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Impact of Renewable Energy Consumption on Economic Growth in Nigeria

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Abstract

This study investigated the impact of renewable energy consumption on economic growth in Nigeria for the period 1990-2019. The study adopted Autoregressive Distributive lag (ARDL) approach and Toda-Yamamoto (T-Y) causality approach as the methods of analysis. The result of the ARDL bound test showed that there were two co-integrating vectors in the model confirming the existence of a long run equilibrating relationship amongst the variables. The result further showed that both the long run and short run estimates established a negative and significant relationship between renewable energy consumption and economic growth in Nigeria. The Toda-Yamamoto result revealed that there was a strong one-way causal relationship between renewable energy consumption and economic growth with direction (flowing) from renewable energy consumption to economic growth in Nigeria. Based on the findings, the study recommended that government, policy makers and all stakeholders in the energy sector should make deliberate policies to diversify the sources of energy to accommodate more streams of renewable energy in order to enhance productivity and foster economic growth in Nigeria.

Keywords: *Renewable energy, Economic Growth, Autoregressive Distribution Lag, Toda-Yamamoto Causality Test.*
JEL Classification: Q4, Q42, Q43, Q47

Contribution/Originality:
This study contributes to knowledge by revealing that renewable energy consumption has impacted significantly on the Nigerian economy via the gross domestic product for the period under study. This is one of the very few studies that adopted Autoregressive Distributive lag (ARDL) approach and Toda-Yamamoto (T-Y) causality approach as methods of analysis to study the impact of renewable energy consumption on economic growth in Nigeria.

1.0 Introduction

Energy plays an important role in the growth and development processes of every economy. Energy is a fundamental resource in the economy as every facet of economic activities in this planet earth requires energy. It is also used as an indicator of economic growth rather than the supply of goods and services. Consequently, economic growth is directly related to energy consumption (Chinedu, Daniel, & Ezekwe, 2019). As Alam (2006) puts it, energy is the indispensable force driving all economic activities.

According to Oinnaka (2008), energy consumption runs hand in hand with the national product. Continuous increase in production in the world has increased the need for energy, but the insufficiency of oil and natural gas resources in the world poses an obstruction for sustainable economic growth. Again, the global increase in demand for oil and carbon emissions with its attendant climatic and environmental degradation problems has continued to shape the renewed efforts in harnessing renewable sources of energy (Uzokwe & Onyije, 2020; Iorember, Goshit, & Dabwor 2020). Developing countries like Nigeria are faced with the twin challenges of sluggish economic growth and the mounting imperative to decarbonize their economies. Countries are looking for solutions to improve their economic performance while minimizing further greenhouse gas emissions. Given this context, renewable energy is emerging not only as a solution to meet growing energy demand while sharply reducing carbon emissions but also as a potential engine for economic growth and diversification (IRENA, 2016).

The generation and utilization of renewable energy in Nigeria is still in the infantry stage (Akorede et al, 2017). According to Renewable Energy Master Plan (REMP) developed by the energy commission in 2005, Nigeria targets to expand energy access to 90 percent of its population by 2030 and 30 percent of their total generation to be from renewable sources (Gerretsen, 2018; Aliyu, Modu, & Tan, 2018). The Renewable Energy Master Plan (REMP) seeks to increase the supply of renewable electricity from 13% of total electricity generation in 2015 to 23% in 2025 and 36% by 2030. Renewable electricity would then account for 10% of Nigerian total energy consumption by 2025. However, these targets are far near actualization given the current level of generation of renewable electricity to the total energy consumption in the country. Furthermore, literature for transiting to renewable energy is not yet clear and proven particularly for countries like Nigeria that are huge exporters of conventional energy sources. Given these facts, the objective of this study is to investigate the impact of renewable energy consumption on economic growth in Nigeria.

This paper is structured into five sections with the introduction as section one. Section two is the conceptual, theoretical and empirical review related to the study. Section three deals with the Methodology applied in the study. Section four presents the results and discussed the findings of the study. Section five provides the conclusion and policy recommendation of the study.

