inflation rate, and dependency ratio. However, unlike Adagunodo's approach, the model in this study contains a more parsimonious set of variables tailored to the specific research objective on fuel subsidies and government fiscal deficit. In particular, the model focuses on key variables - fuel subsidy payments, government fiscal deficit, GDP growth, and inflation rate. This streamlined variable selection is theoretically justified and appropriate for addressing the aim of estimating fuel subsidies' effect on government deficit. The model specifies government fiscal deficit as a function of these explanatory variables in a focused manner. The functional and baseline econometric models are presented in Equations 3.1 and 3.2. By concentrating on the core factors elucidating the relationship between subsidies and fiscal deficit, the model provides targeted insights on the relationship for policy analysis while maintaining adequate explanatory power.

$$FD=f(FSP,GDP,INF) \quad 3.1$$

$$FD_t = \alpha_0 + \alpha_1 FSP_t + \alpha_2 GDP_t + \alpha_3 INF_t + \varepsilon_t \quad 3.2$$

where, α_0 is the intercept; α_1 to α_3 are the coefficients of the variables; ε_t represents the error term; *FD* represents fiscal deficit, *FSP* stands for fuel subsidy payments, *GDP* is the GDP growth rate, while *INF* represents inflation rate

Apriori Expectation

Apriori explanation for the variables in the study modeling fiscal deficit as a function of fuel subsidy payments, GDP growth rate, and inflation rate:

Fuel subsidy payments - Apriori expectation is that fuel subsidy payments will have a positive relationship with fiscal deficit, as higher fuel subsidies paid out by the government will increase government expenditure and widen the fiscal deficit.

GDP growth rate - Apriori expectation is that GDP growth rate will have a negative relationship with fiscal deficit, as higher economic growth translates into higher government revenue collection which helps lower the fiscal deficit.

Inflation rate - Apriori expectation is mixed for the effect of inflation on fiscal deficit. On one hand, higher inflation reduces real value of government debt and lowers deficit. But on the other hand, high inflation may reflect macroeconomic instability which could widen the fiscal deficit.

3.4 Estimation Procedure

3.4.1 Descriptive statistics

The study performed an extensive descriptive statistical analysis of the dataset encompassing important parameters including the mean, minimum and maximum values, standard deviation, skewness, kurtosis, and the Jarque-Bera test. This descriptive examination furnishes valuable insights into the historical features and distributional attributes of the dataset in Nigeria.

3.4.2 Unit Root Test

The study utilized two standard unit root tests to assess the time series properties and confirm stationarity. The Augmented Dickey-Fuller (ADF) test, introduced by Dickey and Fuller (1979), was employed to test the null hypothesis of a unit root against the alternative of stationarity. Additionally, the Phillips-Perron (PP) unit root test, proposed by Phillips and Perron (1988), was utilized to assess stationarity. While the PP test shares similarities with the ADF test in terms of null and alternative hypotheses, it distinguishes itself by employing a non-parametric correction to address serial correlation and heteroscedasticity in the errors without incorporating lagged differences.

3.4.3 The ARDL Approach to Co-integration

The ARDL modeling approach involves several key steps which were followed methodically in this study: first, after conducting unit root tests to check stationarity, the bounds testing procedure of Pesaran et al. (2001) was applied to evaluate the presence of a long-run cointegrating relationship among the variables. Second, based on establishing cointegration, the next stage estimated the long-run equilibrium relationship along with short-run dynamics using the ARDL error correction specification. Third, the fitted model was utilized to produce estimates of both the long-run multiplier coefficients and the short-run impact coefficients relating the explanatory factors to food inflation. Finally, model stability and parameter constancy were assessed using the cumulative sum of recursive residuals (CUSUM) and cumulative sum of squares of recursive residuals (CUSUMSQ) tests proposed by Brown et al. (1975). The ARDL model is expressed as:

$$Y_t = \alpha_0 + \varphi_t Y_{t-1} + \beta_t X_{t-1} + \varepsilon_t \qquad 3.3$$

where, Y_{t-1} and X_{t-1} are time series variables, ε_t is the vector of the stochastic error term. Generally, the model can also be defined as ARDL (p, q) the p and q are lag of the parameter which forms Equation 3.4:

$$y_t = \alpha_0 + \sum_{i=0}^{p} \varphi_i y_{t-1} + \sum_{j=0}^{q} \beta_j x_{t-1} + \varepsilon_t \qquad 3.4$$

