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EXAMINING THE RELATIONSHIP BETWEEN FUEL SUBSIDIES AND GOVERNMENT BUDGET DEFICITS IN NIGERIA

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Abstract
The study investigates the impact of fuel subsidies on government budget deficits in Nigeria over the period 2000:Q1–2022:Q4 using annual time series quarterly data. The Autoregressive Distributed Lag (ARDL) bounds testing approach is employed to estimate the relationship. The results indicate that fuel subsidy payments have a statistically significant positive effect on budget deficits in both the short and long run. In the short run, a 1% increase in subsidies increases the deficit by 0.27% immediately. The long run estimates reveal a proportionally larger impact, with a 1% permanent rise in subsidies expanding the fiscal deficit by 0.69%. This suggests the expansionary effect of subsidies is amplified over time. The findings provide clear empirical evidence that fuel subsidy expenditures have consistently contributed to larger budget deficits and growing public debt in Nigeria. Overall, the time series analysis validates long-standing calls for reforms to the fiscally unsustainable subsidy regime. Gradual, phased reforms are recommended to mitigate short-term impacts. Fiscal rules limiting procyclical spending could also prevent deficits during oil booms. Further reforms will likely reduce budgetary imbalances over the medium to long term.

Keywords: Budget Deficits, Fuel Subsidies, Energy Policy, Fiscal Policy, and Time Series Analysis

JEL: H62, H20, Q48, E62, C22

1. Introduction

Fuel subsidies have been a contentious policy issue in many developing countries including Nigeria. A fuel subsidy is a government policy aimed at keeping fuel prices low for consumers by reimbursing fuel suppliers for the difference between market prices and regulated lower prices (Ehiedu et al., 2023). The rationale behind fuel subsidies is to make fuel affordable and help low-income households manage costs of living. However, fuel subsidies can also be a heavy burden on government budgets, contributing to government budget deficits if not properly managed (McCulloch et al., 2021).

Several factors according to Ozili and Obiora (2023), and Anyaogu (2023) make fuel subsidies a complex policy issue- first, is the fluctuation in global crude oil prices which affects domestic fuel prices. As a major oil exporter, Nigeria's economy is highly dependent on oil revenue. But it also imports refined fuel products to meet domestic demand. Thus, changes in crude oil prices on the international market create volatility in the pricing of gasoline, diesel and other fuel products in Nigeria. Second, there are large economic costs associated with fuel subsidies. Subsidies divert public funds from other productive uses and discourage private investment in the downstream petroleum sector. Third, fuel subsidies tend to benefit wealthy households more than the poor due to greater fuel consumption. And subsidies create incentives for fuel smuggling across borders due to arbitrage opportunities from price differentials with neighboring countries.

In Nigeria, a history of military rule contributed to a culture of fuel subsidies as a "social contract" with citizens. However, as the transition to democracy began in 1999, the fiscal burden of subsidies became more evident. Using data from PricewaterhouseCoopers [PwC] (2023), Central Bank of Nigeria [CBN] (2022), and BudgIT (2018), a look at fiscal deficit and fuel subsidies in Nigeria from 2000 to 2022 shows that at the start of the time period in 2000, Nigeria's fiscal deficit stood at 172.6 billion

naira, while fuel subsidy expenditure was over 120 billion naira. Over the next several years, subsidy spending steadily increased, reaching 150 billion in 2002 and 210 billion by 2004. During this early period, the fiscal deficit also widened, hitting 301.4 billion in 2002 as subsidies rose. From 2005 to 2007, subsidies grew from 240 billion to 272 billion naira. The deficit remained high but fluctuated, improving slightly to 100.8 billion in 2006 before increasing again. In 2008, subsidies jumped sharply to 631 billion naira. Correspondingly, the fiscal deficit ballooned to 47.4 billion that year.

The years 2009-2011 saw fuel subsidies stay elevated, peaking at 2.11 trillion naira in 2011. The massive subsidy spending contributed to large deficits throughout this period, including a record 1.158 trillion deficit in 2011, alongside the historic high subsidy expenditure. Subsidies started declining after 2011 but remained substantial, while deficits persisted as well. In 2016, a notable drop in subsidies to 246 billion coincided with the deficit falling to 2.673 trillion. From 2017 to 2020, subsidies stayed relatively low while deficits grew massively, suggesting other factors at play. In 2021 and 2022, subsidies resurged past 1 trillion naira again, nearing record highs. Accordingly, Nigeria's fiscal deficit expanded greatly, exceeding 9 trillion in 2022 as fuel subsidy costs drained public finances, constituting a major problem. Overall, fuel subsidies contributed to recurring budget deficits and a rapidly growing public debt burden. According to estimates, Nigeria was spending four times as many on subsidies as on education and health combined (Alake, 2019).