2.0 Literature Review

2.1 Conceptual Issues

Energy is generally defined as ability to do work. Energy comes in different forms: Heat (thermal), Light (radiant), Motion (kinetic), Electrical, Chemical, Nuclear energy and Gravitational. Researchers have identified major categories of energy namely: Stored (potential) energy and Working (kinetic) energy. Energy sources are divided into two groups: Renewable (an energy source that can be easily replenished) and Non-renewable energy (source that cannot be easily replenished) such as oil, gas and coal (Chinedu, Daniel, & Ezekwe, 2019). Renewable energy is conceptualized by the U.S. Energy Information Administration (EIA) as, energy from naturally replenishing sources that are inexhaustible (EIA, 2013). This includes sunlight, geothermal heat, wind, tides, water, and various forms of biomass. This energy cannot be exhausted and is constantly renewed. Renewable energy includes all forms of energy produced from renewable sources in a sustainable manner, including bioenergy, geothermal energy, hydropower, ocean energy, solar energy and wind energy (International Renewable Energy Agency, 2013).

Nigeria is blessed with abundant fossil, renewable and nuclear energy sources. The fossil energy resources include crude oil and natural gas, coal and tar sands while the clean and renewable energy include hydro, biomass, wind and solar. The renewable use of energy sources is still on the infant stage in Nigeria unlike nonrenewable sources which have been exploited for decades and used for productive and domestic purposes (Maji, 2015).

Economic growth according to Lipsey (1986) is the positive trend in the nation's total output over a long period of time. This implies a sustained increase in Gross Domestic Product (GDP) for a long time. Economic growth can also be seen as what is most frequently expressed in terms of increase in gross domestic product (GDP), a measure of the economy's total output of goods and services. This GDP as measure of economic growth, like any other economic quantities, must be expressed in real terms. That is, it must be adjusted for the effects of inflation so as for it to provide meaningful measure of growth overtime i.e. rebasing as was done by Nigeria in 2015.

Despite the continent's wealth of alternative and renewable energy sources such as solar, thermal, photovoltaic, wood, biomass, wind, and biogas, a major section of the African population lacks access to power. According to Kaygusuz, Yuksek, and Sari (2007), promoting renewable energies will not only contribute to increased modernisation of the energy sector, but will also benefit many countries' economic development and sustainability goals.

2.2 Theoretical Consideration

Considerable literature exists on the causality on energy-growth nexus and has been largely explored from different competing views which can be divided into four: Growth hypothesis, conservative hypothesis, feedback hypothesis and neutrality hypothesis.

The first view states that energy consumption plays a crucial role in economic growth. This is known as the growth hypothesis which is advanced by ecological economists, who argued that all the other inputs (technological improvement, capital and labour) could not substitute for the important role that energy plays in the production process (Stern, 1993).

The second view states the unidirectional causality that runs from economic growth to energy consumption; this is known as the conservation hypothesis. This theory postulates that a country's economic growth is highly associated with energy consumption because energy as any other production factor may be the limiting factor to economic growth (Alam et al, 2012). In this regard the policy of conserving energy consumption, such as the reduction in greenhouse gas emissions efficiency improvement measures, and demand management policies, designed to reduce energy consumption and waste may have little or no adverse effect on economic growth. As a result, if an increase in real GDP leads to an increase in energy consumption, this theory is justified.

The feedback hypothesis asserts the existence of a bidirectional causal relationship between energy consumption and economic growth. This theory reflects the interdependence between energy consumption and growth, implying that energy consumption and economic growth are jointly determined and affected at the same time. Although bi-directional causality implies that energy conservation policy harms economic growth in aggregated level, energy policy should be carefully regulated, since one-sided policy selection is harmful for economic growth (Yildirim & Aslan, 2012).

The fourth view on the causality relationship between growth and energy is the neutrality hypothesis. This view according to the neoclassical economists argued that energy does not influence economic growth (Stern & Cleveland, 2004). In other words, both energy consumption and economic growth are neutral with respect to each other, meaning that capital and labour are the primary factors of production while energy is seen as intermediate input of production which is used up in the entire production process (Tsani, 2010; Alam et al, 2012). This theory thus postulates that there is no causality between energy consumption and economic growth.