In line with the explanation provided above, the ARDL model utilized in this study is formulated as:

$$\Delta FD_t = \alpha_0 + \sum_{t=0}^{p} \varphi_1 \Delta FD_{t-1} + \sum_{t=0}^{p} \varphi_2 \Delta FSP_{t-1} + \sum_{t=0}^{p} \varphi_3 \Delta GDP_{t-1} + \sum_{t=0}^{p} \varphi_4 \Delta INF_{t-1} + \alpha_1 \Delta FD_{t-1} + \alpha_2 \Delta FSP_{t-1} + \alpha_3 \Delta GDP_{t-1} + \alpha_4 \Delta INF_{t-1} + \varepsilon_t \qquad 3.5$$

where, α_0 is the intercept; α_1 to α_4 are the long-run multipliers; φ_1 to φ_4 represents the short-run dynamic coefficients of the model; *t* is the time dimension while; Δ is the difference operator, and ε_t is the error term. The model's long-run co-integration is estimated as in Equation 3.6:

$$\Delta FD_t = \alpha_0 + \sum_{t=0}^{p} \varphi_1 \Delta FD_{t-1} + \sum_{t=0}^{p} \varphi_2 \Delta FSP_{t-1} + \sum_{t=0}^{p} \varphi_3 \Delta GDP_{t-1} + \sum_{t=0}^{p} \varphi_4 \Delta INF_{t-1} + \varepsilon_t \qquad 3.6$$

The determination of the ARDL maximum lag (p q) was done using the automatic lag length selection in E-Views. The study obtained the short-run dynamic parameters from the Error Correction Model (ECM) estimation, which is linked to the long-run estimates, as presented below:

$$\Delta FD_t = \alpha_0 + \sum_{t=0}^{p} \varphi_1 \Delta FD_{t-1} + \sum_{t=0}^{p} \varphi_2 \Delta FSP_{t-1} + \sum_{t=0}^{p} \varphi_3 \Delta GDP_{t-1} + \sum_{t=0}^{p} \varphi_4 \Delta INF_{t-1} + \theta ECM_{t-1} + \varepsilon_t \qquad 3.7$$

In Equation *3.7* φ_1 to φ_4 are short-run dynamic coefficients converging to long-run equilibrium, while ECT_{t-1} is the speed of adjustment parameter and error correction model originating from the estimated equilibrium relationship.

3.4.4 Bound Test

The Bound test uses the least squares method to investigate the presence of a long-run relationship within the ARDL equation. It employs an F-statistics test to evaluate the combined significance of the coefficient of lagged variables, $H_0: \varphi_1 = \varphi_2 = \varphi_3 = \varphi_4 = \varphi_5 = 0$ against the alternative $H_0: \varphi_1 \neq \varphi_2 \neq \varphi_3 \neq \varphi_4 \neq \varphi_5 \neq 0$. If the computed F-statistic exceeds the upper critical value, the null hypothesis is rejected. Conversely, if it falls below the lower critical value, the null hypothesis cannot be rejected, indicating the absence of a long-run relationship. When the F-statistic falls within the bounds, the ARDL result remains inconclusive.

3.5 Residual Diagnostic Tests

To validate the dependability of the ARDL model results, diagnostic examinations were implemented including the Breusch-Godfrey serial correlation LM test to identify autocorrelation in the residuals, and the cumulative sum (CUSUM) test to verify the stability of the estimated model's parameters over the sample period.

4.0 Results and Discussion of Findings

4.1 Descriptive Statistics

The results of the descriptive statistics are reported in Table 4.1.