Various attempts to reform or remove subsidies since the early 2000s have been met with stiff resistance and policy reversals. But a partial removal of petroleum subsidies finally took effect in 2012 after prolonged debates. The reform triggered nationwide protests and strikes, highlighting the social and political challenges involved in reforming a long-standing subsidy program. In 2023, a total removal has been effected by the government. While the debate continues regarding the reform's impact on living costs for Nigerian versus its fiscal implications, this study highlights the fiscal pressures and distortions associated with Nigeria's fuel subsidy program over the period of 2000 to 2022. Furthermore, existing literatures examining the relationship between fuel subsidies and government budget deficits in Nigeria contains some noticeable gaps. Most studies like Ozili and Obiora (2023), McCulloch, Moerenhout and Yang (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. (2014) focused on analyzing the impacts of fuel subsidy removal or reform rather than directly assessing the linkage between subsidies and deficits. These issues motivate further study on the impact of fuel subsidies for government budgets in the Nigerian context- this constitutes the study's major objective. Examining this relationship can provide insights to inform fiscal friendly subsidy policy reforms.

2. Literature Review

2.1 Conceptual Clarification

Budget Deficit: According to Jalil et al. (2014) budget deficit occurs when government spending exceeds government revenues during a fiscal year. Similarly, Hyman (2014) A budget deficit exists whenever a government's total outlays exceed its total receipts for a given time period, usually a fiscal year. Additionally, Mankiw (2018) noted that budget deficit refers to the amount by which government spending exceeds government revenues during a fiscal year. Also, Abel et al. (2020) sees it as the excess of government expenditures over tax revenues during a fiscal year. Additionally, budget deficit according to Nwosu and Okafor (2014) budget deficit is seen as the excess of government expenditure over government receipts.

This study uses Mankiw's (2018) definition as its working definition because is the most comprehensive.

Fuel Subsidy: The International Energy Agency (2023) defines fuel subsidy as a government measure that lowers the price consumers pay for fossil fuels below international market prices. Kojima (2013) sees fuel subsidies as government policies that reduce the price that consumers pay for fuels such as gasoline, diesel, and kerosene below their cost of supply. Similarly, a fuel subsidy arises when a government keeps the price consumers pay for a fuel such as gasoline below the world market price (Lin & Jiang, 2011). According to Ellis (2010) fuel subsidies are government actions directed at lowering the price

paid by fuel consumers, raising the price received by fuel producers, or reducing the cost of fuel production. Furthermore, Coady et al. (2015) noted that fuel subsidies refer to government policies that lead to consumers facing prices below those that would result from competitive market equilibrium.

The most comprehensive and widely accepted definition is the one by Coady et al. (2015) which is adopted by this study.

2.2 Theoretical Framework

Public Choice Theory

Public choice theory emerged in the mid-20th century through the work of economists such as James Buchanan, Gordon Tullock, and Anthony Downs (Buchanan & Tullock, 1962; Downs, 1957). The theory applies economic tools to analyze political decision-making. Public choice theorists make the foundational argument that politicians, bureaucrats, and citizens are primarily self-interested actors who use the political system to maximize their own utility, rather than seeking an abstract "public good" (Mueller, 2003).

At the core of public choice theory is the idea of concentrated benefits versus diffuse costs. Small, organized interest groups have strong incentives to influence policy in their favor because they can capture concentrated benefits (Olson, 1971). But the costs of their rent-seeking behavior are spread out across society. For example, an oil company lobbyist has more motivation to maintain fuel subsidies that benefit their industry than a single citizen has to advocate for eliminating wasteful subsidies that only cost them a small amount. This asymmetry drives policy outcomes (Buchanan, 1975). Public choice theory provides a skeptical analysis of government and policymaking. By modeling political actors as self-interested and influenced by incentives, public choice explains why ineffective policies that help concentrated interests at the expense of the public purse persist (Tullock, 1967). The insights of public choice theory can help explain the durability of fuel subsidy regimes in Nigeria and elsewhere, despite their fiscal costs. Oil companies, unions, and elites capture the gains while the public bears the costs (Kendall-Taylor, 2012).

