ELECTRICITY GENERATION AND ECONOMIC GROWTH IN NIGERIA

Adeleke A. Oyende
Department of Economics, Crawford University, Igbesa, Ogun State

Abstract

This study examines the effect of electricity generation on economic growth in Nigeria. Access to affordable, reliable and quality electricity power is essential for the inclusive growth of national economy. The Nigeria power industry performance record and statistic are depressing. The power supply is characterized by low accessibility, epileptic and poor transmission system. The social economic activities have been impacted negatively by deficit power supply, in spite of energy potential available. The relevance of electricity in various spheres of the economy is a strong justification for the current study. Time series data is employed and the methodology is based on the Autoregressive distributed lag method of estimation. This shows the short run relationship between the variables at the 1% and 5%, while the causality test shows a little causal relationship; the long run bound test indicates a long relationship between the variables. More-so the cusum test shows the level of reliability in the model. The research work shows that no amount of investment by the government alone can solve the electricity crises. Over reliance of on-grid investment via gas with little investment in off-grid to create enabling competitive environment will not take Nigeria out of the crisis. More licensing needs to be given for off-grid investment as against just few megawatts. Also some policy such as connecting to the national grid with certain MW needs to be adjusted.

Key words: Autoregressive Distributed Lag, economic growth, electricity generation,

Introduction

The growth rate and economic globalization of every nation are increasing the energy demand regularly as this is a driver for most economic activities. Electricity has become a need, an essential part of daily activities, due to its correlation with critical sector of the economy such as; health, educational activities, industrial production, agricultural productivity, security system etc. [Abdul-Hamid, Oppong, and Gyimah, 2017]. The constant availability and accessibility of electricity supply for industrial, domestic, and agricultural unit is a strong indicator of infrastructural development of life with positive economic factors like; poverty reduction, encouraging standard of living, and a desired inclusive growth (Odekanle, Odejobi, Dahunsi and Akeredolu 2020).The most populous black nation (Nigeria), faces the triple challenge of providing reliable power supply, keeping energy affordable to consumers and

reducing greenhouse gas emissions. The shortage of reliable power supply is a constraint on the country's desired growth.

Electricity sector in under-developed Nigeria economy, classified with gas, steam and air conditioning supply recorded a 78.16% of real gross domestic product (GDP) in the second quarter of 2021. This significant is by far the highest decisive growth rate record by any sector in the review period.

According to Kingsley and Tonuchi, (2021) the non-oil sector of Nigeria economy was largely driven by growth recorded in trade, telecommunication, road transport, electricity, crop production, and food production. The sector grew by 56.58% compared to a reduction of 2.78% recorded in the corresponding period of 2020. However, comparing to the previous quarter, the sector recorded a growth of 264.23% to a real aggregate of N134.19 billion in the second quarter of 2021, as opposed to N36.84 billion recorded in the first quarter of 2021 (Kingsley and Tonuchi, (2021). In terms of each sector contribution to the total aggregate GDP, Electricity, steam, gas and air conditioning supply accounted for 0.8% of the total real GDP. A significant leap compared to 0.22% recorded in the preceding quarter. It is worth noting that the sector is not mainly about electrical supplies and includes others like steam, gas and air conditioning.

In nominal terms, the Electricity, stream, Gas, and air Conditioning Supply sector recorded a growth of 114.30% in the second quarter of 2021. This was 105.66% points higher than the 8.64% growth rate recorded in the corresponding quarter of 2020, and 83.60% points higher than the growth rate of 30.70% recorded in the preceding quarter.

The decisive increase in the sector's gross domestic product (GDP) value is largely attributed to the increase in electricity tariff in the country, in January 2021, the Nigerian Electricity Regulatory Commission (NERC) instructed the distributing companies (DisCos) to increase electricity tariffs. across the country, a situation where inflation rate and exchange rate of the economy were considered to determine the percentage increased.

Nigeria has the factor input advantage with economy and population. like many under developed African countries but the country is still faced with the difficulty of meeting its ever-increasing population's electricity demand (Bamisile, Huang and Chen, 2020). Government has introduced different policies and reforms to rescue the situation in the energy sector of the economy but all have been ineffective. The electricity sector has failed to

provide power to over 40% people in Nigeria since the last 10 years and more than 80 million of the citizens are not having access to electricity (Bamisile, Huang and Chen, 2020). After five years of privatizing the power sector, the electricity generation, transmission, and distribution remain inconsistence (Comfort, Ojamaliya, Okafor, Godwin and Oluwapelumi, 2018).

