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Energy Poverty and Economic Growth in Nigeria: An Empirical Analysis From 1990 – 2021

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Abstract: This study empirically investigated the relationship between energy poverty and economic growth in Nigeria from 1990 to 2021. Quantitative methodology was employed and secondary data obtained from the Central Bank of Nigeria, the National Bureau of Statistics, and other pertinent governmental entities were used. The annual time series data covered the period from 1990 to 2021. The study used descriptive statistics, such as percentage, mean, and chart, and ordinary least squares (OLS) were used. ADF Test was used to test for the presence of unit roots in the time series data. The Johansen cointegration test was used to examine the long-run relationship between energy poverty and economic growth in Nigeria. The results showed an upward trend in the GDP between 1990-2014 but from 2014 there was a clear downward trend while an upward trend was observed for access to electricity. ADF test found that the energy poverty and economic growth variables were stationary and non-stationary at the 5% p value, respectively. The OLS regression results showed a statistically significant positive relationship between access to electricity and economic growth, with a coefficient estimate of 0.83 and a p-value of 0.000. The Johansen cointegration test indicated that there is a long-term equilibrium relationship between access to electricity and economic growth. There is a negative relationship between energy poverty and economic growth in Nigeria. The findings suggest that policies aimed at increasing access to affordable and reliable energy services could be beneficial for promoting economic growth in the country.

Keywords: Economic growth, Energy poverty, Johansen cointegration test, Ordinary least squares, Nigeria.

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1. Introduction

Energy poverty is the inability to obtain affordable, sufficient, dependable, environmentally friendly, and high-quality energy services to support human and economic growth (Reddy, 2000). It is primarily found in rural regions of Africa, where there is no access to safe, clean fuels and a reliance on conventional energy sources like biomass. The developing world accounts for an estimated 2 billion people globally (Krueger, & Lindahl, 2011). Access to energy has been quite limited in Nigeria. Less than 60% of the population had continuous access to electricity from 1990 to 2017, according to statistics from the World Development Indicators (2019). This is very concerning because the country has one of the largest economies in both West Africa and the entire continent of Africa. In comparison to rural sections of the nation, access to power in metropolitan areas is far greater.

Nigeria has had difficulties with power generation, transmission, and distribution for more than three decades. The fact that Nigeria is the world's biggest buyer of standby electricity producing plants highlights the depth of this (Braimoh & Okedeyi, 2010). The degree of difficulty the Nigerian government is encountering is demonstrated by the fact that importing energy generators has become the social norm in that nation. Despite the enormous abundance of minerals and other power sources. High levels of electrical poverty, including severe inaccessibility and insufficiency, are present across Nigeria. People who live in energy poverty are not wired into the power grid. These folks spend a lot of time gathering fuel to suit their demands and use unclean, polluting fuels. The effects on one's health, finances and happiness are negative. A lack of development stems from inadequate energy, both in terms of quality and quantity, which raises poverty and suffering among people. Energy is used in practically all economic activities, so it is crucial to have access to sufficient supplies at costs that are both economical and environmentally responsible. This gave rise to the idea of energy security. Coal, crude oil, and natural gas are just a few of the abundant renewable and non-renewable energy resources that Nigeria has available (Afaha, & Ifarajimi, 2021). Although Nigeria has proven reserves of higher than 36,809 million barrels of crude oil and 5,761 billion total standard cubic meters of gas, it also ranked 44th in the world in 2016 for proven coal reserves with 379 million tons . According to OPEC (2019), the majority of Nigerians suffer from severe energy poverty (Allison & Olanshile, 2016). If completely harnessed, Nigeria's tremendous energy potential could meet all of the 208 million people who call the nation home's energy needs. Yet, providing enough reliable energy for an extended period of time has proven difficult for many years (Enesi, Ezechukwu, & Ugwu., 2015; Chidebell-Emordi, 2015).

