ELECTRICITY SUPPLY SUBSIDY AND ECONOMIC GROWTH IN NIGERIA

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Abstract

The purpose of this study is to investigate the impact of electricity subsidies on economic growth in Nigeria from 1990 to 2022 from 1990 to 2022. The long-term relationship among the variables was analyzed using the ARDL (Auto-regressive Distributed Lag) model. A unit root test was performed on various factors, including the economic growth rate and electricity subsidy as a percentage of GDP, which were found to be of order one I(1), while oil prices, gross capital formation as a percentage of GDP, and foreign direct investment as a percentage of GDP were identified as order zero I(0). To establish long-term relationships among the variables, co-integration bound tests were executed. The findings indicate that electricity subsidies and gross capital formation exhibit a negative yet significant correlation with economic growth, whereas oil prices demonstrate a positive and significant relationship with economic growth. Additionally, the results affirm a long-term relationship between economic growth, electricity subsidies, and the other variables analyzed in the study. A serial correlation test was also conducted, revealing no serial correlation among the variables. In light of these findings, the study recommends that the Nigerian federal government should assess the appropriate utilization of funds allocated for electricity subsidies by the Nigerian Electricity Regulatory Commission and Electricity Distribution Companies. Furthermore, it is essential for the federal government to ensure that the private power sector adequately meets the electricity demands of consumers nationwide to alleviate their hardships.

Keywords: Electricity subsidy, Electricity supply, Economic growth rate, Nigeria, ARDL.

1. Introduction

The flow of electrical power, commonly referred to as electricity, is derived from the transformation of various energy sources, including coal, natural gas, oil, nuclear energy, and other natural resources, collectively known as primary sources. Consequently, electricity is classified as a secondary energy source. It is among the most widely utilized forms of energy and serves as a crucial element of the natural environment. Prior to the advent of electricity over a century ago, residential heating was achieved through wood- or coal-burning stoves, food preservation relied on iceboxes, and illumination was provided by kerosene lamps. The phrase "electricity supply" encompasses the total energy delivered, which comprises the electricity generated at a company's own production facilities as well as the electricity acquired from external producers. This supply also includes the necessary tools, materials, and components for the generation, distribution, and consumption of electrical power, such as outlets, switches, circuit breakers, wiring, and other related elements. According to Edomah, Chris, & Aled (2016), Nigeria's inaugural electrical power plant was established in 1896, featuring a 30 kW, 1000 volt, 80 cycle, single-phase supply. A second unit was introduced in 1902, and by 1909, the installed capacity had risen to 120 kW, with a recorded energy demand of 65 kW.

A government initiative referred to as an electricity supply subsidy influences energy pricing, resulting in either elevated costs for producers or reduced rates for consumers compared to market values. Energy subsidies may manifest as direct financial transfers to suppliers, consumers, or related entities, as well as through indirect support mechanisms such as price regulations, trade limitations, rebates, and market access restrictions. In Nigeria, energy companies generate and distribute between 3,500 megawatts and 5,500 megavolt hours of electricity to a population exceeding 200 million. For instance, on December 28, 2023, the national grid produced 4,690.07 megawatts of power. Following the privatization of the sector in November 2013, eleven power firms and six generation companies have been established. The power distribution companies include Abuja, Benin, Eko, Enugu, Ibadan, Jos, Kaduna, Kano, Port Harcourt, and Yola Discos. Notable generation companies include Transcorp Power Limited, Shiroro Hydroelectric Power Station, Sapele Power Plc, Ughelli Power Plc, Geregu Power Plc, and Kainji Hydroelectric Power Station. The privatization process in 2013, which encompassed both generation and distribution entities, yielded approximately \$2.5 billion for the Federal Government (Nnodim, 2023). In 2020, the Federal Government, under President Muhammadu Buhari, initiated the gradual removal of electricity subsidies through the implementation of the Service Based Tariff. This decision was driven by the financial strain associated with fuel and electricity subsidies. Between 2015 and 2020, the average deficit in energy tariffs was around N200 billion annually, escalating to an extraordinary N600 billion in 2022. Projections indicate that by the end of 2024, the subsidy could rise to at least N1 trillion (BusinessDay, 2023).

