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The impact of renewable energy consumption on Nigeria economy (1980-2022)

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Abestract
This paper investigates the impact of renewable energy consumption on the Nigerian economy. The data spanned from 1980 to 2022. The use of renewable energy consumption has become increasingly important in the global effort to reduce greenhouse gas emissions and mitigate the impacts of climate change. Quite a few studies have found that increasing renewable energy consumption in Nigeria can have a positive impact on economic growth by reducing energy costs, creating jobs, increasing access to electricity, improving living standards, reducing air pollution, and improving the balance of trade. The study conducts a pre-estimation test using descriptive statistics and ordinary least square. But due to inherent problem associated with ordinary least square (OLS) estimates, the study went further to conduct a post-estimation test using Augmented Dickey fuller test and Auto-regressive distributed lag model. The result of the study showed that a lack of investment in renewable energy infrastructure is hindering the growth of the renewable energy sector in Nigeria.

Keyword: Renewable energy consumption, economic growth, OLS, ARDL

Intorduction

It is without doubt that one of the most severe problems of the modern world isclimate change and its important negative consequences on the environment. Human activity, particularly the consumption of energy, has been considered among the main factors contributing to the changing of climate in the last decades (IPCC, 2007). To tackle the future changes in the environment, among other measures, a change in the current technologies of generating energy is imperative. Traditional generation techniques such as coal burning have detrimental effects to the environment and hence, internationally, countries have turned towards more environmentally friendly generation techniques from renewable sources such as solar and wind.

The Energy Information Administration (EIA) reports that the generation of energy through renewable sources has been the fastest-growing source recently (EIA, 2009). Developed economies promote renewable sources in order to strengthen the energy security supply and control their greenhouse gas emissions (GHG) (Moselle, 2011). For example, the European Commission aims to increase the share of renewable sources to 20% of the total by 2020 (EC, 2009). On the other hand, developing economies see the use of renewable energies, as solutions to the challenges of rural electrification and lack of access to electricity (Munasinghe, 2010, Pereira *et al*., 2010) [10]. For example, a large proportion of the African population has no access to electricity, even though the continent has a great abundance of alternative and renewable energy sources such as solar, thermal, photovoltaic, wood, biomass, wind, and biogas. Kaygusuz *et al*. (2007) and Kaygusuz (2007) also mention that the choice to promote renewable energies will lead not only to further modernization of the energy sector but also to support the various countries' goals for economic development and sustainability.

The purpose of this paper is to determine quantitatively the impact of renewable energy consumption to the economic conditions in a panel data framework including all the OECD countries for the period from 1990 to 2010. The results of this analysis have important implications for the implementation of future policies on promoting renewable energies in combination with macroeconomic policies. The importance of this paper lies with the fact that it takes into account the importance of not only the volumes of renewable energies consumed but also their share in the total energy mix of each country; an indicator that shows the importance of renewable energies in a country's energy planning and future. Moreover, this paper uses a sound theoretical framework, assuming that the renewable energies are part of the production capacity of a country.

In 2013, all renewables accounted for an estimated 19.1% of global final energy consumption. According to a recent scenario, the growth of electricity sector is led by renewable energy sector; namely, solar PV, hydropower, and wind, while renewable energy consumption increases every year by 3.0%. The share of natural gas (15.1%), coal (11.5%), and oil (39.9%) increased in 2013. At this point, environmental economists and policymakers need to focus on increasing the share of renewable energy to substitute traditional energy consumption; moreover, it is a major solution tool for sustainable economic growth. Renewable energy technology (sources e.g. hydro, geothermal, wind, solar, wave, tidal, and biomass), has generated energy which is used by industrial (production purpose) and household (daily uses). In this way, energy technology not only affects consumption-side but also affects production-side which in resulting, affects domestic production. On other hand, heavy energy is requiring in the process of production whose aim is producing sufficient renewable energy to fulfill demand for the process of production. In doing so, renewable energy (renewable technology) increases economic growth. Against this background, the IEA built an optimistic scenario; renewable energy share of electricity production will increase by 39% in 2050 (in 2002, production was at 18.3%). Thus, reducing worldwide CO_2 emissions by 50% will reduce global temperature by 2050. Therefore, renewable energy production will have an important role in maintaining global temperature between 2.0 and 2.4 °C.

