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Renewable Energy Consumption and Economic Growth in Nigeria Nexus

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Abstract

With rising rates of globalization, increasing climate change and economic growth, energy usage and energy security, governments are paying more attention to the impact of renewable energy consumption on the economies. The paper examines the relationship between renewable energy consumption and economic growth in Nigeria using a time series data from 1996 to 2021. The results of the unit root show mixed stationarity from our variables which result in the usage of ARDL technique of analysis. The long run results show that renewable energy was negative and significant thus, validates the conservative hypothesis. C02 was also negatively significant to RGDP while labor force was positively significant. The ECM shows 77% adjustment level backs to equilibrium. Granger causality test validated the feedback hypothesis of no causality among the renewable energy and the Nigeria economy.

Keywords: ARDL, carbon dioxide emission, RGDP and Renewable energy consumption.

JEL Classification: Q42

1. Introduction

In the past four thousand years, source of power that has been used for a wide range of uses both in human and industrial contexts is known as renewable energy. (Golding, 1955). It came to the forefront of public consciousness in the 1970s, following the 1973 Arab oil embargo, which led to the first significant increase in the price of oil (Lin, *et al.*, 2010). Since that time, people all around the world have been conducting investigations into various forms of renewable energy as an approach to achieving energy and climatic security. Governments are paying more attention to the far-reaching impacts that rising rates of globalization, increasing climate change and economic growth, energy demand, and energy security have on national and global economies as these trends continue to gain momentum. Over the course of the last decade, renewable sources of energy have garnered a significant amount of interest. Since the late 2000s, renewables have been the energy source with the fastest growing market share across the world (Apergis and Payne, 2012). Energy that comes from sources like air, water, sunlight, waves, waste, biofuels, and other are essentially endless, unrestricted, and rapidly replenished is referred to as renewable energy. change in climatical conditions is one of the most urgent glitches facing the world right now, and it is the primary reason why renewable energy sources have become increasingly popular. The majority of studies in the field of science are in agreement that the extraction of fossil fuels has a sizeable bearing on the release of greenhouse gases, the most important factor in the progression of global warming (Herzog, H., *et al.*, 2000). In spite of growing concerns regarding rising CO2 levels and global warming, the use of fossil fuels has historically been one of the most important contributors to economic prosperity in European nations (Pirlogea & Cicea, 2012). In point of fact, nations are reticent to reduce emissions because doing so would cost them increased revenue. In another way, the continuation of economic advancement is dependent on the use of more energy, which in turn leads to a rise in the amount of emission of carbon dioxide. There is a widespread belief that the use of renewable energy has the ability to bring about improvements in both the quality of the environment and the growth of the economy. As a consequence of this, a number of countries, most notably the EU, are concentrating on the effects of renewable energy. Cifuentes-Faura, J. (2022) stated that the European Union's (EU's) national climate change policy for 2030 established goals for increasing the contribution from renewable sources (to at least 32 percent) and improving energy efficiency to at least 32.5 percent. In point of fact, the expansion of renewable energy sources has already been signaled as a potentially fruitful strategy for lowering emissions of greenhouse gases and accomplishing long-term expansion goals. (2019, Lee). In another way, fossil fuels are potential drivers of climate change, which has become a threat to the continued expansion of the economy over the long term (Kaygusuz, 2007). In light of this, government officials across the world, particularly in industrialized nations (such as Brazil and China), are working to increase the amount of power that can be generated and this also is true for authorities in developing countries too. Regulations that are effective in promoting the use of renewable energy can, among other things, lower greenhouse gas emissions and slow climate change. In other words, renewable sources of energy have the potential to bring about sustained economic growth.

