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Accessing Renewable Energy and Nigeria Economic Growth Nexus: A Critical Evaluation

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Abstract
This research accesses the nexus of renewable energy on Nigeria's economic growth. The study covered the period of 1981–2014, and the Autoregressive Distributed Lag (ARDL) approach to co-integration was used to evaluate the presence of co-integration between variables. The long-run and short-run findings indicate a significant negative relationship between the economic growth and renewable energy in the country.The significant relationship between renewable energy consumption and economic growth confirms the presence of unidirectional causality from energy consumption to economic growth or the growth hypothesis, indicating that measures to curb pollution using renewable energy sources or to transition to renewable energy sources will be associated with decline in economic growth.Similarly, capital formation was found to decrease economic growth in the long-run, while labour force participation increased economic growth in the long-run. We concluded that despite the estimated negative long-run relationship between economic growth and renewable energy consumption, Nigeria has potentials of renewable energy to be reaped in near future given necessary regulatory reforms.

Key Words: Renewable Energy, Capital, Economic Growth, Labour.

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I. Introduction

Nigeria is a vast, multi-ethnic, multi-religious, and multi-cultural country with a population size of above 200m (World Bank, 2019). Nigerian economy is a mixed one, with people distributed over land area of about 923,768 square kilometers, lying East of Benin Republic, South of Niger / Chad Republic, West of the Republic of Cameroun and North of the Gulf of Guinea. Renewable energy usage in Nigeria is still in its infancy with non-renewable sources that have been used for decades and used for domestic and competitive purposes.

Latterly, renewable and clean energy alternatives have widespread attention due to the long-term threats of climate change to global ecosystems and economies (Simsek & Simsek, 2013). Sustainable energy solutions are urgently needed to adapt to this challenge of climate change and rising global energy demand. The need for a change from the use of traditional, fossil energy sources that release harmful emissions into the atmosphere to greener energy sources is a current concern in the energy-dependent growth literature. Most developed countries have developed a legislative framework to promote the use of renewable energy sources in accordance with the goals of the World Energy Organization and the General Union for Climate Change and Environmental Cooperation, such as the International Energy Agency (IEA) and the Kyoto Protocol (Maji,2015). Such goals include the improvement of the global energy supply and demand system by creating new sources of renewable energy and increasing the efficiency of energy consumption.

Nigeria has abundant sources of renewable energy, which includes solar energy, wind energy, hydropower and biomass, among others. Interest in the adoption of renewable energy has increased, caused in part by the volatility in global energy prices and quest for sustainable growth and development (Adewuyi etal.,2020;Owusu &Asumadu-Sarkodie, 2016; Shaaban &Petinrin, 2014). Despite the fact that the promotion of renewable energy sources is central to the National Energy Master Plan (NEMP) of the country according to the Inter-Ministerial Committee on Renewable Energy and Energy Efficiency (ICREEE)(FGN,2016), the pace of development of renewable energy technologies has been sluggish. There is also a lack of a clear regulatory system for renewable energy. It may have contributed to a decrease in the energy contribution to the Gross Domestic Product (GDP) from 15.50 per cent in 2010 to 13.70 per cent in 2013(FGN,2016). An immense amount of renewable energy was required to reach the nation's goal to develop the economy at a rate of 11 percent to 13 percent as was stated in the Vision 20:2020; to be one of the 20 largest economies in the world by 2020 (FGN, 2016; Maji, 2015;NDC, 2016; Oyeleke &Akinlo, 2019).

TheNigerian government has announced signing an agreement to introduce a national renewable energy policy in Nigeria. This is supposed to increase the availability of renewable and environmentally sustainable energy sources. Nigeria's electricity supply requirement of 30,000 MW is expected to be generated from renewable sources and certain initiatives aimed at promoting growth in this sector include: the implementation of a regulatory structure for renewable energy, the licensing of private sector investment in clean energy relevant industries and an affordable tariff for international investments in renewable energy, among others. Against this background, this study critically evaluates the link between renewable energy and Nigeria's economic growth.