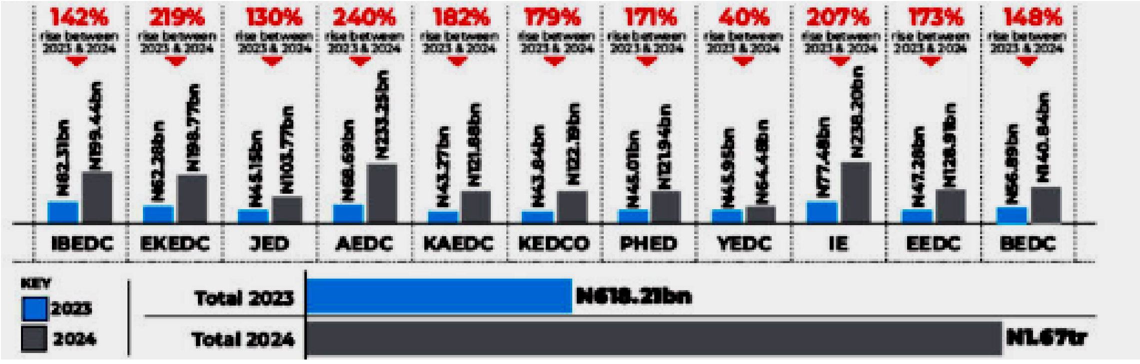
Olubiyo (2013) indicated that research findings showed an investment of approximately \$50 billion in the business sector, which has not resulted in significant returns. To ensure the reliability of the power grid, the Federal Government has allocated over N2.8 trillion in subsidies to the sector, alongside an investment of at least \$10 billion in the industry over a decade (Nnodim, 2023). As reported by The Punch (2023), the Federal Government subsidized energy costs amounting to N375.8 billion from January to September 2023, while power users collectively paid N782.6 billion for electricity during the same period. Recent data on power subsidies obtained from the Nigerian Electricity

Regulatory Commission in Abuja indicated that the government provided electricity subsidies in the first, second, and third quarters of 2023. Furthermore, it was revealed that despite frequent blackouts in Nigeria, power distribution companies generated N782.6 billion in revenue during the nine-month timeframe, billing energy users a total of N1.06 trillion nationwide. In terms of subsidy payments, the Federal Government subsidized power by N36 billion in the first quarter of 2023, which increased to N135.2 billion in the second quarter, and further rose to N204.6 billion in the third quarter. By the conclusion of 2023, the Federal Government had expended over N600 billion on electricity subsidies.

On January 17, 2024, the Nigerian Electricity Regulatory Commission (NERC) unveiled a new electricity tariff structure for the eleven distribution companies (DisCos). However, NERC indicated that these utilities would not implement the increase due to the Federal Government's commitment to providing N1.6 trillion in consumer subsidies by 2024, averaging N120 billion monthly. NERC clarified that this new policy would maintain the electricity tariff at its current level, unchanged since December 2022. For customers under the Abuja Electricity Distribution Company (AEDC) franchise, the government will allocate N232.26 billion in subsidies for 2024, equating to N19.44 billion each month, based on an analysis of the order submitted by DisCos. AEDC had requested a cost-reflective price of N151.07 per kilowatt-hour, but the Commission approved a rate of N120.88/kWh. Consequently, customers will pay N63.24/kWh under the tariff freeze, while the government will cover N58.12/kWh. Additionally, the government will provide N238.20 billion in subsidies to customers of Ikeja Electric in 2024, amounting to N19.85 billion monthly. Although IKEDC sought a cost-reflective tariff of N128.18/kWh, the Commission sanctioned N112.10/kWh. Under the tariff freeze, customers will pay N56.60/kWh, with the government subsidizing N55.50/kWh. Furthermore, in 2024, the government will allocate N129.92 billion in subsidies to Enugu DisCo customers, translating to N10.74 billion per month. The Commission approved a tariff of N128/kWh after EEDC requested a cost-reflective rate of N155/kWh. Customers will pay N59/kWh due to the tariff freeze, while the government will subsidize N69.40/kWh. Lastly, Benin DisCo customers will benefit from a total subsidy of N140.85 billion, or N11.74 billion monthly. Although Benin DisCo requested a cost-reflective tariff of N277.70/kWh, the regulator approved N126/kWh. Under the tariff freeze, customers will pay N60.10/kWh, with the government subsidizing N65.90/kWh (Vanguard 18, 2024).

Over the past decade, the federal government of Nigeria has allocated more than N5 trillion, reflecting an increase of over 664 percent, towards energy rate subsidies for its citizens (NERC, 2024). Furthermore, the government's expenditures from 2015 to 2024 have surged by 171% concerning the eleven Electricity Distribution Companies (DisCos) that it would have compensated between 2023 and 2024. A detailed analysis reveals that the government disbursed N225 billion in 2015, which rose to N302 billion in 2016. This amount further escalated to N351 billion in 2017, N440 billion in 2018, and N528 billion in 2019. However, in 2020, the expenditure decreased to N501 billion due to the implementation of the Multi Year Tariff (MYTO), leading to a reduction in subsidies to N251 billion in 2021 and N144 billion in 2022. In 2023, the subsidy was increased to N618 billion, attributed to rising inflation and the depreciation of the naira. Experts anticipate a decline in Nigeria's economy in 2024, yet the government has announced a projected expenditure of N1.673 trillion for that year, while consumers will continue to pay the previous rates (Daily Trust, 2024; Shuaibu, 2024).