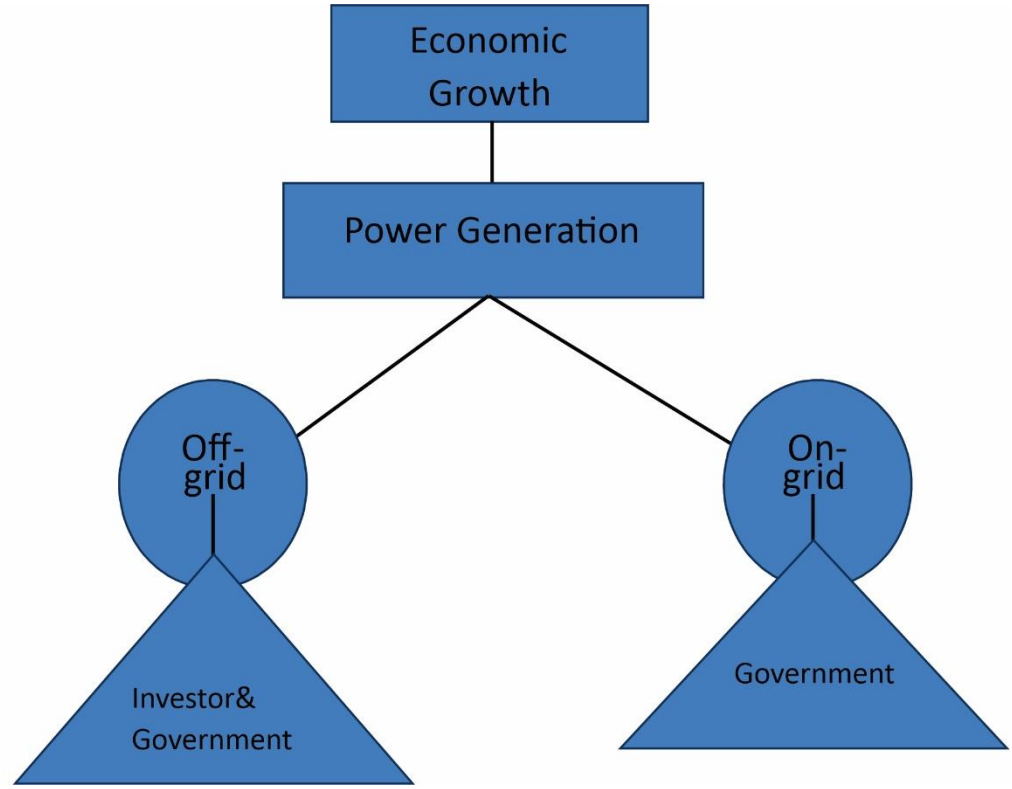
The investors who acquired the electricity distribution and generation companies are faced with problems of gas shortfall, electricity theft, inadequate supply, water management, huge metering gap and limited distribution networks, (Owusu, Asamadu-Sarkodie and Ameyo, 2017). The crisis in the sector has drawn both political attention and researchers to the need for an impending solution and rotate sources to acclaim the existing system. According to Barasa, Bogdanov, Oyewo, and Breyer, (2018) Local and international Researches, have offered renewable energy sources as the most reliable way forward. In another context, Mukhtar, Obiora, Yimen, Quixin, Bamisile, Jidele, and Irivboje,(2021) highlighted the prospect and challenges of solar thermal energy for electricity production in Nigeria. The research work shows that fossil fuels subsidy in the country and the cost of solar thermal technology are two main factors not encouraging investors and hindering the use of solar thermal technologies for power generation. Ejiofor et al. (2020) explore the potential of the rice husk technology for off-grid electricity generation in Nigeria, where 1.52 MW power generation potential from rice husk which includes a yearly, monthly, and daily total generation of 13,132.8 MWh, 1094.4 MWh, and 36.48 MWh was reported from the research work. The potential for electricity generation from abattoir wastes in Nigeria was highlighted in another study an estimated range of 1040 MWh to 1665 MWh of electricity could be generated monthly from these wastes (Odekanle, Odejobi, Dahunsi and Akeredolu, 2020). Also Mukhtar, Obiora, Yimen, Quixin, Bamisile, Jidele, and Irivboje, (2021) proposed the use of solar PV and wind turbines to fully drive the electricity sector. With the potential, it was also estimated that about 1.54 million renewable energy technology jobs can be created in Nigeria by 2050.