Statement of the problem

Nigeria has been facing inadequate electricity production over the years, despite being one of the biggest economies in sub-Saharan Africa. Nigeria is abundantly endowed with both traditional energy resources (oil, natural gas, lignite and coal) and alternative energy sources (biomass, solar, hydropower and wind). Several studies have linked higher energy consumption to positive economic growth. However, energy production and use from fossil fuels has been related to greenhouse gas (GHG) emissions, which also exacerbate global warming and climate change. Due to current global drive to reduce greenhouse through agreements such as the Paris Agreement which Nigeria is a party and Nationally Determined Contributions (NDCs) (NDC, 2016), several nations, including Nigeria, are seeking to reduce GHG emission, energy security through renewable energy sources and sustainable economic growth and development. It is unclear, however, how this transition will impact the global economy, especially in developing countries such as Nigeria. There is still a knowledge gap in the economic literature of how transition to renewable energy will have effect on the economy in both the long run and short run.

Research questions

1. To what extent does renewable energy affect Nigeria’s economic growth?
2. To what extent does renewable energy productionaffect Nigeria’s economic growth?

Objectives of the study

The main objective of this study is to critically evaluate and access the effect of renewable energy on Nigeria economic growth.

Research hypothesis

H_0 = renewable energy has no effect on Nigeria economic growth.

H_1 = renewable energy has effect on Nigeria economic growth.

Conceptual Clarifications

There is no consensus in the literature on the relationship between renewable energy consumption and economic growth, because the institutional features of the countries studied, their level of development and the timeline studied are different. According to word web dictionary, renewable energy is simply defined as energy generated without using up limited resources such as fossil fuels. However, several scholars have outlined the key conclusions of the literature, noting that four separate hypotheses have been tested and confirmed. These hypotheses are summarized as follows (Marinas, Dinu, Socol, & Socol, 2018):

The first, known as the "non-causality hypothesis" or the "neutrality hypothesis," suggests that there is no econometrically valid relationship of dependency between energy consumption and economic growth. It occurs in countries where actual GDP growth depends to a greater degree on a service sector with low energy consumption. Therefore, validating this hypothesis means that measures aimed at lowering energy consumption in order to minimize the effects of greenhouse gas emissions do not adversely affect domestic production. In other terms, the system can be seen as being decoupled from the energy demand dynamics.

The second is the "uni-directional causality of economic growth" or "conservation hypothesis" according to which GDP growth impacts energy use. In this situation too, decisions to minimize energy consumption would have only a marginal effect on the structure of the economy. Conservation hypothesis can be studied both in the sense of economic activity contributing to higher energy use and in the assumption that economic activity contributes to lower use as a result of resource limitations and decreased demand for energy-intensive goods.

The next hypothesis is the "uni-directional causality of energy consumption" or the "growth hypothesis" that energy consumption has a significant effect on the process of economic growth. Unless there is a positive relationship between these variables, the interventions to mitigate emissions would adversely impact economic growth. Nevertheless, economic experience has demonstrated that there can be a negative association between energy consumption and real GDP growth that can be viewed differently based on the exogenous variable adjustment. Thus, decreasing energy demand positively improves domestic production if the economy is based, to a greater degree, on services that consume less electricity. Similarly, increased energy consumption has a negative impact on GDP if the economy is based on sectors with high energy intensity and low energy efficiency.

The final hypothesis is the "bi-directional causality" or "feedback hypothesis" according to which energy consumption and economic growth are interrelated. As a result, rising energy usage contributes to higher real GDP, which in turn has a positive impact on energy use across the world. In this situation, environmental policy will reduce both emissions and GDP, and economic stimulation will contribute to both GDP growth and decreased energy use.

Economic growth is an increase in the capacity of an economy to produce goods and services, compared from one period of time to another (Loto, 2011). It can be measured in nominal or real terms, the latter of which is adjusted for inflation.