Fig 1: Breakdown of Electricity subsidy payment between 2023 and 2024



Source: Daily Trust (2024)

Fig 1 shows the breakdown of electricity supply subsidy between 2023 and 2024 among the different power holdings across the country. It can be seen that Abuja electricity distribution company (AEDC) has the highest percentage of the subsidy while Yola electricity distribution company (YEDC) has the lowest percentage of the subsidy breakdown. It is important to highlight that in the second quarter of 2023, the government assumed a subsidy obligation amounting to \$135.23 billion, representing an increase of \$99.21 billion (+275%) from the N36.02 billion recorded in the first quarter of 2023. This surge is largely due to the absence of cost-reflective tariffs across all Distribution Companies (Discos). The rise in subsidy obligations is primarily linked to the government's initiative to align exchange rates. During the second quarter of 2023, the average monthly subsidy commitment by the government was N45.08 billion. The Market Operator (MO) is authorized to collect the entirety of its revenue requirements from the Discos, while the Market Revenue Operator (MRO) is limited to dealings with the Nigerian Bulk Electricity Trading (NBET) to streamline subsidy administration. Consumers of electricity are expressing significant dissatisfaction and frustration due to the private power sector's failure to meet their electricity demands nationwide. Additionally, there is widespread discontent regarding the privatization process. Various electricity-using groups are voicing their concerns about the poor quality of power supply, asserting that privatization has not positively impacted the industry (Nnodim, 2023).

The Nigerian government has faced ongoing challenges in delivering electricity subsidies to the Nigeria Electricity Supply Industry. There are growing concerns about the sustainability of these subsidies, which serve to reconcile the difference between the Allowable Tariff and the Cost Reflective Tariff, and have become a significant financial strain on the government. The rationale for the power subsidy is based on three primary factors: welfare, economic stability, and political stability. The subsidy aims to enhance social welfare, ensure a consistent and affordable energy supply to foster economic development, and mitigate the risk of potential social unrest. However, this longstanding approach has come under scrutiny due to its impact on government finances. Recent data indicates that higher-income regions benefit disproportionately from these subsidies compared to lower-income areas, which is concerning. This situation contradicts the initial objective of providing greater support to low-income households. Notably, only 20% of electricity consumers belong to the affluent class, suggesting that the wealthy are reaping more benefits from the subsidies than the intended low-income recipients (BusinessDay, 2023).

Numerous research studies have investigated the impact of gasoline subsidies on Nigeria's macroeconomic stability and overall economy. Notable contributions include works by Agboje (2022), Omotosho (2020), and Ozili & Obiora (2023), as well as Ovaga & Okechukwu (2022) and Adekunle & Oseni (2021). Some findings suggest that the removal of fuel subsidies could yield several advantages: it would allocate resources to other economic sectors, reduce Nigeria's dependence on imported fuel, enhance employment opportunities, decrease government borrowing, mitigate corruption associated with fuel subsidy payments, and alleviate pressure on the exchange rate. Conversely, the elimination of fuel subsidies may also have detrimental effects, such as potentially hindering short-term growth, increasing inflation and poverty levels, fostering fuel smuggling, escalating crime rates, and raising the costs of petroleum products, which could lead to job losses in the informal sector. Additional research indicates that the removal of fuel subsidies may heighten macroeconomic volatility and significantly influence the responsiveness of monetary policy to rising oil prices. Several studies, including those by Essien, Esu, & Amba (2016), Nwankwo & Njogo (2013), Awe & Ugbaka (2021), and Laissouf & Lahouel (2022), have also explored the connection between Nigeria's economic growth and electricity supply. This body of research suggests that a stable and reliable electricity supply could substantially and sustainably enhance Nigeria's national output. Furthermore, it has been established that there is a positive correlation between the quality of electricity supply and the country's GDP per capita, which has imposed considerable costs on the business sector. This study adds to the existing literature by analyzing the impact of electricity supply subsidies on economic growth and development in Nigeria, utilizing recent data and the Autoregressive Distributed Lag (ARDL) model from 1990 to 2022. The objective of the study is to examine electricity supply subsidy on Economic growth in Nigeria