The provision of social services like health and education, as well as agriculture, and industry, all depend on energy for their existence. The type and extent of energy access significantly affect a nation's wealth and development status as well as the welfare of its population (Aigheyisi, & Oligbi, 2020). Many schools of thought hold that the universe is powered and sustained by energy. Energy is undoubtedly essential to human survival, especially in light of the role it plays in the socio-economic and infrastructural development of every country (Afaha, & Ifarajimi, 2021). However, the level of energy poverty that the world is experiencing appears to be increasing incrementally with population growth, particularly in a nation like Nigeria, which also happens to be the research work's study subject. These concerns, which are a focus of this study, are top-of-mind for all decision-makers around the world.

1.1 Research objectives

The objective of this study is to empirically analyse the relationship between energy poverty and economic growth in Nigeria from 1990 to 2021.

2. Literature review

Several research have tried to look at the connection between energy poverty and economic growth. This section reviews a few of the studies.

Using data from the 2018 Nigeria Demographic and Health Survey (NDHS), Afaha, and Ifarajimi (2021) examined the impacts of energy poverty and climate change on economic growth. The impact of energy poverty was estimated using the Autoregressive Distributed Lagged (ARDL) model throughout the period of 1980 to 2018. The findings demonstrated that the GDP growth was negatively impacted by energy poverty. However, energy imports contribute positively to GDP growth by 10%. In the same vein, Aigheyisi and Oligbi (2020) used the S-estimation method of the robust least squares estimator to analyze yearly time series data in order to investigate the impact of energy poverty on economic development in Nigeria from 1990 to 2017. Their research showed that energy poverty has a negative impact on the economic growth of the nation, suggesting that increased access to power is beneficial to development.

Zhang, Shi, Zhang and Xiao (2019) study the effect of access to energy on some selected socio economic indicators such as education, access to finance and economic development. They employed Bayesian Model Averaging approach to examine the effects in a sample of 48 developing countries. Evidence from the study

indicated positive long run relationship between access to electricity and infrastructure, industrialization, education, access to finance and economic development.

Additionally, Acharya and Sadath (2019) used household level data to examine how energy poverty affects India's economic development. The study discovered that energy poverty, which was also found to be highly connected with social-economic backwardness, had a negative impact on India's economic progress. The study further found that education and income level played some roles in reducing energy poverty in the country, the role of education being more significant.

Bridge (2017) used data from household surveys, geography information, and population density data from Nicaragua for their investigation of the relationship between access to electricity and key human development metrics. Systems of simultaneous equations were specified and estimated using the two-stage least-squares estimation technique. The study found that access to electricity improved individual and household income levels and consumption and completion of primary school education.

The aforementioned empirical studies are only a few of the numerous additional studies that have been conducted, indicating that researchers have made an attempt to learn more about the impacts and implications of energy poverty on a country's economic and social well-being. A summary of the whole body of material under examination reveals the critical role that energy and access to it play in the expansion and advancement of states and civilizations. So, by empirically examining the impact of energy poverty on economic growth in Nigeria, this study will contribute to the body of information already in existence.

3. Methodology

The study was carried out in Nigeria. Descriptive statistics, Regression, Augmented Dickey-Fuller (ADF) test and Johansen Cointegration Test were used to analyse the collected data.

3.1 Source of Data

The use of secondary data was necessary due to the nature of this investigation. The data used are obtained from various sources, including the World Bank, and the Nigerian National Bureau of Statistics databases and are annual time series covering the years 1990 to 2021. Relevant data on energy access and economic growth were analyses using the STATA 17 package. The GDP was used to measure the economic growth in Nigeria.

3.2 Analytical techniques used

3.2.1 Descriptive Statistics

The descriptive statistics was used to summarize the data collected. Measurements of variability, including standard deviation and range, as well as measures of central tendency, such as mean, was be calculated for each variable.