Nigeria as it is referred to as the continent's superpower when it comes to energy, the continent's most productive oil-producing nation, with two-thirds of the continent's crude oil reserves. It is regarded as the second-best source of natural gas (Sambo 2008). The country holds the majority of Africa's oil and coal reserves. the country has a rare blend of traditional energy reserves which no other country in the continent can stand match against it. As a result, the economy of the country is heavily reliant on energy exports. Furthermore, fundamental energy resources supply the majority of the country's industrial raw material supply. The world's current pattern for energy consumption demonstrates that Nigeria, and moreover African continents, when considering their rates of consumption of energy is the lowest. Nigeria, on the other hand, has a scarcity of usable energy that can tackle the fast-growing demand for it, as is feature of a growing economy. Astonishingly, the country may be blessed with long-term renewable energy sources. Oil, natural gas, limestone, and coal are among its abundant sources of energy. wood, sun, hydroelectric, and wind are also examples of its blessed sources of renewable energy (Okafor, E. N. C., & Joe-Uzuegbu, C. K. A. 2010). According to Inglesi-Lotz and Dogan (2018), developing nations face a difficulty in changing energy usage away from fossil fuels and toward renewable energy.

Due to technical and economic differences, the power architecture of advancing and industrialized nations varies. In light of the current circumstances, it is abundantly clear that supplying Nigeria's energy requirements only through the use of fossil fuels (petroleum) will not be sufficient. It is vital to make use of the large renewable sources of energy that are available in Nigeria in order to establish a new energy economy for the country. These sources of energy include hydroelectric, solar, wind, tidal, and bioenergy. In this regard, it is the responsibility of the government to ensure that renewable energy sources are available to the general public and do not exceed their financial means.

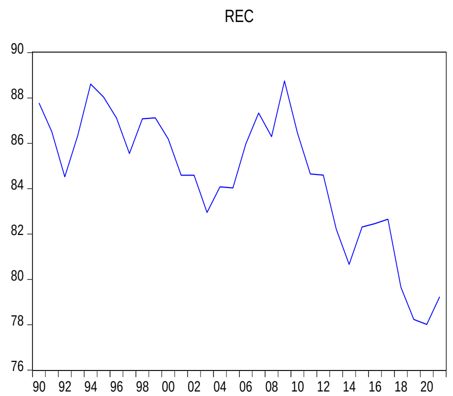

Figure: 1 the renewable energy consumption in Nigeria from 1990 – 2021

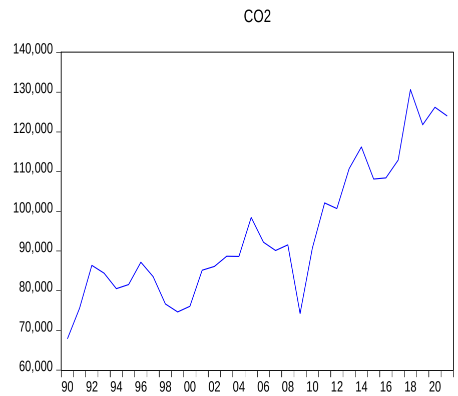

Figure 2: carbon dioxide omission in Nigeria from 1990 – 2021

The above figure having a downward fluctuating trend shows the situation of renewable energy consumption in Nigeria from 1990 – 2021 with a high peak on of energy consumption in 1994 and secondly in 2008 after which there's fluctuations downwards in the other years in the level of renewable energy consumption. The preceding curve demonstrates an increasing trend of fluctuation in the country, with a high peak around 2009, which coincides with an upsurge in the rate of consumption of renewable energy in the country at that particular year, demonstrating an inverse connection between the consumption of renewable energy and carbon emission in the country.

In today's economies, the traditional method of meeting energy needs is to burn fossil fuels. The percentage of energy produced from alternative, cost-effective, and greener sources is likely to have increased marginally. Nonetheless, fossil fuels remain the common energy source, accounting for roughly 85% of global energy production. The principal human activity influencing the cost and rate of global warming is the burning of fossil, which results in carbon dioxide emissions (World Bank, 2017). By spewing carbon dioxide into the atmosphere, fossil fuels significantly contribute to global warming, as well as promoting deforestation and, producing significant changes in our climate systems. Sequel to this, sustainable and renewable energy sources must be used to solve the trade-offs between energy needs and the environmental effects of rising energy usage. For all the above reasons, this research is aimed at analyzing the effect of renewable energy consumption in the country to economic growth given a time series data from 1990 – 2021.