2. Review of Literature

2.1 Theoretical Literature

The energy consumption hypothesis posits that the overall positive economic effects of production and service enterprises, along with their associated material acquisitions and procurement activities, can counterbalance the expenses related to energy generation and resource utilization. In the field of economics, theories of economic growth encompass a collection of concepts that elucidate how a nation allocates its resources and manages its economic variables to attain economic empowerment. These theories have evolved over time, shaped by the contributions of prominent economists such as Adam Smith, David Ricardo, and John Maynard Keynes, all of whom aimed to accelerate a country's economic development. Adam Smith initially introduced the classical theory in 1776, which was later expanded upon by David Ricardo and Robert Malthus. They argued that deliberate efforts to enhance GDP could lead to the overexploitation of resources, thereby hindering economic growth. This suggests that markets should be permitted to operate freely in response to changing circumstances to facilitate economic advancement.

The Solow-Swan Growth model presented the exogenous model, also referred to as neo-classical theory. This theory asserts that increases in labor or capital inputs may eventually yield diminishing returns, indicating that growth is observable only up to a certain threshold. It underscores the interconnections between labor, capital, and output, illustrating how these relationships can be leveraged to achieve sustained growth. Enhancing GDP and investing in technological progress are crucial for increasing the growth rate. The endogenous growth theory, developed by Paul Romer and Robert Lucas, explains how knowledge fosters growth and highlights the significance of human contributions. It posits that external factors, such as legislation and regulations, can also influence economic growth and the impact of private sector technological innovation.

2.2 Empirical Literatures

Hosan, Rahman, Karmaker, & Saha (2023) examined the impact of energy subsidies on the advancement of energy technologies in the 25 leading countries that provided such subsidies from 2010 to 2020. Their research revealed a significant co-integration between energy subsidies and innovations in energy technology, indicating that the reduction of energy subsidies encouraged the implementation of a poly-generation system utilizing renewable energy sources. Between 2004 and 2019, the research conducted by Briton, Yohou, & Ballo (2023) examined the effects of energy subsidies on human capital expenditure in both emerging and developing countries. The results derived from the GM approach indicate that energy subsidies have a significant negative impact on social spending related to human capital across all countries in the panel, regardless of their poverty levels or resource wealth. Using the least square dummy variable corrected (LSDVC) approach, Abdulwakil, Abdul-Rahim, Sulaiman, Alsaleh, & Bah (2022) investigated the effects of energy subsidies on the environmental quality of seventy low- and middle-income countries between 2010 and 2019. The study found that energy subsidies had a positive effect on environmental degradation; additionally, the estimated results suggest a significant negative relationship between energy subsidies and environmental degradation in low-income countries after breaking down the countries into income categories (low income, lower middle income, and upper middle income). Laissouf & Lahouel (2022) conducted a study utilizing panel data to analyze the effects of power subsidies on economic growth across 11 countries from 2010 to 2019. The findings indicate a significant negative relationship between economic growth and the factors associated with power subsidies.

The energy subsidy policies in Taiwan were assessed by Yau and Chen (2021) through the application of a structural macroeconomic model. Given that industries consume the majority of energy in this economy, their analysis suggests that directing subsidies towards corporations is the most effective approach. However, the overall welfare benefit derived from this strategy is quite limited. Mostafa (2021) examined the impact of energy subsidies on Egypt's economic growth during the period from 2013 to 2020. The research assessed the indirect consequences of reforming energy subsidies on economic development through the application of the Autoregressive Distributed Lag Model. The findings indicated that the reform of energy subsidies in Egypt has negative implications for economic growth in both the short and long term, affecting the economy in direct and indirect ways. Omotosho (2019) investigated the magnitude of Nigeria's fuel subsidy program and the macroeconomic repercussions of fluctuations in oil prices. The research employed the New-Keynesian DSGE model, which accounts for the transmission effects of global oil prices on domestic fuel retail prices. The findings indicate that oil price shocks exert a significant and enduring impact on economic output. Furthermore, the results derived from the model excluding fuel subsidies reveal that overall inflation decreases, the exchange rate experiences a more pronounced short-term depreciation, and the adverse effects of a negative oil price shock on aggregate GDP are mitigated. Azam et al. (2020) investigate the Granger causality relationship between electricity supply and economic growth in Pakistan for the period from 1990 to 2015. The research utilized a multivariate framework employing time series statistical methods. The findings indicate that the variables of economic growth (GDP), electricity supply (ELS), investment (INV), and exports (EX) are co-integrated. Furthermore, the analysis reveals a unidirectional Granger causality from economic growth to electricity supply, with no feedback effects observed.