2.3 Empirical Review

The empirical literature provides mixed and conflicting evidence with respect to the energy consumption-growth nexus (Pradhan, 2010; Shuyun & Donghua, 2011; Ma, Bin, & Long, 2011). This phenomenon can be attributed to a number of factors, including estimation techniques, choice of variables, study period, and level of development of the country being studied, among other things.

Haseed, Abidin, Hye, and Hartami (2019) examined the role of renewable energy in influencing economic well-being in Malaysia from 1980–2016. They adopted ARDL method of estimation. The results of the auto regressive distributed bound testing approach confirmed a valid long-term connection among renewable energy and economic well-being in Malaysia. Furthermore, the results indicated that renewable energy had significant and positive impact on economic well-being in short and long run.

Uzokwe and Onyije (2020) examined the relationship between renewable and non-renewable energy consumption and economic growth in Nigeria from 1984 to 2015 deploying the Autoregressive distributive lag model (ARDL) approach and the Vector autoregressive (VAR) as well as Granger Causality test. The overall findings suggested the absence of causality which supports the neutrality hypothesis and the presence of a positive relationship between non-renewable energy consumption, renewable energy consumption and economic growth both in the short run and long run.

Iorember, Goshit, and Dabwor (2020) investigated the nexus between renewable energy consumption and environmental quality in Nigeria; accounting for the role of financial development and re-examines the validity of the environmental Kuznet curve (EKC) hypotheses for Nigeria covering 1990 to 2016. The study employed Lee and Strazicich (2013) and Bayer and Hanck (2014) combined cointegration tests to check for stationarity and cointegration among the variables, and then apply autoregressive distributed lag (ARDL) and vector error correction model (VECM) Granger causality tests to explore the effect and causal relationship respectively. The results divulge that renewable energy consumption improves environmental quality, while financial development hurts the environment. Further, the results validated an inverted U-shaped association between economic growth and environmental degradation in Nigeria.

Chinedu, Daniel, and Ezekwe (2019) examined the impact of energy consumption on economic growth in Nigeria over a period 1980 to 2017. The Study adopted Engle-Granger Co-integration test and the error-correction mechanism to analyze the relationship between energy consumption and economic growth in Nigeria. The study concluded that there is a positive relationship between energy consumption and economic growth in Nigeria.

Bello, Dalhatu, and Dahood (2018) examined the relationship between energy consumption and economic growth in Nigeria for the period 1986-2016. The study adopted a survey method in investigating the relationship. Findings of the study revealed that, energy consumption has significant relationship with economic growth in Nigeria over the period.

Aminu and Aminu (2015) in their study to re-examine the causal relationship between energy consumption and economic growth using Nigeria's data from 1980 to 2011 in a multivariate framework by including labour and capital in the causality analysis. Applying Granger causality test, impulse response and variance decomposition analysis; the results of the causality test reported absence of causality and that of variance decomposition found that capital and labour are more important in affecting output growth compared to energy consumption.

Maji (2015) examined the impact of clean energy on economic growth in Nigeria. Autoregressive distributed lag (ARDL) approach to cointegration was used to determine the existence of cointegration among the variables. The long run results suggested a significant negative relationship between two indicators of clean energy (alternative and nuclear energy and electric power consumption) and economic growth. The result further revealed a significant positive relationship between combustible renewables and waste and economic growth. Mixture of negative and positive relationships between clean energy indicators and economic growth was obtained in the short run, although not significantly different from zero.

Dantama and Inuwa (2012) examined the causality relationship between energy consumption and economic growth in Nigeria by employing Granger causality test for 1980-2010 periods. The results obtained herein revealed that there exists a unidirectional causality running from energy consumption to economic growth without feedback. Thus, energy conservation policies will have a negative repercussion on economic growth in Nigeria. As evidenced from the study, causality runs from energy consumption to economic growth.

2.4 Research Gap

This study improved on existing studies as it relates to Nigeria by assessing explicitly the impact of renewable energy component of the energy mix on Nigeria's economic growth from

1990-2019. The study also improved on the methodology used by other researchers in the study area in Nigeria by adopting ARDL methodological approach, Toda-Yamamoto causality technique which is robust and a more advance technique of finding the direction of causality as compared to Engle-Granger technique.