2.3 Empirical Review

Ozili and Obiora (2023) examined the implications of fuel subsidy removal on the Nigerian economy. The scope covered the years from 1970 to 2019. The study utilized multiple regression analysis to estimate the impact of fuel subsidy removal on key economic indicators. The variables used were fuel subsidy spending, government revenue, government expenditure, gross domestic product (GDP) growth rate, inflation rate, and exchange rate. The key findings were that fuel subsidy removal significantly reduced government revenue and increased government expenditure, inflation rate, and exchange rate volatility. However, fuel subsidy removal had an insignificant impact on GDP growth.

Similarly, McCulloch et al. (2021) analyzed the distributional and welfare impacts of fuel subsidy reform in Nigeria using microeconomic analysis. The scope covered the years 2011 to 2015. The study utilized a microsimulation model based on the 2012/13 Living Standards Measurement Study (LSMS) household survey data. The key variables were household consumption, fuel spending, and welfare. The findings showed that the poorest households are hit hardest by fuel subsidy removal, with average welfare losses of 8-10 percent. However, well-targeted cash transfers to the poorest 40 percent of households could offset these losses at reasonable cost.

In a study outside Nigeria, Badli et al. (2020) assessed the efficiency of fuel subsidy expenditures in Indonesia using the Stochastic Frontier model. The scope covered the years from 2010 to 2017. The key variables were fuel subsidy spending, fuel consumption, economic growth, and an inefficiency determinant (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.

Omotosho (2019) in a Nigeria based study examined the impact of oil price shocks and fuel subsidies on macroeconomic stability. The scope covered the period from 1970 to 2013. The study utilized structural vector auto-regression (SVAR) and innovation accounting methodologies. The key variables were international oil prices, fuel subsidy spending, government expenditure, GDP, and other macroeconomic indicators. The findings showed that

positive oil price shocks and higher fuel subsidies significantly increased government spending, which temporarily boosted GDP growth but had adverse effects on macroeconomic stability.

Also, Harun et al. (2018) assessed the effects of fuel subsidy removal on production input costs in Malaysia using the Leontief input-output price model. The scope covered the period from 2009 to 2013. The key variables were fuel prices, input costs of major economic sectors, and production output prices. The findings showed that fuel subsidy removal led to increases in input costs across all sectors, with the transportation, construction, agriculture and manufacturing sectors being the most affected. However, the impact on output prices was muted due to minimal pass-through of higher input costs.

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

In a Nigeria based study, Akinyemi et al. (2017) simulated the impact of fuel subsidy removal on the agricultural sector using a Dynamic Computable General Equilibrium (DCGE) model. The scope was a 10-year period simulation from 2015 to 2025. The key variables were producer prices, consumer prices, production levels, and welfare indicators for the agricultural sector. The findings showed that complete removal of fuel subsidies results in decreased agricultural production and intra-sectoral demand in the short run. However, in the long run, resources are reallocated towards more efficient sectors improving overall welfare.

Similarly, Osunmuyiwa and Kalfagianni (2017) examined whether Nigeria's fuel subsidy reforms could catalyze sustainable energy transitions. The scope covered the period from 1970 to 2014. The study utilized a qualitative analytical framework drawing on energy transition and political economy theory. The key variables were fossil fuel subsidies, renewable energy investment, and political and socioeconomic contextual factors. The findings showed that fuel subsidy reforms face challenges in light of path dependencies, vested interests, and weak governance institutions.

In a cross-country study, Sulistiowat (2015) study analyzed the impact of fossil fuel subsidies on economic growth. The scope covered 1987 to 2012 for a panel of 37 developing and emerging countries. The study utilized fixed effects regression analysis. The key variables were fossil fuel subsidies, GDP per capita growth, investment, trade openness, and control variables. The findings showed that higher fossil fuel subsidies have a negative relationship with economic growth in both the short and long run. Fuel subsidies were also found to disproportionately benefit the non-poor.

In another Nigeria based study, Siddig et al. (2014) analyzed the poverty and distributional impacts of removing fuel import subsidies using microsimulation analysis. The scope was the short-run impacts based on 2011 household survey data. The study utilized a static microsimulation model linked to a global trade model. The key variables were fuel prices, household welfare, poverty rate, and inequality. The findings showed that complete removal of fuel subsidies leads to higher poverty, particularly in urban areas.

Additionally, the Organization for Economic Co-operation and Development. (OECD) (2013) analyzed energy subsidies and their reform in Eastern Europe, Caucasus and Central Asia countries. The scope covered the period from 2007 to 2012. The study utilized a price-gap approach to estimate subsidies across different energy types including petroleum, natural gas, coal, and electricity. The key variables were reference prices, regulated end-user prices, and quantities consumed. The findings showed that fuel subsidies in these countries amounted to USD 40 billion in 2012, with petroleum subsidies representing the largest share.

