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The Impact Population Growth on Disaggregate Energy Generation Source from (Hydro Power, Natural Gas, Oil and Coal Source) in Nigeria

Umar Bala[1]
Ayatu Yusuf[2]
Rabiu Maijama'a[3]

(Corresponding Author

[1,2]*Department of Economics, Faculty of Social and Management Sciences Bauchi State University, Gadau Nigeria.*
[1]*Email: umarbala@basug.edu.ng Tel: +2348032739714*
[2]*Email: hayat4meandyou@gmail.com Tel: +2348100551681*
[3]*NNPC Retail Sales Representative, Nigerian National Petroleum Corporation, NNPC Towers, Central Business District Abuja Nigeria.*
[3]*Email: rabiumaijamaa19@gmail.com Tel: +2347033336334*

Abstract

This research tries to investigate the impact of population growth on energy generation in Nigeria using Auto Regressive Distributive Lag (ARDL). The study employed an econometric methodology involving the use of unit root test, cointegration test technique. The study use of different source of electricity production in Nigeria such as hydro power source (HPS), natural gas source (NGS), oil and coal sources (OCS) , as dependents variables which were regress against population and real gross domestic product (GDP) as explanatory variables which altogether serve as determinants of energy generation. The ARDL Bound test reveals that both the three equations under studies are cointegrated. Consequently, the study finds that the long run and short run dynamics of the variables involved. From the long run coefficients the study found that population growth has a positive and significant impact on energy generation from natural gas source, oil and coal source but negative impact on hydropower sources. Based on these findings some recommendations were made, Nigeria government should adequately project the growing rate of population in advance so as to generate volume of energy that will cater for the population so as to avoid the risk of energy shortage in Nigeria.

Keywords: Population growth, Energy generation source, Hydro power, Natural gas, Oil, coal, Gross domestic product.
JEL Classification: A32.

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Ethical: This study follows all ethical practices during writing.

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Contribution of this paper to the literature

Based on the existing literatures, there is limited research which disaggregates the energy generation source into different categories, from (Hydro Power, Natural Gas, Oil and Coal Source) in Nigeria and look at their Impact on Population Growth. The research will contribute significantly toward deep understanding on different source of energy generations. The result is useful for Nigerian policy makers to know among the energy sources which have significant impact when population is growing.

1. Introduction

Electricity production (energy capacity) of a nation has remains the notorious input in contemporary production process. The stable power supply brings a brightness to ensure and improve the standard of living as well as the welfare of the citizens. Optimal energy generation and utilization seems to be the main driver of economic growth of any country in the world (Yakubu, Salisu, & Umar, 2015). In a well-organize economies, households, industries and transport sectors are well powered. Beside the significant impact of energy sector on production also create employment. Steady energy and electric power that meet the demand of the entire nation provide means of productivity and constant economic growth (Onayemi, Olomola, Alege, & Oluwakemi, 2020). Nigeria power generation capacity is low and unstable supply which delayed the development of manufacturing sectors and other small and medium producers. Industries have to powered production by their internal generators (Olugbenga, Jumah, & Phillips, 2013). The process of producing electric energy or the amount of electric energy produced by transforming other forms of energy into electrical energy; commonly expressed in kilowatt-hours (KWh) or megawatt-hours (MWh).

In Nigeria there is there is abundant renewable and non-renewable energy resources yet to explore. That makes shortage in modern energy generation, more than 80 per cent of the population used charcoal and fire wood for daily utilization (Mohammed, Mustafa, Bashir, & Mokhtar, 2013; Ogundiran, 2018). Energy generation includes all technologies that turn some form of energy into useful electric energy. Electricity is a form of energy that has magnetic, radiant and chemical effects. Electric current is created by a flow of electrons. Only about 40 per cent of the Nigerian populations are connected to power generation and distribution (Sadiq, Ramli, & Saleh, 2013). There are some factors that determine population growth and the cause of the unprecedented growth in world population in history medical advances, improvements in public health, sanitation and hygiene, increased food availability and agricultural productivity, extension of cultivation, and development of trade and transportation. Surprisingly, high quality energy sources are rarely mentioned or quickly discounted. Yet an argument can be made that each of the above factors contributing to population growth is aided and influenced by high quality energy supplies. Cheap and abundant fossil fuels have been a necessary precondition for the past century's population growth. And while not all countries benefit directly from the consumption of high quality energy supplies, most countries benefit from the impact of high energy societies on low energy societies. Mishra, Sharma, and Smyth (2009) studies 13 Pacific Island countries found that energy consumption per capita in approximately 60 per cent.

