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Impact of Electricity Consumption on Economic Growth in Nigeria

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ABSTRACT: The study examined the impact of electricity consumption on economic growth in Nigeria during the period 1993-2022 based on ex-post factor design, sourcing data from central bank of Nigeria statistical bulletin, Nigeria Energy Information, and International Energy Agency databases. Augmented Dickey-Fuller (ADF) method for unit root test and Johansen cointegrating method was employed, and the variables were found to be stationary and cointegrating. The study employed the Vector autoregression (VAR) model for estimation. The findings revealed commercial electricity consumption (CEC) has short run positive impact and long run positive and significant impact on economic growth, and industrial electricity consumption (IEC), has a long run significant positive impact on economic growth, while, residential electricity consumption (REC) and Special Tariff Electricity Consumption (STEC) has positive but insignificant impact on economic growth in Nigeria. Therefore, the study found that electricity consumption largely has positive impact on economic growth in Nigeria for the period investigated indicating Nigeria to be a strong electricity dependent nation. As a result, the study recommends that the Federal government should sustain and improve rural electrification and house to house free metering strategy to eradicate electricity loss through bypass connection, and since by implication of the findings of the study; the higher the electricity consumed for productive economic activities the higher and more significant the economic growth so as to create more avenue for productive electricity consumption there is need to pursue an improved industrialization promotion policy by ensuring availability of zero interest rate credit and provision of enabling environment. In addition, the activities of the electricity sector should be fully privatized to foreign multinational companies.

Keywords: Residential Electricity Consumption, Commercial Electricity Consumption, Industrial Electricity Consumption, Special Tariff Electricity consumption, Economic Growth

I INTRODUCTION

Electricity as a form of energy is considered a dominant factor to economic growth in most developing countries, and with no exception to Nigeria. Electricity reflects one of the main inputs of the production process and has a significant impact on the economic activities of every society [20]. [12] opined that not only can electricity consumption improve the quality of living and reduce poverty; it is instrumental to industrialization and technological advances. It is central to many parts of life in modern societies whether developed or developing, considering its role in transport and heating, making possible electric vehicles and heat pumps. There are evidences that show the correlation between electricity consumption and economic growth, which is the reason why government spends heavily on the power sector from time to time for electricity generation.

Developed economy like China is the highest producer and consumer of electricity in the world followed by the United State of America (USA), while in Africa, Egypt has the highest access to and consumer of electricity followed by Morocco, Tunisia and Algeria. According to Electricity Regulatory Index (ERI) report (2020), Uganda also has a well-developed electricity framework. Electricity access plays a significant role in the status of a Country's manufacturing sector and in the general transformation of economic activities of the Country. The Small and medium enterprises (SMEs) which are the engine room to business activities suffer most. According to [21] Inclusive diversified growth in the country depends on growth of the

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SME sector and SMEs are arguably the segment of the Nigerian economy so disadvantaged by a lack of access to reliable power.

Electricity shortages constitute one of the main challenges facing Nigeria as a nation. The situation of inability of the electricity supply to meet the consumers demand in the residential, commercial and industrial sectors of the nation's economy, negatively affects the economic performance of the country. The World Bank asserted that the quality of the electricity services is the largest barrier to business in Nigeria [29]. Nigeria as of 2020 has 54% electricity access, which is below 1,000MW to one million people, according to international standards and especially for a large population as we have in Nigeria where at least about 200,000MW is expected to be produced to give about 200 million people better access to electricity. Unfortunately Nigeria has not been able to surpass 5,800MW of electricity generation over time in spite of government efforts. This affect access to electricity, coupled with the fact that Nigeria exports electricity to other African countries like Niger, Benin, Togo, and Burkina Faso; which further limits what is available for local consumption. Electricity access serves a significant constraint to the country's manufacturing [30]

The historical trend of electricity consumed in Nigeria shows that the average percentage rate of electricity consumed from the period 2000-2007 is 100%, from 2008-2014 is 99% and from 2015-2022 is 100%.; but yet there exist an alarming complains of insufficiency of electricity from various sectors. This demonstrates that the major cause of electricity crises in Nigeria is insufficient generation and supply since it is revealed from the trend that what is supplied for consumption is used up to maximum capacity. In bid to link electricity consumption to economic growth, the trend of GDP growth rate which is a proxy for economic growth from World Bank indicators 20223; indicates that GDP grew at an average rate of 7.7% from the period 2000 -2007, and 6.4% between 2008 and 2014, while the GDP growth rate between 2015 and 2022 is 1.4%. It can be observed that even when what the country was able to generate and supplied was 100% used up between 2015 and 2022, the average growth rate of GDP fell to 1.6% which is due to the fact that during this period many companies and industries moved out of Nigeria and relocated to other African countries as a result of poor availability of power, and this period is also charaterised with many incidences of grid collapse. According to [7], the manufacturing sector contributed 9.4 percent of GDP on average between 2011 and 2019.