The existing literature examining the relationship between fuel subsidies and government budget deficits in Nigeria contains some noticeable gaps. Most studies like 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. (2014) focused

on analyzing the impacts of fuel subsidy removal or reform rather than directly assessing the linkage between subsidies and deficits. An exception is the Drama and Ange-Patrick (2018) study which analyzed oil prices, deficits and macroeconomic variables in WAEMU countries rather than specifically focusing on Nigeria. Additionally, there is a lack of recent empirical analysis establishing the statistical relationship between fuel subsidies and budget deficits in Nigeria using time series econometric approaches. Many existing studies like those utilizing regression models, microsimulations and CGE models did not concentrate specifically on quantifying deficit impacts. Furthermore, most analyses like Siddig et al. (2014) and Akinyemi et al. (2017) had a short-term orientation, without adequately examining the long-run dynamics between subsidies and deficits. While some studies assessed distributional and welfare effects, the fiscal and budget deficit implications were not sufficiently highlighted. Overall, the gap in literature points to the need for an up-to-date econometric study that directly estimates the linkage between fuel subsidies and government budget deficits in Nigeria based on recent time series data. This can help quantify the magnitude of impact and provide insights into both short and long-run relationships.

3. Methodology

3.1 Data and Sources

This study exclusively relied on secondary data, utilizing annual time series quarterly data from 2000 to 2022, with the choice of the base year corresponding to Nigeria's return to democracy and the terminal year selected to capture the contemporary relationship between fuel subsidies and government budget deficits. The data-set of government deficit, inflation, exchange rate and GDP were sourced from the Annual CBN Statistical Bulletin (2022), while the dataset of fuel subsidy payment was gotten from PricewaterhouseCoopers [PwC] (2023), and BudgIT (2018) data-set releases.

3.2 Model Specification

While there are limited studies on fuel subsidies and government budget deficits, this study however adapted the model of Drama and Ange-Patrick (2018) that used international crude oil prices, budget deficits, broad money supply, and consumer price index in its model specification. Consequently, Unlike Drama and Ange-Patrick's study, this study model only contains the variables of interest which are government deficit, subsidy payments, the country's GDP, inflation rate and exchange rate. Particularly, the model includes the optimal set of variables to address the research objective regarding fuel subsidies' impact on budget deficits, while controlling for economic conditions through GDP, inflation and exchange rate. This focused variable selection is appropriate and justified for the purpose of this study. As such it models budget deficit as a function of fuel subsidy payments and economic growth. The functional, baseline, and ARDL models are presented as Equations 1,2 and 3:

$$BD = f(FSP, GDP, INF, EXR) \quad (1)$$

$$LnBD_t = \delta_0 + \delta_1 LnFSP_t + \delta_2 LnGDP_t + \delta_3 LnINF_t + \delta_4 LnEXR_t + \varepsilon_t \quad (2)$$

where, is the intercept; are the coefficients of the variables; represents the error term; the *Ln* component represents the natural log, *BD* represents government deficit; *FSP* stands for fuel subsidy payments; *INF* stands for inflation; while *EXR* denotes exchange rate.

Based on the above models, the ARDL model used in this study is presented as:

$$\Delta BDt = \delta 0 + \sum_t^p = 0 \varphi_1 \Delta BDt\text{-}1 + \sum_t^p = 0 \varphi_2 \Delta FSP_{t-1} + \sum_t^p = 0 \varphi_3 \Delta GDP_{t-1} + \sum_t^p = 0 \varphi_4 \Delta INF_{t-1} + \sum_t^p = 0 \varphi_5 \Delta EXR_{t-1} + \delta_1 \Delta BD_{t-1} + \delta_2 \Delta FSP_{t-1} + \delta_3 \Delta GDP_{t-1} + \delta_4 \Delta INF_{t-1} + \delta_5 \Delta EXR_{t-1} + \varepsilon_t \quad (3)$$

Where, δ_0 is the intercept; $\sum_t^p = 0$ are the long-run multipliers; $\delta_1 \Delta BD_{t-1}$ represents the short-run dynamic coefficients of the model; *t* is the time dimension while; ε_t is the difference operator, and is the error term. A priori Expectation-