Gelan (2018) conducted an analysis of the economic and environmental consequences associated with the reduction of electricity subsidies in Kuwait. The research involved the development of a Social Accounting Matrix (SAM) alongside an assessment of energy consumption and CO2 emissions, which was subsequently calibrated using a computable general equilibrium (CGE) model. The reduction in subsidies within the electricity sector was distributed among users based on their proportion of total electricity expenditure in the base year. The findings revealed that these transfers would mitigate negative economic impacts, resulting in a 0.5% decrease in CO2 emissions. Using a multivariate approach, Ucan, Aricioglu, & Yucel (2014) examined the connection between economic growth and the consumption of renewable and non-renewable energy for a panel of 15 European Union nations between 1990 and 2011. The study's findings demonstrate that a long-run equilibrium relationship between real GDP, energy consumption—both renewable and non-renewable—greenhouse gas emissions, and research and development is presented by the heterogeneous panel co-integration test. Additionally, the data demonstrates a unidirectional causal relationship between economic growth and non-renewable energy consumption. Khanh (2012) employed an input-output methodology to analyze the implications of rising power tariffs on the Vietnamese national economy, the Long Run Marginal Cost (LRMC) associated with consumer goods and services pricing, and the anticipated distribution of these effects across different quintiles of household income. The findings of the study suggest that the prices of all other goods would increase as a result of this tariff hike. Nevertheless, the effects on pricing and the distribution among household income quintiles are not deemed to be particularly substantial.

3. Methodology and Data

3.1 Theoretical Framework

The Solow-Swan model, recognized as the most basic and widely accepted variant of the neoclassical growth model, forms the basis of this analysis. This theory posits that variations in labor and capital, which are crucial components of the production process, are responsible for achieving short-term economic equilibrium. As an exogenous model of economic growth, it investigates how changes in savings rates, population growth, and technological progress influence an economy's output over time. Additionally, the Solow-Swan model serves as a framework for understanding long-term economic growth, focusing on capital accumulation, labor or population growth, and productivity improvements primarily driven by technological advancements. The production function takes the following form:

$$Y = aK^{b}L^{1-b} \text{ where } 0 < \text{b} > 1 \tag{1}$$

The production function is known as the Cobb-Douglas Production function.

3.2 The Model

The autoregressive distributed lag (ARDL) model, which is based on ordinary least squares (OLS), serves as a suitable framework for analyzing both non-stationary time series and those with mixed orders of integration. This model is particularly advantageous when dealing with variables that exhibit different integration orders, such as I(0), I(1), or a combination thereof, as it employs ARDL co-integration techniques. These techniques demonstrate robustness even in small sample sizes when there exists a singular long-run relationship among the variables (Nkoro & Uko, 2016). Furthermore, the ARDL model can be conveniently re-parameterized into an error correction (EC) form, which distinctly delineates short-run dynamics from long-run relationships. In this context, the long-term relationship represented in an EC model aligns with a co-integrating relationship when the variables are non-stationary, specifically those integrated of order 1 (Engle & Granger 1987; Hassler & Wolters 2006). Our ARDL package incorporates this bounds test as a post-estimation feature for the evaluation of single-equation ARDL and EC models.

Suppose we expect the existence of an equilibrium relationship between an outcome variable y_t and a set of K explanatory variables $x_t = (x_{1t}, x_{2t}, ..., x_{Kt})'$:

$$y_t = b_0 + b_1 t + x_t'\theta + \varepsilon_t \tag{2}$$

b_o is the intercept of the regression line, and b_1 is the slope coefficient of a linear time trend.

The data are observed at consecutive time points $t = 1,2...,T$. Even in cases where there is no underlying relationship between the variables, using ordinary least squares (OLS) to estimate the regression coefficients in a static model may produce spuriously large coefficient estimates. The goal of this kind of model augmentation is to create a dynamically complete model without serial correction in the regression error term: μ_t

$$y_t = c_0 + c_1 t + \sum_{i=1}^{p} \phi_i y_{t-i} + \sum_{i=0}^{q} \beta_i' x_{t-i} + \gamma' z_t + \mu_t \tag{3}$$

$t = 1 + p*,....,T$. Leaving aside the variables Z_t, this is a general ARDL *(p,q,..,q)* model with intercept c_0,linear trend $c_1 t$, and lag order $p \in [1, p*]$ and $q \in [0, p*]$. In order to guarantee an adequate number of degrees of freedom for accurately fitting the model's coefficients, we might have to select the maximum permissible lag order $p*$ cautiously.

