Volume: 12, Issue: 5 September 2024| Impact Factor (SJIF 2024):8.311 | Journal DOI: 10.36713/epra2712 ISSN: 2277 – 5692
International Journal of Southern Economic Light (JSEL)
- Peer Review Journal

THE RELATIONSHIP BETWEEN ELECTRICITY CONSUMPTION, TRADE, AND ECONOMIC GROWTH IN NIGERIA

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Article DOI: https://doi.org/10.36713/epra18560
DOI No: 10.36713/epra18560

ABSTRACT----------
The study examines the relationship between electricity consumption, trade, and economic growth in Nigeria. The results show that increased electricity consumption positively impacts economic growth in both the short and long run. Foreign direct investment (FDI) also has a positive and significant effect, indicating that higher FDI leads to long-term economic growth. Trade openness was found to contribute to environmental growth. The study recommends that policymakers strengthen the manufacturing sector to better harness the benefits of trade openness and reduce its negative impacts.----------

1.1 Background to The Study

Electricity is a critical sector that plays a pivotal role in the economic development of many countries by supporting a broad range of industries and services. It improves living standards, enhances productivity, and attracts investment and entrepreneurial activities. Industries rely heavily on electricity to produce goods and services, which are either consumed locally or exported through international trade. Trade openness allows countries to exchange goods and services, promoting economic growth by encouraging domestic production and facilitating the importation of advanced technologies from developed nations.

The relationship between electricity consumption, economic production, and international trade is intertwined, making it vital to study their impact on an economy. Electricity is not only a factor of production but also a catalyst for capital formation and labor productivity. However, access to electricity remains a challenge, particularly in developing countries. According to the World Bank (2017), over one billion people lacked access to electricity in 2014, with around 40% of Nigerians being affected.

Despite various policies, the industrial sector in Nigeria faces slow growth due to inadequate electricity supply. A survey by the Manufacturing Association of Nigeria (MAN) in 2006 showed that only 10% of manufacturers could operate at 48.8% of installed capacity, while 30% had to shut down entirely due to insufficient electricity. This poor electricity infrastructure not only increases operational costs but also diminishes the competitiveness of Nigerian exports.

As electricity demand grows, improved transportation channels (air, road, rail, and pipelines) and increased trade activities play a crucial role in shaping electricity consumption patterns. International trade helps distribute technology, services, and sustainable production strategies, which can support economic diversification and sustainable development. To achieve these goals, comprehensive electricity sector development is needed, focusing on building human and productive capacity, generating employment, and providing essential services such as energy, water, education, and transportation, thereby contributing to overall economic growth and poverty reduction.

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1.2 Statement of The Problem

Over the years, successive Nigerian governments have tried to address electricity issues by maintaining a monopoly and investing billions annually since 1999, but with minimal improvements. Many industries have relocated due to unreliable power and high fuel costs, leading to a decline in foreign direct investment. The increased electricity consumption reflects consumer frustration over frequent power outages that disrupt daily life and business activities. Despite this, the government has not adequately invested in upgrading equipment or hiring skilled personnel. This has forced producers to rely on costly fuel alternatives, raising production costs and hindering economic growth. In the coming years, electricity demand is expected to grow rapidly due to rising business activities and population growth, projected at 2.7% per year, far exceeding the global average of 1.1%. However, if Nigeria can invest heavily on sustainable source of electricity, this will increase the inflow and out flow foreign trade to Nigeria economy.

This study seeks to answer several key research questions, including: What are the trends in electricity consumption, trade, and economic growth in Nigeria? How does electricity consumption influence economic growth in the country? And what role does trade play in Nigeria's economic development?

The main objective of this research is to explore the relationship between electricity consumption, trade, and economic growth in Nigeria. To achieve this, the study aims to: (1) examine the patterns in electricity consumption, trade, and economic growth, (2) evaluate the effect of electricity consumption on economic growth, and (3) analyze the contributions of trade to Nigeria's overall economic performance.

The rest of the paper is organized as follows. In Section 2, we review the literature. In Section 3, we explain the empirical approach and describe the data. In Section 4, we present and discuss the results. Section 5 concludes the paper.