3.0 Data and Methodology

To achieve the objective of this study annual time series data from 1990 to 2019 was employed. This period was chosen because the quest for the development of the Nigerian renewable energy sector was heightened within these periods. The data set on Renewable Energy Consumption, Gross Fixed Capital Formation and Labour Force were obtained from World Development Indicators (WDIs) whereas, data on Real Gross Domestic Product was obtained from Central Bank of Nigeria Statistical Bulletin 2020 edition.

The Solow growth model is adopted to capture the relationship between renewable energy consumption (technology) and economic growth in Nigeria. This model is included in the framework to justify the inclusion of labour and capital as control variables. Thus, mathematically, the model is expressed as:

$$Out(Q) = a(L,K) \quad (1)$$

Where**:** **a** is the technical coefficient, **L** is labour and **K** is capital

Keeping all the above theoretical argument in view, the algebraic model is specified as follows:

$$RGDP = f\left(REC, GFCF, LF\right) \quad (1)$$

Where: *RGDP* is real gross domestic product, REC is renewable energy consumption, GFCF is gross fixed capital formation and LF is the total labour force. The econometrically estimable equation is specified thus:

$$RGDP_t = \beta_0 + \beta_1 REC_t + \beta_2 GFCF_t + \beta_3 LF_t + \mu_t \quad (2)$$

Here the parameters, β_i i =1, 2, and 3 are the coefficients of the estimable variables in the model. μ_t is the error term. On apriori ground: β_1, β_2, $\beta_3 > 0$.

This study adopted the Autoregressive Distributed Lag (ARDL) cointegration technique introduced by Pesaran, Shin and Smith (2001), to analyse both the long-run and short-run relationship between economic growth and the explanatory variables. Researchers are using ARDL estimator due to its several advantages; For example, it does not impose the restriction that all under consideration data series have the same order of integrations and it is applicable irrespective of whether the regressors are I(0) or I(1) order of co-integration (Pesaran & Pesaran, 1997). Pesaran and Shin (1999) note that ARDL estimators produce the true parameters as compared to Johansen and Juselius's co-integration technique in the case of small sample and the coefficients from the ARDL estimators are super consistent in small sample sizes. Therefore, this is more relevant in this case where we have a data series of 30 annual observations. Furthermore, endogeneity is less a problem in ARDL framework because it is free of residual correlation. Pesaran and Shin (1999) have shown that the ARDL method can distinguish between dependent and explanatory variables and the estimation is possible even when the explanatory variables are endogenous (Pesaran & Pesaran, 1997; Pesaran, Shin, & Smith, 2001). ARDL model of equation (2) is presented below:

$$\begin{aligned} \Delta \ln RGDP_t = \alpha_0 + \sum_{i=1}^{\rho}\alpha_1 \Delta \ln RGDP_{t-1} + \sum_{i=1}^{\rho}\alpha_2 \Delta \ln REC_{t-1} + \sum_{i=1}^{\rho}\alpha_3 \Delta \ln GFCF_{t-1} + \\ \sum_{i=1}^{\rho}\alpha_4 \Delta \ln LF_{t-1} + \lambda_1 \ln RGDP_{t-1} + \lambda_2 \ln RE_{t-1} + \lambda_3 \ln GFCF_{t-1} + \lambda_4 \ln LF_{t-1} + \varepsilon_t \end{aligned} \tag{3}$$

On the left-hand side Δ is the lag operator and the expression from λ_1 to $\lambda_4$on the right-hand side depicts the long-run relationship between the variables, while the expression from α_1 to α_4 with the summation signs corresponds to the short-run dynamics of the variables. α_0 represents drift constant and μ_t is disturbance term. To avoid size distortion, this study adopts the critical values of small sample size as computed in Narayan (2005) for bound testing. If co-integration is detected among the series, both short-run and long-run coefficients are estimated (Pesaran et al. 2001). The short run dynamics and the error correction model is specified as.

$$\begin{aligned} \Delta \ln RGDP_i = \beta_0 + \sum_{i=1}^{\rho}\delta_i \Delta \ln RGDP_{t-1} + \sum_{i=1}^{\rho}\varnothing_i \Delta \ln REC_{t-1} + \\ \sum_{i=1}^{\rho}\omega_i \Delta \ln GFCF_{t-1} + \sum_{i=1}^{\rho}\lambda_i \Delta \ln LF_{t-1} + \alpha ECM_{t-1} + \mu_t \end{aligned} \tag{4}$$

The ECM measures the speed of adjustment to long-run equilibrium after a short-run distortion in the model (Onisanwa, Shido-Ikwu & Mercy, 2018). According to Narayan (2005), the system can only converge to equilibrium in the long-run, if the coefficient of the error correction model is less than zero and negatively signed.