It is imperative to increase electricity consumption in Nigeria by raising its supply to encourage old and new investors from within the Country, in order to stimulate economic activities. This is because the resulting effect of Poor accessibility to electricity and rising cost of production in the country on the Nigeria's economy is such that companies, small and medium scale businesses (SMEs) that could not afford an alternative source of power supply through use of generators or solar; closed down, while some other companies and factories relocated to other Africa countries such as Ghana, Kenyan, South Africa etc, for better access to power [31]) and [2]. This has contributed to high rate of unemployment that now prevails in all parts of the country and as well, slows down industrial growth. Most poor economies have less access to electricity and consume less while the richer economies have more access to electricity and consume more electricity which indicates the significance of electricity consumption to economic growth.

Despite the policy effort of government and the massive investment expenditure on the power sector there is still a sharp difference between electricity demand and its supply overtime. According to [21] the current crisis in Nigeria's power sector is a result of deep structural distortions. The sector is constrained by legacy corruption, technical inefficiency, the adverse selection of politically connected investors, and financial illiquidity. Due to these factors, privatisation has not been as successful as expected in improving Nigeria's power sector. The country witnessed a significant gap in electricity generated and electricity billed which indicates there is electricity loss in transmission and theft from unauthorized connections. This loss in transmission has however been reduced since power holding company took over from NEPA

It is no exaggeration that this is a major challenge faced in the country over the years, and the inability of the government to actually solve power sector problem has called for concern. Some economist alleged that the underlying problem of the power sector is the plaque of corruption that needs a strong political will to curtail. The government recently signed the full privatization of electricity generation, transmission and distribution for purpose of decentralization, but the electricity company immediately announced 40% increase in the electricity tariff. The fear now is, the electricity made efficiently available at very high prices, may not be very attractive to investors because investors would always go to areas where they can minimise

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cost of production and make profit. Overtime, Government has spent heavily on the power sector according to budget records. Revenue has also been generated from sale of electricity to residential, commercial, industrial and special tariff electricity users and yet Nigerians are yet to experience better electricity service in the country. The numerous complains of insufficiency of electricity for consumption from various sectors of the Country, propelled the need for this study, to investigate the impact of electricity consumption on economic growth in Nigeria.

The broad objective of the study was to investigate the impact of electricity consumption on economic growth in Nigeria for the period 1993 – 2022. And the specific objectives include

(a) to determine the impact of residential electricity consumption on economic growth in Nigeria, (b) To analyse the impact of commercial electricity consumption on economic growth in Nigeria, (c) To examine the impact of industrial electricity consumption on economic growth in Nigeria, (4) To evaluate the impact of special tariff electricity consumption on economic growth in Nigeria.

II LITERATURE REVIEW

This chapter explained the concepts, theories adopted in the study which help to achieve the study aim and objectives. This covers the conceptual, the theoretical and the empirical review.

A. Conceptual Review

1. Electricity Consumption

Electricity consumption measures the production of power plants and combined heat and power plants less transmission, distribution, and transformation losses and own use by heat and power [11]).Coming from the point view of [4]), electricity consumption simply means total electricity used by the economic agents of an economy at a particular time. Electricity consumption according to [1] is the total amount of electrical energy consumed by each industry and household in an economy. Electricity consumption represents the amount of electricity that has been consumed over a certain period and measured in kilowatt-hour (KWh). While [9] also view electricity consumption as electricity consumed by the various sectors in an economy, measured in kWh. It can also be said that electricity consumption as the total quantity of electrical power put into desired use by households, firms, and government over time and for the purpose of generating some level of benefits. This electricity consumption is usually measured in kilowatt per hour whereall electricity users are grouped into different tariff band (A, B, C, D, & E) depending on the area, and the band determines the number of hours such user is entitled to electricity supply in a day. The higher the number of hours of electricity supply, the higher the tariff it attract.

2. Economic Growth

Economic growth is defined by different authors from different perceptions. Economic growth is defined from the viewpoint of increase in the productive capacity of a country, resulting in rise in output [27], [13] and which also align with [22]). The productive capacity here means economic resources in the form of factors of production required to produce economic goods and services. In economics, growth is modeled as a function of factors consisting of physical capital, human capital, labor force, and technology which are fundamental to generating the desire growth. Thus increase in physical capital stock, increase in human capital, increase in labour force and progress in technology would result in increased national output or product (GDP)

In the context of economic theory, economic growth generally refers to an increase in wealth over an extended period is the process by which a nation's wealth increases over time. This could mean more of short-term economic performance.. [14]) viewed economic growth as a quantitative sustained increase in a Country's per capita income or output accompanied by expansion in its labour force, consumption, capital and volume of trade. While [8] saw economic growth as an increase in the net national product in set period of time and further explained that economic growth is generally referred to as a quantitative change in economic variables, persisting over time. From the aforementioned, we can deduce that, for economic growth to be meaningful to any economy, it must be sustained from the short run to the long run as that would pave way for economic development. Most times, economic growth is mostly viewed as a quantitative concept including the work of Kuznet. In this case, the percentage changes in some measure of output with basic indicators as per capita income and gross domestic product (GDP) which could be real or nominal. Growth therefore could be seen as a process of transformation and uneven.