Empirical Review

The scant literature on renewable energy consumption in practice has been varied and so are the respective empirical findings, suggesting mixed results on the effect of renewable energy consumption on economic growth. This has informed the need to explore the relationship between renewable energy and economic growth in Nigeria.The effect of renewable energy on Nigeria economy is reflected on the level of energy consumption in the country. Present levels of energy consumption around the world suggest that Nigeria is one of the countries with the lowest consumption rates given plentiful, renewable energy supplies (Oyeleke &Akinlo, 2019).

Miraj etal (2022) in their study, made use of prism guidelines from 2010 to 2021 to study renewable energy consumption and economic growth, the study showed that renewable energy does not hinder economic growth for both developed and undeveloped countries, but there is a little significance of consumption of renewable energy on economic growth for developed countries.

Ugwoke etal(2020), reviewed Nigeria energy access act from 1978 to 2019 and the result revealed that there is no consensus on the standardised frame work to synergy between the already strategy and methodologies for improving Nigeria energy access.

Ozcan and Ozturk (2019) aver that renewable energy use and energy efficiency have rapidly become a major field of focus in the field of carbon-driven growth. Olugasaetal (2014) investigated methodological analysis of the production of renewable energy from biogas for use in Nigeria; having studied global techniques such as how to store and produce renewable electricity from biogas, they pointed out its long-term economic benefits and applications in addressing energy demand in developing countries such as Nigeria. Vuval (2020) studied the impact of renewable energy and economic growth using cross sectional dependence, second generational unit root test, pedroni cointegration test, panel fully modified ordinary least square (FMOLS) and the result showed a positive effect of renewable energy on economic growth.

Similarly, Ajayi and Ajayi (2013) evaluated energy policies and ethical procedures for the development of renewable energy in Nigeria. They concentrate on Nigeria's legislative structure for the production of renewable energy through the review of the Vision 20:2020 of the Nigerian federal government and the Clean Energy Master Plan brought together by the Nigerian Energy Commission (ECN) and the United Nations Development Program (UNDP), among others. Any of the policy issues listed in the report includes insufficient government fiscal benefits, unfair tax and tariff schemes to support renewable energy technologies. They also proposed that the Nigerian Government change the Land Use Act, the Development Law and the Environmental Impact Assessment Decree. Maji etal (2019) in their study of effect of renewable energy consumption on economic growth of 15 West African countries using panel dynamic ordinary least square (DOLS) found out that there is a negative effect of renewable energy consumption on economic growth of the studied countries. Apergis and Paynet (2011) investigated 80 different countries using panel error correction model (PECM) to study the relation between renewable energy and economic growth. The result showed evidence of feedback hypothesis between renewable energy consumption and economic growth. In addition, Sbia, Shahbaz and Hamdi(2014) studied the relationship between economic growth and foreign direct investment (FDI), trade openness, greenhouse gas emissions and renewable energy for the UAE. They applied the autoregressive distributed lag method to cointegration. Their results indicate that trade openness, greenhouse emissions and foreign direct investment decrease energy use, while renewable technology and economic growth have a positive impact on energy consumption. Additionally, Kanellakis etal (2013) investigated the European Union's energy policies and highlighted the Union 's strategy on energy related issues, including the antecedent of the creation of the Union in 1951. Implemented Union policies include: clean energy, energy savings and efficiency, energy security, and so on. Pfeiffer and Mulder (2013) studied the diffusion of non-hydro renewable energy technologies for electricity production in 180 developing countries using two-stage estimation techniques. They found that diffusion rises with the deployment of economic and regulatory instruments. Similarly, expanded funding and transparency, organizational policy support, increases in the use of electricity and the development of fossil fuels hinder the diffusion of non-hydro renewable energy.

II. Methodology

To ascertain the phenomena under study, the study employed the secondary source of data collection. World Bank Development Indicators (WDI) dataset covering the period from 1981 to 2014. The data set was tailored to the need of the empirical framework and it contained information on economic variables such as Real Gross Domestic Product (Y) as proxy for economic growth, labour (L), labour is believed to be a key determinant of productivity in the short run, provided that capital is set during the development cycle. Capital (K) capital is another theoretically established stimulant of growth performance. Interest rate (I) interest rate is the lending interest rate adjusted for inflation as measured by the GDP deflator. Energy is considered an important factor of production, Combustible renewable energy is used as proxy for renewable energy (RE),this consists of combustible renewable and waste comprise solid biomass, liquid biomass, biogas, industrial waste, and municipal waste, measured as a percentage of total energy use, and Autoregressive Distributed Lag (ARDL) model with E-view software package is used.