3.3 Error Correction representation

To gain a better interpretability of the model's coefficients, we can reformulate the ARDL model in EC representation (Hassler & Wolters, 2006):

$$\Delta y_t = c_0 + c_1 t - \alpha(y_{t-1} - \theta x_{t-1}) + \sum_{i=1}^{p-1} \varphi_{yi} \Delta y_{t-1} + \omega' \Delta x_t + \sum_{i=1}^{q-1} \varphi_{xi}' \Delta x_{t-1} + \gamma' z_t + \mu_t \tag{4}$$

3.4 Model Specification

$$GDPgr = f(S - eletricity\%GDP, OilP, GCF\%GDP, FDI\%GDP) \quad (5)$$

Where GDPgr = Gross domestic product growth rate, S-electricity%GDP = Subsidy on electricity%GDP, OilP = Oil price, GCF%GDP = Gross capital formation % GDP, FDI%GDP = Foreign direct investment % GDP.

The data generating process for equation 5 is define in econometric form as:

$$GDPgr_t = \alpha_0 + \sum_{i=1}^{p}\alpha_{1i}\Delta GDPPC_{t-i} + \sum_{i=0}^{p}\alpha_{2i}\Delta S - electricity\%GDP_{t-i} + \sum_{i=0}^{p}\alpha_{3i}\Delta OILP_{t-i}$$
$$+\sum_{i=0}^{p}\alpha_{4i}\Delta GCF\%GDP_{t-i} + \sum_{i=0}^{p}\alpha_{5i}\Delta FDI\%GDP_{t-i} + \beta_1 GDPgr_{t-1} + \beta_2 S - electricity\%GDP_{t-1} + \quad (6)$$
$$\beta_3 OILP_{t-1} + \beta_4 GCF\%GDP_{t-1} + \beta_5 FDI\%GDP_{t-1} + \varepsilon_{t.}$$

3.5 Diagnostic/Estimation Techniques

Unit root test

To completely eliminate autocorrelation, Dicky and Fuller suggest adding additional lagged components of the dependent variable to their test approach. The equation that can be utilized to ascertain the potential form of the ADF is as follows:

$$\Delta y_t = a_0 + \lambda y_{t-1} + a_{2t} + \sum_{i=1}^{p}\beta_i \Delta y_{t-1} + \mu_t \quad (7)$$

If the variables are significant, the stationary test indicates that the variable series is stationary and has no unit root. The null hypothesis will be accepted as the outcome of the significant test.

ARDL Bound Test Approach

A strong statistical method for estimating level relationships in cases where the underlying property of the time series is fully I(0), totally (1), or jointly co-integrated is the autoregressive distributed lag model (ARDL) bound testing procedure. When it is uncertain whether the data producing process underlying a time series is trend or first difference stationary, bound testing, an extension of ARDL modeling, uses F and t-statistics to examine the significance of the lagged levels of the variables in a univariate equilibrium correction system. Here, the short- and long-term relationships between variables are investigated using the ARDL model

Stability Test

Pesaran & Pesaran (1997) assert that evaluating the stability of long run coefficients involves a substantial amount of short run dynamics. For this test, the CUSUM square test (CUSUMSQ) and cumulative sum of recursive residuals (CUSUM) were proposed by Broen et al. in 1975.

4. Results and Discussion of Findings

The findings presented in Table 1 indicate the outcomes of unit root tests conducted on the levels of oil price (OILP), gross capital formation as a percentage of GDP (GCF%GDP), and foreign direct investment as a percentage of GDP (FDI%GDP), all of which suggest the existence of a unit root. However, upon applying first differencing to the series, the null hypothesis of a unit root is robustly rejected, signifying that these series are integrated of order I(1). In contrast, the results for the growth rate of gross domestic product (GDPgr) and electricity subsidy as a percentage of GDP (ES%GDP) do not indicate the presence of a unit root, as the null hypothesis is rejected at the levels. Consequently, these series are integrated of order zero, I(0). This allows for the estimation of the ARDL model based on the unit root test results of I(0) and I(1).

Table 1 − Unit root test

Variables	ADF (5%)	Level diff	First diff	Order of Integration
GDPgr	-3.557759	-3.597445		I(0)
ES%GDP	-3.557759	-6.413136		I(0)
OILP	-3.557759	-2.561226	-7.065840	I(1)
GCF%GDP	-3.557759	2.165524	-3.788747	I(1)
FDI%GDP	-3.562882	-2.005431	-6.631621	I(1)

Source: E-views 10

The ARDL Co-integration Bound test

Should the computed F-statistic surpass the critical value of the upper bound I(1), it indicates the presence of co-integration, signifying a long-term relationship. Consequently, the null hypothesis must be rejected. Conversely, if the F-statistic falls below the critical value of the lower bound I(0), it suggests the absence of co-integration, leading to the acceptance of the null hypothesis.