From the review above, it is observed that this study aligned with [14] who viewed economic growth as a quantitative sustained increase in a Country's per capita income or output accompanied by expansion in its labour force, consumption, capital and volume of trade. Therefore, this study

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would say economic growth is the additions generated by various economic inputs put into use in the process of production over time in an economy.

B. Theoretical Review

The theoretical review deals with the theories upon which the study derives it investigations on solving the problem at hand. The paper consideredNew Growth Theory and Solow Growth Theory.The new growth theory (NGT) which is an off shoot of endogenous theory was formulated by Romer, (1990). The theory postulates that economic growth is driven by change in technology, and this change in technology is endogenous rather than exogenous.NGT is relevant to this study because technological advancement positively affects electricity market, and electricity is a product of ideas and innovations.

The Solow Growth Theory is also relevant to this research work since the study is centered on economic growth and technological progress. Electricity consumption can be impacted or influenced by improvement in technology to be able to attain a certain level of desired economic growth in Nigeria.

C. EMPIRICAL REVIEW

[16] examined renewable electricity consumption and economic growth in South Africa and Zimbabwe for period 1990 to 2019. The Generalised Least Squares and Phillips-Perron unit root test and ARDL test revealed renewable electricity consumption was negative in both countries in the short run while the impact was negative in South Africa but positive on economic growth in Zimbabwe in the long run In the same vein, [15], Solomon & Festus (2020), [17], [18] and [3] in their various study to determine the impact of electricity consumption on economic growth covering different Countries, periods, and with the use of different techniques, found out that electricity consumption had positive impact on economic growth in both the long run and short run.

[17] who investigated the relationship between electricity consumption and economic growth in Nigeria from 1971-2012, using Johansen Co-integration, the Error Correction Mechanism (ECM) and Granger Causality method; discovered causality was found not to run from electricity consumption to GDP and also from GDP to electricity consumption during the year of study. Contrary to this, the study of [5] confirmed the presence of a causal relationship between electricity consumption on economic growth in Nigeria, for the period covering 1990-2011, including capital formation and labor stock to electricity consumption in a multivariate system. After carrying out ADF and Philip Perron unit roots test; Johansen test for co integration, vector error correction and Granger causality test; and discovered a unidirectional causality runs from electricity consumption to real gross domestic product and recommended that the diversification of electricity sources. Furthermore, [10] in exploring the influence of electricity consumption on economic growth in Ghana for period the 1984-2013 also Found a unidirectional causality running from electricity consumption to economic growth, although the work of [6] discovered a reverse in their findings as they explored using Cobb-Douglas growth model covering time series data from 1970 to 2014.in Ghana and found out that a unidirectional causality was running from GDP to electricity consumption, and recommended electricity conservation policy. Bennett (2014) examined the long-run and causal relationship between electricity consumption and economic growth for the period 1980 to 2010 in Swaziland, confirming the existence of a long-run relationship between RGDP and ELEC, and Causality running from economic growth to electricity consumption. While [25] in their study in Lesotho for the period 1972–2011 discovered a unidirectional causality running from economic growth to electricity consumption. But the work of [28] for 17 industries in Taiwan; for the period 1998–2014 and the study of [24] in Iran for the period 1975 to 2011,.both Confirmed a bi-directional causality between electricity consumption and economic growth.

III METHODOLOGY

Using an ex – post facto design, the study adopts the unrestricted Vector Autoregression (VAR) model, which is an econometric model even as similarly used in the study of [18] who examine electricity consumption and economic growth in Nigeria with modifications.This model can be applied when the variables are integrated of order one, implying that the variable must be stationary at first difference, and all the variables treated as endogenous.

$$Yt = C + \sum_{i=1}^{n} \varphi i\, Yt\text{-}1 + Et \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3.1)$$

.Where:
Yt = Vector of all variables (nx1)
C = intercept vector of VAR (C1…..C7)
φi= ith matrix Autoregressive Coefficients

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Et = Disturbance Term

Modifying equation (3.1) to incorporate the variables of this study as stated thus::
InRGDP = B0 + B1InRECt-1+B2InIECt-1+B3InCECt-1+B4InSTECt-1+Ut ……..(3.2)
Where:
RGDP = Real Gross Domestic Product
REC = Residential Electricity Consumption (KWH)
CEC = Commercial Electricity Consumption(KWH)
IEC = Industrial Electricity Consumption(KWH)
STEC = Special tariff Electricity Consumption(KWH)
GCF = Gross Capital Formation
LF = Labour Force
B0-B7 = Parameters
Ut = Error Term.
With the application of the matrix form $A = \beta' X + \mu$ the model is stated below with 5×5 vector variables matrices.