Selected Existing Literature

The literature is beset with studies on the relationship between energy consumption and economic growth. Pla Julian and Guevara (2019), pointed out that, for the economic development based on sacrificing the natural ecological environment, the goal and consensus of sustainable development should be established to ensure the sustainable development of the Earth. Transforming consumption and the production processes is a fundamental priority of this development agenda. As an alternative model, the circular economy has emerged because of its potential to create a value and has positive social and environmental impacts (Pla Julian and Guevara). Eihigiamusoe and Lean (2019), used the first and the second-generation cointegration and estimation procedures to solve the different economic and econometric problems and found that there is a co-integration relationship between the variables. In the whole sample, energy consumption, economic growth and financial development have adverse effects on the carbon emissions, and energy consumption will increase the carbon emissions. The results show that the high-income level and financial development can reduce the carbon emissions, while low-income and financial development may aggravate the carbon emissions (Ehhigiamusoe and Lean). The results show that energy consumption has a positive and a significant impact on the economic growth. There is a positive correlation between the financial development and economic growth (Sadraoui*etal*. 2019) [18]. According to the non-stationary time series that may appear in some provinces, the autoregressive distribution lag (ARDL) modeling method is adopted. The estimation results show that the relationship between per capita energy consumption and per capita GDP varies greatly among provinces. Asumadu and Vladimir (2019) [16] used panel data regression with the Driscoll Kraay standard error and the U test estimation method and panel quantile regression with the nonadditive fixed effect. It is found that the energy consumption has a strong positive impact on the greenhouse gas emissions.

Jin and Yu (2020) [5], pointed out that China's total energy consumption has increased sharply, and also China's dependence on coal is relatively high. This has also brought about serious environmental problems, which will become one of the main reasons for restricting China's economic development. Using the annual data from 1980 to 2011, Deonanan and Ramkissoon (2018) [14], studied the causal relationship between energy consumption and economic development in 13 Caribbean small island developing states. The multivariate model including the environmental emissions is estimated, and the Granger causality is tested by the Toda-Yamamoto method to determine the causality of each country. The evidence for the four different types of causality was found. These results have an impact on the various energy policies in the Caribbean economies. Tran *et al* (2019), used the system generalized moment method (SGMM) to comprehensively estimate the three simultaneous equations of human development, energy consumption, and dioxin emissions in 90 countries from 1990 to 2014. The results showed that the improvement of human development level leads to the reduction of carbon emissions in global sample countries and developing countries. However, in developed countries, there is no significant relationship between the carbon emissions and human development. Mohsin *et al* (2019) [8] used the econometric method to test the relationship between economic growth and energy consumption. The research results showed that economic growth at the cost of energy consumption leads to urban environmental degradation, and it is difficult to carry out the sustainable development path. Erzi *et al* (2018) [17], established a model based on the heterogeneous productivity to analyze the macroeconomic problem of energy consumption changing with the economic development when the economy becomes more productive. Studies have shown that when an economy becomes more productive, it will have more output and will input more resources, and most importantly, energy will also increase. Taking nine resource-based regions in China as the research objects, Hao and Deng (2019) [19] used the variable coefficient panel model and the Hansen panel threshold model to quantify the marginal effect and threshold effect of innovation ability in optimizing energy consumption structure. The results show that the total index of energy consumption structure in the analysis region is 0.563, indicating that the structure is relatively low, and the regional economic development mainly depends on low-grade energy.