2.0 LITERATURE REVIEW

2.1 CONCEPTUAL REVIEW

2.1.1 An Overview on the Electricity Sector in Nigeria

Nigeria has struggled to provide sufficient electricity for its growing population. Since gaining independence in 1960, the sector has underperformed, leaving approximately 80 million Nigerians without electricity, despite multiple reform efforts (Okafor, 2018). In 2009, only about 47% of the population had access to power (UNDP, 2009). Electricity generation in Nigeria began in 1896, and the Nigerian Electricity Supply Company (NESCO), established in 1929, was the first utility company. After 22 years, NESCO was replaced by the Electric Corporation of Nigeria (ECN) in 1951, which took over its assets and responsibilities. In 1962, the Nigeria Dams Authority (NDA) joined forces with the ECN to promote hydropower development. The two organizations merged in 1972 to form the National Electric Power Authority (NEPA). However, due to inefficiency and inadequate funding, NEPA was later privatized and rebranded as the Power Holding Company of Nigeria (PHCN).

Following sector reforms in 2005, the Nigerian Electricity Regulatory Commission (NERC) was established as the primary regulator, and 60% of the shares in 11 newly created distribution companies were sold to private investors, while the government retained control of electricity transmission. Another reform occurred in 2013, but electricity generation and distribution remained stagnant, with Nigeria producing only about 3,500 MW insufficient for the needs of its 180 million citizens. On December 18, 2017, the country reached a peak power generation of 5,222 MW, the highest in its history, though this achievement has not been consistently maintained.

2.1.2 Trade and Economic Growth in Nigeria

International trade is crucial because no country can produce all the goods and services needed for domestic consumption due to resource limitations and constraints. Thus, countries rely on exporting goods and services to generate revenue needed to finance the import of items that cannot be produced locally.

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Despite its abundant resources, including 37 types of solid minerals, a population of over 160 million, and one of the world's largest oil and gas reserves, Nigeria's economic performance has been underwhelming compared to its peers. Emerging economies like Thailand, Malaysia, China, India, and Indonesia, which were once on par or lagging behind Nigeria in terms of GDP per capita in the 1970s, have since transformed their economies to become major global players. For instance, in 1970, Nigeria's GDP per capita was $233.35 (ranked 88th globally), while China was ranked 114th with a GDP per capita of $111.82 (Sanusi, 2010). Today, China has risen to become the world's second-largest economy, largely due to its strategic trade policies.

2.3 Empirical Review

Marques et al. (2016) used the ARDL bounds test to examine the relationship between the electricity generation mix and economic growth in France, confirming a long-run relationship among the variables. The study found that nuclear energy positively impacts economic growth while producing fewer CO2 emissions.

In a separate study on Greece, Marques et al. (2016) analyzed the link between electricity consumption and industrial production using monthly data from 2004 to 2014. The results indicated that electricity generated from fossil fuels significantly contributes to industrialization and economic growth.

Kouakou (2014) investigated the relationship between per capita electricity consumption and per capita GDP in Cote d'Ivoire for the period 1971-2008, finding a bi-directional causality between the two variables. Similarly, Ouadraogo (2014) studied fifteen ECOWAS countries from 1980-2008 using a panel cointegration technique and found a long-term co-integrating relationship between GDP and energy consumption, as well as between GDP and electricity, with a unidirectional causality running from GDP to energy consumption.

Akpan & Akpan (2018) applied a Multivariate Vector Error Correction Model (VECM) and found a long-run relationship among variables in Nigeria, but did not validate the Environmental Kuznets Curve (EKC) hypothesis. Instead, they discovered a negative relationship between electricity consumption and emissions, which could be due to the imbalance between electricity supply and demand in Nigeria. Similarly, Ben Nasr et al. (2018) found no evidence supporting the EKC hypothesis for South Africa.

Bakirtas & Akpolat (2018) explored the causal relationship between economic growth, urbanization, and energy consumption in six emerging-market countries from 1971 to 2014 using an Error Correction Model (ECM) in Nigeria. The analysis showed unidirectional causality from economic growth to energy consumption, and from urbanization to both economic growth and energy consumption. Kumari & Sharma (2018) examined the causal link between GDP and electricity consumption from 1981 to 2013, revealing that electricity consumption not only drives economic growth but also plays a critical role in attracting FDI inflows.

3.0 METHODOLOGY

This chapter outlines the methodology used to analyze the relationship between electricity consumption, trade, and economic growth in Nigeria. It includes the theoretical framework, model specification, a priori expectations, estimation techniques, and data sources.