3.2.2 OLS Regression

Ordinary Least Squares (OLS) regression was used to analyse the relationship between energy poverty and economic growth in Nigeria. The dependent variable was economic growth, as measured by GDP, while the independent variable was energy access, as measured by the percentage of the population with access to electricity, school enrolment and gross domestic product per capital. The functional form of the model is specified as:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \varepsilon_t$$

where

Y = Gross domestic product (GDP)

X_1= Access to electricity

X_2= School enrolment

X_3= Gross domestic product per capital.

B_1, B_2 and B_3 = Coefficient to be estimated

ε_t is a error term,

The regression results was used to test the hypothesis that there is a causal relationship between energy poverty and economic growth in Nigeria.

3.2.3 The Augmented Dickey-Fuller (ADF) test

ADF Test was used to test for the presence of unit roots in the time series data. The ADF test shows if the data is stationary or not.

3.2.4 Johansen Cointegration Test

The Johansen cointegration test was used to examine the long-run relationship between energy poverty and economic growth in Nigeria. Cointegration test examine whether the time series are related by a long-term relationship.

4. Result and Discussion

4.1 Trend in the data

The figure 1 shows that from 1990-2014 there is an upward trend in the GDP and GDP per capita but from 2014 there was a clear downward trend in the GDP and GDP per capita in Nigeria, as indicated by the declining trend line. At the same time, there was an upward trend in access to electricity, as indicated by the upward sloping trend line. This suggests a possible relationship between increasing access to energy and economic growth in Nigeria. The highest level of GDP was observed in 2014 while the lowest level was observed in 1992 and 2016 the population have the highest access to electricity while the lowest level was observed in 1990.

4.2 Descriptive Analysis

The descriptive statistics is presented in Table 1, consisting of all the four variables that is included in this study over the whole sample period. The average value of the GDP was 2.387e+11; access to electricity, school enrolment and GDP per capita were 47.15, 90.54 and 1435.06 respectively, while the standard deviation, maximum and minimum value were show in Table 1.

Table 1: The Descriptive statistics

Variable	Mean	Std. Dev.	min	max
GDP	2.387e+11	1.838e+11	2.775e+10	5.742e+11
Access to electricity	47.145	7.837	27.3	59.3
School enrollment	90.542	6.204	78.663	102.108
GDP per capita	1435.057	929.683	270.028	3200.953