The giant of Africa is a remarkable member of the West Africa Power Pool (WAPP), a regional market launched in 2018, with the significant impact of improving the electricity supply among the West Africa countries. It is expected that all 14 countries in the WAPP will be interconnected. However, is the government of Nigeria ready to meet the actual electricity demand of the Nigerians? Hence the study intends to examine effect of electricity infrastructure on growth and the causality between electricity consumption and growth and s well as identify the link between the On-grid and Off- grid

electrification. The session one of the research work is about the introduction, session two is about the review literature, session three is the methodology while session four emphasize on the data analysis. Session five is concerned with conclusion and recommendation of the research.

Conceptual Framework and Theoretical Underpinning

CONCEPTUAL FRAMEWORK



Author's design (2022)

off-grid or mini-grid generation is a standalone power system that serves small cluster or communities such as industrial cluster, communities, housing estate and rural areas. producing electricity for the such classes will decentralized power generation in the economy. Currently total off-grid electricity generation capacity approved by the government, Nigeria electricity regulation commission (NERC) is about 500MW compared to on-grid power generation of about 12,500MW. The potential of the off-grid electricity generation attracts investors which will have a high multiplier effect on macro-economy objective such as unemployment. With the increase in the off-grid, more electricity will be generated and it reduces the cost of doing businesses

which has also made the nation inflation unfriendly. With government focusing on the on-grid will create a competition that will enhance efficiency in the sector. Breaking up the sector monopoly has the potential of being the game changer to power sector of the nation.

Empirical Review

Usman and Ome, (2018) examine the relationship between energy consumption and growth of Nigeria's economic, Using time-series data co-integration and ordinary least square techniques. The statistical result revealed that, in the long run, total energy consumption had a similar movement with economic growth except for consumption of coal. The empirical results highlight that electricity, petroleum and the aggregate energy consumption have significant and positive relationship with growth in Nigeria. However, consumption of gas although positive, but not statistically significant. Also in the write up of Ohler and Fetter (2014) indicates a bidirectional relationship between renewable generation and gross domestic product (GDP) in 20 OECD Countries. In contrary, Marques et al. (2014) found no evidence of causal relationships between renewable electricity to economic growth but economic growth gives rise to renewable electricity. Al-Mulali et al. (2014) highlighted that both renewable electricity consumption and non-renewable electricity consumption have a long-run linear effect on GDP growth in 18 Latin American Countries and all the three variables have a feedback causal relationship. In support of Al-Mulali et al (2014) and Ohler and Fetter (2014).

In contrary, Rahman (2020) argued that there is unidirectional causality from economic growth to energy in the 10 most electricity consuming Countries. Using panel data for 174 Countries, Atems and Hotaling, (2018) reported that there is a strong linear relationship between renewable and non-renewable electricity generation and growth. The authors also argued that electricity generation is more important than consumption since consumption is determined by distribution and transmission, which are largely affected by distribution theft and loss. The existing empirical studies on Nigeria and West Africa have focused on the relationship between renewable and non-renewable energy and economic growth (Ackah, 2015; MajiSulaiman and Abdul-Rahim, 2019; Tiwari et al., 2014) and few empirical studies have examined the relationship between electricity and economic growth (Akinlo, 2009; Iyke, 2015; among others), Akinlo (2009) observed unidirectional Granger causality running from electricity consumption to real GDP in the economy.

In the context of Chinedu, Daniel and Ezekwe, (2019). carried a study aiming at examining the extent to which electricity consumption influences economic growth in Ghana The study employed Augmented Dickey Fuller test, Co-integration test, Vector Error Correction Model and Granger Causality test. The study indicates that, in the long term, a hundred percent increase in electricity power consumption will cause real gross domestic product per capita to increase by approximately fifty-two percent. In the short run, electricity consumption negatively affects real gross domestic product per capita. The study again revealed that unidirectional causality run from electricity consumption to economic growth meaning that any policy actions taken to affect the smooth consumption of electricity in Ghana will definitely affect her gross domestic product per capita.