This study also employed the Toda-Yamamoto Causality technique proposed by Toda-Yamamoto (1995) in testing the causal relationship between real gross domestic product and renewable energy consumption using regression model which is based on a modified version of Granger non-causality test. This technique was employed in order to overcome the weaknesses in the ordinary Granger causality test. The T-Y test uses an augmented SVAR K+dmax which generates asymptotic VAR statistic in the form of chi-squared distribution. Where K is the optimal lag length and dmax is the maximum order of integration.

4.0 Results and Discussion

The unit root results of the variables employed in the model were presented in Table 1. Therefore, the properties of the time series were carefully evaluated using Augmented Dickey-Fuller (ADF) test, Phillip-Perron (PP) test and Kwiatkowski-Phillips-Schmidt-Shin (KPSS) test. The series were converted into natural logarithm before the unit root tests were performed.

Table 1: Stationarity Test

Variable	ADF Units Root Test				PP Unit Root Test			
	Intercept		Intercept with trend		Intercept		Intercept with trend	
	I(0)	I(1)	I(0)	I(1)	I(0)	I(1)	I(0)	I(1)
LRGDP	-1.8096	-5.1978***	-1.8681	-5.1547***	-1.8627	-5.1978***	-1.8681	-5.1546***
LREC	-2.6500*	-5.3058***	-2.6053	-5.1963***	-2.7819*	-5.3363***	-2.7414	-5.2723***
LGFCF	-0.9852	-5.6993***	-2.5077	-5.6218***	-0.9852	-6.1398***	-2.5288	-6.0253***
LIF	1.4880	-3.4486**	-0.174	-3.5767*	1.0968	-3.3959**	-0.8109	-3.5370

Table 2: KPSS unit root test

	Intercept		Intercept with trend	
	I(0)	I(1)	I(0)	I(1)
LRGDP	0.1487***	0.1091***	0.1345***	0.0702***
LREC	0.1081***	0.1960***	0.0945***	0.1961***
LGFCF	0.6779***	0.0801***	0.0859***	0.0592***
LLF	0.6956***	0.2296***	0.1240***	0.1295***

Note: ***, ** & * denote significance level at 1%, 5% and 10% respectively. In ADF and PP test, the values are the t-statistics for testing the null hypothesis that the series has unit root. While in KPSS test, the values are the t-statistics for testing the null hypothesis that the series are stationary. In KPSS, the null hypothesis is accepted only if the t-statistics fall below the asymptotic critical values. Source: Author's computation using Eviews 10.

The first panel of Table 1 depicts the output from the ADF and PP unit root test. The ADF and the PP results showed that all variables except LREC were found to be non-stationary at level when considering intercept without trend. LREC was found to be stationary at 10% level of significance. However, LRGDP, LREC and LGFCF were found to be stationary at 1% level of significance after taking the first difference when considering intercept without trend. LLF was found to be stationary at 5% level of significance.

Consequently, when considering intercept with trend, all the variables (LRGDP, LREC, LGFCF and LLF) where found to be non-stationary at level in both ADF and PP test. Meanwhile, after adjusting for first difference; LRGDP, LREC and LGFCF became stationary at 1% level of significance respectively, while LLF was found to be stationary at 10% level of significance.

The second panel of Table 1 depicts the output from the KPSS unit root test. The KPSS result showed that all the variables are stationary at 1% level of significance for all tests. Since the variables have a mixture of order of integration and none of them was found stationary beyond first difference, such unit root characteristics therefore justify the use of the Autoregressive Distributed Lag Model and the data being a good fit.

ARDL Bound Cointegration Test

Cointegration is established among the series if the calculated F- statistic is beyond the upper critical values at any conventional levels of significance. However, if the value of F- statistic is found less than the lower critical bound value, then long run relationship does not exist. Besides, if the computed value of the F-statistic lies in between the range of lower and upper value then the long run relationship is inconclusive.