The hypothesis has been stated with the view of ascertaining the significant effect of renewable energy on Nigeria economic growth. The functional form of the model is expressed below

$$Y_t = f(RE_t, C_t, L_t, I_t). \qquad (1)$$

The above equation can be written in economic model and equation (1) be transformed to an econometric model by including a constant, a slope for each independent variable and a stochastic error term. The model variables in equation. (1) are further transformed into natural logarithms to enable efficient estimation, see below:

$$lnY_t = \pi_0 + \pi_1 lnRE_t + \pi_2 lnK_t + \pi_3 lnL_t + \pi_4 lnI_t + \mu_t \qquad (2)$$

Where Y_t represents economic growth, RE_t denotes combustible renewable energy, K_t represents capital, $L_t$represents labour and I_t represents interest rate. π_0 Is the intercept, while μ_t is the random error term that is expected to be normally distributed with zero mean and constant variance.

The study adopts the Autoregressive Distributed Lag (ARDL) approach to co-integration as mentioned earlier developed by Pesaran, Shin and Smith (2001) to test the long-term equilibrium between economic growth and renewable energy consumption(Pao etal., 2014; Sbiaetal., 2014).A few of the advantages of using the ARDL co-integration approach over other approaches include: the derivation of the error correction model through a simple linear transformation that incorporates short-run shock adjustment and long-run without losing long-run information; it can be used regardless of whether the variables are stationary at I(0), I(1) or a mixture of both; On the basis of these justifications, this study constructs the unrestricted error correction model of the ARDL co-integration method as follows:

$$\Delta lnY_t = \gamma_0 + \sum_{i=1}^{n} \gamma_{1i}\, \Delta lnY_{t-1} + \sum_{i=0}^{n} \gamma_{2i}\, \Delta lnRE_{t-1} + \sum_{i=0}^{n} \gamma_{3i}\, \Delta lnK_{t-1} + \sum_{i=0}^{n} \gamma_{4i}\, \Delta lnL_{t-1} + \sum_{i=0}^{n} \gamma_{5i}\, \Delta lnI_{t-1} + \alpha_1 lnY_{t-1} + \alpha_2 lnRE_{t-1} + \alpha_1 lnK_{t-1} + \alpha_1 lnL_{t-1} + \alpha_1 lnI_{t-1} + \vartheta_t \quad (3)$$

Having specified an unrestricted error correction model, the researchers then test the joint null hypothesis of the variables, to create a long-run equilibrium relationship between them. The null hypothesis is given as H_0: α_1 = α_1 = α_1 = α_1 =α_1= 0 while the alternative hypothesis is H_1: $\alpha_1 \neq \alpha_1 \neq \alpha_1 \neq \alpha_1 \neq \alpha_1 \neq 0$. the null hypothesis assumes that there is no co-integration, while the alternative implies the presence of co-integration between variables. In order to develop the co-integration of economic growth and renewable energy indicators in Nigeria, the researchers estimate the value of the ARDL co-integration F-statistics via the OLS and compare it with the Narayan Critical Bounds Tables (Narayan, 2005). Co-integration occurs if the sum of the F-statistics is greater than the value of the upper limits of the Narayan critical bounds table. Conversely, there is no co-integration if the approximate F-statistics are less than the lower bound value of the Narayan critical table and the result is inconclusive if the F-statistics falls between the upper and lower bound values. Next, we construct the long-run model of the ARDL co-integration method before estimating equation 3 as follows:

$$lnY_t = \rho_0 + \sum_{i=1}^{n} \rho_{1i}\, lnY_{t-i} + \sum_{i=0}^{n} \rho_{2i}\, lnRE_{t-i} + \sum_{i=0}^{n} \rho_{3i}\, lnK_{t-i} + \sum_{i=0}^{n} \rho_{4i}\, lnL_{t-i} + \sum_{i=0}^{n} \rho_{5i}\, lnI_{t-i} + \vartheta_t \qquad (4)$$