Through the relevant research on economic growth and energy consumption by many scholars at home and abroad, we can see that the regular content between the energy consumption and economic growth is analyzed, and the relationship between the urbanization rate, industrial structure, and other related factors and the energy turning point is subdivided. To analyze the relationship between energy consumption and economic growth in China, it is very important to establish the energy turning point. In short, the relevant literature shows the theoretical analysis of the relationship between energy consumption and economic growth, establishes the inherent law between the two and the empirical analysis of the relationship between the energy consumption and economic growth in various countries, and finds out the turning point of energy consumption is an important theoretical basis for coordinating energy consumption and economic growth.

Theoretical review

GDP = f (energy consumption) ……. (1.2)

Equation (1.2) can be broadened to include the fundamentals of infrastructure.

GDP = f (REC, OR, GFCF) ……. (1.3)

Expressing equation **(1.3)** in linear form**:**

$GDP = \beta_0 + \beta_1 EC + \beta_2 OR + \beta_3 GFCF + Ut$ …... (1.4)

Description of variables in the model:

Where

REC = Renewable energy consumption

OR = Oil rent

GFCF= gross fixed capital formation

GDP = Gross Domestic Product (Proxy for Economic Growth)

Ut = stochastic error term with zero mean and constant variance

$\beta 0$, β_1, β_2 = parameters to be estimated.

The data were sourced from the World Bank Development indicator

Data analysis and discussion

Table 1: ADF Unit Root Test/ Philips Perron Unit Root Test (PP)

Adf Variables	Adf Statistics	Critical Value	Probability	Order of integration	Remark
GDP	-7.604637	-2.967767	0.0000	I (1)	Stationary
REC	-4.443848	-2.971853	0.0016	I (2)	Stationary
GFCF	-3.396989	-2.967767	0.0194	I (1)	Stationary
OR	-7.461166	-2.971853	0.0000	1(1)	Stationary

Table 2

PP Variables	PP Statistics	Critica Value	Probability	Order of Integration	Remark
GDP	-13.04255	-2.967767	0.0000	I(1)	Stationary
REC	-4.378679	-2.971853	0.0019	I(2)	Stationary
GFCF	-3.491521	-2.967767	0.0156	I(1)	Stationary
OR	-10.10727	-2.967767	0.0000	I(1)	Stationary

Table 4.2 shows the result of the unit root test conducted with both the Augmented Dickey-Fuller Test (ADF) and Philips Perron Test (PP). To get a robust result for this empirical study, we adopted the outcome of Philip Perron statistics due to the robustness of the result in point of structural breaks. In line with the prepositions of Jenkins and Box (1970). The variable that is not stationary at levels would be made stationary after the first difference. The following variables in the model were made stationary after the first difference, GDP, GFCF, OR while REC was at the second difference level of co-integration. stationary

Autoregressive Distributed Lag (ARDL) Model and Bounds Test for Co-integration the (ARDL) model approach of Shin and Smith (2001) is applied to investigate the relationship between energy consumption and economic growth in Nigeria. The ARDL model is chosen because of the inbuilt co-integration procedure called the bounds test for co-integration or long-run relationships. The ARDL bounds test is more flexible when compared to other co-integration methods. The ARDL bounds test is used to test the null hypothesis that there is no Co-integration among the variables against the alternative hypothesis. If the calculated F-statistics is greater than the upper bound then the null hypothesis is rejected in favor of the alternative hypothesis and if it is below the lower bound then there is no co-integration.

Table 3: Bound Test for GDP Model

ARDL Bounds Test		
Date: 04/26/23 Time: 13:50		
Sample: 1995 2021		
Included observations: 27		
Null Hypothesis: No long-run relationships exist		
Test Statistic	**Value**	**k**
F-statistic	4.718834	3
Critical Value Bounds		
Significance	**I0 Bound**	**I1 Bound**
10%	2.72	3.77
5%	3.23	4.35
2.5%	3.69	4.89
1%	4.29	5.61

Source: Computed from E-view

The result presented in Table4.2, shows that the calculated F-statistics of 4.718834is higher than the upper bound critical value of 4.35 at a 5% significant level. Based on this result, it is concluded that a long-run relationship exists among the variables of the GDP model. So, there is a long-run co-integration among the variables in the model.