3.1 Theoretical Framework

The Energy Ladder concept suggests that households and firms move from using lower-quality fuels to higher-quality ones as their income increases (Reddy, 1994). This model operates at both micro and macro levels. At low-income levels, industries and households use cheap but inefficient fuels. As income and development increase, reliance shifts to cleaner, modern fuels (Hosier & Dowd). Energy is essential for survival and welfare, serving as both a consumption good and an input for production. Renewable sources like solar and wind are free, while non-renewable sources like oil and coal have costs. Fuel choice depends on availability, price, appliance compatibility, and efficiency, with income being the main determinant of fuel use in households.

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3.2 Model Specification

The model specification should study the model of energy ladder model in the modification and the study took its roots from energy ladder model. Also, this study will employ auto regressive distributed lag model. Therefore, the model for this study is specified below:

$$GDP = f(TRD,,FDI,ELC)$$
$$GDP = \beta_0 + \beta_1 FDI + \beta_2 ELC + \beta_3 TRD + \mu_t$$

$$\Delta GDP_t = \beta_0 + \beta_1 FDI_{t-1} + \beta_2 ELC_{t-1} + \beta_3 TRD_{t-1} + \sum_{i=1}^{n} \beta_{4i} \Delta FDI_{t-1} + \sum_{i=0}^{N} \beta_{5i} \Delta ELC_{t-1} + \sum_{i=0}^{N} \beta_{6i} TRD + u_t$$

Where:

ELC = Electricity consumption
TRD = Trade.
FDI = Foreign Direct Investment.
GDP = Gross Domestic Product.

3.5 Sources of Data

The data used in this study was primarily obtained from the Central Bank of Nigeria (CBN) Statistical Bulletin (2019) and the World Bank database. Secondary data collection methods were utilized, relying on published statistical data. This approach was selected because it was deemed the most suitable for acquiring the necessary information for this research.

4.0 RESULT AND DISCUSSION OF FINDINGS

This section presents the detailed results of the analyses conducted towards achieving the objectives of the study. The chapter presented the descriptive statistics, unit root test, Johansen co-integration test result and long-run and short-run regression result with other post estimate test results.

4.1 Unit Root

Table 4.1: Augmented Dickey Fuller unit root test result

Variables	Level		First difference		I(d)
	Intercept and trend	Prob.	Intercept and trend	Prob.	
LNELC	-1.949960	0.6095	-6.928660	0.0000***	I(1)
LNFDI	-3.242786	0.0916	-10.11383	0.0000***	I(1)
LNGDP	-1.824850	0.6717	-4.471586	0.0306**	I(1)
LNTRADE	-2.885650	0.1780	-7.342604	0.0000***	I(1)

Source: Author's computation 2021
Note * (**) (***) denotes null hypothesis at 10%, 5% and 1% respectively

Table 4.1 presents the results of the Augmented Dickey-Fuller unit root test for Foreign Direct Investment, Electricity, Trade, and Gross Domestic Product. The test is evaluated at a 5% significance level (0.05). If the probability value is greater than 0.05, the null hypothesis that the variables have a unit root is accepted, indicating non-stationarity. Conversely, if the probability value is less than 0.05, the alternative hypothesis is accepted, meaning the variables are stationary. The table shows that all variables are stationary at the first difference since their probability values are below 0.05. In other words, the variables initially had a unit root but became stationary after first differencing. Given this, we proceed to determine whether the variables have a long-term relationship using the ARDL Bound test.

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4.2 Long-Run Estimates

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNFDI	0.676516	0.291284	2.322533	0.0269
LNELC	0.840489	1.111695	0.756043	0.4553
LNTRADE	0.288996	0.350758	0.823918	0.4163
C	13.404770	9.338712	1.435398	0.1612

Source: Authors' computation 2021

*** (**) (***) denotes significances at 10%, 5% and 1%**

Table 4.2 clearly shows that foreign direct investment has a positive and significant impact on Nigeria's economic growth. A long-term increase in foreign direct investment results in a 0.676516 rise in economic growth. Similarly, electricity consumption also has a positive and significant effect on long-term economic growth, as it is essential for most productive activities in the country. Higher electricity consumption leads to greater productivity, thereby boosting economic growth. Additionally, trade has a positive influence on economic growth, with an increase in trade contributing to a 0.019748 rise in economic growth.