2. Literature Review

Theoretical framework

Since Kraft and Kraft (1978) initially suggested the concept of a causation connection between energy use and real GDP, there have been four theories that have been developed to explain it (Taylor and Payne, 2010). To begin, the growth hypothesis presupposes that there is either a direct or indirect connection between these two factors. A contribution is considered direct when it relates to the production process, while a contribution is considered indirect when it acts as a complement to capital and labor. This growth hypothesis has policy implications in that energy conservation programs may lower real GDP, hence producing a unidirectional Granger causation link. Second, the conservation hypothesis proposes that there would be no negative impact on real GDP from implementing energy conservancies such as plummeting greenhouse gas emissions, increasing energy efficiency, enacting sustainable policies to minimize waste and energy use. This is backed further by the concept of unidirectional causality. The feedback hypothesis postulates that economic expansion is intrinsically linked to real GDP and is buoyed by a granger causality result of bi directional movement in conclusion. This finding lends credence to the feedback hypothesis. Last but not least, the neutrality hypothesis makes the assumption that the amount of energy consumed has a negligible impact on the amount of real GDP, and thus that efforts to reduce energy consumption have no adverse effect on the amount of real GDP. The neutrality hypothesis is supported by the lack of Granger-causality seen between total energy use and real GDP.

Empirical Literature

In order for nations to meet their development objectives in the years to come, it will be necessary for them to adopt a strategy for economic expansion that is less harmful to the natural environment. In recent years, research on the connection between renewable energy and economic growth has been an increasingly popular issue to discuss in the many bodies of scholarly writing. Studies that are empirical in nature on renewable energy and growth often have conflicting perspectives and conclusions on the outcome of the study. Al-Mulali and Sab (2012); Shahbaz et al. (2013); Apergis and Tang (2013); Apergis and Payne (2010); Odhiambo (2010); Arifin and Syahruddin (2011); Al-Mulali and Sab (2012); Wadström, C., Wittberg, E., Uddin, G. S., & Jayasekera, R. 2019); and Khan et al (2020). Studies conducted in South American countries, African countries, Indonesia, 30 Sub-Saharan African countries, China, 46 countries, Canada, and ASEAN countries revealed a positive correlation between the consumption of renewable energy and economic growth in these countries. On the other hand, it was revealed that there was not a statistically significant impact on the quantity of energy consumed nor the expansion of the economy. This is demonstrated by the research that was carried out by Payne (2009), Bowden and Payne (2009), Menegaki (2011), Ozcan and Ozturk (2019), Destek and Sinha (2020), and Chen et al. (2020) in a variety of countries, including the United States of America, 27 European nations, 17 developing nations, and 24 OECD countries. Another sort of document that was discovered asserted that the high costs of constructing renewable energy infrastructure hinder economic growth and that alternative energy sources are responsible for this. They found a correlation that was not beneficial between the use of renewable energy sources and economic expansion. In a study that was carried out in Turkey, India, Ukraine, and the United States, both Ocal and Aslan (2013) and Bhattacharya et al. (2016) reported that there was a negative impact among these variables. Israel. inglesi - lotz (2016) examines the effects of use of renewable energy sources on economic growth in OECD nations from 1990 to 2010 using the OLS with fixed effect estimate. When the absolute value of renewable energy is employed as a proxy, the influence on economic growth is positive for lower and moderate quantiles, but it is negative for middle, high-middle, and upper quantiles when a panel quantile estimation on renewable energy is utilized. In addition, the usage of renewable energy has been shown to have a negative effect on economic growth across almost all quantiles, as measured by the proportion of total energy consumption that is comprised of renewable energy.