Saifuddin, Bello, Fatihah and Vigna, (2016). examined the relationship between electricity consumption and economic growth in Nigeria using the Cobb-Douglas growth model covering the period 1980-2008. The study adopted also conducted the Vector Error Correction Modelling and the Pairwise Granger Causality test. The researchers found the existence of a unique co-integrating relationship among the variables in the model with the indicator of electricity consumption impacting significantly on growth. More-so, there exist bi-directional causal relationship between electricity consumption and economic growth. Derrick, Thomas and Francis, (2021). observe the determinant of Energy Consumption on Economic Growth in Cameroon from the period of 1980 to 2014. The energy sources used to test for this relationship were Petroleum and electricity, with the use of Generalized Method of Moments statistical technique, the result shows that Gross Domestic Product (GDP), petroleum prices and population growth rate have a positive relationship with petroleum consumption. More-so, there was a positive relationship between Gross Domestic Product (GDP), consumption of electricity with prices and population growth rate. the study found a positive and significant relationship between petroleum consumption, electricity consumption, Gross domestic investment (GDI), population growth rate and economic growth. Aminu, and Aminu, (2015) provided empirical evidence on causal relationship between energy consumption and economic growth with data sourced in Nigeria economy.

Methodology

This study mainly employed the Autoregressive Distributed lag model estimation technique using secondary data on economic variables obtained from the Central Bank of Nigeria Statistical Bulletin, various issues

The variables of the macroeconomic growth model are the gross domestic product, output or income of a nation in a particular year. It is disaggregated to a summative component unit. The aggregate units are the variable in the circular flow of income that plays the individual role in the growth of an economy. The disaggregated variables are the firm producing goods and services for the household and government consumption in the economy. The external sector receives payment for goods sold and services rendered. Importation and factor income are in form of interest, profit wages & salaries and rental payment to factor owners. The household receives income for factor services rendered pay government income taxes. The household generate both private consumption expenditure (C_p) and investment expenditure (I_p), while the government sector in the economy generating for government consumption expenditure (C_G) and investment expenditure (I_G).

More-so, the external sector relating export (X) and import (M) of goods and service, these includes factor service. It also involves balance of payment and net foreign capital inflow into the economy. At equilibrium, aggregate supply of the economy is always equal to aggregated demand since no factor input revenue income until what was sold are paid for. Therefore, the equilibrium analysis is stated as below.

$$AS = AD \quad \ldots\ldots 1$$

$$Y = C + I + G + (X - M) \quad \ldots\ldots 2$$

$$Y = (C_{pt} + C_{Gt}) + (I_{pt} + I_{Gt}) + (X - M_t) \quad \ldots\ldots 3$$

Summarizing the equilibrium growth model

$$Y = C_t + I_t + (X_t - M_t) \quad \ldots\ldots 4$$

Showing the growth of an economy depending on the level of industrialization, this study therefore make investment in year t, a major variable in the equation.

$$I_t = (Y_t - C_t) + (M - X_t) \quad \ldots\ldots 5$$

$$I_t = S_t + F_t \quad \ldots\ldots 6$$

Using aggregate saving of the economy as the subject

$$S_t = Y_t - C_t \quad \ldots\ldots 7$$

With the inflow of capital into the economy, as the subject variable

$$F_t = M_t - X_t \quad \ldots\ldots 8$$

If investment is represented by output of the economy with industrialization effectiveness

$$PGDP = f(GNS, FPI) \quad \ldots\ldots 9$$

Model Specification and Data

A modification to equation (9) yields the following specification

$$PGDP = F(EC, EP, AE, GCF) \quad \ldots\ldots 10$$

considering the constant and the white noise

$$PGDP = \beta_0 + \beta_1 EC + \beta_2 EP + \beta_3 AE + \beta_4 GCF + \mu_t \quad \ldots\ldots 11$$

The long run form of the equation is as follow

$$PGDP_t = \beta_0 + \beta_1 EC_t + \beta_2 EP_t + \beta_3 AE_t + \beta_4 GCF_t + \mu_t \quad \ldots\ldots 12$$