3.3 Method of Analysis

The study used the Autoregressive Distributed Lag (ARDL) model to carry out its empirical study. The ARDL model, also known as bounds testing approach, has become a popular modeling technique in recent years for analyzing relationships between variables (Pesaran et al., 2001). The key advantage of ARDL models is that they can be estimated using ordinary least squares regression regardless of whether the variables are I(0), I(1) or mutually cointegrated (Nkoro & Uko, 2016). This avoids the

pre-testing issues associated with standard cointegration techniques. Additionally, the ARDL approach allows modelling variables as a mix of both levels and first differences, providing robust long-run and short-run estimates simultaneously (Harris and Sollis, 2003). For this study on fuel subsidies and budget deficits in Nigeria, the ARDL technique is well-suited for several reasons. First, the variables likely demonstrate a mix of I(0) and I(1) characteristics which fits the ARDL framework. Second, the annual time series data over multiple decades make ARDL appropriate for determining cointegration relationships. Third, the ability to estimate short and long-run effects in one model provides useful policy insights.

3.4 Estimation Procedure

Descriptive statistics

The dataset was subjected to a comprehensive descriptive analysis in the study, wherein key statistical parameters such as mean, minimum and maximum values, standard deviation, skewness, kurtosis, and the Jarque-Bera test were examined. This analysis provided valuable historical insights into the behavior of the data.

Test for Stationarity: To examine the presence of non-stationarity in the data, the Augmented Dickey Fuller (ADF) stationarity and the Phillips-Perron (PP) tests will be conducted.

The ARDL Approach

The ARDL approach involves a series of sequential steps. Firstly, after performing the stationarity test, the presence of co-integration is assessed using the bounds testing procedure introduced by Pesaran et al. (2001). Once long-run relationships among the variables are established, the next step is to estimate both the short and long-run relationships. Finally, the stability of the model is assessed in the fourth stage using the cumulative sum of recursive residuals (CUSUM) and cumulative sum of squares of recursive residuals (CUSUMSQ) tests.

4. Results and Discussion

4.1 Descriptive Statistics

The results of the descriptive statistics are presented on Table 1

Table 1: Descriptive Statistics Result

	BD	***FSP***	***GDP***	***INF***	***EXR***
Mean	2025.235	0.816522	5.734783	13.07174	198.9996
Median	987.0625	0.476719	5.610469	12.09688	153.6683
Maximum	10445.55	6.071875	15.18406	24.76750	431.4581
Minimum	21.91250	0.009375	0.741563	5.687500	98.08121
Std. Dev.	2568.696	0.977094	3.354353	4.334758	98.85162
Skewness	1.523191	2.949049	0.646487	0.794270	1.065488
Kurtosis	4.379399	13.98537	3.171069	3.391356	2.709644
Observations	92	92	92	92	92

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

The mean budget deficit (BD) over the period was 2025.235, indicating that on average the government ran a relatively large budget deficit over the 2000-2022 period. The maximum deficit reached 10445.55 while the minimum was only 21.91250. The large standard deviation of 2568.696 and positive skewness indicates there was substantial variation and asymmetry in the deficits. The mean fuel subsidy payment (FSP) was 0.816522. This payment fluctuated widely over the period, ranging from a minimum of 0.009375 to a maximum of 6.071875. The high standard deviation of 0.977094 and large positive skewness of 2.949049 indicates the subsidy payments were highly variable and skewed to the upper end. Inflation (INF) averaged 13.07174% with a range of 5.687500% to 24.76750%. The standard deviation of 4.334758 indicates moderate variability in inflation over the period. Inflation was moderately positively skewed. The exchange rate (EXR) averaged 198.9996 over the period, ranging from 98.08121 to 431.4581. The high standard deviation indicates substantial volatility in the exchange rate. The exchange rate was positively skewed. In summary, the descriptive

statistics indicate high variability and positive skewness in budget deficits, fuel subsidies, inflation and the exchange rate over the 2000-2022 period. This suggests that increases in fuel subsidies were associated with widening budget deficits, higher inflation and currency depreciation over the period under study. More advanced statistical analysis would be required to determine the magnitude of the impact of fuel subsidies on the fiscal deficit.

4.2 Unit Root Test

The Augmented Dickey-Fuller (ADF) and the Phillips-Perron (PP) tests were used to carry out the study's Unit root test as presented in Table 2.