Table 3: ARDL Bound Co-integration Test Result

Model (vector)	F-Statistics	Significance level	Critical values I(0)	Critical values I(1)
LRGDP	7.0908***	10%	3.008	4.15
LREC	3.2853	5%	3.71	5.018
LGFCF	3.2093	1%	5.333	7.063
LLF	6.4905**			

Note: ***, ** and * represent significance level at 1% 5% and 10% respectively. The critical values are based on Narayan (2005) case III for T = 30, due to the small sample size of the study.
Source: Author's Computation using Eviews10.

Table 3 shows the existence of two different co-integrating vectors in the model. We can therefore infer that there is a long-run equilibrating relationship between renewable energy consumption, gross fixed capital formation, total labour force and economic growth in Nigeria.

Long Run Relationship

The long run result of the estimated model is presented in Table 4. The main variables of interest are renewable energy consumption and real gross domestic product. The result of the long run coefficients is depicted in Table 4.

Table 4: ARDL Long Run Estimates

Variable	Coefficient	Std.	t-statistic	Prob.
C	57.26173	21.57882	2.653608	0.0139
LRGDP (-1)	0.752337	0.119823	6.278750	0.0000
LREC (-1)	-8.068721	2.616032	-3.084336	0.0051
LGFCF (-1)	-0.284156	0.375999	-0.755737	0.4572
LLF (-1)	-0.918924	0.858173	-1.070791	0.2949

Source: Author's computation using Eviews 10

Table 4 shows how the variables under study relate to economic growth in the long-run. It is observed that the coefficient of Renewable Energy Consumption (LREC) is negatively signed and statistically significant. This means that renewable energy consumption is significant in explaining the exchanges in economic activities in Nigeria. This finding is in line with the work of Uzokwe and Onyije (2020) who found out that Renewable Energy Consumption has a significant impact on economic growth in Nigeria. In terms of size, it denotes that a percentage point increase in Renewable Energy Consumption would contract the economic growth of Nigeria by 8.0687. The negative coefficient of renewable energy further explains Nigeria's over dependence on fossil fuels or energy (oil and gas) sources for its survival. The controlled variables; Gross Fixed Capital Formation (LGFCF) and labour Force (LLF) respectively were found not to be statistically significant in explaining the level of changes in economic activities in Nigeria. The sizes of the coefficients connote that a percentage increase in gross fixed capital formation and labour force would retard economic growth in Nigeria by 0.28 and 0.92 percent respectively. These findings are in contrast with the work of Haseeb, Abidin, Hye and Hartani (2019), who established a positive relationship between the LGFCF, LLF and economic well-being. These results were in disagreement with the stated apriori expectation.

Short Run Relationship

Table 5 shows that the short-run coefficients of the ARDL result are almost similar to those obtained in the long run. This finding indicates that our selected variables have a stronger impact on economic growth in the long run than in the short run.

Table 5: ARDL Short Run Dynamics and Error Correction Model Result

Variable	Coefficient	Std. Error	t-statistic	Prob.
C	-0.076831	0.091889	-0.836128	0.4121
D(LRGDP) (-1)	0.871807	0.290566	3.000376	0.0066
D(LREC) (-1)	-7.562882	2.908809	-2.599993	0.0163
D(LGFCF) (-1)	-1.079142	459380	-2.349127	0.0282
D(LLF) (-1)	1.221942	3.394361	0.359992	0.7223
ECM (-1)	-1.022937	0.340166	-3.007169	0.0065

Source: Author's computation using Eviews10

The coefficient of ECM_{t-1} shows the speed of adjustment back to the long-run equilibrium after a short run shock. Here, it can be deduced that the disequilibrium that occurred in the short run can revert back to equilibrium in the long run at the speed of 100 percent. The negativity and significance of the term confirms the long run relationship that exists between economic growth and its determinants in the model.

Diagnostic Analysis

Table 6 depicted the results of the diagnostic checks. The study examined the consistency of coefficients of the estimates based on chi-square and Lagrange Multiplier (LM) test as well as stability test using recursive residuals suggested by Brown et al (1975). All test statistics on each null hypothesis could not be rejected at any conventional level of significance. Hence, there is no serial correlation, non-normality and heteroscedasticity.