Table 5: ARDL-ECM Short-run Results for GDP model

ARDL Cointegrating And Long Run Form				
Dependent Variable: GDP				
Selected Model: ARDL (4, 4, 3, 4)				
Date: 04/26/23 Time: 14:01				
Sample: 1991 2021				
Included observations: 27				
Cointegrating Form				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
D (GDP (-1))	-0.254704	0.249968	-1.018945	0.3381
D (GDP (-2))	0.397584	0.188388	2.110449	0.0678
D (GDP (-3))	0.296044	0.145391	2.036189	0.0761
D(ECT)	-0.043007	0.017492	-2.458619	0.0394
D (REC (-1))	-0.044466	0.063055	-0.705186	0.5007
D (REC (-2))	-0.106471	0.058086	-1.832990	0.1042
D (REC (-3))	0.081178	0.037532	2.162918	0.0625
D(GFCF)	0.271429	0.183347	1.480413	0.1770
D (GFCF (-1))	-0.134287	0.396089	-0.339032	0.7433
D (GFCF (-2))	-0.334384	0.337099	-0.991945	0.3503
D(OIL_RENT)	0.409970	0.120492	3.402471	0.0093
D (OIL_RENT (-1))	-0.221452	0.106567	-2.078041	0.0713
D(OIL_RENT (-2))	0.095882	0.113506	0.844726	0.4228
D(OIL_RENT(-3))	0.264947	0.101962	2.598497	0.0317
CointEq (-1)	-0.883961	0.292045	-3.026798	0.0164
Cointeq = GDP - (-0.2115*ECT -0.6644*GFCF + 0.2058*OIL_RENT +				
43.9638)				

Source: Computed from E-view

The result of the short–run dynamic regression of the model is presented in Table 4.3. The regression result indicates that in the short run, the renewable energy consumption coefficient has a negative relationship with GDP and is statistically significant at 0.0394, that is, an increase in electricity consumption will result in a decrease in the gross domestic product by 0.04 percent in the short run all things being equal.

The gross fixed capital formation coefficient has a positive relationship with GDP and is not statistically significant at 0.1770, that is, an increase in gross fixed capital formation will lead to an increase in gross domestic product by 0.27 percent in the short run all things being equal.

oil rent coefficient has a positive relationship with GDP and is statistically significant at 0.0093, that is, an increase in oil rent will lead to an increase in gross domestic product by 0.40 percent in the short run all things being equal.

The ECM turned up with a negative value of -0.883961 as the ECM coefficient which suggests 17% speed of adjustment. This means that approximately 88% of discrepancy in the previous year is adjusted for the current year.

Table 4: ARDL Long Run Regression for RGDP Model

Long Run Coefficients				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
ECT	-0.211496	0.058151	-3.637001	0.0066
GFCF	-0.664421	0.152311	-4.362260	0.0024
OIL_RENT	0.205823	0.214356	0.960195	0.3651
C	43.963798	9.458525	4.648060	0.0016

The result of the long–run dynamic regression of the model is presented in Table 4.4. The regression result indicates that in the long run, the renewable energy consumption coefficient has a negative relationship with GDP and is statistically significant at 0.0066, that is, a decrease in renewable energy consumption will result in a decrease in the gross domestic product by 0.21 percent in the long-run all things being equal.

The regression result indicates Gross fixed capital formation coefficient has a negative relationship with GDP and is statistically significant at 0.0024, that is, a decrease in gross fixed capital formation will lead to a decrease in gross domestic product by 0.66 percent in the long run all things being equal.

oil rent coefficient has a positive relationship with GDP and is not statistically significant at 0.3651, that is, an increase in oil rent will lead to an increase in gross domestic product by 0.20percent in the long run all things be equal.