Growing populations consume more energy. Availability of energy allows populations to grow. Energy consumption exerts demands on energy resources making them scarcer. They become harder to extract. Nearby forests are depleted, coal mines must dig deeper, oil has to be drilled in more complex environments. In other words, energy resource extraction experiences declining marginal returns. This has led to the exploitation of new energy sources, which in turn expands the Earth's carrying capacity. Then populations grow once more. Perhaps, at a macro level, we can study this cycle of dependency and use it to model population growth, to try to understand where population might be headed in the future. Essah (2011) found that in Ghana's there 10 per cent increasing of electricity consumption per annum due to the increasing demand by the growing population. Figure 1 show the trend of three (3) energy sources in the study. The trend of hydro power generation has consistently decline while the natural gas, oil and coal sources are not increasing with the proportional increasing in population growth.

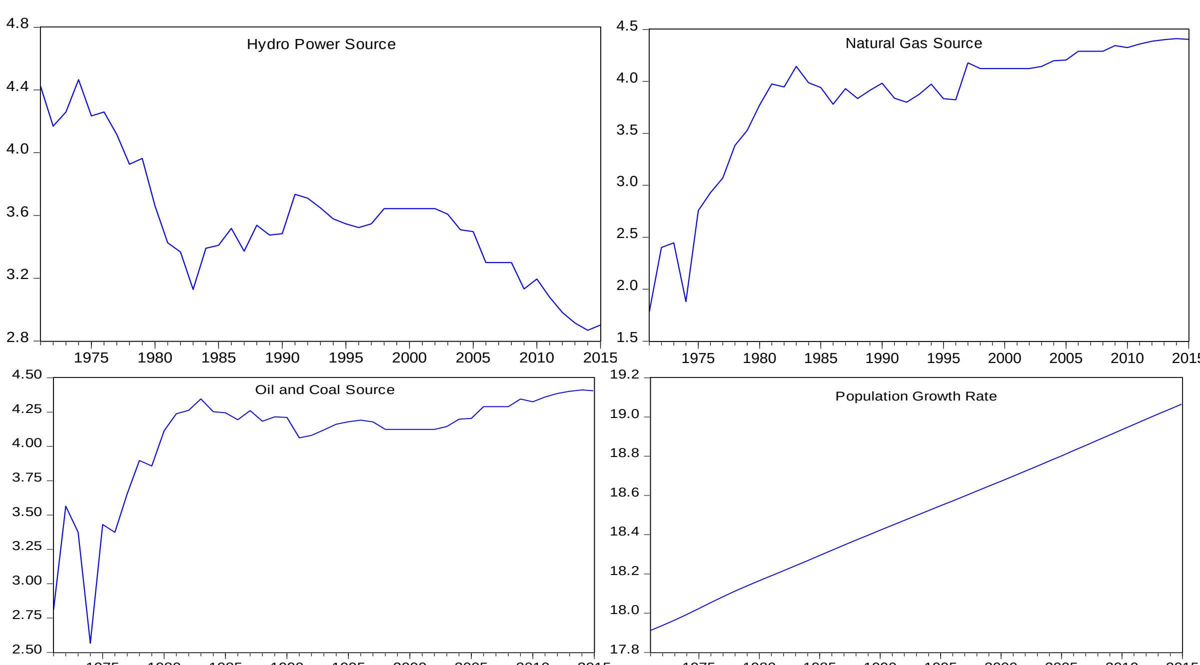

Figure-1. Trend of energy sources and population growth.

2. Literature Review

The impact of population growth on energy generation in Nigeria has received a very little attention in previous research work. Research efforts lean towards the study of energy consumption and few macroeconomic variables. Ebohon (1996) found bidirectional causality between energy consumption and economic growth for Nigeria and Tanzania. Adeniran (2008) on the other hand using aggregate and disaggregate energy consumption data for Nigeria from 1980 to 2006, applying Hsiao's Granger causality and ECM reported unidirectional causality running from GDP to coal consumption to electricity consumption. But for aggregate energy consumption data, total energy consumption Granger causes GDP without feedback and no causality between oil, gas and GDP. However, Omotor (2008) used disaggregate time series data for Nigeria's energy consumption from 1970 to 2005 and applying cointegration and Hsiao's version of Granger causality supported the feedback hypothesis thus vindicating Ebohon (1996); Okonkwo and Odularu (2009) set a new pace by including additional variables capital and labor together with the disaggregate energy consumption variables. The empirical evidence suggests that crude oil, electricity and coal consumption are positively related to economic growth. Aliero and Ibrahim (2012) indicate absence of causality between total energy consumption and GDP using aggregate energy consumption data. From the disaggregate energy consumption data for the period 1970 to 2009, the study shows evidence of causality running from coal, petrol and electricity consumption to GDP and a causality both ways between gas consumption and GDP.

Other research applied ARDL bound approach to cointegration using unrestricted error correction model (UECM) on disaggregated energy consumption Dantama, Abdullahi, and Inuwa (2016) reported a long run cointegrating relationship of petrol, coal and electricity consumption with real GDP. Coal consumption coefficient, although negative, but statistically insignificant while both petroleum and electricity consumption have positive and are statistically significant on economic growth. Another study Suberu, Mokhtar, and Bashir (2012); Amoo and Fagbenle (2013) use the Nigerian population benchmark has another source of power considering the abundant waste that can generate energy. Found that approximately 442MWe in one state. While Oji et al. (2012) explore the need of Nigeria to give lay emphasis on solar energy generation which is suitable for modern world. The consistence increases in population growth need to appropriate increases in energy generation with the same proportion (Wojuola & Alant, 2017).