Conceptual framework

Figure 3 depicts a research conceptual framework model that was constructed based on a review of the relevant literature. This review demonstrates the connections between the dependent variable GDP renewable energy consumption and the independent variables trade openness, labor force, capital, and carbon dioxide emissions. Figure 3 can be found here. The use of renewable energy is the most vital variable of interest among the independent variables, whereas the other variables are referred to as controlled variables.

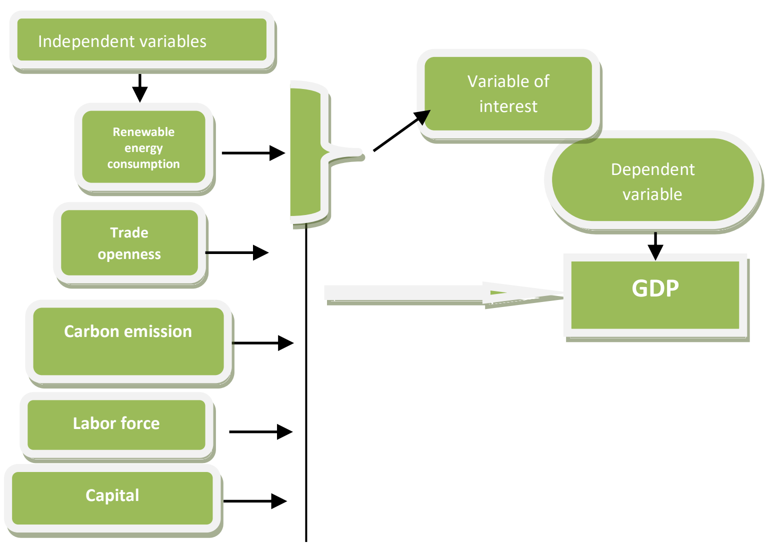

Figure 3: Conceptual Framework

Source: Authors Compilation

3. Methodology

The study used a secondary data source from the World data indicators. The data that was collected started from 1990 – 2021. This period is long enough to cover a good time series analysis using time series data. The number of observations used is 31 observations given four (4) variables in our observations. The study conduct the stationarity test of the data based on the Augmented Dickey-Fuller (ADF) (Dickey & Fuller 1981) and Phillips-Perron (PP) (Phillips & Perron, 1988). Unit root tests will be employed to test the integration level of the variables, that is the level of stationary prior to examinations of likely co-integration amongst the variables. The PP measures will be applied to check for unit roots as an alternative to ADF. To evaluate results and confirm the right level of integration of the variables, the research will adopt a linear model that shows the relationship between the variables. The three main equations are used to calculate the ADF test statistic. Only a constant is used in Equation 1 to test the unit root. Equation 2 incorporates a time trend along with the constant. A pure random walk equation is given by Equation 3.

$X_t = \mu + \infty x_{t-1} + \sum_{i-1}^{k} \alpha \Delta X_{t-i} + \varepsilon_t$ ……………...1

$\Delta X_t = \mu + \alpha t + \infty x_{t-1} + \sum_{i-1}^{k} \alpha \Delta X_{t-i} + \varepsilon_t$ ……………………………………………….2

$\Delta X_t = \infty\, x_{t-1} + \sum_{i-1}^{k} \alpha \Delta X_{t-i} + \varepsilon_t$ …………………………………………………………3

The above equations can be explained where the first difference operator is denoted by, ΔX_{t-i} series of laggedgiven the first differences which usually engage to rectify serial correlation issue, the consideration variable is , μ is intercept term, t denotes trends of time, x_{t-i} tested lagged series, k lag length which is resolved using any of the legged length criteria selections for ideal lag selections and it helps to verify that the disturbance term are included in the process of the residual, lastly, ε denotes the disturbance noise Dickey & Fuller, 1979). The H0 shows that ADF test asserts that there is stationary associated to the unit root of the series. whereas the data is not stationary is linked to the alternative hypothesis, as a result, the series is termed stationary if the t-statistic falls below the critical values at the proper level of significance. The analysis uses a linear paradigm in which the inside boundary between both the variables of the study is stretched. The following is a linear representation of our model which is linear in the parameter of the model.