$$RGDP_t=\beta_{10}+\sum_{i=1}^{n}\beta_{11i}RGDP_{t-i}+\sum_{i=1}^{n}\beta_{12i}REC_{t-i}+\sum_{i=1}^{n}\beta_{13i}CEC_{t-i}+\sum_{i=1}^{n}\beta_{14i}IEC_{t-i}+\sum_{i=1}^{n}\beta_{15i}STEC_{ti}+U_{1t}\ldots\ldots(3.3)$$

$$REC_t=\beta_{20}+\sum_{i=1}^{n}\beta_{21i}RGDP_{t-i}+\sum_{i=1}^{n}\beta_{22i}REC_{t-i}+\sum_{i=1}^{n}\beta_{23i}CEC_{t-i}+\sum_{i=1}^{n}\beta_{24i}IEC_{t-i}+\sum_{i=1}^{n}\beta_{25i}STEC_{t-i}+U_{2t}\ldots.(3.4)$$

$$CEC_t=\beta_{30}+\sum_{i=1}^{n}\beta_{31i}+RGDP_{t-i}+\sum_{i=1}^{n}\beta_{32i}REC_{t-i}+\sum_{i=1}^{n}\beta_{33i}CEC_{t-i}+\sum_{i=1}^{n}\beta_{34i}IEC_{t-i}+\sum_{i=1}^{n}\beta_{35i}STEC_{t-i}+U_{3t}\ldots.(3.5)$$

$$IEC_t=\beta_{40}+\sum_{i=1}^{n}\beta_{41i}+RGDP_{t-i}+\sum_{i=1}^{n}\beta_{42i}REC_{t-i}+\sum_{i=1}^{n}\beta_{43i}CEC_{t-i}+\sum_{i=1}^{n}\beta_{44i}IEC_{t-i}+\sum_{i=1}^{n}\beta_{45i}STEC_{t-i}+U_{4t}\ldots(3.6)$$

$$STEC_t=\beta_{50}+\sum_{i=1}^{n}\beta_{51i}+RGDP_{t-i}+\sum_{i=1}^{n}\beta_{52i}REC_{t-i}+\sum_{i=1}^{n}\beta_{53i}CEC_{t-i}+\sum_{i=1}^{n}\beta_{54i}IEC_{t-i}+\sum_{i=1}^{n}\beta_{55i}STEC_tU_{5t}\ldots(3.7)$$

Sources and measurement of data

The study engaged the use of secondary data to investigate the impact of electricity consumption on economic growth in Nigeria from 1993 to 2022. The data was sourced from Central Bank of Nigeria Statistical Bulletin, Nigeria Energy Information and International Energy Agency. Moreover, the data on the components of electricity consumption variables are measured in kilowatt per hour (KWh) yearly.

I. Data Analysis

In analyzing the data, this study starts with trend analysis of the variable used for the period investigated. To determing the impact of electricity consumption on RGDP (a proxy) for economic growth, the study conducted Unit root test, using Augmented Dickey-Fuller (ADF) method in order to determine the stationarity of variables under study to avoid spurious outcome, and as well as certain the Cointegration properties of the time series used. Thereafter, Johnansen cointegration method was employed to find a possible correlation between time series processes in the long run. It is applied when te data has unit root. The cointegration properties require all variables to converge in the long run. The study also employed Granger causality test to determine whether one time series is useful in forecasting another. The data has to be stationary by having constant mean and also constant variance. This test is important in this study because it enable us to know the variable that precedes the other, which is useful for forecasting purpose. Furthermore, Vector Auto Regressive (VAR) technique was used to carry out the estimation of data andit is often accompanied by Impulse Response function and Variance Decomposition analysis.

IV DISCUSSION OF RESULTS

A. Trend Analysis Result

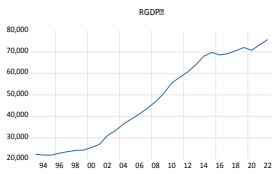

Fig. 1 Trend of Real Gross Domestic Product

From fig.1 the forecasting evaluation of the trend result revealed that the dependent variable, Real gross domestic product (RGDP) is uptrend which is a sign of economic strength and growth. But between 2016 and 2020, the trend swings a little down which was associated with the period the grid was experiencing serious challenge but trend up again in 2022.

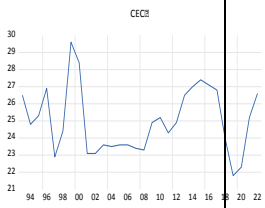

Fig. 3:Trend of Commercial Electricity Consumption.

The trend of commercial electricity consumption exhibited a downward and upward swing which shows that the trend was unstable throughout the period 1993-2022. The trend remained consistently unstable for the period.

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Fig. 2 Trend of Residential Electricity Consumption

The trend of residential electricityconsumption (REC) is unstable trend as it is seen swingingdownward between1993and 1999 andtrend upward in year 2000 and swings down again 2014. This trend is characterized by fluctuations due to unsteady and insufficient availability of electricity for consumption.

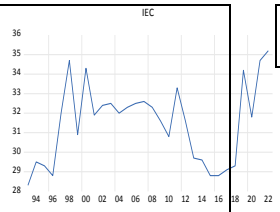

Fig. 4: Trend of Industrial Electricity Consumption

It can also be observed in fig. 4 that industrial electricity consumption is charaterised with unstable swings or trend. It trends upward and downward between period 1993 and 2022 which can be seen to display a consistent fluctuations and unstable trend for the period.