The long run model is followed by the error correction model presented in Eq. (5):

$$\Delta lnY_t = \varphi_0 + \sum_{i=1}^{n} \varphi_{1i}\, \Delta lnY_{t-i} + \sum_{i=0}^{n} \varphi_{2i}\, \Delta lnRE_{t-i} + \sum_{i=0}^{n} \varphi_{3i}\, \Delta lnK_{t-i}$$

$$+\sum_{i=0}^{n}\varphi_{4i}\,\Delta lnL_{t-i}+\sum_{i=0}^{n}\varphi_{5i}\,\Delta lnI_{t-i}+\tau ECM_{t-1}+\vartheta_t \quad (5)$$

As is customary in econometric analysis, this study first carried out a unit root test on economic growth, renewable energy and other control variables, to prevent spurious results. The unit root tests performed were the most widely used in econometric research: Augmented Dickey-Fuller (ADF) and Phillips and Perroni (PP) root tests (Maji, 2015; Oyeleke &Akinlo, 2019)

Descriptive Statistics and Correlation Matrix

The descriptive statistics and the correlation matrix are reported in Table 1.

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Sample: 1981-2014

Included observations: 34

Table 1. Report of Descriptive Statistics and Correlation Matrix

Descriptive Statistics					
Variable	**Obs.**	**Mean**	**Std. Dev.**	**Min.**	**Max.**
*Ln*_GDP per Capita	34	7.401	0.214	7.849	7.189
*Ln*_Renewable Energy	34	4.343	0.028	4.388	4.293
*Ln*_Capital	34	3.533	0.508	4.493	2.651
*Ln*_Labour	34	4.098	0.028	4.129	4.004
Interest	34	-0.725	15.347	18.180	-65.857
Correlation Matrix					
Variables	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**
(1) *Ln*_GDP per Capita	1.000				
(2) *Ln*_Renewable Energy	-0.684	1.000			
(3) *Ln*_Capital	-0.802	0.655	1.000		
(4) *Ln*_Labour	-0.706	0.562	0.793	1.000	
(5) Interest	0.215	-0.259	-0.477	-0.375	1.000

Note: Obs. Stand for number of observations. Std. Dev. Stands for standard deviation. Min and Max stand for minimum and maximum values of the variables, respectively.

INTERPRETATION

Unit Root

The stationarity property of economic growth and indicators of renewable energy were tested using the Augmented Dickey Fuller and Phillips and Perron unit root tests. Table 2 shows the results of the unit root tests. The test interpretations for these tests are:

H_0= there is unit root for the series and

H_1=no unit root for the series (meaning the series is stationary).

Performed first at levels, the results validated that the null hypothesis is not rejected at conventional critical values for all series in levels, except interest rate. This implies that all variables, except interest rate, are non-stationary at levels. Transformed into first differences, the results posit that the null hypothesis is rejected. Therefore, we conclude that economic growth, renewable energy consumption, capital and labour are stationary and hence integrated of first order, I(1).

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Table 2.Panel unit root test result

Augmented Dickey-Fuller (ADF) Unit Root Test Results					
	At Level		First Differences		O. of I.$^{+}$
	t-Statistic	Prob.	t-Statistic	Prob.	I(1)
Ln GDP per Capita	0.553	0.986	-4.096***	0.003	I(1)
Ln Renewable Energy	-1.896	0.330	-5.505***	0.000	I(1)
Ln Capita	-1.052	0.723	-5.576***	0.000	I(1)

Ln Labour	0.156	0.964	-3.790***	0.008	I(1)
Interest Rate	-6.856***	0.000	-9.145***	0.000	I(0)