RGDPt= β0 + β1RECt +β2CO2t +β3LBFt +μt …………………………………………..… 4

With the betas being the parameters of the variables, RGDP, denotes real gross domestic product and the dependent variable of the model, CO2 denotes carbon dioxide emission, LBF is total labor force, REC as renewable energy consumption rate with μ as error term given a subscript t time frame and the βare the parameter coefficient of our variables.

Estimation Procedure

ARDL was utilized in running the research. This method was further developed by Pesaran, Shin, and Smith in 2001 so that it could be used to assist in the investigation of the co-integration relationships between the DV and IVs. The ARDL model will be used to analyze the level of co integration between GDP and renewable energy, but only after a bound test has been run to guarantee that the variables are co integrated. The research will first ensure that the variables are co integrated. Pesaran et al. (2001) and Narayan's descriptions of the robust ARDL model served as the basis for this study's analysis (2005). The bound's test approach is utilized so that it may be determined whether or not there is any co integration between the variables. The framework for the research is as follows:

$$GDPt = \beta_o + \beta_1 GDP_{t-1} + \beta_2 CO2_{t-1} + \beta_3 LBF_{t-1} + \beta_4 LREC_{t-1} + \sum_{i=0}^{p} \Upsilon_1 \Delta GDP_{t-1} + \sum_{i=0}^{p} \psi 1 \Delta \text{CO2}_{t-1} + \sum_{i=0}^{p} \varphi_1 \Delta \text{L} LBF_{t-1} + \sum_{i=0}^{p} \lambda_1 \Delta REC_{t-1} + \mu_t \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad 5$$

GDP denotes gross domestic product and the real GDP was used as a proxy to calculate the influence on economic growth. C02 denotes carbon dioxide emission, LBF denotes total labor force, REC denotes renewable energy consumption, the parameters for each variable are denoted by it β, lag period of the series denoted by subscript $_{t-1,}$ first difference operator denoted by Δ, parameters of the variables at first difference denoted by coefficients $\psi, \gamma, \varphi, \lambda, \delta$, μ denotes the

$$\sum_{i=0}^{p} \Upsilon_1 \Delta GDP_{t-1} + \sum_{i=0}^{p} \psi 1 \Delta \text{CO2}_{t-1} + \sum_{i=0}^{p} \varphi_1 \Delta \text{L} LBF_{t-1} + \sum_{i=0}^{p} \lambda_1 \Delta REC_{t-1} + \mu_t \quad \ldots\ldots\ldots \quad 6$$

Equation 6 above is used to discussed the speed of adjustment (ECT) in the short run model. The ECM's significance is most likely to have a negative value ranging from 0-1 which helps to explain the speed of adjustment in the short run. After the paradigm has been constructed, cumulative sum of recursive residuals (CUSUM) and CUSUM of square (CUSUMSQ) tests was conducted to assess parameter consistency as suggested by Pesaran and Pesaran (1997). The study used Engle and Granger's approach to determine the interconnectedness between the variables (1987).

Table 1: List of variables and sources

Variables	Explanations	Sources
RGDP	GDP growth (annual %)	WDI
REC	Renewable energy consumption (% of total energy consumption)	WDI
C02	C02 emission (kt)	WDI
LBF	(Labor force statistics) total labor force	WDI