Table 2 presents the bound test methodology for assessing long-term relationships. When the F statistic surpasses the upper threshold of the 5% Pesaran critical value, the estimated outcome allows for the rejection of the null hypothesis. In this instance, the F-statistic is recorded at 5.210252, while the 5% critical values established by Pesaran et al. (1999) indicate a lower bound of 2.56 and an upper bound of 3.49. Given that the F-statistic exceeds the upper bound, the null hypothesis (H0) is rejected, thereby supporting the alternative hypothesis (H1). Consequently, a long-term relationship is established among electricity subsidies, oil prices, gross capital formation as a percentage of GDP, foreign direct investment as a percentage of GDP, and the economic growth rate. With the presence of a long-run relationship among these variables, we proceed to estimate the long run using the error correction model (ECM).

Error Correction Model (Long Run Estimation)

The findings indicate that both the current and lagged values of electricity subsidies have a negative and statistically significant impact on the economic growth rate in Nigeria. This suggests that an increase in funding for electricity subsidies adversely affects the economy's growth rate. Additionally, other factors such as gross capital formation, both in its current and past values, also exert a negative influence on economic growth. Conversely, an increase in oil prices within the country is positively and statistically significant to economic growth, indicating a beneficial effect on the growth rate. The coefficient estimate for CointEq(-1), which represents the error correction model (ECM) term, is -0.688226, suggesting that approximately 68.82% of any deviations from equilibrium are corrected within one time period. Furthermore, the significance of this coefficient is underscored by a substantial t-statistic of -6.360509. This evidence points to a long-term relationship between electricity subsidies and economic growth in Nigeria. The Durbin-Watson statistic of 2.445826 confirms the absence of serial correlation or autocorrelation in the data.

Table 2 − Bound test for assessing long-term relationships

Levels Equation Case 2: Restricted Constant and No Trend				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
ES_GDP	0.895462	0.420438	2.129831	0.0481
OILP	0.047427	0.039985	1.186112	0.2519
FDI_GDP	-0.173046	1.262400	-0.137077	0.8926
GCF_GDP	0.533637	0.291150	1.832857	0.0844
C	-55.15471	27.03613	-2.040037	0.0572
F-Bounds Test		Null Hypothesis: No levels relationship		
Test Statistic	Value	Signif.	I(0)	I(1)
			Asymptotic: n=1000	
F-statistic	5.210252	10%	2.2	3.09
K	4	5%	2.56	3.49
		2.5%	2.88	3.87
		1%	3.29	4.37
Actual Sample Size	30		Finite Sample: n=30	
		10%	2.525	3.56
		5%	3.058	4.223
		1%	4.28	5.84

EC = GDPGR - (0.8955*ES_GDP + 0.0474*OILP -0.1730*FDI_GDP + 0.5336*GCF_GDP -55.1547)
Source: Estimation by the Researcher by Using E-views 10

Table 3 – Dependent variable: D (GDPGR)

ECM Regression

Case 2: Restricted Constant and No Trend

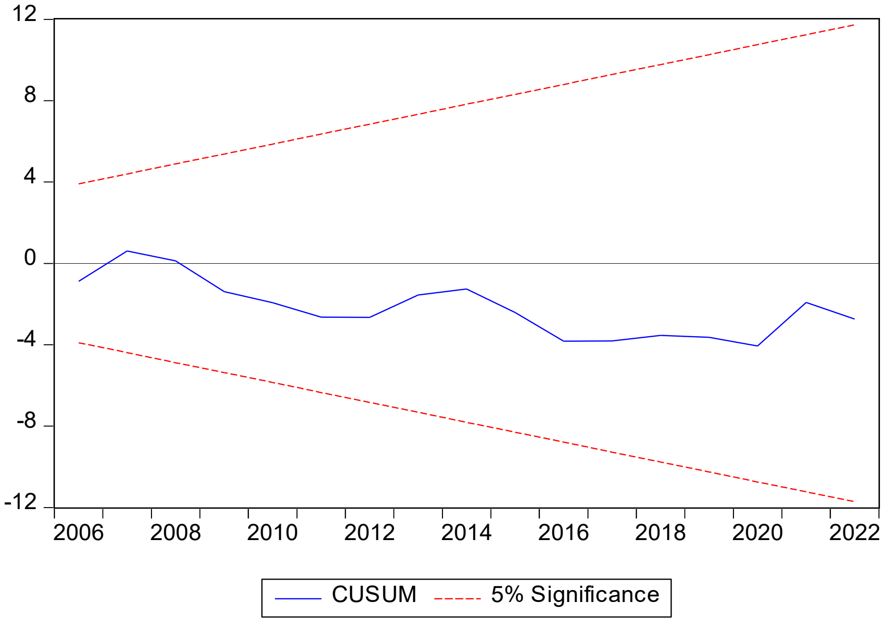
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(GDPGR(-1))	0.306768	0.154345	1.987547	0.0632
D(GDPGR(-2))	0.699817	0.137716	5.081596	0.0001
D(ES_GDP)	-0.487263	0.145293	-3.353662	0.0038
D(ES_GDP(-1))	-0.638958	0.162362	-3.935390	0.0011
D(OILP)	0.093067	0.021141	4.402231	0.0004
D(GCF_GDP)	-0.306785	0.151069	-2.030759	0.0582
D(GCF_GDP(-1))	-0.911648	0.193963	-4.700108	0.0002
CointEq(-1)*	-0.688226	0.108203	-6.360509	0.0000
R-squared	0.740769	Mean dependent var		-0.045984
Adjusted R-squared	0.658287	S.D. dependent var		3.507865
S.E. of regression	2.050566	Akaike info criterion		4.497287
Sum squared resid	92.50606	Schwarz criterion		4.870940
Log likelihood	-59.45931	Hannan-Quinn criter.		4.616822
Durbin-Watson stat	2.445827			