Most of the extant literatures reviewed above have focused on the impact of either population growth on economic growth, economic development or energy consumption. From the reviewed, none of the work has made attempt to integrate the two components of population growth and energy generation into a single model. This work fills the gap by examining the impact of population growth on energy generation in Nigeria.

3. Research Methodology

In considering the relationship between population growth and energy generation in Nigeria, the study applied Malthusian population growth model. Figure 1 called a simple exponential growth model, based on the idea of the function being proportional to the speed to which the function grows. The linear functional relationship of the model can be expressed as:

$$P(t) = P_0 e^{rt} \qquad (1)$$

Where

- $P_0 = p(0)$ is the initial population size.
- r = the population growth rate, sometimes called Malthusian parameter.
- t = time.

3.1. Model Specification

This research adopts this model with modification on the dependent variable from energy generation (EG) and the independent variables to include; gross domestic product (GDP), to keep the model simple. Figure 2 shows the model for this study shall be specified:

$$EG\ (HPS,\ NGS\ and\ OCS) = F\ (PG,\ GDP,) \qquad (2)$$

Figure 3 shows the econometric model can thus be specified as:

$$EG_t = \beta_0 + \beta_1 PG_t + \beta_2\ GDP_t + \varepsilon_t \qquad (3)$$

EG = Energy generation (HPS: Hydro Power Source, NGS: Natural Gas Source, OCS: Oil and Coal sources).
PG = Population Growth.
GDP = Real Gross Domestic Product Per Capita.
$\beta 0$ = intercept of relationship in the model/constant.
$\beta 1$, $\beta 2$, = coefficient of each of the independent variable.
μt= stochastic/error term

3.2. Unit Root Test

Many macroeconomics data have a stochastic trend, that is their mean and variance is not constant with time and thus can't be used for analysis because they will pose a spurious regression result. Non stationary (random walk without drift) variables can be differenced using unit root test i.e. integrated at levels I (0) or of order one I (1) or order two I (2). The form and presence of non-stationary can be detected using the unit root test. They are called unit root because under the null hypothesis, the characteristics polynomials have a unit root equal to unity (Khazan, 2010). The Augmented Dickey Fuller (ADF) and Phillips Perron (PP) will be used to test the presence of unit root. A series is said to be stationary if it's mean, variance and co-variance do not vary over time. The results of the unit root test are useful in the choice of the econometric technique for any empirical analysis

3.3. Auto Regressive Distributed Lag (ARDL)

The works of Pesaran and Shin (1999) as well as Pesaran, Shin, and Smith (2001) makes ARDL one of the most widely accepted method considering its numerous advantage over other co-integration techniques such as Engle, Granger, and Mar (1987); Johansen (1988). One of those advantages is that it does not require pre-tests for unit roots unlike other techniques and it is preferable when dealing with variables that are integrated of different order, I (0), I (1) or combination of both and, robust when there is a single long run relationship between the underlying variables in a small sample size (Ali & Ozturk, 2010; Ali & Ozturk, 2013).

3.4. Long-Run Cointegration Test

Based on Equations 4, 5 and 6 we proceed to formulate our autoregressive distributed lags (ARDL) that will be estimated in order to find the links among the variables under investigation

$$Y_1\ logHPS_t = \beta_0 + \beta_1 logPOP_{t-1} + \beta_1 logGDP_{t-1} + \sum_{i=1}^{n} yi\Delta logHPS_{t-1} + \sum_{i=1}^{n} yi\Delta logPOP_{t-1} + \sum_{i=1}^{n} yi\Delta logGDP_{t-1} + \varepsilon_t \quad (4)$$

$$Y_2\ logNGS_t = \beta_0 + \beta_1 logPOP_{t-1} + \beta_1 logGDP_{t-1} + \sum_{i=1}^{n} yi\Delta logNGS_{t-1} + \sum_{i=1}^{n} yi\Delta logPOP_{t-1} + \sum_{i=1}^{n} yi\Delta logGDP_{t-1} + \varepsilon_t \quad (5)$$

$$Y_3\ logOGC_t = \beta_0 + \beta_1 logPOP_{t-1} + \beta_1 logGDP_{t-1} + \sum_{i=1}^{n} yi\Delta logOGC_{t-1} + \sum_{i=1}^{n} yi\Delta logPOP_{t-1} + \sum_{i=1}^{n} yi\Delta logGDP_{t-1} + \varepsilon_t \quad (6)$$

The co-integration test involves estimating and then testing the null hypothesis (H_0) of no long run relationship against the alternative hypothesis (H_1) that there is a long-run relationship, that is: H_0: $\alpha_1 = \alpha_2 = 0$, against the alternative hypothesis: H_1: $\alpha_1 \neq \alpha_2 \neq 0$.