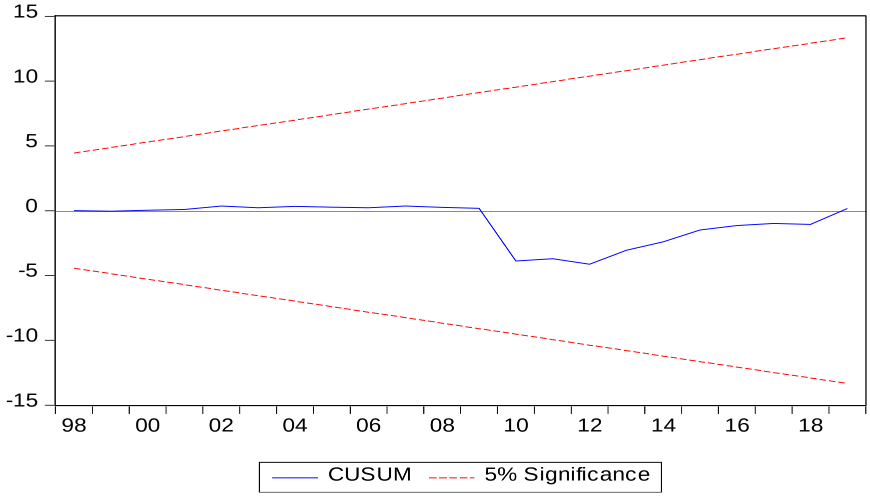
Table 6: Diagnostic Test Result

Test Statistics	Probability Value
χ^2 Serial correlation LM test	0.7108
Heteroscedasticity	0.8419
Jaque-Bera (Normality)	0.9248

Source: Author's Computation using Eviews

The study evaluated the stability of the estimated coefficients using cumulative sum of recursive residual (CUSUM) The results obtained suggest that the coefficients are stable over the study period. This is supported by the graph on figure 1 showing that the series are all within the critical bound at 5% level of significance.

Figure 1: Cumulative Sum of Recursive Residual (CUSUM).



Source: Author's computation using Eviews 10

Toda –Yamamoto Causality Test

The Toda-Yamamoto causality test result presented in Table 7 shows that there is a strong one-way causal relationship between renewable energy consumption and economic growth in Nigeria with direction (flowing) from renewable energy consumption to economic growth. The result supported the growth hypothesis of the energy-growth nexus.

Table 7: Toda –Yamamoto Causality Test Result

Dependent variable: LRGDP

Excluded	Lag(k)	Lag(K+dmax)	Chi-sq	df	Prob.
LREC	1	1+1	7.929842	1	0.0049

Dependent variable: LREC

Excluded	Lag(k)	Lag(K+dmax)	Chi-sq	df	Prob.
LRGDP	1	1+1	0.352843	1	0.5525

Source: Author's computation using Eviews 10

5.0 Conclusion and Policy Recommendation

This study examined the nexus between renewable energy consumption and economic growth in Nigeria for the period 1990-2019. The ARDL bound testing result confirmed a long-run equilibrating relationship between renewable energy consumption, gross fixed capital formation, total labour force and economic growth in Nigeria. The long-run and short-run estimates both established a negative and significant relationship between renewable energy consumption and economic growth in Nigeria. The negative coefficient of renewable energy further explains Nigeria's over dependence on fossil fuels or energy (oil and gas) sources for its survival. A peculiar observation in the estimates was the insignificance of labour force in affecting economic growth in both the long-run and short-run. This was possibly due to the fact that increase in labour force in Nigeria has not translated into increase in the level of productivity. This is due to lack of enabling environment, inadequate human developmental infrastructures, corruption among others, hence making it insignificant in contributing to economic growth in the country, during the period under study. The Toda-Yamamoto causality test result established a strong one-way causal relationship between renewable energy consumption and economic growth in Nigeria with direction (flowing) from renewable energy consumption to economic growth. Based on the findings, the study recommended, that government, policy makers and all stakeholders in the energy sector should make deliberate policies to diversify the sources of energy to accommodate more streams of renewable energy in order to enhance productivity and foster economic growth in Nigeria.

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