Source: E-views 10

Stability test

Figure 2 shows that the blue line lies between the 5% significant boundary so we can say the model is stable.

Figure 2 – Stability test



Discussion of Findings

The results of the study reveal a significant connection between Nigeria's economic growth and electricity subsidies. Specifically, there exists a long-term negative correlation between electricity subsidies in Nigeria and economic growth. Furthermore, economic growth is negatively correlated with elements such as gross capital formation, both historically and currently. In the context of Nigeria, the sole factor that demonstrates a positive correlation with long-term economic development is oil prices. This study aligns with various other investigations, including those conducted by Mostafa (2021), Omotosho (2019), Laissouf and Lahouel (2022), and Briton, Yohou, and Ballo (2023). However, the findings of this research diverge from those presented by Abdulwakil, Abdul-Rahim, Sulaiman, Alsaleh, and Bah (2022). Additionally, research conducted by Hosan, Rahman, Karmaker, and Saha (2023), Yau and Chen (2021), Ucan, Aricioglu, and Yucel (2014), and Khanh (2012) indicates that subsidies for gasoline, fuel, and electricity positively influence Nigeria's economic growth.

5. Conclusions and Policy Recommendations

This research utilized ARDL estimation alongside annual data to investigate the impact of power subsidies on economic growth in Nigeria. The analysis incorporated data spanning from 1990 to 2022, sourced from the World Bank Indicator (WDI, 2022). The findings revealed a significant correlation between Nigeria's economic growth during the examined period and the provision of power subsidies. It can be concluded that there exists a long-term relationship between economic growth in Nigeria and electricity subsidies. Consequently, an increase in the financial resources allocated to power subsidies within the country is likely to adversely affect economic growth. Despite substantial government expenditure on power subsidies, citizens and consumers continue to face considerable annual electricity costs. There remains uncertainty among consumers regarding whether these funds are effectively utilized to reduce electricity prices or if they are misappropriated. Furthermore, even with the high electricity tariffs imposed, consumers experience inconsistent access to electricity.

Based on the findings, the study recommends that:

i. The Nigerian federal government should investigate whether the Nigerian Electricity Regulatory Commission and the Electricity Distribution Companies are utilizing the funds allocated for electricity subsidies effectively.
ii. The federal government should exert pressure on private electricity distribution companies to assess whether the tariffs imposed on consumers are fair, particularly after accounting for the government's electricity subsidy.
iii. The federal government must guarantee that the funds allocated for electricity subsidies protect consumers from incurring exorbitant electricity tariffs, regardless of their income levels.
iv. To alleviate the burden on consumers, the federal government should ensure that the private electricity sector meets the energy needs of users across the nation.
v. Private sector and household should utilize the subsidy on electricity supply and other energy supply provided by the government to reduce poverty and increase the standard of living.

This study has made significant contributions to the broader discourse within existing literature by employing ARDL analysis to assess the effects of electricity supply subsidies on economic growth. It has provided valuable insights to the Nigerian government and relevant authorities regarding the effective utilization of funds designated for electricity subsidies. Looking ahead, there remain clear areas for enhancement in future research endeavors:

- Fuel subsidy and energy subsidy reform and economic development in Nigeria.
- Implications of electricity supply subsidy removal on the economic growth in Nigeria.

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