Phillips-Perron (PP) Unit Root Test Results

	At Level		First Differences		
	t-Statistic	Prob.	t-Statistic	Prob.	I(1)
Ln GDP per Capita	0.376	0.979	-3.653***	0.010	I(1)
Ln Renewable Energy	-2.006	0.283	-5.746***	0.000	I(1)
Ln Capita	-1.052	0.723	-5.915***	0.000	I(1)
Ln Labour	1.910	1.000	-3.057**	0.040	I(1)
Interest Rate	-6.856***	0.000	-28.133***	0.000	I(0)

Note: $^{+}$ O. of I. means order of integration.*** Significant at 1 percent significance level.
Source: Own calculations

The suitable ARDL model is chosen by using the Likelihood Ratio (LR), Akaike Info Criterion (AIC) and Schwarz Bayesian Criterion (SBC), Hannan-Quinn (HQ). To select the suitable model, several lag models were fitted. Among the models the preferred models to explain the long run relationship were AIC and SBC. These two criteria indicated the lag 2 as the best lag length for the model.

Bounds test to Co-integration

The next step is to explore the presence of the long run relationship between economic growth, renewable energy, capital, labour and interest rate in our model. The study applies the bounds F-test and presents the findings in Table 3.

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Table3. ARDL Bound co-integration test

Null Hypothesis: No long-run relationships exist				
Test Statistic	Value	k		
F-statistic	7.719	4		
Critical Value Bounds				
Significance	I0 Bound	I1 Bound		
10%	2.45	3.52		
5%	2.86	4.01		
2.5%	3.25	4.49		
1%	3.74	5.06		

The findings of the bounds test approach to co-integration of test suggest, based on the F-statistics, that co-integration exists in our model. This is because the F-statistic, 7.719, is greater than the upper bound critical values at 5% level of significance. As a result, the null hypothesis of no co-integration is rejected. Therefore, the results fail to reject the null hypothesis of no co-integration.

Estimation Results of Long-run and Short-run Elasticities

The estimates of the long run and short run using the ARDL approach are reported in Tables 4. Commencing with the long run elasticities, Panel A shows that renewable energy consumption and capital have negative and significant effects on economic growth at 5% and 1% levels of significance, respectively. The relationship is such that a 1% increase in renewable energy consumption leads a 2.12% decrease in economic growth, while a 1% increase in capital leads to 0.74% decrease in economic growth. On the other hand, labour exhibits a positive and significant effect on economic growth. The relationship is such that a 1% increase in labour leads a 9% increase in economic growth. Interest rate, on the other hand, has a positive effect on economic only on the 10% significance level.

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Table 4. Estimated long and short run coefficients

Dependent variable: Log Gross Domestic Product per Capita				
Variable	Coefficient	Std. Error	T-Statistic	P-value
Panel A: Long run results				
Ln Renewable Energy	-2.121**	0.862	-2.460	0.022
Ln Capita	-0.741***	0.115	-6.432	0.000
Ln Labour	9.000***	3.084	2.918	0.008
Interest Rate	0.004*	0.002	1.880	0.073
Constant	-17.672	11.801	-1.498	0.149
Panel B: Short run results				
Δ(Ln Renewable Energy)	-0.644**	0.288	-2.233	0.036
Δ(Ln Capital)	-0.145**	0.055	-2.641	0.015
Δ(Ln Capital (-1))	0.103*	0.055	1.873	0.074
Δ(Ln Labour)	1.960**	0.838	2.339	0.029
Δ(Ln Labour (-1))	-3.970**	1.656	-2.397	0.025
Δ(Interest Rate)	0.001**	0.001	2.072	0.050
Constant	-5.751	4.122	-1.395	0.177
ECM(-1)	-0.303***	0.065	-4.701	0.000

Note: *, **, *** indicate significance at 10%, 5% and 1% significance at levels, respectively.