Table 2: ***ADF & PP Unit Root Test Results***

Variable	ADF Stat.	Order of Integration	PP Stat.	Order of Integration
BD	-5.049309 (-3.465548)	1(1)	-4.188220 (-3.459950)	1(0)
FSUB	-7.364451 (-3.462912)	1(1)	-6.761743 (-3.460516)	1(1)
GDP	-4.128291 (-3.462912)	1(1)	-5.611888 (-3.460516)	1(1)
INF	-5.685077 (-3.465548)	1(1)	-6.149281 (-3.460516)	1(1)
EXR	-4.243224 (-3.460516)	1(0)	-4.511504 (-3.459950)	1(0)

Figures in parenthesis represents the critical values at the 5% level (in brackets are the t statistics)
Source: *Author's computation using E-views.*

The unit root test result on Table 2 showed some discrepancies between the two tests. The BD series was found to be stationary in first differences according to the ADF test, but the more robust PP test indicated it was stationary in levels. This discrepancy could be due to the PP test's ability to account for autocorrelation and heteroskedasticity. For the other variables, the results were more consistent. Both the ADF and PP tests found FSUB, GDP and INF to have unit roots and be stationary in first differences. The tests concurred that the exchange rate (EXR) did not have a unit root and was stationary in levels. Overall, the unit root test results confirm that the ARDL approach is appropriate for modeling the relationship between budget deficits and fuel subsidies. The mixture of I(0) and I(1) variables and uncertainty around BD makes ARDL suitable.

4.3. ARDL Bounds Test

The study begins the ARDL estimation by carrying out the Bound test. The study reports the ARDL optimal model to be (2, 2, 2, 2, 2). Table 4.6 presents the ARDL bounds test results.

Table 3: ARDL Bound Test Result

F-Bounds Test		Null Hypothesis: No levels relationship		
Test Statistic	Value	Signif.	I(0)	I(1)
F-statistic	7.022731	10%	2.2	3.09
k	4	5%	2.56	3.49
		2.5%	2.88	3.87
		1%	3.29	4.37

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

The Bound test yielded an F-statistics value of 7.02, which surpassed the upper bound critical values at all levels of significance. This provides strong evidence rejecting the null hypothesis of no long-run relationship. The F-statistic exceeding the upper critical bounds indicates the

definitive presence of a cointegrating long-run relationship between budget deficits and fuel subsidies in the ARDL model. With the existence of cointegration confirmed, the next step was estimating the short-run and long-run forms of the ARDL model to evaluate the impact of fuel subsidies on budget deficits in Nigeria.

4.4 ARDL Short-run Estimation

The ARDL short-run model presented on Table 4 was estimated to confirm the short-run dynamics and interactions of the parameters in the model.

Table 4 A*RDL Short-Run Coefficient Estimates:*Dependent Variable: *D(LNBD)*

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNFSP)	0.266919	0.097716	2.731588	0.0079
D(LNFSP(-1))	0.220987	0.141998	1.556274	0.1239
D(LNGDP)	0.032513	0.196276	0.165648	0.8689
D(LNGDP(-1))	0.091308	0.191690	0.476332	0.6352
D(LNINF)	0.137433	0.169959	0.808626	0.4213
D(LNINF(-1))	-0.306837	0.178510	-1.718883	0.0898
D(LNEXR)	4.498950	1.021583	4.403901	0.0000
D(LNEXR(-1))	0.665265	1.099135	0.605262	0.5468
CointEq(-1)*	-0.152756	0.030106	-5.074001	0.0000
R-squared	0.936359			
Adjusted R-squared	0.872719			

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

The short-run model shows that the contemporaneous change in fuel subsidies (D(LNFSP)) has a positive and statistically significant impact on the change in budget deficits (D(LNBD)). The coefficient of 0.266919 suggests that a 1% increase in fuel subsidies leads to a 0.27% increase in the budget deficit in the short run. The lagged change in fuel subsidies (D(LNFSP(-1))) also has a positive coefficient of 0.220987 but is not statistically significant. Changes in GDP do not significantly affect budget deficits in the short run. For inflation, only the lagged effect (D(LNINF(-1))) is significant, with a negative coefficient suggesting a 1% rise in inflation decreases the deficit by 0.31% in the next quarter. The exchange rate (D(LNEXR)) contemporaneously has a large, positive and highly significant effect on the deficit. But its lagged effect is insignificant. The error correction term (CointEq(-1)) is correctly signed (negative) and highly significant, confirming error correction behavior that drives the model back to equilibrium. Overall, the key takeaway is fuel subsidies have an immediate positive and significant impact on budget deficits in the short run in Nigeria over the 2000-2022 period. Along with exchange rate depreciation, fuel subsidies expand deficits in the immediate quarter before equilibrating effects occur.

4.5 ARDL Long-run Estimation

The ARDL short-run model coefficient estimates are presented in Table 5.