Source: Data analysis 2023

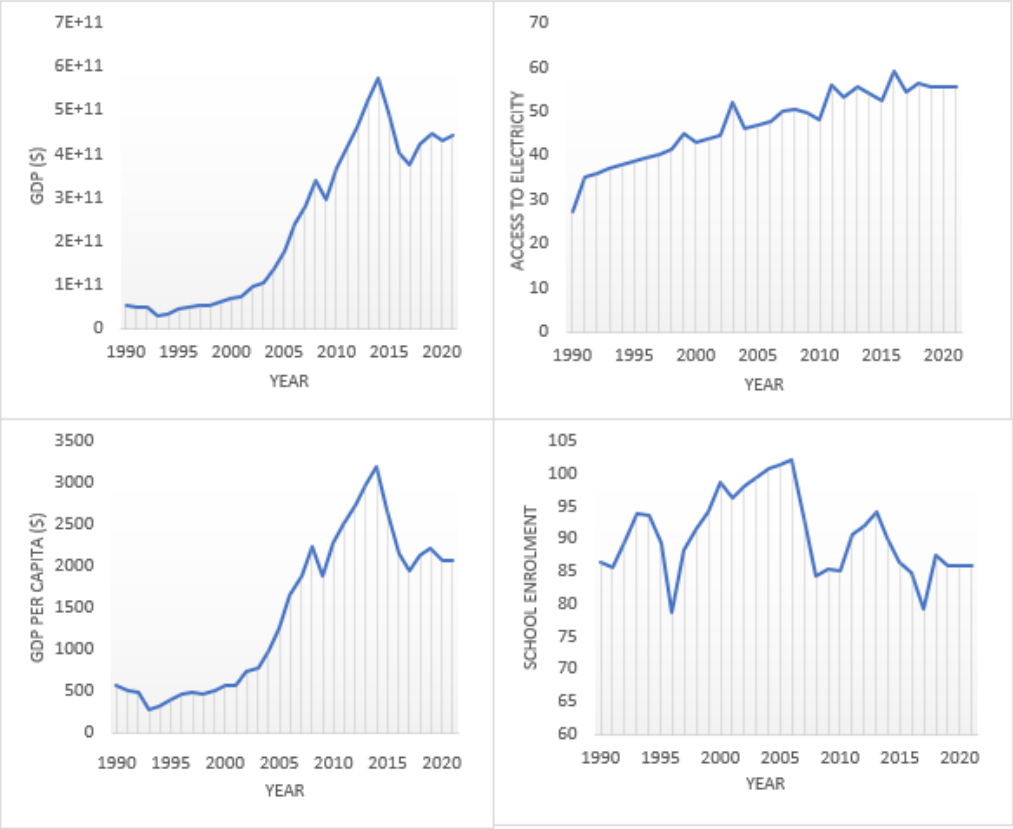

Figure 1: GDP, GDP per capital, access to electricity and school enrolment from 1990-2021

4.2 The OLS regression analysis

The results of this study, which employed the ordinary least squares (OLS) method, are displayed in Table 2. The model's R^2 is 0.996, which indicates that the explanatory variables included in the model adequately explained 99.60 percent of the observed variations in GDP. The computed F-ratio was statistically significant at the 1% level, indicating that all the explanatory factors together had joint effects on the GDP. With an estimated coefficient of 0.832 and a p-value of 0.000, the coefficient estimations demonstrate that having access to electricity has a positive and substantial influence on economic growth. According to this, when all other factors are held equal, an increase in access to electricity of one unit is correlated with an increase in GDP of 0.82 units. The positive effect conforms to *a priori* expectation, and also implies that a reduction in access to electricity (which implies an increase in energy poverty) adversely affects the economic development of the country. This is in sync with previous empirical studies Zhan *et al.* (2019) and Aigheyisi and Oligbi, (2020) which also found that energy poverty negatively affects development.

Table 2: The OLS regression analysis

GDP	Coef.	St.Err.	t-value	p-value
Access to electricity	0.832***	0.130	6.40	0.000
School enrollments	-0.488**	0.193	-2.53	0.017
GDP per capital	1.119***	0.030	36.78	0.000
Constant	16.948***	0.892	18.99	0.000
R-squared	0.996			
F-test	2132.638			
Prob > F	0.000			

Source: Data analysis 2023 Note: **** p<.01, ** p<.05, * p<.1*

With an estimated coefficient of -0.488 and a p-value of 0.017, enrolment in schools has a negative and significant effect on economic growth. This means that, when all other factors are held equal, a one-unit increase in school enrolment is correlated with a 0.488-unit decline in GDP. With an estimated coefficient of 1.11 and a p-value of 0.005, GDP per capita has a positive and significant influence on GDP. According to this, when all other factors are held equal, an increase in GDP per capita of one unit is correlated with an increase in economic growth of 0.06 units.

4.3 The ADF test

The ADF test is presented in Table 3. The ADF test indicates that the null hypothesis of a unit root in the time series of access to electricity is rejected at the 5% level of significance. This means that the time series of access to electricity is stationary and does not have a trend or random walk component. Therefore, any changes in the level of access to electricity over time are likely to be driven by underlying economic or social factors rather than simply by chance. The ADF test for the other three variables indicates that the null hypothesis of a unit root in the time series is not rejected at the 5% level of significance. This means that the time series of GDP, GDP per capita and school enrolment is not stationary.