Source: Authors Compilation

4. Results

Table 2: Descriptive statistic result

Statistics	RGDP	REC	CO2	LBF
Mean	4.330515	84.51730	94441.25	41241059
Median	4.430627	84.62025	89405.00	41307045
Maximum	15.32916	88.74930	130670.0	41307045
Minimum	-2.035119	78.01290	67850.00	62447230
Std. Dev.	4.015828	2.978682	17043.51	13226757
Skewness	0.428111	-0.686234	0.593571	-0.781852
Kurtosis	3.286476	2.593798	2.300957	3.944912
Jarque-Bera	1.086914	2.731556	2.530625	4.450706
Probability	0.580737	0.255182	0.282151	0.108029
Sum	138.5765	2704.554	3022120.	1.32E+09
Sum Sq. Dev.	499.9331	275.0489	9.00E+09	5.42E+15

Source: Authors Computation

Given a normal skewness value on 0.43 and the kurtosis is mesokurtic in nature (value 3), the results of the statistical distribution, which can be seen in table 1 above, show that RGDP has a maximum value of 15.3 and a minimum value of -2.03. The jarquebera test shows that we accept the null hypothesis with a critical value that is greater than 0.05, which states that the series is normally distributed. REC has a maximum value of 88.7 and a minimum value of 78.0. It also has a left tail skewness of -0.68 and a platykurtic kurtosis (2.56 3). Furthermore, the probability results reveal that the null hypothesis is being accepted. With a normal skewness of 0.59, platykurtic kurtosis (2.30 3), and the probability value of adopting the null hypothesis, C02 has a maximum value of 13067 and a minimum value of 67850. A normal distribution can be inferred from the fact that the LBF has a maximum value of 41307 and a minimum value of 6244, as well as left tail skewness, a leptokurtic kurtosis (3.99 > 3), and a jarque bera prob value of accepting null.

Unit root results

Table 3: Results for ADF unit root

Variable	Constant		Constant with trend	
	Level	1st Difference	Level	1st Difference
RGDP	-3.64362*	-3.55934*	-9.00804***	-8.85482***
REC	-1.08632	-2.17968	-5.16086***	-5.14344***
LBF	-1.59933	-2.64328	-5.43905***	-5.80225***
C02	-1.15819	-2.72953	-6.34705***	-6.26773***

*Note: The critical values for intercept without trend are -3.483, for 1%, -2.884 for 5% and -2.579 for 10% whereas the critical values for intercept with trend are -4.032 for 1% -3.146 for 5% and -3.148 for 10%, denoted by ***, **, and *respectively. Given that the null hypothesis has unit root using schwarz criteria for lag selection. Source: Authors Computation*

The unit root results show stationarity in the variables used at one stage or the other, the results in ADF shows mixed stationarity in the variables. RGDP is stationary at level given constant and constant with trend and also stationary at first difference given constant and constant with trends. Other variables which include LBF, REC, and C02 were only stationary at first difference given constant and constant with trend at 1% level of significant. The decision rule in the result shows the rejection of the null hypothesis which states that there is no stationarity amongst the variables and we accept the alternative hypothesis showing that our results in both tables has stationarity of mixed orders.

Table 4: Results for Bound Test

	F (RGDP/ REC, LBF, C02)	
Structure optimal lag	(1, 4, 4, 2)ARDL	k = 3
f- test	3.67	
Level of significance	Critical Value	
%	I (0) Lower bound	I (1) upper bound
10	2.37	3.2
5	2.79	3.67
2.5	3.15	4.08
1	3.65	4.66

*Note: The significant levels at 1%, 5%, and 10% are shown by ***, **, and *, respectively. The f statistics numbers are used to test the null hypothesis that there is no cointegration between the series.*
Source: Authors Computation

The presence of a co integration relationship between RGDP and some other variables was determined using results of F- test which explain absent of cointegrations among the parameters of the variables as the null hypothesis the F-statistics for the co integration test F (RGDP/ REC, LBF, C02) = 3.67, which is higher than the 10% upper bound critical value (3.2). also, higher than the lower bound at 5% level of significance (2.79) but equal to the higher boundary at 5%. This shows, however, that RGDP and other variables in our research are co-integrated, as proposed by Narayan (2005).