The Schwarz Bayesian criterion (SBC) is selected to represent the length of the lag of the model. Equations 7, 8 and 9 below shows the error-correction model is used in order to determine the dynamics of the variable in the short run as in the below equations. The error correction model also provides information about the speed of adjustment of the model:

$$Y_1\ \Delta logHPS_t = \beta_0 + \sum_{i=1}^{n} yi\Delta logHPS_{t-1} + \sum_{i=1}^{n} yi\Delta logPG_{t-1} + \sum_{i=1}^{n} yi\Delta logGDP_{t-1} + \theta ecm_{t-1} + e_t \quad (7)$$

$$Y_2\ \Delta logNGS_t = \beta_0 + \sum_{i=1}^{n} yi\Delta logNGS_{t-1} + \sum_{i=1}^{n} yi\Delta logPG_{t-1} + \sum_{i=1}^{n} yi\Delta logGDP_{t-1} + \theta ecm_{t-1} + e_t \quad (8)$$

$$Y_3\ \Delta logOGC_t = \beta_0 + \sum_{i=1}^{n} yi\Delta logOGC_{t-1} + \sum_{i=1}^{n} yi\Delta logPG_{t-1} + \sum_{i=1}^{n} yi\Delta logGDP_{t-1} + \theta ecm_{t-1} + e_t \quad (9)$$

The stability of the model's long-run coefficient and short-run dynamics is tested based on the cumulative sum of recursive residuals (CUSUM) and the cumulative sum of squares of recursive residuals (CUSUMSQ) as highlighted by Pesaran and Shin (1998)

3.5. Data Collection

Table 1 shows the data used in this study, has been collected from World Bank development indicator from 1971-2015 based on the available data. The study utilizes the secondary source because it provides a basis for purposeful research work and also gives a direction for the research work.

Table-1. Data Sources and Descriptions.

S/No	Variable	Symbol	Description	Source of Data
1	Energy Generation (Hydro Power, Natural Gas, Oil and coal source)	EG (HPS, NGS and OCS)	It measures the amount of energy generation	World Bank development indicator
2	Population Growth	PG	Annual population growth rate	World Bank development indicator
3	Real Gross Domestic Product	GDP	The total monetary value of goods and services usually a year	World Bank development indicator

4. Results and Discussion

This section presents the outcome of applying various methods and techniques that help to empirically ascertain to answer the objectives of the study are been achieved or not. To avoid spurious regression, the stationary test has been done using Augmented Dickey Fuller (ADF) test, the co-integration test was conducted using Autoregressive Distributed Lag (ARDL) and finally, al residual tests were conducted.

4.1. Unit Root Test

Table 2 shows the augmented dickey-fuller (ADF) and Phillips Perron (PP) tests for stationarity. The tests proceed with Schwarz Information Criteria (SIC) of which the selected optimal lags are 9 for PG and 0 for all other variables. The null hypothesis is that the underlying series has a unit root. The stationarity tests were also conducted based on the assumption of the presence of trend and intercept in the individual series. The results suggest that using ADF HPS is stationary at first difference both constant and trend at 1per cent , while PP suggest that at constant it is stationary at first difference and with trend it is stationary at both level and first difference at 1 per cent . Also both results show that at constant NGS is stationary at both level and first difference at 1 per cent, with trend at first difference only. Only PG is stationary at level at 5 per cent GDP and OCS were all stationary at first difference and at 1 per cent level of significance.

Table-2. Unit root results.

Variable	ADF Test Statistics				Phillips Perron Test Statistics			
	Constant		Trend		Constant		Trend	
	Level	First Difference	Level	First Difference	Level	First Difference	Level	First Difference
HPS	-1.5600 (0.4942)	-7.5278*** (0.0000)	-2.0025 (0.5838)	-7.4287*** (0.0000)	-1.5868 (0.4807)	-8.332*** (0.000)	-7.4268*** 0.000	-7.3420*** (0.000)
NGS	-3.601*** (0.0097)	-8.5333*** (0.000)	-3.3580 (0.0704)	-8.8858*** (0.000)	-3.60*** (0.0097)	-9.847*** (0.000)	-3.3984 (0.0646)	-8.9740*** (0.000)
OCS	-3.5061 (0.0124)	-10.356*** (0.0000)	-3.7919 (0.0264)	-4.792*** (0.003)	-3.5382 (0.0114)	-10.7990 (0.000)***	-3.7638 (0.0282)	-10.751*** (0.000)
PG	-1.1316 (0.6925)	-2.1839 (0.2155)	-3.973** (0.0191)	-3.209 (0.102)	-1.2576 (0.6407)	-2.1208 (0.2378)	-2.5218 (0.3167)	-2.3809 (0.3838)
GDP	1.3390 (0.9984)	-4.8122*** (0.0003)	-3.6862 (0.0360)	-5.4004*** (0.0003)	0.7926 (0.9928)	-5.024*** (0.0002)	-1.2453 (0.8882)	-5.4767*** (0.003)