Fig. 5: Trend of Special Tariff Electricity Consumption

The trend of special tariff electricity consumption trended up and moved downward trend between 1998 and 2011 and trend up again from 2012. It is also characterized with fluctuation

B. Unit root Test Results

To attain Stationarity, we compare the ADF test statistics with the critical value at various levels of significance. If the value of the ADF test statistics in absolute term is greater than the critical value, or if the estimated p-value is less than (0.05), stationary is obtained but if otherwise, there is no stationary.

Table 1: Augmented Dickey-Fuller (ADF) Test for Unit Root

Variables	ADF Test Statistics	1% Critical value	5% Critical Value	10% Critical Value	Order of Integration	Probability Value
RGDP	-3.089368	-3.689194	-2.971853	-2.625121	I (1)	0.0390
REC	-4.660649	-4.323979	-3.580622	-3.225334	I (1)	0.0046
CEC	-3.878147	-3.724070	-2.986225	-2.632604	I (1)	0.0070
IEC	-8.207958	-3.689194	-2.971853	-2.625121	I (1)	0.0000
STEC	-5.982307	-4.323979	-3.580622	-3.225334	I (1)	0.0002

Note; MacKinnon (1996) one-sided p-values
Author's Computation 2023, using E-views version 12.0

The unit root test result on table 1: revealed that aside RGDP whose ADF t-statistics is greater than its critical value at 5% and 10% significant level, all the absolute values of ADF test statistics are respectively greater than their critical values at 1%, 5% and 10% level of significance for all the variables; and again all the p-values are also less than 0.05. This imply that all the variables are stationary at all levels of significance and integrated at first difference of order 1; that is, I (1) and thereby, leading to the rejection of the null hypothesis of unitroot.

Cointegration Test Results

Unrestricted Cointegration Rank Test (Trace) Results

C. Cointegration Test Results

Table 2: Johansen Cointegration Test Results;

(2a) Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.925272	231.0315	125.6154	0.0000
At most 1*	0.810057	158.4023	95.75366	0.0000
At most 2*	0.769556	111.8934	69.81889	0.0000
At most 3*	0.721423	70.79643	47.85613	0.0001
At most 4*	0.516921	35.011	29.79707	0.0115

Note: Trace test indicates 4 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the Null hypothesis at the 0.05 level

(2ii) Unrestricted Cointegration Rank Test (Maximum Eigenvalue

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Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.925272	72.62926	46.23142	0.0000
At most 1*	0.810057	46.50890	40.07757	0.0083
At most 2*	0.769556	41.09693	33.87687	0.0058
At most 3*	0.721423	35.78572	27.58434	0.0636
At most 4	0.516921	20.37209	21.13162	0.0636

Note: Max-eigenvalue test indicates 3 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the Null hypothesis at the 0.05 level
Source: Author's Computations 2023 using E-views 12.0

From the conitegratio result, the t-calculated of the Trace statistics and Max-eigenvalueare greater than their critical values at the 5% level of significance, The co-integrating of fourvector or equations from the trace statistics results and the cointegrating of three vectors from theMax-eigenvalueled to the rejection of Null hypothesisof no cointegration and conclude that RGDP, REC, CEC, IEC, and STEC, are confirmed to be cointegrating at 5% level of significance. Hence, there is a long run relationship between the variables for the period under study

D. Causality Test Results

The results of thePairwise Granger Causality test conducted to check the causality between real gross domestic product, residential, commercial, industrial, and special tariffs electricity consumption in Nigeria for the period under observation are shown in table 4.4 below

Table 3: Pairwise Granger Causality Tests Results

Null Hypothesis	**Lags**	**Obs**	**F-Statistic**	**Prob.**	**Decision**	**Remark**
REC does not Granger Cause RGDP	2	28	1.63627	0.2166	Reject Ho	Bi-directional
RGDP does not Granger Cause REC			1.55241	0.2331	Reject Ho	
CEC does not Granger Cause RGDP	2	28	0.54772	0.5856	Accept Ho	
RGDP does not Granger Cause CEC			0.72746	0.4939	Reject Ho	Unidirectional
IEC does not Granger Cause RGDP	2	28	9.30818	0.0011	Reject Ho	Unidirectional
RGDP does not Granger Cause IEC			0.21377	0.8091	Accept Ho	
STEC does not Granger Cause RGDP	2	28	2.49038	0.1050	Reject Ho	Bi-directional
RGDP does not Granger Cause STEC			3.77999	0.0381	Reject Ho	

Source: Author's Computation 2023, using E-views 12.0

The granger causality result, causality is seen to run from REC to RGDP, and also from RGDP to REC. since their F-values are greater than their respective P-values, we reject Ho and conclude that there is a direction of causality or relationship flow from Residential Electricity Consumption (REC) to Real Gross Domestic Product (RGDP), and also there is a feedback flow of relationship from RGDP to REC. Hence, there exist a bi-directional relationship between Residential Electricity Consumption (REC) and Real Gross Domestic Product (RGDP). In order words, changes in each of these two variables precede changes in the other. for the period of study.Similarly, the causality result also shows that causality is not found to flow from CEC to RGDP since its F-value is less than its P-value and thereby leading to the acceptance of the Null hypothesis (Ho), and conclude there is no causality from CEC to RGDP. But RGDP granger cause CEC because its F-value is greater than its P-value, therefore we reject Ho and conclude that there is causality from RGDP to CEC. This means that there exists a unidirectional relationship running from RGDP to CEC which implies that changes in RGDP precede changes in CEC. in Nigeria for the sampled period.