Tables 5: Residual Diagnostics Test for GDP

Breusch-Godfrey Serial Correlation LM Test:			
F-statistic	0.661490	Prob. F(2,6)	0.5500
Obs*R-squared	4.877858	Prob. Chi-Square (2)	0.0873

Source: Computed from E-view(10)

The null hypothesis states that there is no serial correlation. Since each of the F-statistics probability values is greater than five percent we cannot reject the null hypothesis of no serial correlation. It means that the result is good for prediction.

Heteroskedasticity Test: Breusch-Pagan-Godfrey			
F-statistic	0.572458	Prob. F(18,8)	0.8450
Obs*R-squared	15.19946	Prob. Chi-Square(18)	0.6482
Scaled explained SS	1.379562	Prob. Chi-Square(18)	1.0000

Source: Computed from E-view

The null hypothesis states that there is no heteroskedasticity. Since each of the F-statistics probability value is greater than five percentage we cannot reject the null hypothesis of no heteroskedasticity. It thus means that the result of the model can be taken seriously, that is the result is good for forecast.

Summary of the findings

The result of the short–run and long-run dynamic regression of the model is presented in Table 4.4. The result revealed that in the short run and long run, the renewable energy consumption coefficient has a negative relationship with GDP and is statistically significant at 0.0394 while in the long run in Table 4.4 renewable energy consumption coefficient has a negative relationship with GDP and is statistically significant at 0.0066 this is likely attributed to the explanation that renewable energy consumption and productivity in the short run could be hinderedas a resultof poor electricity supply leading to a reduction in output and productivity in affected industries, which could negatively impact on GDP.

However, in the long run, the impact of renewable energy consumption on productivity and GDP may become significant due to improvements in technology, infrastructure, and energy efficiency. As the country invests in improving its energy infrastructure and reducing electricity shortages, the negative relationship between renewable energy consumption and productivity no longer exist.

The result of the short–run and long-run dynamic regression of the model is presented in table 4.3. Shows that in the short run and long run, the Gross fixed capital formation coefficient has a positive relationship with GDP and is statistically insignificant at 0.1770 while in the long run renewable energy consumption and gross fixed capital formation are positivelyassociated with GDP and are statistically significant at 0.0066 this is likely attributed to investment in fixed assets such as buildings, machinery, and equipment may have increased in productivity and output in the economy. The increase in output would lead to an increase in GDP in the long run.

However, in the long run, the impact of GFCF on GDP may be less significant due to diminishing marginal returns. As more and more capitalareinvested, the marginal increase in output and productivity may decrease, resulting in a less significant relationship between GFCF and GDP over time.

The result of the short–run and long-run dynamic regression of the model is presented in Table 4.3. Shows that in the short run and long run, the oil rent coefficient has a negative relationship with GDP and is statistically significant at 0.0093 while in the long run in table 4.4 oil rent coefficient has a negative relationship with GDP and is statistically insignificant at 0.0066 this is likely attributed tooil rent and productivity in the short run, could be facing Dutch disease effect, as well as the fact that the oil sector may be relatively capital-intensive and require specialized skills, which could lead to a misallocation of resources away from other sectors of the economy.

Yet, in the long run, the impact of oil rent on GDP and productivity may be less significant due to other factors such as the diversification of the economy, changes in technology, and improvements in human capital. As the economy becomes more diversified and less dependent on the oil sector, the impact of oil rent on GDP and productivity may become less significant over time.