4.2. ARDL Bound Test Estimation Results

This bound test enables us to test for long run dynamic relationship among the variables in ARDL modeling approach. The rule is that if computed F-statistics falls below the lower bound value I (0), the null hypothesis (no co-integration) will not be rejected. Otherwise, if the computed F-statistics exceeds the upper bond value, I (1), then null hypothesis is rejected which indicates that there is co-integration. If the computed result falls between the lower and upper bonds, the test is inconclusive. This is in line with Pesaran et al. (2001) that in the case of inconclusive report, investigation may be based on the short-run analysis (Adeyemi & Ogunsola, 2016). Table 3 below reports the bound test. It can be observed that the value of F-statistics is greater than the lower bound as well as the upper bound at 5 percent level of significance. Which therefore, confirmed the existence of long run relationship and the null hypothesis of no cointegration has to be rejected given the F-statistics in both the three models. The ARDL Bound test to cointegration the results indicate the existence of long run relationship between population growths and disaggregate power generations (energy generation from hydro power source, energy generation from natural gas source and energy generation from oil and coal). All the three F-statistics 5.783, 9.5865 and 9.0486 are greater than upper bound of the ARDL critical values as stated below.

Table-3. ARDL Bound Tests.

				Bounds critical values [Unrestricted intercept and no trend]	
Models	F-stats	Lag	Level of significance	I(0)	I(1)
$HPS_t = \beta_0 + \beta_1 PG + \beta_2 GDP + \varepsilon_t$	5.7813	3	1 per cent	5.15	6.36
			5%	3.79	4.85
$NGS_t = \beta_0 + \beta_1 PG + \beta_2 GDP + \varepsilon_t$	9.5865	3	1%per cent	5.15	6.36
			5%	3.79	4.85
$OCS_t = \beta_0 + \beta_1 PG + \beta_2 GDP + \varepsilon_t$	9.0486	3	1%	5.15	6.36
			5%	3.79	4.85

4.3. ARDL Short-Run Long-Run Results

Having found a long run relationship between the series, estimation long run model was conducted to obtain the short-run and long-run coefficients whose results are presented in Table 4. The results indicate that Hydro Power Source (HPS) generation coefficient is negative means that an increase in population is more than the increases in hydro power generation. One per cent increase in population leads to a proportionate decrease in hydro power generation by -6.8605 in the long run. The results indicate that GDP coefficient is positive and statistically insignificant. This means that GDP has positive impact on hydro power generation the higher GDP accelerates hydro power generation in the long run. The result of the second proxy of power generation indicates that Natural Gas Source (NGS) coefficient is positive related to population growth. This means that PG has s positive impact on energy generation through natural gas source. GDP coefficient is negative means that GDP has negative impact on energy generation from natural gas source. While the result of the third proxy of power generation indicates that coefficient of Oil and Coal Source (OCS) is positive related to population growth (PG). Means that population growth has positive impact on energy generation through oil and coal source. The results indicate that GDP coefficient is negative means that GDP has negative impact on energy generation through oil, natural gas and coal source.

Table-4. Estimated short-run and long-run coefficients.

Variables	Short-run		Long-run	
	Coefficient	T-ratio	Coefficient	T-ratio
Model 1: HPS			-6.8605*	-2.0838
GDP			3.3479	1.6957
Constant			52.3409***	3.5613
ΔLPG_t	-476.6745**	-2.4971		
ΔLPG_{t-1}	1265.9219***	2.7690		
$\Delta LGDP_t$	0.1942	0.4717		
$\Delta LGDP_{t-1}$	-0.9847**	-2.2868		
ECT_{t-1}	-0.2068***	-2.9696		
Model 2: NGS			8.1303***	5.1536
GDP			-4.4429***	−4.4935
Constant			-32.3209***	-6.3135
ΔLPG_t	836.0366***	3.4817		
ΔLPG_{t-1}	2129.7398***	-3.6143		
$\Delta LGDP_t$	-1.4495**	-2.6617		
$\Delta LGDP_{t-1}$	1.1398**	2.0086		
ECT_{t-1}	-0.4909***	-4.7544		
Model 3: OCS			9.4160***	3.0444
GDP			-5.4300***	-2.8675
Constant			-31.5751***	-3.0054
ΔLPG_t	480.3091**	2.5472		
ΔLPG_{t-1}	1252.0335***	-2.7604		
$\Delta LGDP_t$	-0.9140*	-1.9708		
$\Delta LGDP_{t-1}$	0.8389*	1.7289		
ECT_{t-1}	-0.3160***	-3.0795		

Note: ***, **, and * are significant at 1%, 5%, and 10% levels, respectively.