The causality result further revealed that granger causality runs from IEC to RGDP because the F-value is greater than its P-value; therefore we reject Ho and conclude that there is causality from IEC to RGDP. But RGDP does not granger cause IEC since its F-value is less than the P-value; so we accept Ho and conclude that there is no causality from RGDP to IEC. This also means there is a unidirectional relationship which flows from the direction of IEC to RGDP, denoting that changes in IEC precedes influence in RGDP. n Nigerian for the period under investigation. The causality test result also revealed that STEC granger cause RGDP, and also RGDP granger cause STEC because their F-values are greater than their respective P-values; and thereby leading to the rejection of the Null hypothesis (Ho) for the both and conclude that there is causality from STEC to RGDP, and from RGDP to STEC. This demonstrates the existence of bi-directional relationship between them because there is a direction of relationship flowing from STEC to RGDP, and with a feedback flow of relationship

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from RGDP to STEC. This means that changes in each of the variables precede changes in the other, suggesting that both the Special tariffs electricity Consumption and Real Gross Domestic Production exhibits a strong influence on each other for the sampled period in Nigeria.

E. Vector Autoregression Estimate

Table 4: Vector Autoregression Estimate

	LRGDD	LREC	LCEC	LIEC	LSTEC
LRGDP(-2)	-0.236677	-0.408006	1.354410	-0.484454	0.399301
	(0.16353)	(0.69470)	(0.41239)	(0.34708)	(1.97481)
	[-1.44726]	[-0.71873]	[3.28431]	[-1.39580]	[0.20220]
LREC(-2)	0.109065	-1. 210410	0.151219	0.187221	2.169822
	(0.21471)	(0.74533)	(0.54145)	(0.45570)	(2.59283)
	[0.50796]	[-1.62398]	[0.27929]	[0.41084]	[0.83685]
LCEC(-2)	0.336124	-0.955950	-0.559856	0.270053	3.845719
	(0.22002)	(0.76376)	(0.55483)	(0.46696)	(2.65693)
	[2.52769]	[-1.25164]	[-1.00906]	[0.57832]	[1.44743]
LIEC (-2)	0.656687	-0.340725	0.501364	-0.124203	-2.439887
	(0.21069)	(0.73137)	(0.53130)	(0.44716)	(2.54424)
	[3.11685]	[-0.46587]	[0.94366]	[-0.27776]	[-0.95898]
LSTEC(-2)	0.003511	-0.173209	-0.003497	0.020409	1.286712
	(0.03171)	(0.11007)	(0.07996)	(0.06730)	(0.38291)
	[0.11072]	[-1.57361]	[-0.04374]	[0.30326]	[3.36035]
C	-4.618720	-4.67649	11.23535	3.357229	33.48232
	(5.36185)	(18.6126)	(13.5211)	(11.3798)	(64.7487)
	[-0.86140]	[-0.25127]	[0.83095]	[0.29502]	[0.51711]

Cointegrating Eq:

LRGDP(-1)	LREC(-1)	LCEC(-1)	LIEC(-1)	LSTEC(1)
1.000000	0.039908	-0.916157	1.716832	0.144404
	(0.42663)	(0.41133)	(0.04557)	(0.35415)
	[0.11269]	[-2.14741]	[4.17384]	[3.16913]

Error Correction

(LRGDP)	D(LREC)	D(LCEC)	D(LIEC)	D(LSTEC)
CointEq1	-0.025693	-0.171123	0.735686	-0.376361	0.866580
	(0.06433)	(0.19320)	(0.16074)	(0.13076)	(0.84365)
	[-0.39940]	[-0.88574]	[4.57695]	[-2.87819]	[1.02718]
R-squared	= 0.999084	0.794578	0.809029	0.788150	0.959339
Adj R-squared	= 0.998097	0.573355	0.603367	0.560005	0.915551
F-statistic	= 1012.753	3.591742	3.933789	3.454592	21.90851

This extract from the VAR regression estimation table is a cointegrating equation and short run model stated thus;

$ECTt\text{-}1 = Yt\text{-}1 - \eta jXt\text{-}1 - \xi\, m\, Rt\text{-}1 - \mu t$

$ECT\text{-}0.025693_{t-1} = 1.000000DLRGDP_{t-1} - 0.171123DLREC_{t-1} + 0.735686DLCEC_{t-1} - 0.376361DLIEC_{t-1} - 0.866580DLSTEC_{t-1}$