While the short run form of the equation is as follow

$$\begin{aligned}\Delta PGDP_t &= \beta_0 + \sum \beta \Delta PGDP_{t-1} + \sum \beta \Delta PGDP_{t-2} \\ &+ \sum \alpha \Delta EC_t + \sum \alpha \Delta EC_{t-1} + \sum \alpha \Delta EC_{t-2} + \sum \phi \Delta EP_t \\ &+ \sum \phi \Delta EP_{t-1} + \sum \phi \Delta EP_{t-2} + \sum \lambda \Delta AE_t + \sum \lambda \Delta AE_{t-1} \\ &+ \sum \lambda \Delta AE_{t-2} + \sum \pi \Delta AE_t + \sum \pi \Delta AE_{t-1} + \sum \pi \Delta AE_{t-2} \\ &+ \sum \theta \Delta GCF_t + \sum \theta \Delta GCF_{t-1} + \sum \theta \Delta GCF_{t-2} + \mu_t \quad \ldots\ldots 13\end{aligned}$$

Estimation technique

The study adopts the Autoregressive Distributed Lag (ARDL) with long run bound test because it has been widely employed in various empirical studies. Data for this study has been obtained mainly from the World Development Indicator (WDI)

Empirical Results and Discussion

Table 1: **Descriptive Statistic of the Variables**

	AE	EC	EP	GCF	PGDP
Mean	47.19646	116.9972	71.15098	3.626262	1.500798
Median	47.89431	122.1338	70.15675	4.886500	1.830209
Maximum	59.30000	156.7972	82.40869	40.74386	12.45747
Minimum	27.30000	74.49062	58.13510	-22.79282	-4.457078
Std. Dev.	7.889399	28.28306	8.570610	11.74069	4.032093
Skewness	-0.504269	-0.155753	0.057977	0.206244	0.441897
Kurtosis	2.473451	1.442080	1.385494	5.634383	3.144579
Jarque-Bera	1.725871	3.365533	3.493435	9.480160	1.069325
Probability	0.421922	0.185859	0.174345	0.008738	0.585867

Sum	1510.287	3743.911	2276.831	116.0404	48.02553
Sum Sq. Dev.	1929.521	24797.88	2277.116	4273.156	503.9910
Observations	32	32	32	32	32

The descriptive analysis shows that electricity consumption (EC) has the highest mean value of 116.9972 while the per capital gross domestic product (PGDP) has the lowest mean value from the model. The consumption of electricity variable also has the maximum value with 156,7972 while the gross capital formation (GCF) has the minimum negative value (-22.79282). The standard deviation shows that electricity consumption in the economy is the most volatile with a value of 28.28 and the least volatile variable is the (PGDP) annual growth rate of the economy with a value of 4.032. the skewness statistic shows that electricity consumption and access to electricity are negatively skewed while other variables are positively skewed. The gross capital formation (GCF) value is leptokurtic, having greater kurtosis than the normal distribution

Table 2: **Augmented Dickey Fuller unit root test**

VARIABLES	@LEVEL	@1ST DIFFERENT	OOI
PGDP	-3.3699**	-9.1723***	I{0}
AE	-2.6432	-10.2339***	I{1}
EC	-1.0367	-6.6907***	I{1}
EP	-0.4125	-7.4844***	I{1}
GCF	-9.0709***	-7.1954***	I{0}

Author's computation via e-view 10

Table 2 shows the result of the stationarity test at both level and the first different for all the variables in the model. The study applied constant, intercept and trend term as appropriate. The optimal lag length of each variable is chosen using the Schwarz information criteria (SIC). As specified in the table, only two variables were stationary at level but after taking the first different of other variables, they become stationary. This imply that the variables in the model are integrated of order 0 and 1 denoted by I(0) and I(1). The study further carried out a co-integration test, using the ARDL bound's test. These results are shown in table 3 as follows.

Table 4: Long run Bound Test

F-Bounds Test		Null Hypothesis: No levels relationship		
Test Statistic	Value	Signif.	I(0)	I(1)
			Asymptotic: n=1000	
F-statistic	16.25165	10%	2.2	3.09
K	4	5%	2.56	3.49
		2.5%	2.88	3.87
		1%	3.29	4.37
			Finite Sample: n=30	
Actual Sample Size	30			
		10%	2.525	3.56
		5%	3.058	4.223
		1%	4.28	5.84

Author's computation via e-view

Given that, result of unit root test as presented in table 2 have varying level of stationarity with some stationary at level, while others at first difference; it then becomes important that we find a statistical measure which can help to find that since all are not stable in the long run, when they are combined, can the model be cointegrated in the long run? To do this, Pesaran, Shin and Smith (2001) recommended a bound testing approach that ensures that cointegration exist. According to them, the bounds test examines the condition that there is cointegration by checking that, F-statistics is greater than I(1) at 5% critical value. Result from table 2 shows that, F-statistics of 16.29 is greater than I(I) upper bound of 4.43. Thus, we conclude that, there is cointegration related to the regression result.