Conclusion

This paper empirically investigated the impact of energy consumption on economic growth in Nigeria from the period 1980 to 2022. The study investigated the short-run and long-run relationship between the variables by using Autoregressive distributed lag (ARDL). The empirical results show that gross domestic product (GDP) is influenced positively by renewable energy consumption in the short run and statistically significant only in lag three but the coefficient is negatively signed and also statistically significant in the long run. The coefficient of crude oil price is positively signed in both the long run and short run but it is only statistically significant in the long run. Based on the findings enumerated above, this study, therefore, recommends that the government should Encourage investment in fixed capital; and that increasing investment in fixed capital (e.g., buildings, machinery, equipment) may lead to higher economic growth. Therefore, the study recommends policies or initiatives that encourage businesses and individuals to invest in fixed capital. And also reduces dependence on oil; and relying heavily on oil revenues may harm economic growth. As such, the government coulddiversify the economy to reduce dependence on oil, such as by investing in other industries or increasing exports of non-oil products.

References

1. Menegaki Growth AN. renewable energy in Europe: a random effect model with evidence for neutrality hypothesis *Energy Econ*, 2011.
2. Tugcu CT, *et al.* Renewable and non-renewable energy consumption and economic growth revisited: evidence from G7 countries*Energy Econ*, 2012.
3. Pla-Julian, Guevara S. Is circular economy the key to transitioning towards sustainable development? challenges from the perspective of care ethics," Futures,2019:105:67–77.
4. Bugaje Renewable IM. energy for sustainable development in Africa: a review*Renew. Sust. Energ. Rev*, 2006.
5. Jin J. Yu Z. Current situation statistics and macroeconomic policy analysis of China's energy consumption structure*," Journal of Physics: Conference Series*, Article ID 012074,2020:1437:1.
6. Ehigiamusoe KU, Lean HH. Effects of energy consumption, economic growth, and financial development on carbon emissions: evidence from heterogeneous income groups," *Environmental Science and Pollution Research*,2019:26(22):22611–22624.
7. Im KS, *et al.* Testing for unit roots in heterogeneous panels*J. Econ*, 2003.
8. Mohsin M, Abbas Q, Zhang J, Ikram M, Iqbal N. Integrated effect of energy consumption, economic development, and population growth on CO2 based environmental degradation: a case of transport sector," Environmental Science and Pollution Research, vol. 26, no,2019:32:32824–32835.
9. Frondel M, *et al.* Experience*Energy Policy*, 2010.
10. Pereira MG, *et al.* Rural electrification and energy poverty: empirical evidences from Brazil Renew. *Sust. Energ*. *Rev*, 2010.
11. Tran NV, Tran QV, Do LTT, Dinh LH, Do HTT. Tradeoff between environment, energy consumption and human development: do levels of economic development matter?" *Energy*,2019:173:483–493.
12. Apergis N, *et al.* Renewable energy consumption and economic growth: evidence from a panel of OECD countries*Energy Policy*, 2010.
13. Sadorsky Renewable P. energy consumption and income in emerging economies*Energy Policy, 2009.*
14. Deonanan R, Ramkissoon B. Energy consumption and economic development in Caribbean SIDS," *Social and Economic Studies*,2018:67(2-3):65–93.
15. Sari R, *et al.* Disaggregate energy consumption, employment, and income in Turkey*Energy Econ*, 2004.
16. Asumadu SS, Vladimir S. Effect of foreign direct investments, economic development and energy consumption on greenhouse gas emissions in developing countries," The Science of the Total Environment,2019:646:862–871.
17. Erzi T, Chong P, Yilan X. Changes of energy consumption with economic development when an economy becomes more productive, Journal of Cleaner Production,2018:196:788–795.
18. Sadraoui T, Hamlaoui H, Youness Z, Ben Sadok I. A dynamic panel data analysis for the relationship between energy consumption, financial development, and economic growth," International Journal of Econometrics and Financial Management,2019:7(1):20–26.
19. Hao X, Deng F. The marginal and double threshold effects of regional innovation on energy consumption structure: evidence from resource-based regions in China," *Energy Policy*,2019:131:144–154.
20. Fang Y. Economic welfare impacts from renewable energy consumption: the China experience*Renew. Sust. Energ*. Rev, 2011.