Table 5: Result for ARDL long run

ARDL coefficient – RGDP as the Dependent Variable		
Regressor	Coefficient	P-Value
REC	-2.1582	0.0360*
C02	-0.0010	0.0014**
LBF	8.01E-0	0.0072**
C	242.4516	0.0203*

Source: Authors Computation

The results from Table 5 show the long run connection between the independent and dependent variables. A significant p. value of renewable energy consumption at 10% level of significant shows more increase in renewable energy consumption by a unit reduce economic growth by 2.16 units. Ocal and Aslan (2013), Bhattacharya et al. (2016) in a study in Turkey as well as other study conducted in India, Ukraine, the United States, reported a negative effect of renewable energy consumption and economic growth in their area of study. The long run results of this study are in line with the theory of growth hypothesis which stated that renewable energy can contribute either directly on production or indirectly to compliment labor and capital but has a reduce real GDP. C02 given a statistical pro value at 5% level of significant shows that a unit increase in carbon dioxide emission reduces economic growth performance by 0.001 unit, LBF was significant and positive at 5%, the idea of increased labor force power increases economic growth by the unit of the parameter of LBF. The Cob Douglas production theory stated that increased productive labor force in the economy increases positively the total output level i.e. Y= f(k,l) output is a function of capital and labor. Additional increase in the total labor force increases economic growth in the country.

Table 6: Result for ECM

Variable	Coefficient	Std. Error	T- Statistic	Prob
Δ (REC (-2)	1.605218	0.541488	2.964456	0.0110*
Δ (REC (-3)	1.734039	0.624496	2.776704	0.0157*
Δ (CO2 (-1)	0.000390	0.000146	2.675084	0.0191*
Δ (CO2 (-2)	0.000397	0.000123	3.227739	0.0066**
Δ (CO2 (-3)	0.000403	0.000133	3.035316	0.0096**
Δ (LBF)	1.04E-07	5.31E-08	1.953916	0.0726*
Δ (LBF (-1)	-7.15E-07	1.26E-07	-5.687753	0.0001***
ECM (-1) *	-0.772591	0.157807	-4.895794	0.0003***

Source: Authors Computation

The short run result shows that REC at time frame of lag 2 and 3 was significant but positive in the short run. Increased unit of renewable energy consumption will increase economic growth by the parameter of renewable energy consumption. The work of Khan et al. (2020) shows a positive connection amid the two variables i.e., renewable energy consumption and economic growth. The short run result on renewable energy shows the idea behind the conservative hypothesis that suggests the energy conservative idea of reduction in greenhouse effect, reduce waste and consumption of energy, and improve the efficient of energy. C02 was significant and positive at lag 1, 2, 3 in the short run. LBF was also positive and significant in the short run but significant and negative at lag 1. The error correction term (ECM) which measures the adjustment speed in the short run shows significant and negative with the expected value to be as expected between range value of 0 – 1. The adjustment speed level in the short run shows 77% adjustment level in equilibrium.

Table 7: Diagnostic testing

Diagnostic test	Tests statistic
Jarcuebera normality test	25.6592 (0.0003) ***
serial correlation LM test using Breusch Godfrey	2.7594 (0.1393)
Heteroskedasticity	0. 9015 (0.5768)

Source: Authors Computation

The model predicted accurately diagnostic tests run for serial correlation and heteroskedasticity, as displayed in table 7. The table demonstrates that the LM serial correlation test yielded non-significant rate of prob values, indicating that the data does not exhibit serial correlations. We reject H0 and accept H1 if the p-value at the 5% level of significance is less than 0.05, finding that there is no serial correlation; else, accept H0 as explained by Gujarati (2004). As a result, because the p. value is greater than 0.05 at 0.1393, we do accept the null hypothesis which started that there is no auto correlation among the variables. In case of hetero result, we accept the null hypothesis that started that our series is homokedasticity showing that there's no problem of heteroskedasticity because the P-value for the heteroskedasticity test is greater than 0.05 level of significance at 0.5768.