Cointeq = NGS - (8.1304*LPG -4.4430*LGDP -32.3209). The cointegration equation is -0.4909 which is below 100per cent, as such cointegrating test should be taking each year. Cointeq = HPS - (-6.8606*LPG + 3.3480*LGDP + 52.3409). The cointegration equation is -0.2068 which is below 100%, as such cointegrating test should be taking each year. Cointeq = OCS - (9.4161*LPG -5.4301*LGDP -31.5752). The cointegration equation is -0.3160 which is below 100per cent, as such cointegrating test should be taking each year.

4.4. ARDL Diagnostic Tests

The diagnostic tests are conducted and the result as showed that, model 1 and 2 passed the Heteroscedasticity, Serial correlation, Normality and functional form time series problems and model 3 has serial correlation and normality problems. The result therefore justifies the consistency and efficiency of the model 1 1nd 2 as the probability values are above 5per cent, and therefore the hypothesis of no time series problem has to be accepted. It can be deduced that the model 1 and 2 are valid and can be used for policy making without re-specification. The Table 5 below reports the result of the test.

Table-5. Diagnostic Test with HPS, NGS and OCS.

Test	F-Statistics	P-Value
Heteroskedasticity	0.509786	0.8564
Serial Correlation	0.667197	0.5208
Normality	1.33445	0.513132
Functional Form	0.014755	0.9042
Heteroskedasticity	1.222734	0.3154
Serial Correlation	0.762039	0.4761
Normality	3.949977	0.138763
Functional Form	12.23866	0.0002
Heteroskedasticity	1.699733	0.1254
Serial Correlation	0.1254	0.0175
Normality	8.770155	0.0000
Functional Form	1.517863	0.468166

Note:
*Autoregressive conditional heteroskedasticity ARCH is used to test for heteroskedasticity.
*Breusch-Godfrey Serial correlation test is used to test for serial correlation.
*Jacque-Bera test is used to test for normality.
*Ramsey's RESET test is used to test for functional form.

The stability test is shown by cumulative sum of recursive residuals (CUSUM) and cumulative sum of squares of recursive residuals (CUSUMSQ) in appendix. Figures 2, 3 and 4 of model 1, 2 and 3 respectively, depict that the position of the blue line within the critical bound implies that the model is stable over the sample period as it lies between the critical bound at 5 per cent level of significance.

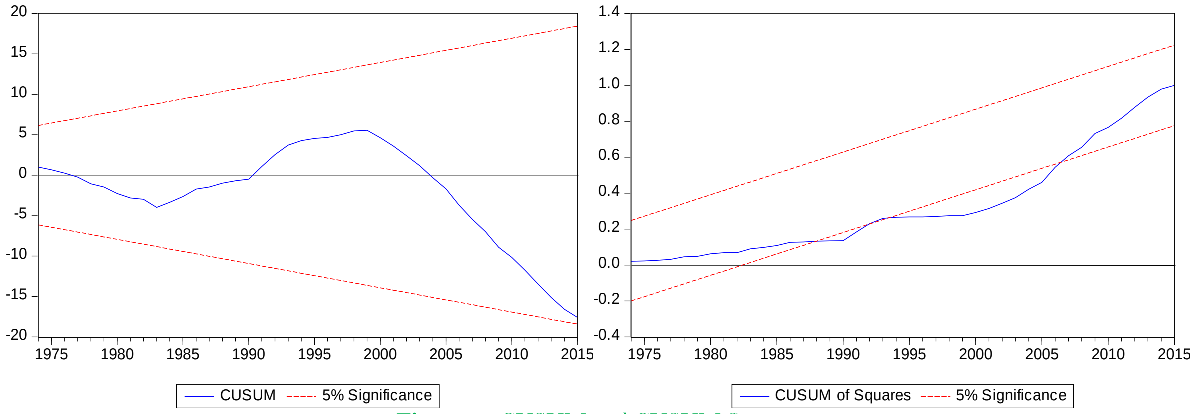

Figure-2. CUSUM and CUSUM Square.

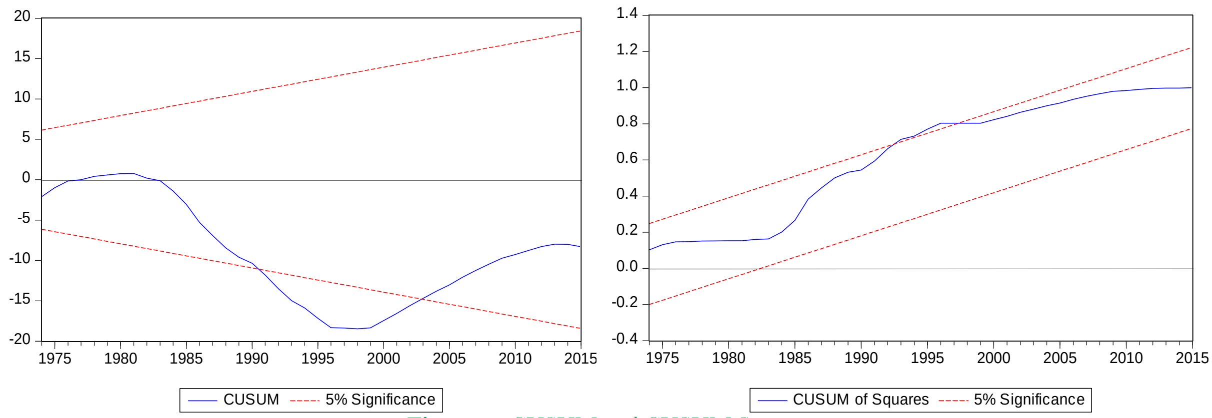

Figure-3. CUSUM and CUSUM Square.