Table 5: Short run Autoregressive Distributed Lag (ARDL)

Dependent Variable: D(PGDP)
Method: ARDL
Date: 05/05/22 Time: 16:38
Sample (adjusted): 1992 2021
Included observations: 30 after adjustments

Maximum dependent lags: 1 (Automatic selection)
Model selection method: Akaike info criterion (AIC)
Dynamic regressors (1 lag, automatic): D(AE) D(EC) D(EP) D(GCF)
Fixed regressors: C
Number of models evalulated: 16
Selected Model: ARDL(1, 0, 1, 0, 0)

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
D(PGDP(-1))	-0.352105	0.156291	-2.252880	0.0341
D(AE)	-0.184347	0.205821	-0.895664	0.3797
D(EC)	0.051282	0.057913	0.885496	0.3851
D(EC(-1))	-0.105619	0.060098	-1.757447	0.0921
D(EP)	-0.206509	0.326286	-0.632910	0.5330
D(GCF)	0.067050	0.035264	1.901389	0.0699
C	0.231786	0.639043	0.362707	0.7201

R-squared	0.391302	Mean dependent var	-0.005184
Adjusted R-squared	0.232511	S.D. dependent var	3.442553
S.E. of regression	3.015898	Akaike info criterion	5.246636
Sum squared resid	209.1997	Schwarz criterion	5.573582
Log likelihood	-71.69953	Hannan-Quinn criter.	5.351228
F-statistic	2.464263	Durbin-Watson stat	1.686336
Prob(F-statistic)	0.054732		