Panel B in Table 4 presents the short run elasticities. We also note that the results are similar to the long run estimates. The results show that renewable energy consumption and contemporaneous capital have negative and significant effects on economic growth at the 5% level of significance, respectively. The relationship is such that a 1% increase in renewable energy consumption leads a 0.64% decrease in economic growth, while a 1% increase contemporaneous capital leads to 0.15% decrease in economic growth. On the other hand, the first lag of capital has a negative effect on economic growth only at the at the 1% significance level. Both the contemporaneous and the first lag of labour have significant effects on economic growth at the 5% significance level. However, while contemporaneous labour increases economic growth by 1.96%, the first lag decreases economic growth by 3.97% for every 1% increase in each of the variable's components. Additionally, interest rate has a positive effect on economic only at the 5% significance level. The relationship is such that a 1% increase in interest rate leads a 0.001% increase in economic growth. Panel B in Table 4 also presents the error correction term. The coefficient of the error correction term indicates the speed of adjustment in the long run due to a shock. The coefficient of the ECM term is -0.303, and it implies that 30.3% of the disequilibrium in economic growth of the previous year's shock adjusts back to the long run equilibrium in the current year.

The significant relationship between renewable energy consumption and economic growth confirms the presence of unidirectional causality from energy consumption or the growth hypothesis (Marinas etal., 2018). Furthermore, it shows that measures to curb pollution using renewable energy sources or to transition to renewable energy sources will be associated with decline in economic growth (Marinas etal., 2018).

Model Diagnostic Tests

The ARDL model diagnostics are reported in Table 5. The estimates indicate that the model passes all the diagnostic tests. The Breusch-Godfrey LM serial correlation andthe Breusch-Pagan-Godfrey tests suggest that the error term of the short run model has no serial correlation and is homoscedastic. Similarly, the Jarque-Bera test suggests that the errors are normally distributed. The absence of serial correlation is also strengthened by the Durbin-Watson statistic of 2.31, which suggests no problem with serial correlation. The Ramsey RESET test validated that the functional form of the model is well specified.

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Table 5. Model Diagnostic Tests

Test	F-statistic	P-value
Breusch-Godfrey LM (Serial correlation)	1.599	0.227
Breusch-Pagan-Godfrey (Heteroscedasticity)	0.885	0.553
Jarque-Bera (Normality)	1.166	0.558
Ramsey RESET	0.195	0.663
Durbin-Watson Statistic	2.31	
Adjusted R-squared	0.98	

III. Conclusion

The objective of this paper is to critically access the nexus of renewable energy on economic growth in Nigeria. ARDL approach was adopted to test the long run relationship between renewable energy and economic growth. This study utilized the traditional production function to access the relationship between renewable energy consumption and economic growth by incorporating capital formation, labour participation and real interest rate as intermittent variables. The time series data for Nigeria spans between 1981 and 2014. The Augmented Dickey Fuller (ADF) and Phillips and Perron (PP) unit root tests were employed to ensure that none of the variables is not integrated at I(2) or above. To confirm the existence of the long run among the variables, the Autoregressive Distributed Lag (ARDL) model was applied.

The result suggests the existence of long-run relationship (cointegration) among the variables at 1% level of significance. Specifically, renewable energy consumption has a negative and significance effect on economic growth. The results are such that a 1% increase in renewable energy consumption decreases economic growth by 2.12% and 0.64% in the long-run and short-run, respectively. These results confirm that there is a unidirectional causality flowing from renewable energy consumption to economic growth. Furthermore, this finding suggests that renewable energy consumption has a crowding out effect on other macroeconomic variables that contribute to economic growth. On the other hand, capital formation was found to decrease economic growth in the long-run, while labour force participation increased economic growth in the long-run

IV. Recommendations

The policy implication of the above finding is that energy conservation policies will have an adverse effect on economic growth in Nigeria. Put differently, any current policy of government to increase renewable energy may retard economic growth over some period in Nigeria. This may have resulted from the fact that the economy has not fully developed its renewable energy sources. There is also the absence of separate legal and institutional framework for renewable energy development in the country. Given this result, the desire to drive sustainable growth and development and keeping to the Paris Agreement commitments, the government have to pay more attention to renewable energy resources to fully improve regulatory framework and investment climate in the renewable energy sector.

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