From economic theory and following the signs of the cointegrating parameters, the coefficient (-0.171123) of log of Residential Electricity Consumption (REC) is negative,indicating a negative relationship with RGDP. This implies that a unit change in REC will result in 17.1% decrease in Real Gross Domestic Product ($RGDP_t$)at current period, while the coefficient (0.735686) of log of commercial electricity consumption(CEC) is positive and indicate a positive short run influence. Hence, a unit change in Commercial Electricity Consumption (CEC) will results in 73.6% increase in $RGDP_t$. The coefficient (-0.376361) of Industrial Electricity Consumption (IEC) also indicate a negative relationship which means that a unit change in Industrial Electricity Consumption (IEC) will lead to 37.6% decrease in RGDPt,. Also, the coefficient (-0.866580) of Special-tariff Electricity Consumption (STEC) indicate a negative influence, implying that a unit change in STEC will bring about 86.7% decrease in RGDPt.. The negative sign of the ECT_{t-1} coefficient-0.028085 shows that variables included in the model have the ability of returning to their long-run equilibrium values after experiencing short-run disequilibrium at a speed of adjustment of 2.6% although, the adjustment is slow.

But the long run model as observed from the VAR estimates in the table shows that log of Real gross domestic product (RGDP) in lag (-2) exhibited endogenous and a negative influence on itself as seen from coefficient of RGDP (-0.236677). This means that a unit change in lag (-2) of RGDP results in 23.6% decrease in RGDPt. and the explanatory variables were strongly exogenous.. Likewise, the long run impact of the components of electricity consumption on RGDP indicates that the coefficient (0.109065) of Residential Electricity Consumption (REC) in lag (-2), attached to RGDP is positive and indicate that there is a long run positive relationship between REC and RGDP in accordance with appriori expectation which implies that REC positively influences $RGDP_t$. Therefore, a unit change in the residential electricity consumption results in 10.9% increase in RGDPt on average in the long run. Moreover, RECwas endogenous. While the coefficient (0.336124) imply that Commercial electricity consumption *CEC) in lag (-2) indicate there is a strong positive relationship between CEC and RGDP in line with expectation with a great influence on RGDP.A unit change in commercial electricity consumption is associated with 33.6% increase in real gross domestic product RGDP and CEC was endogenous. Similarly, the coefficient (0.656687) demonstrate that Industrial electricity consumption (CEC) in lag (-2)strong influence on RGDP as a strong positive relationship exist between IEC and RGDP in line

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with appriori expectation. Which mean a unit change in IEC exert 65.6% increase in RGDPt on the average in the long runand was also endogenous. In the same vain, Special Tariff Electricity Consumption (STEC) positively influenced RGDP as the coefficient (0.003511) revealed that a positive relationship exist between STEC and RGDP, implying that a unit change in special tariff electricity consumption (STEC) is associated with 0.35% increase in real gross domestic product (RGDP) on the average in the long run. for the period investigated.

The value of the coefficient of determination (R-square = 0.999084) indicates that the variability in the explanatory variables (REC, CEC, IEC, and STEC,) accounts for 99.9% of variation in RGDP which means the regression is not spurious. Even the Adjusted R-square accounted for 99.% which also support the strength of the explanatory power of the independent variables. The value of F-statistics (1012.753) is very large enough to support the model, which means that the model is of good fit.

F. Impulse Response Function Analysis

Table 5: Impulse Response Function **of** RGDP

Period	LRGDP	LREC	LCEC	LIEC	LSTEC
1	0.019281	0.000000	0.000000	0.000000	0.000000
	(0.00258)	(0.00000)	(0.00000)	(0.00000)	(0.00000)
2	0.029267	0.008780	0.000228	0.001100	0.001114
	(0.00554)	(0.00479)	(0.00462)	(0.00552)	(0.00370)
3	0.029160	0.012940	0.019678	0.026034	0.007672
	(0.01077)	(0.01162)	(0.01595)	(0.01467)	(0.00929)
4	0.025058	0.017585	0.030635	0.032759	0.010692
	(0.01579)	(0.02138)	(0.02906)	(0.02594)	(0.01744)
5	0.017258	0.019917	0.030398	0.042322	0.011216
	(0.02165)	(0.03162)	(0.04064)	(0.03782)	(0.02633)
6	0.015010	0.018835	0.013858	0.031839	0.012678
	(0.02572)	(0.03941)	(0.04971)	(0.04647)	(0.03494)
7	0.016540	0.012064	-0.004772	0.017792	0.014426
	(0.02847)	(0.04527)	(0.05272)	(0.04970)	(0.03960)
8	0.017541	0.002494	-0.010635	0.009049	0.021775
	(0.02920)	(0.04392)	(0.04377)	(0.04068)	(0.03721)
9	0.011449	-0.000762	0.001559	0.014964	0.035728
	(0.02717)	(0.03439)	(0.05643)	(0.03998)	(0.03330)
10	-0.003296	0.006850	0.023281	0.032333	0.055170
	(0.02825)	(0.04679)	(0.08109)	(0.06003)	(0.04107)

Source: Author's Computation 2023, using E-views version 12.0

From the impulse response of real gross domestic product (RGDP) in Nigeria for the 10 years period forecast in table 5,it is revealed that economic growth (RGDP) would responds positively to own shock initially as seen in period 1 and 2 even when there was zero shock from the explanatory variables, and reverted to consistently negative response from period 3 and reverted to positive response in period 7 and 8, and then reverted back to negative from period 9 down.