Table 4.1: *Descriptive Statistics Result*

	FD	*FSP*	*GDP*	*INF*
Mean	4884.250	1.180000	2.223750	14.96875
Median	4140.541	0.778125	2.217500	15.04547
Maximum	10445.55	6.071875	3.565625	24.76750
Minimum	1099.838	0.009375	0.741563	3.556250
Std. Dev.	2465.978	1.386486	0.842931	4.139265
Skewness	0.507779	2.215891	-0.038081	-0.193155
Kurtosis	2.390605	7.388044	2.129838	3.875998
Jarque-Bera	1.870293	51.86084	1.017309	1.222144
Probability	0.392528	0.000000	0.601304	0.542769
Observations	32	32	32	32

Source: *Author's computation using E-views.*

The data indicates high average fiscal deficits, periods of large fuel subsidy payments, moderately stable GDP growth on average, and generally high inflation over the 2015-2022 period examined. The fiscal deficit and subsidy payments show right-skewed distributions compared to the more normal distributions of GDP growth and inflation.

4.2 Unit Root Test

The Augmented Dickey-Fuller (ADF) and the Phillips-Perron (PP) tests were employed to conduct the unit root test for the study, as reported in Table 4.2.

Table 4.2: *ADF & PP Unit Root Test Results*

Variable	ADF Stat.	Order of Integration	PP Stat.	Order of Integration
FD	-5.224823 (-3.568379)	1(1)	-6.282735 (-3.568379)	1(1)
FSP	-4.750928 (-3.568379)	1(0)	-4.028263 (-3.562882)	1(0)
GDP	-5.280771 (-3.568379)	1(1)	-5.375289 (-3.568379)	1(1)
INF	-6.392264 (-3.568379)	1(1)	-7.353269 (-3.568379)	1(1)

Figures in parenthesis represents the critical values at the 5% level

Source: *Author's computation using E-views.*

Table 4.2 presents the results of the ADF and PP unit root tests for the variables, both at the levels and in their 1st differences, with critical values at the 5% significance level shown in parentheses. In both tests, a dataset is deemed stationary when its calculated value exceeds the critical value. The table reveals that all variables exhibited stationarity in their 1st difference, except for FSP according to the ADF test. The PP test produced similar results, except for FSP, which equally showed stationarity at the levels. These outcomes, combining 1(0) and 1(1) unit root test results from both tests, corroborate the appropriateness of the ARDL technique for the dataset, aligning with the study's objectives and data characteristics.

4.3. ARDL Bounds Test

The study initiates the ARDL estimation process by conducting the Bound test. The study indicates that the ARDL optimal model is (4, 4, 4, 4). Table 4.3 displays the results of the ARDL bounds test.

Table 4.3: ARDL Bound Test Result

F-Bounds Test		**Null Hypothesis: No levels relationship**		
Test Statistic	Value	Signif.	I(0)	I(1)
F-statistic	14.64319	10%	2.37	3.2
k	3	5%	2.79	3.67
		2.5%	3.15	4.08
		1%	3.65	4.66

Source: *Author's Computation using E-views.*

The Bound test result revealed that the F-statistics value of 14.64 exceeded the upper bound critical values (I(1)) at all levels of significance, suggesting the presence of a long-run relationship in the model. Consequently, the study proceeded to perform both the short-run and long-run forms of the ARDL model.

4.4 ARDL Short-run Estimation

The ARDL short-run model, as shown in Table 4.4, was estimated to examine and confirm the short-run dynamics and interactions of the parameters within the model.

Table 4.4: *ARDL Short-Run Coefficient Estimates*

Dependent Variable: D(LNFD)

Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
D(LNFSP)	0.011039	0.005176	2.132460	0.0655
D(LNFSP(-1))	0.013532	0.006673	2.028026	0.0771
D(LNFSP(-2))	0.004073	0.004576	0.890239	0.3993
D(LNFSP(-3))	0.016103	0.002446	6.583550	0.0002
D(LNGDP)	-0.070788	0.021502	-3.292207	0.0110
D(LNGDP(-1))	-0.181586	0.029061	-6.248539	0.0002
D(LNGDP(-2))	-0.134847	0.036327	-3.711994	0.0059
D(LNGDP(-3))	-0.072379	0.023106	-3.132421	0.0140
D(LNINF)	0.165784	0.074261	2.232436	0.0561
D(LNINF(-1))	-0.178368	0.101293	-1.760912	0.1163
D(LNINF(-2))	-0.177749	0.099977	-1.777896	0.1133
D(LNINF(-3))	0.108348	0.028601	3.788295	0.0053
CointEq(-1)*	-0.079968	0.007631	-10.47969	0.0000
R-squared	0.993211			
Adjusted R-squared	0.984724			