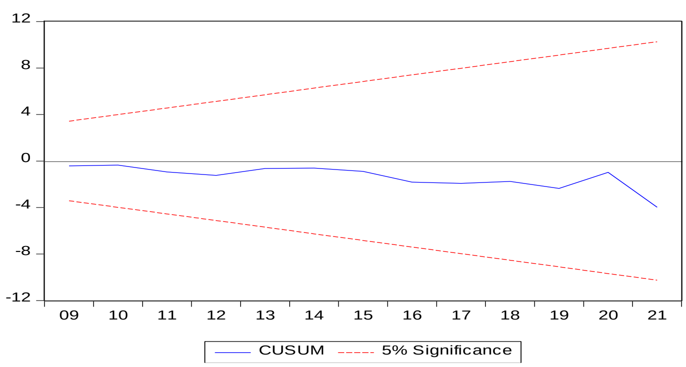

Figure 4: Stability test: CUSUM

The result of stability test from the CUSUM diagram in Figure 4 shows that the coefficient of the regressor is stable at 5% significance showing from the blue line within the boundary we therefore accept the null hypothesis stating that our series is stable given CUSUM.

Table 8: Result of causality

H0	F-test	Prob.	Decision
REC does not granger cause RGDP	1.02986	0.3717	Accept null
RGDP does not granger cause REC	1.23111	0.3091	Accept null
C02 does not granger cause RGDP	1.04267	0.3673	Accept null
RGDP does not granger cause C02	0.07981	0.9235	Accept null
LBF does not granger cause RGDP	0.85438	0.4376	Accept null
RGDP does not granger cause LBF	0.33980	0.7151	Accept null

Source: Authors Computation

All causality results show that we accept the null hypothesis with all the prob values to be $>$ 0.05 critical value stating that all our variables do not granger cause with the dependent variable RGDP. The granger causality results show the neutrality hypothesis stating that energy consumption has minimal or no effect on RGDP.

5. Conclusion and Recommendations

This research aimed to analyze the long run relationship between renewable energy consumption and economic growth using real gross domestic product in Nigeria using a time series data from the period of 1990 – 2021 framework. The results from the unit roots shows mixed stationarity of I (0) and I (1) in the variables which warrants the use of ARDL mode of analysis, the present of significance in the bound results with the F-statistics greater than the upper and lower bound at 5% significant level shows the existence of long run correlation among the variables. The relationship in the long run indicates increase in consumption level of renewable energy reduces RGDP, a negative relationship between C02 and RGDP and a positive relationship between labor force and RGDP. An increment in consumption of energy has a negative impact on Nigeria's economic growth, because the country's expanding economy necessitates a reduction in energy consumption as industry switches to less energy-intensive service industries. The results in the short run show significant and positive, implying an increase in renewable energy consumption increases economic growth in the short run in Nigeria. The granger causality results show that there is no causality between renewable energy consumption and GDP in Nigeria and this validates the neutrality hypothesis of causality test between the variables in Nigeria.

Because fossil fuels make up around 80 percent or more of the energy mix in the country, efforts to increase energy efficiency and restructure the energy mix would be good for the country. In order to accomplish the goal of lowering global carbon emissions, it is necessary to make active progress toward the development of energy sources that do not rely on fossil fuels and to establish suitable reduction targets for carbon. The findings and recommendations may be useful to governments in their efforts to increase energy efficiency and lessen their over-reliance on energy for economic expansion. Altering the current paradigm of single economic development, cutting down on energy consumption, and coordinating regional development are all things that would be beneficial to undertake.

Policymakers all over the world should encourage teamwork among the public, private sectors by raising awareness of information concerning financial and technical know-how. This should be done in conjunction with the policy of the country, as well as any measures and incentive mechanisms that are being implemented to promote the renewable energy sector. This can help improve accessibility of renewable energy, which is essential for advancing sustainability goals (Hirschl, 2009).

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