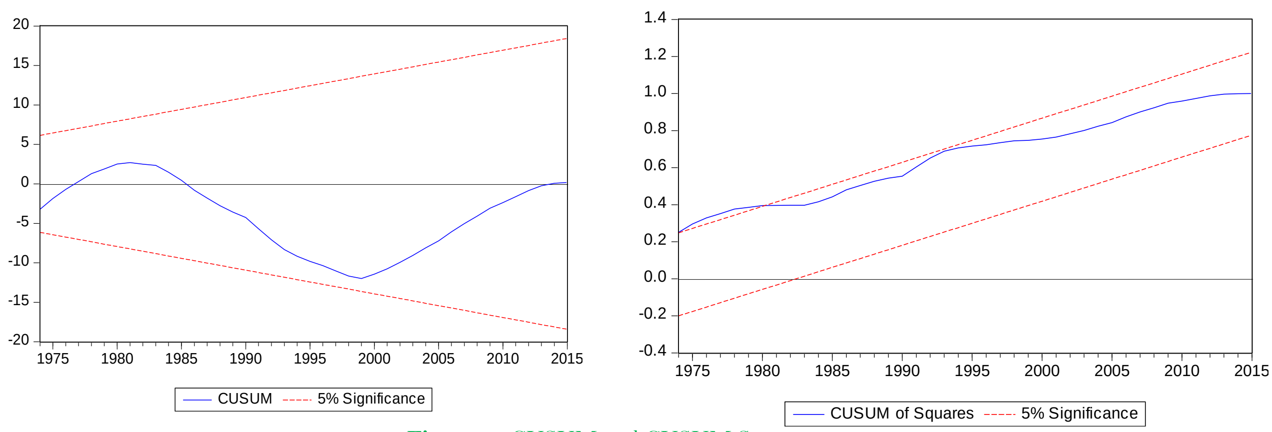

Figure-4. CUSUM and CUSUM Square.

5. Conclusion and Recommendations

This study has examined the role of population growth on energy generation in Nigeria. All the independent variables (population and real gross domestic product) have statistical significance on the dependent variables (hydro power source HPS, natural gas source NGS and oil and coal OCS). A graphical representation of the movement and variations in the values of different sources of energy generation, population, and real gross domestic product for the 44-year period was captured to depict the movement of values and also to compare the influence of each of the independent variables on the dependent variables. Findings of this study therefore provide insight into the impact of population growth on energy generation in Nigeria. It also provides an affirmation of the extent to which the variations in the dependent variable are caused by the independent variables. The study concludes that population growth have significant negative impact on the energy generation from hydro power source, conversely population growth have positive and significant impact on energy generation from natural gas, oil natural gas and coal over the period of study. The two result showed positive relationship are satisfactory than the first result, because energy is generated exogenously by government independent of the population. The above statement can be back up by china and USA population compare to their level energy resources.

5.1. Recommendations

Nigeria government should adequately project the growing rate of population in advance so as to generate volume of energy that will meet the demand of the entire citizens as population is growing. Strengthen and develop strong state and federal energy policies that encourages strategic role of the private sector in the national energy generation. Ensure the oil and gas producers develop an environmental management policy indicating specific target to manage gas flares responsibly, for which they should be held accountable like it is obtained in Norway and the UK. Massive and strategic investment in pipeline distribution infrastructure from the south to the north of the country as it's done in developed countries. There is need to stipulate very stiff penalties to companies flaring natural gas and monitor its implementation doggedly.

5.2. Suggestion for Further Studies

This study focused on the impact of population growth on energy generation in Nigeria. It is suggested that future studies should extend the research to other modes of energy generation that will be tally for the growing rate of population in Nigerian.

References

Acaravci, A., & Ozturk, I. (2010). On the relationship between energy consumption, CO2 emissions and economic growth in Europe. *Energy, 35*(12), 5412-5420.Available at: https://doi.org/10.1016/j.energy.2010.07.009.

Acaravci, A., & Ozturk, I. (2013). The long-run and causal analysis of energy, growth, openness and financial development on carbon emissions in Turkey. *Energy Economics, 36*, 262-267.

Adeniran, O. (2008). *Does energy consumption cause economic growth? An empirical evidence from Nigeria.* United Kingdom: University O Dundee.