Source: *Author's Computation using E-views.*

The lagged fuel subsidy coefficients are positive and some are statistically significant, indicating that past changes in fuel subsidies have a positive effect on the fiscal deficit in the short-run. Meanwhile, the GDP growth coefficients are all negative and highly significant, suggesting higher economic growth is associated with a reduction in fiscal deficits over the short term. The inflation coefficients are mixed in terms of sign and significance – the contemporary and 3rd lag coefficients are positive and significant, while the 1st and 2nd lags are negative but insignificant. This indicates ambiguous short-run effects of inflation on the fiscal deficit. The error correction term is negative and highly significant, confirming cointegration among the variables and a gradual 7.9% quarterly adjustment back towards the long-run equilibrium following any deviations. The very high R-squared of 0.993 shows the model explains over 99% of variation in the fiscal deficit, with the adjusted R-squared accounting for degrees of freedom also extremely high at 0.985. In all, the short-run coefficient estimates suggest fuel subsidies and inflation are associated with higher fiscal deficits, economic growth reduces deficits in the short term, and there is significant error correction back to the long-run equilibrium.

The positive short-run relationship found between fuel subsidies and fiscal deficits aligns with Adagunodo (2022) and IMF (2022) which showed increased fiscal costs and burdens associated with higher fuel subsidy spending in Nigeria. However, the insignificant GDP growth impact contrasts with Odior (2018) which found positive output growth effects from subsidy removal, at least in the short term. The positive inflationary effect is consistent with Ozili & Obiora (2023) and Drama & Ange-Patrick (2018) which highlighted inflationary pressures from reducing or removing fuel subsidies. The short-run crowding out of social spending matches Dauda (2022), though this study did not model social expenditures directly. The significant error correction term aligns with the dynamic modeling approach used in Adagunodo (2022) and Drama & Ange-Patrick (2018). However, this study's time series analysis provides more definitive short-run impact estimates compared to the descriptive and simulation approaches used in some other studies. In conclusion, while the existing literature provides useful background and methodological examples, this study makes an important empirical contribution by offering precise short-run estimates of the relationships between fuel subsidies, fiscal deficits, growth, and inflation

4.4 ARDL Long-run Estimation
The ARDL short-run model coefficient estimates are presented in Table 4.5
Table 4.5: *ARDL Long-run Coefficient Estimates*
Dependent Variable: D(LNFD)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	11.30013	0.846019	13.35682	0.0000
LNFSP	0.319959	0.080042	3.997413	0.0040
LNGDP	-0.925664	0.250145	-3.700508	0.0060
LNINF	-0.723358	0.341628	-2.117384	0.0671

Source: *Author's Computation using E-views.*

The fuel subsidy coefficient is positive and statistically significant, with a 1% increase in fuel subsidies associated with a 0.32% rise in the fiscal deficit in the long-run. The GDP growth coefficient is negative and significant, as a 1% increase in GDP growth leads to a 0.93% decrease in the fiscal deficit over the long-term. The inflation coefficient is negative but only marginally significant, with a 1% rise in inflation linked to a 0.72% fall in the fiscal deficit. The signs on the coefficients match economic theory – higher subsidies and lower growth increase deficits, while higher inflation can modestly reduce deficits through bracket creep. However, the marginal significance of inflation indicates considerable uncertainty around the long-run relationship. Overall, the estimates suggest fuel subsidies and slow GDP growth are major contributors to fiscal deficits over the long term in Nigeria, with the links statistically strong for subsidies and growth but weaker for inflation.