It is also observed that economic growth (RGDP) responded negatively to shock from REC in period 9, and responded positively to shock from CEC in period 7 but negatively in period 8.

G. Variance Decomposition of RGDP

Table 6: Variance Decomposition of RGDP

Variance Decomposition of LRGDP:

Period S.E.	LRGDP	LREC	LCEC	LIEC	LSTEC
1	0.019281	100.0000	0.000000	0.000000	0.000000	0.000000
2	0.036451	92.44749	5.801630	0.003922	0.091134	0.093366
3	0.059177	59.35661	6.982482	11.05844	19.38927	1.715994
4	0.081380	40.86748	8.361172	20.01823	26.45611	2.633502
5	0.101568	29.12373	9.213016	21.80870	34.34705	2.910054
6	0.111629	25.91836	10.47408	19.59565	36.56965	3.699045
7	0.117266	25.47576	10.54961	17.92260	35.44037	4.865421
8	0.122944	25.21272	9.638837	17.05363	32.78420	7.563371
9	0.130578	23.11960	8.548147	15.13214	30.37621	14.19143
10	0.148157	18.00823	6.853774	14.22350	28.35798	24.89006

Source: Author's Computation using E-views 12.0

The variance decomposition (VD) of the real gross domestic product (RGDP) is spread into two periods analysis, which are the short run (1 – 5) and long run (6 – 10) periods. In the short run (period 1), a maximum of 100% of the forecasted error variance in RGDP is explained by the variable itself in the short run and declined continuously to

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18% in the long run. At the beginning of the short run period, all the explanatory variables explained 0% forecasted error variance in RGDP. While the forecasted error variance in RGDP explained by RECin the short run was 9% and later declined in the long runto 6%. The forcast error variance in RGDP explained by CEC in the short run increased to 21%, maximum, and declined to 14% in the long run. IEC explained a maximum of 34% forecasted error variance in RGDP in the short run, increased into the long run but later declined in the long run to 28%. While the percentage of forcast error variance explained by STEC increased continuously from the short run into the long run period to a maximum of 24%.

CUSUM Stability Test Result

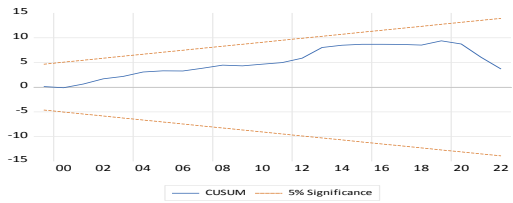

Figure 6: CUSUM
Source: Author's computation using E-view 12.0

The Cusum test result shows that the model meets the required stability at 5% significant level. This is revealed as seen above, as the blue colour line is within and inside the two red lines. Therefore, since the residuals are within the critical bounds at 5% level of significance in respect to the CUSUM test; it signifies that the model estimates are dynamically and structurally stable, consistent and reliable

Conclusion

The study, employing disaggregated electricity consumption approach in the modeling was aimed to determine the impact of electricity consumption on economic growth in Nigeria for the period 1993 to 2022 with the series data sourced from Central Bank of Nigeria, Nigeria Energy Information and International Energy Agency. The findings are significantly pointing to the need for direction of policies towards increasing electricity production and supply for consumption in Nigeria. It is confirmed that the Nigerian economy is electricity dependent for growth, and by implication of the fact that all components of electricity consumption impacted positively on economic growth; especially with a strong positive and significant impact from Commercial electricity consumption and Industrial electricity consumption. Therefore, there is need for the Federal Government to embark on electricity consumption promotion policy; by fully privatising the generation, transmission and distribution of the product to foreign companies while their profit can be taxed and their activities regulated by Nigeria Electricity Regulatory Commission (NERC), and through diversification into other systems of power generation like solar system so to augment hydro generated power that is insufficient. More also, the Government can engage in industrialization promotion policy, as this would help create more avenue for productive electricity consumption which will further stimulate economy diversification, employment creations, export promotion and invariably leading to economic growth and development in the Nigeria. This is because by implication of the findings of the study, the higher the electricity consumed for productive economic activities the higher and more significant the economic growth. Finally, for the purpose of further research work on impact of electricity consumption on economic growth in Nigeria the paper also suggest the need to incorporate Public offices electricity consumption (POEC) into electricity consumption model in order to create an avenue for recommendation for inclusion of payment for such consumption, at the budgetary level to Ministry of power as this would put a hut to disconnection of electricity in such places as this power distortion often stagnate work process in these offices.

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