Table 5: ARDL Long-run Coefficient Estimates; Dependent Variable: D(LNFD)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	1.840296	3.888041	0.473322	0.6374
LNFSP	0.690197	0.198065	3.484708	0.0008
LNGDP	-0.356534	0.158770	-2.245597	0.0275
LNINF	0.189641	0.090888	2.086542	0.0402
LNEXR	1.446665	0.739067	1.957419	0.0540

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

The long-run estimates provide insight into the equilibrium relationships between the variables.

Fuel subsidies (LNFSP) have a positive and highly statistically significant coefficient of 0.690197. This suggests that in the long run, a 1% permanent increase in fuel subsidies leads to a 0.69% rise in the budget deficit. This implies fuel subsidies have an expansionary effect on deficits in Nigeria in the long run. GDP (LNGDP) has a negative and significant coefficient, indicating higher economic growth reduces budget deficits in the long run. Inflation (LNINF) is positive and marginally significant, implying higher inflation leads to slightly higher deficits in the long run. The exchange rate (LNEXR) also has a positive effect on the deficit in the long run but is only weakly significant. Overall, the key finding is the statistically significant long-run effect of fuel subsidies expanding budget deficits. A permanent increase in subsidy payments results in a proportionally higher permanent increase in the fiscal deficit for Nigeria in the long run. This suggests fuel subsidy reforms could help reduce budget deficits over time.

This study's ARDL model results showing a positive short and long-run impact of fuel subsidies on budget deficits in Nigeria aligns with some existing literature, while also differing from others in certain aspects. On similarities, the short-run expansionary effect of fuel subsidies on deficits corroborates Drama and Ange-Patrick (2018) who found oil price shocks transmit through to higher budget deficits and money supply in the short term for WAEMU countries. The long-run finding of a proportionally larger effect of subsidies on deficits also aligns with Osunmuyiwa and Kalfagianni (2017) who concluded subsidy reforms can create fiscal space for clean energy investments. However, the results differ from studies like Ozili and Obiora (2023) and Omotosho (2019) which found insignificant GDP effects, whereas this study shows negative long-run GDP effects on deficits. The positive inflationary effect also contrasts with Akinyemi et al. (2017) which predicted consumer price decreases from subsidy removal based on a DCGE model. A key similarity with Sulistiowat (2015) is confirming the inefficiency of fuel subsidies in growing deficits rather than growth. But the long-run focus here provides more definitive estimates of fiscal effects compared to the cross-country regressions. The Nigeria-specific time series analysis provides more precise short and long-run estimates of deficit impacts compared to studies like McCulloch et al. (2021) that focused more on distributional effects. The quarterly frequency also enables detailed short-run dynamics modeling. Overall, while the findings reinforce some conclusions in literature, the direct modeling of fuel subsidies and budget deficits using recent data provides more robust fiscal-specific evidence. The ARDL approach also allows deeper insights into short and long-run dynamics compared to methods used in previous studies.

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 6

Table 6: Breusch-Godfrey Serial Correlation LM Test

F-statistic	1.687116	Prob. F(2,73)	0.1922
Obs*R-squared	3.976222	Prob. Chi-Square(2)	0.1370

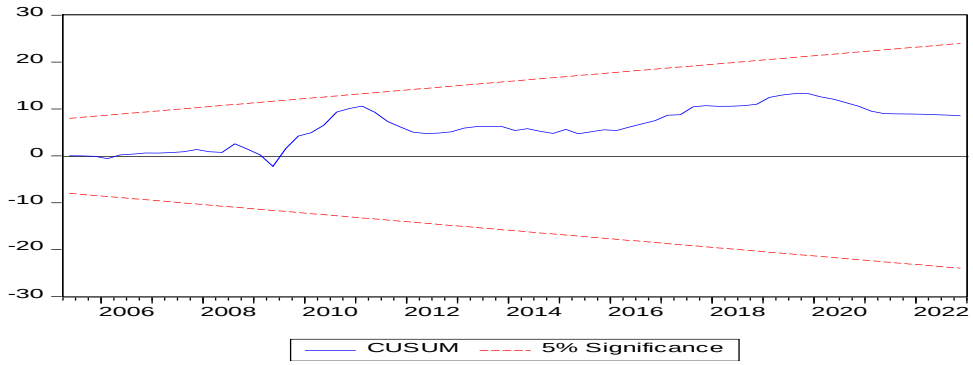
Source: *Authors computation using E-view*

The Breusch-Godfrey LM test yielded an F-statistics value of 0.19, with an associated probability exceeding the 5% significance level. As the p-value was greater than 0.05, the null hypothesis of no serial correlation could not be rejected at the 5% level. The test provides no evidence against the null. Therefore, the Breusch-Godfrey LM test confirms the absence of serial autocorrelation in the residuals of the estimated ARDL model. The model satisfies the crucial assumption of no autocorrelation, validating the integrity of the ARDL estimates.