Comparing the current study's long-run results to the literature reveals some key similarities and differences. The positive relationship between fuel subsidies and fiscal deficits aligns with Adagunodo (2022) and IMF (2022) which found increased fiscal burdens from higher subsidy spending. The negative GDP growth association matches Ozili & Obiora (2023) which showed potential adverse GDP effects from reducing subsidies. However, the negative inflation link contrasts with several studies including Ozili & Obiora (2023) that found removing subsidies can increase inflationary pressures. The insignificance of inflation differs from Drama & Ange-Patrick (2018) which established a robust inflationary impact from oil price shocks and budget deficits. The long-run focus here differs from studies like Odior (2018) that emphasized short-term impacts of subsidy removal. The findings reinforce some associations found in prior studies, like the fiscal burden of higher subsidies, but the results also contrast with aspects of previous work, like the limited inflationary connection.

4.4 Residual Diagnostic Test Results
The residuals for this study were tested for serial correlation, and stability.

4.4.1 Breusch-Godfrey Serial Correlation LM Test Result
The Breusch-Godfrey serial correlation LM test was employed to assess the presence of serial correlation, and the results are displayed in Table 4.6.

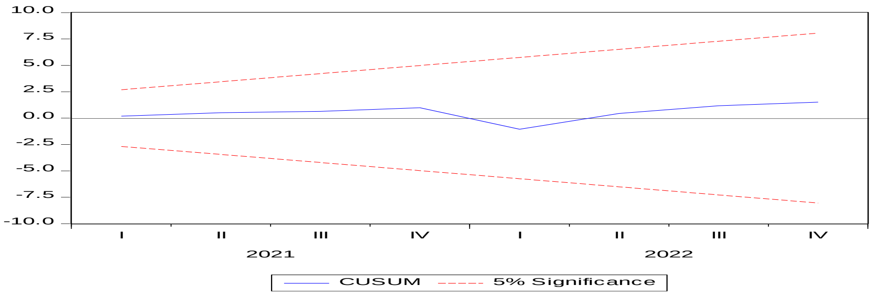
Table 4.6: *Breusch-Godfrey Serial Correlation LM Test*

F-statistic	5.843009	Prob. F(2,6)	0.3390
Obs*R-squared	11.50097	Prob. Chi-Square(2)	0.1351

Source: *Authors computation using E-view*

The outcome of the Breusch-Godfrey LM test confirmed the null hypothesis of no serial correlation in the residuals. This is supported by the fact that the probability associated with the F-statistics value of 0.34 exceeded the 5% significance level. Consequently, it can be concluded that the ARDL model did not exhibit an issue with serial autocorrelation.

4.4.2 CUSUM Stability Test Results
The outcomes of the CUSUM test, employed to assess the stability of the ARDL model, are presented in Figure 1. This test is conducted on the residuals of the estimated model.



Source: *Authors computation using E-view*
Figure 1: *CUSUM Plot Result*

An examination of the CUSUM statistics plots on Figures 1 reveals that they all fall within the two straight lines, suggesting the stability of the ARDL model.

5.0 Conclusion and Recommendations

5.1 Conclusion

In conclusion, the study provide evidence of a significant positive relationship between fuel subsidy expenditures and fiscal deficits in Nigeria in both the short-run and long-run. The analysis finds economic growth has a significant negative association with deficits, while inflationary impacts are ambiguous. The models demonstrate explanatory power and cointegration relationships. Overall, the findings suggest fuel subsidies are a major contributor to fiscal deficits in Nigeria. Reducing subsidies while boosting growth could significantly improve fiscal balances.

5.2 Recommendations

Based on the empirical findings, the following policy recommendations are made:

i. A phased and structured reduction of fuel subsidies over a defined timeline could significantly reduce fiscal deficits based on the strong positive association found between subsidies and deficits. Gradual subsidy cuts need to be combined with improvements in fuel sector efficiency and targeted social assistance programs to protect vulnerable groups.

ii. Fiscal reforms should prioritize stimulating rapid, sustainable and inclusive economic growth given the robust negative relationship between GDP growth and fiscal deficits. Supporting agriculture, manufacturing, infrastructure development and human capital formation can boost productivity and incomes, expanding the revenue base.

iii. Establishing rules-based fiscal frameworks including clear budgetary processes, spending limits and debt sustainability thresholds can instill fiscal discipline and transparency. This can delink government spending from volatile oil revenues.

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