4.3 Short-Run Estimates and Error Correction Model

Table 4.3: Estimated short-run parameter

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNFDI)	0.023882	0.014035	1.701659	0.0988
D(LNELC)	0.057433	0.059602	0.963605	0.3427
D(LNTRADE)	0.019748	0.022409	0.881253	0.3850
CointEq(-1)	-0.768332	0.036762	-1.858766	0.0226

Source: Authors' computation 2021

*** (**) (***) denotes significance at 10%, 5% and 1%**

The short-run estimates indicate a positive impact of FDI on economic growth, with a 0.02382 increase in economic growth for every rise in FDI. In the long run, electricity consumption also shows a positive relationship with economic growth. The error correction term has the expected sign and is statistically significant at a 95% confidence level, indicating that the model converges properly and the parameters are reliable. The Equilibrium Correction Model (ECM) reveals that approximately 77% of any disequilibrium in economic growth caused by temporary shocks in the Nigerian economy is adjusted within a year.

4.4 Discussions of Findings

The study utilized secondary data sourced from the Central Bank Statistical Bulletin (2020) and employed E-Views 9 for econometric analysis. It included descriptive statistics, regression analysis, and several post-estimation tests to evaluate the variables. The descriptive statistics confirmed that the data was well-behaved, with no irregularities or abnormal distributions. To ensure a suitable estimation technique and avoid spurious regression, an Augmented Dickey-Fuller (ADF) unit root test was conducted, showing that all variables were stationary at the same order, I(1). Consequently, the ARDL Bound test was used to assess long-term relationships, which confirmed the presence of a long-run association.

Both the long-run and short-run estimates indicated that foreign direct investment, electricity consumption, and trade positively impact economic growth. The Error Correction Model (ECM) revealed that about 78% of short-term imbalances are corrected each period, indicating a steady adjustment process that achieves stability within a year. Further diagnostic tests showed that the model is free from issues like autocorrelation and heteroskedasticity, making it reliable for forecasting. This implies that the residuals follow a normal distribution, there is no serial correlation, and the variance of the error term is constant, affirming the model's stability and robustness.

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5..0 SUMMARY, CONCLUSION AND RECOMMENDATION

5.1 Summary of the Findings

The study investigates the impact of electricity consumption on economic growth using secondary data from the World Bank Database and the Central Bank Statistical Bulletin. The research employs the Autoregressive Distributed Lag (ARDL) model to analyze both long-run and short-run dynamics, complemented by various pre- and post-estimation tests.

Before applying the ARDL model, the study conducted several preliminary analyses, including descriptive statistics and unit root testing using the Augmented Dickey-Fuller (ADF) test to assess the stationarity of the data. The results revealed that all variables were stationary at first difference I(1). An ARDL Bound test was also carried out to evaluate the presence of a long-term relationship among the variables, which confirmed a significant long-run relationship.

The findings indicate that electricity consumption has a statistically significant effect on economic growth. Moreover, post-estimation diagnostic tests suggest that the model is robust, with no issues of serial autocorrelation or heteroskedasticity, and that the residuals are normally distributed. This confirms the model's reliability and stability, indicating that it provides a good fit for explaining the relationship between electricity consumption and economic growth.

5.2 Conclusion

The findings indicate that electricity consumption positively impacts economic growth in both the short and long term. This suggests that an increase in electricity usage in Nigeria contributes to higher levels of economic growth. Additionally, foreign direct investment (FDI) was found to have a positive and significant effect on economic development, implying that an increase in FDI will boost long-term economic growth. Moreover, the study revealed that trade openness in Nigeria contributes to environmental growth.

5.3

5.4 Recommendation

Based on the empirical findings, the study recommends the following.

1. The study recommends that policymakers strengthen anti-dumping regulations to protect the manufacturing sector from foreign competition, boosting demand for locally produced goods and supporting the growth of smaller firms.
2. Additionally, the government should reform the power sector and explore alternative energy sources to ease reliance on non-renewable energy and ensure long-term energy security.
3. Lastly, enabling private sector participation in power generation and distribution, similar to the oil industry, will increase efficiency and benefit industrial entrepreneurs.

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