Adeyemi, P. A., & Ogunsola, A. J. (2016). The impact of human capital development on economic growth in Nigeria: ARDL approach. *IOSR Journal of Humanities and Social Science, 21*(3), 1-7.

Aliero, H. M., & Ibrahim, S. S. (2012). The relationship between energy consumption and economic growth in Nigeria: A causality analysis. *International Journals of Marketing and Technology, 2*(3), 1-13.

Amoo, O. M., & Fagbenle, R. L. (2013). Renewable municipal solid waste pathways for energy generation and sustainable development in the Nigerian context. *International Journal of Energy and Environmental Engineering, 1*(4), 1-17.

Dantama, Y. U., Abdullahi, Y. Z., & Inuwa, N. (2016). Energy consumption-economic growth nexus in nigeria: An empirical assessment based on ardl bound test approach. *European Scientific Journal, 8*(12), 141–157.

Ebohon, O. J. (1996). Energy, economic growth and causality in developing countries: A case study of tanzaniya and Nigeria. *Energy Policy, 24*(5), 447–453.

Engle, R. F., Granger, C. W. J., & Mar, N. (1987). Co-Integration and error correction: Representation, estimation, and testing. *Econometric Society Monographs, 55*(2), 251–276.

Essah, E. A. (2011). Energy generation and consumption in Ghana. *West Africa Built Environment Research*, 391–401.

Johansen, S. (1988). Statistical analysis of cointegration vectors. *Journal of Economic Dynamics and Control, 12*(2-3), 231-254.

Khazan, Y. (2010). Melt segregation and matrix compaction: The mush continuity equation, compaction/segregation time, implications. *Geophysical Journal International, 183*(2), 601-610.

Mishra, V., Sharma, S., & Smyth, R. (2009). Are fluctuations in energy consumption per capita transitory? Evidence from a panel of Pacific Island countries. *Energy Policy, 37*(6), 2318-2326.

Mohammed, Y., Mustafa, M., Bashir, N., & Mokhtar, A. (2013). Renewable energy resources for distributed power generation in Nigeria: A review of the potential. *Renewable and Sustainable Energy Reviews, 22*, 257-268.

Ogundiran, P. (2018). Rrnewable energy as alternative source of power and funding of renewable energy in Nigeria. *Asian Bulletin of Energy and Technology, 4*(1), 1-9.

Oji, J., Idusuyi, N., Aliu, T., Petinrin, M., Odejobi, O., & Adetunji, A. (2012). Utilization of solar energy for power generation in Nigeria. *International Journal of Energy Engineering, 2*(2), 54-59.

Okonkwo, C., & Odularu, O. (2009). Does energy consumption contribute to economic performance? Empirical evidence from Nigeria. *Journal of Economics and International Finance, 1*(2), 044-058.

Olugbenga, T. K., Jumah, A.-G. A., & Phillips, D. (2013). The current and future challenges of electricity market in Nigeria in the face of deregulation process. *African Journal of Engineering Research, 1*(2), 33-39.

Omotor, D. G. (2008). Causality between energy consumption and economic growth in Nigeria. *Pakistan Journal of Social Sciences, 5*(8), 827-835.

Onayemi, S. O., Olomola, P. A., Alege, P. O., & Oluwakemi, O. O. (2020). Foreign direct investment, electricity power supply and economic growth in Nigeria. *International Journal of Energy Economics and Policy, 10*(5), 243–247.

Pesaran, M. H., & Shin, Y. (1999). An autoregressive distributed lag modelling approach to cointegration analysis. *Econometrics and Economic Theory in the 20th Century, 32*(7), 371-413.

Pesaran, M. H., & Shin, Y. (1998). An autoregressive distributed-lag modelling approach to cointegration analysis. *Econometric Society Monographs, 31*(7), 371-413.

Pesaran, M. H., Shin, Y., & Smith, R. J. (2001). Bounds testing approaches to the analysis of level relationships. *Journal of Applied Econometrics, 16*(3), 289-326.

Sadiq, A. A., Ramli, A. T., & Saleh, M. A. (2013). Nigeria electricity crisis: Power generation capacity expansion and environmental ramifications. *Energy, 61*, 354-367.

Suberu, M. Y., Mokhtar, A. S., & Bashir, N. (2012). Renewable power generation opportunity from municipal solid waste: A case study of Lagos metropolis (Nigeria). *Journal of Energy Technologies and Policy, 2*(2), 1-14.

Wojuola, R. N., & Alant, B. P. (2017). Public perceptions about renewable energy technologies in Nigeria. *African Journal of Science, Technology, Innovation and Development, 9*(4), 399-409.

Yakubu, Y., Salisu, B., & Umar, B. (2015). Electricity supply and manufacturing output in Nigeria: Autoregressive distributed lag (ARDL) Bound testing approach. *Journal of Economics and Sustainable Development, 6*(17), 7-19.