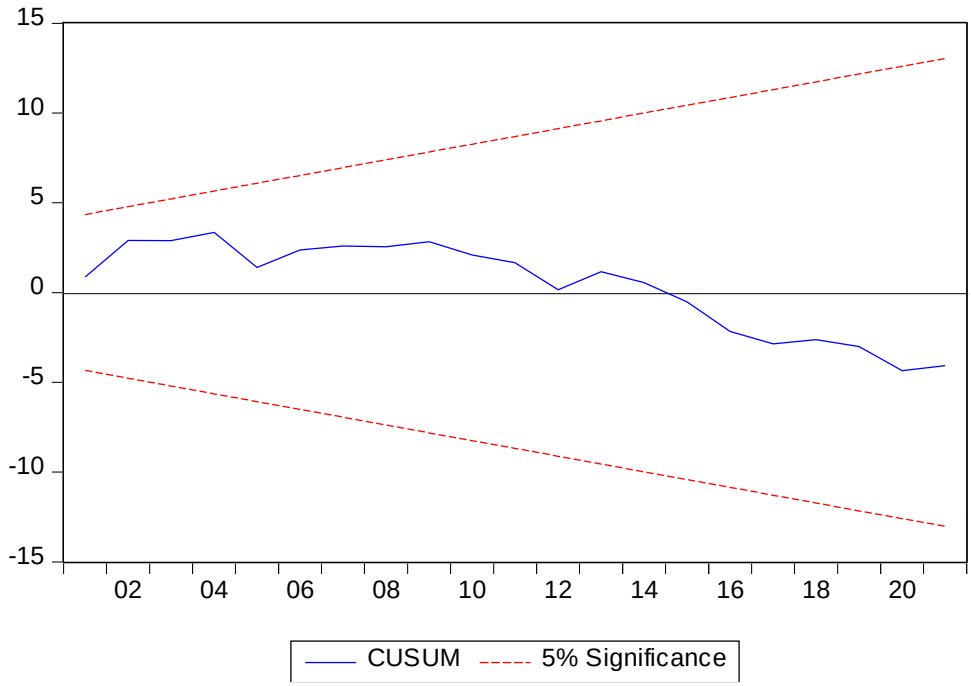
Author's computation via e-view 10

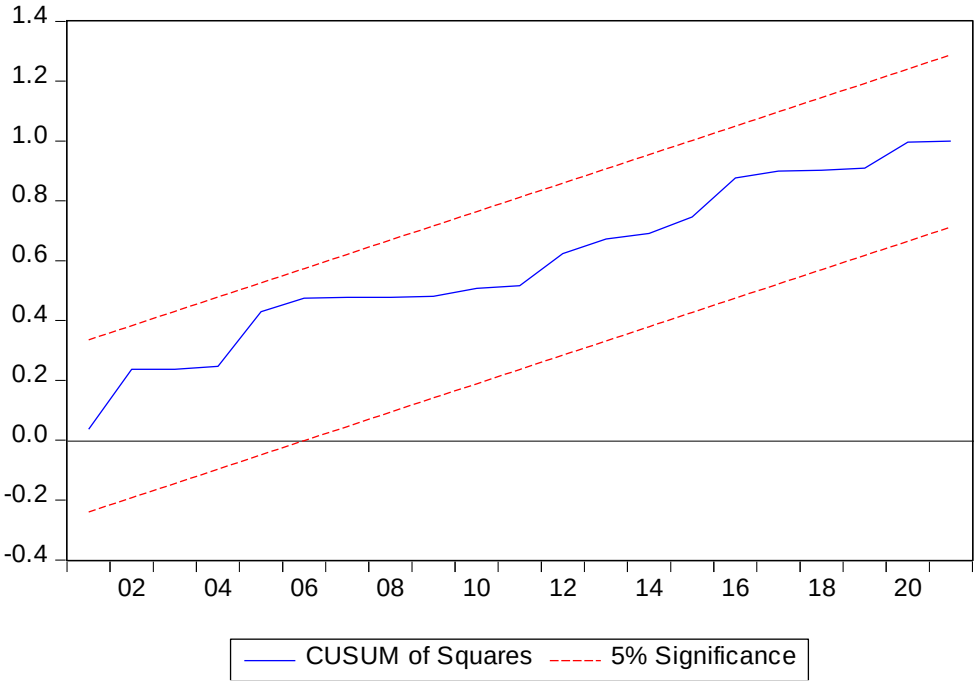
The result of the dynamic ARDL model of growth function in Nigeria economy is presented in table 5 it is the short run growth model and it takes into consideration instability of the variables and the adjustment process to long run equilibrium since they are linearly integrated. The result shows that access to electricity (EC) is negatively related to the annual growth rate of the economy and it is not statistically significant with the probability of 0.38. lag of electricity consumption is negatively related to the annual growth rate and slightly significant while the present electricity consumption is linearly related to the annual growth rate of the economy, indicating that for every 100% increase in the growth rate, EC contributes 5.1% of it but it is not statistically significant. Electricity production in the economy is inversely related to the annual growth rate, the average production is not economical to the growth

of a nation. the GCF is positively related to the annual growth rate for every 100% increase in the growth rate, GCF contributes 6.7% but it is slightly significant.

On statistical ground, the R-square and adjusted R-square show that 39% variation of the annual growth rate in Nigeria economy is explained by all the included explanatory variables and that if other variables that influence PGDP are put into consideration, the included variables in this model will explain 23% variation in it. The Durbin Watson statistic (DW) with the R-square value comparison shows that the short run model as estimated is not spurious and thus is reliable. Also the DW statistic (1.686) shows that there is no autocorrelation or serial correlation in the model.

Table 6: **Stability test**





Author's computation via e-view 10

The Cusum stability test result for the model under study are within the %% critical bound as indicated by the two lines that bounded the trend curve. The implication of this for the model is that the parameters of the model do not suffer from any structural instability over the period of study.

Conclusion and Recommendations

Finding permanent solutions that will resolve these problems is a challenging task for the government. This situation persists even though Nigeria is well endowed with a large amount of renewable energy and non-renewable. Most of the electricity generated in Nigeria comes from non-renewable sources. Although the Federal government targets over 30 per cent integration of renewables into the energy mix by 2030, it is important for the country to respond to the demand of the people and act fast on the energy policies. Proposed Solutions to Nigeria Electricity Sector Crisis in order to meet the high demands of electric power, there is a need to adopt multiple sources of energy with proper energy policies. The low power generation experienced in Nigeria since independence is mainly due to the nations' concentrated efforts on electricity generation from only two sources which are hydro and natural gas. From observation and obvious results both in literature and experiences, these two energy sources have been poorly harnessed and mismanaged. To overcome the challenge of low power generation in Nigeria, there is a need to

supplement both hydro and gas with other energy sources such as solar and wind. It is also recommended that the current electric power generation capacity will have to rise to 160 GW by 2030 to solve Nigeria's electricity sector crisis. Adequate finance must be set aside for the operation, maintenance, upgrading, and expansion of the power sector infrastructure to solve this electricity crisis. Access to electricity infrastructure should be provided for the citizen at affordable costs to spur sustainable economic growth in Nigeria.