Table 3: The ADF test

Variable	T stat	P value.	Status
GDP	-0.515	0.889	Not stationary
Access to electricity	-3.413	0.010	Stationary
School enrolment	-2.220	0.199	Not stationary
GDP per capita	-0.636	0.863	Not stationary

Source: Data analysis 2023

4.4 The Johansen test cointegration

This study evaluates whether the GDP, access to electricity, GDP per capita, and school enrolment indices are integrally associated. This study employed the cointegration test suggested by Johansen (1988), and the test results are shown in Table 4. The findings show that the trace statistic (51.982) exceeds critical values in both the trace test and maximum eigenvalue test at maximum rank zero (47.68). Thus that the time series variables GDP, access to electricity, GDP per capita, and enrolment in schools are cointegrated, rejecting the null hypothesis. The null hypothesis is rejected for max statistics as well because the result of 40.508 is greater than the critical value of 27.07. As a result, the time series are cointegrated according to maximum rank zero. The trace statistic does not exceed critical values at maximum rank one and rank two. Accept the null hypothesis that cointegration exists for one equation and for two equations, respectively. The null hypothesis is accepted for max statistics similarly because the value does not exceed a critical value.

Table 4: The Johansen test

Max rank	**Parms**	**LL**	**Eigen value**	**Trace statistic**	**5% critical value**	**Max statistic**	**5% critical value**
0	20	-1073.670	.	51.982	47.21	40.508	27.07
1	27	-1053.416	0.740	11.473*	29.68	9.406	20.97
2	32	-1048.713	0.269	2.066	15.41	2.066	14.07

Source: Data analysis 2023

The trace statistic does not reach critical levels at maximum rank one and rank two. Accept the null hypothesis that cointegration exists for one equation and for two equations, respectively. The null hypothesis is accepted for max statistics similarly because the value does not exceed a critical value.

5. Summary, policy implication, and conclusion

The analysis using the ADF test found that the energy poverty and economic growth variables were stationary and non-stationary at the 5% significance level, indicating that they were likely influenced by some underlying trend or seasonality. However, the OLS regression results showed a statistically significant positive relationship between access to electricity and economic growth, with a coefficient estimate of 0.83 and a p-value of 0.000. This suggests that an increase in energy poverty is associated with lower economic growth in Nigeria. Finally, the Johansen cointegration test indicated that there is a long-term equilibrium relationship between the two variables, implying that they will tend to converge towards a common trend in the long run. The findings suggest that there is a negative relationship between energy poverty and economic growth in Nigeria. This implies that an increase in access to electricity (decrease in energy poverty) is associated with higher economic growth in Nigeria. This result is consistent with previous studies that have found a positive relationship between access to electricity and economic growth (Aigheyisi & Oligbi, 2020). The limitations of this study are that it is based on aggregate data and does not provide insights into the causal mechanisms underlying the relationship between energy poverty and economic growth. Future studies should focus on examining the specific channels through which energy poverty affects economic growth in Nigeria.

Furthermore, the study adds to the existing literature on energy poverty and economic growth by providing empirical evidence of a positive relationship between the two variables in Nigeria. The study also contributes to the literature by examining the specific context of Nigeria and the potential policy implications of our findings for the country. The findings have important policy implications for Nigeria. Policies that aim to increase access to affordable and reliable energy services could be beneficial for promoting economic growth in Nigeria. This could include policies aimed at increasing investment in the energy sector, as well as policies that encourage the use of renewable energy sources. Additionally, policymakers should focus on addressing the root causes of energy poverty in Nigeria, such as lack of infrastructure and low income levels, to ensure sustainable economic growth in the long run.

In conclusion, the study provides valuable insights into the relationship between energy poverty and economic growth in Nigeria. The findings suggest that policies aimed at increasing access to affordable and reliable energy services could be beneficial for promoting economic growth in the country. However, further research is needed to better understand the specific mechanisms through which energy poverty affects economic growth in Nigeria.

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