4.4.2 CUSUM Stability Test Results

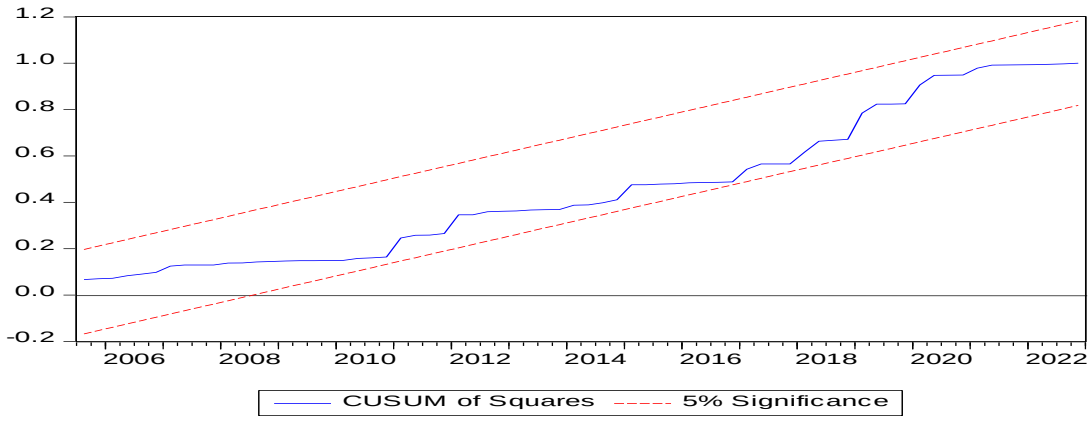
The outcomes of the CUSUM test, employed to assess the stability of the ARDL model, are presented

in Figure 1 and 2. This test is conducted on the residuals of the estimated model.



Source: *Authors computation using E-view*

Figure 1: *CUSUM Plot Result*



Source: *Authors computation using E-view*

Figure 2: CUSUMSQ *Result*

The CUSUM plots and CUSUMSQ in Figures 1 and 2 demonstrate stability of the estimated ARDL model, as the CUSUM statistics remain within the critical bounds represented by the two straight lines. The CUSUM statistics not crossing the critical lines provides strong visual evidence that the coefficients in the ARDL model are stable over the sample period. This stability is a key diagnostic validating the reliability of the ARDL model for analyzing the impact of fuel subsidies on budget deficits in Nigeria.

5. Conclusion and Recommendations

This study investigated the relationship between fuel subsidies and government budget deficits in Nigeria over the period 2000 to 2022 using the ARDL bounds testing approach. The results showed fuel subsidy payments have a statistically significant positive impact on budget deficits in both the short and long run. In the short run, a 1% increase in fuel subsidies increases the budget deficit by 0.27% in the immediate quarter. The long run estimates indicate a proportionally larger effect, with a 1% permanent increase in subsidies expanding the fiscal deficit by 0.69%. This implies the expansionary effect of subsidies on deficits is amplified over time. The findings align with certain existing studies like Drama and Ange-Patrick (2018) that found oil price shocks increase budget deficits in the short term. However, the direct estimation of the fiscal impact of subsidies provides new evidence. The results confirm the view that fuel subsidies contribute to recurring budgetary imbalances and growing public debt in Nigeria. Overall, the time series analysis indicates fuel subsidy expenditures consistently widened fiscal deficits both immediately and in the long run from 2000 to 2022. The statistically significant positive effects highlight the fiscal distortions caused by fuel subsidies in Nigeria.

Based on the conclusions, the following policy recommendations are proffered:

i. Gradual fuel subsidy reforms that phase out untargeted subsidies will likely reduce budget deficits over the medium to long term based on the results.
ii. Fiscal rules limiting deficit spending could mitigate the expansionary impacts of subsidies during oil booms. Saving windfalls in stabilization funds can also prevent deficits.
iii. Complementary social assistance policies are needed to protect poor households from price impacts during reforms; this stems from the high inflationary pressures from the study's findings.
iv. Anti-corruption and transparency measures in the oil sector are essential to ensure subsidy savings translate to fiscal gains rather than merely accrue as rents to vested interests.

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