References

Abdul-Hamid, H. S., Oppong, R. A., &Gyimah, K. A (2017). Building safer cities: Assessing green infrastructure for storm water management at Kwame Nkrumah Interchange, Accra.

Bamisile, O., Huang, Q., Xu, X., Hu, W., Liu, W., Liu, Z., & Chen, Z. (2020). An approach for sustainable energy planning towards 100% electrification of Nigeria by 2030. *Energy*, *197*, 117172.

Barasa, M., Bogdanov, D., Oyewo, A. S., & Breyer, C. (2018). A cost optimal resolution for Sub-Saharan Africa powered by 100% renewables in 2030. *Renewable and Sustainable Energy Reviews*, *92*, 440-457.

Chimezie, I. C. (2020). Nigeria-china relations: impact on power and development in Nigeria. *ВестникСанкт-Петербургскогоуниверситета. Востоковедение и африканистика*, *12*(1), 141-151.

Chinedu, U. A., Daniel, O. C., &Ezekwe, U. C. (2019). Impact of Energy Consumption on Economic Growth in Nigeria: An Approach of Time Series Econometric Model.". *International Journal of Academic Research in Economics and Management and Sciences*, *8*(2), 65-77.

Comfort, E., Ojamaliya, A., Okafor, V., Godwin, A., &Oluwapelumi, A. (2018). Dynamic impact of energy consumption on the growth of Nigeria economy (1986-2016): Evidence from symmetrical autoregressive distributed lag model. *International Journal of Energy Economics and Policy*, *8*(2), 188.

Derrick, F. O. S. S. O. N. G., Thomas, N. D., & Francis, B. M. (2021). The implications of renewable and non-renewable energy consumption for economic growth in Cameroon. *Energy Economics Letters*, *8*(1), 29-41.

Galadima, M. D., &Aminu, A. W. (2020). Nonlinear unit root and nonlinear causality in natural gas-economic growth nexus: Evidence from Nigeria. *Energy*, *190*, 116415.

Jamil, F. (2013). On the electricity shortage, price and electricity theft nexus. *Energy policy*, *54*, 267-272.

Kingsley, I., & Tonuchi, J. E. (2021). Contribution to the empirics of electricity blackouts and productivity in Nigeria. *Energy Economics Letters*, *8*(1), 60-69.

Mukhtar, M., Obiora, S., Yimen, N., Quixin, Z., Bamisile, O., Jidele, P., &Irivboje, Y. I. (2021). Effect of inadequate electrification on Nigeria's economic development and environmental sustainability. *Sustainability*, *13*(4), 2229.

Odekanle, E. L., Odejobi, O. J., Dahunsi, S. O., &Akeredolu, F. A. (2020). Potential for cleaner energy recovery and electricity generation from abattoir wastes in Nigeria. *Energy Reports*, *6*, 1262-1267.

Odugbesan, J. A., &Rjoub, H. (2020). Relationship among economic growth, energy consumption, CO2 emission, and urbanization: evidence from MINT countries. *Sage Open*, *10*(2), 2158244020914648.

Orhewere, B., & Henry, M. (2011). Energy Consuption and Economic Growth in Nigeria. *Journal of Research in National Development*, *9*(1), 153-165.

Paul, O. U., Albert, O., &Adeiza, A. S. (2015). Electricity crisis in Nigeria: the way forward. *American Journal of Renewable and Sustainable Energy*, *1*(4), 180-186.

Saifuddin, N., Bello, S., Fatihah, S., &Vigna, K. (2016). Improving electricity supply in Nigeria-potential for renewable energy from biomass. *International Journal of applied engineering research*, *11*(14), 8322-8339.

Sampson, E. M., &Longe, O. M. (2021). Review of the Role of Energy Pricing Policies in Electricity Retail Market. *2021 IEEE PES/IAS PowerAfrica*, 1-5.

Usman, I. C., &Ome, W. E. (2018). Energy Efficiency and Manufacturing Sector Performance in Nigeria: Dynamic Model Approach. *Noble International Journal of Economics and Financial Research*, *3*(8), 86-94.