Asymmetric Effects of Renewable Energy Consumption on Life Expectancy in Nigeria

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Abstract
This study investigates the asymmetric impact of renewable energy consumption on life expectancy in Nigeria using data from 1980 to 2021. The analysis utilizes the non-linear Autoregressive Distributed Lag (NARDL) methodology to examine the relationship between these variables. The results reveal a combination of positive and negative effects of renewable energy consumption on life expectancy. While certain positive effects are statistically significant, others are not in the short run. However, in the long run, the positive effect prevails over the negative effect, indicating an overall favorable influence of renewable energy consumption on life expectancy. Additionally, GDP per capita and urbanization are found to have positive impacts on life expectancy, whereas inflation rate shows an adverse effect. In light of these findings, it is recommended that the Nigerian government focuses on investing in renewable energy infrastructure while addressing any potential negative consequences associated with specific aspects of renewable energy production. Moreover, policymakers should implement strategies to foster economic growth, stabilize inflation, enhance access to healthcare and education, and effectively managing the challenges posed by rapid urbanization.
Keywords: Renewable Energy, Life Expectancy, Inflation, GDP Per Capita, Secondary School Enrolment Urban Population
JEL Classification:Q1, I15, O44

Introduction

The Sustainable Development Goals (SDGs), established by the United Nations, provide a global framework for addressing social, economic, and environmental challenges by 2030 (Echendu, 2020). Within these goals, two key targets of utmost importance are renewable energy consumption and improving life expectancy. These targets recognize the significance of transitioning to sustainable energy sources while simultaneously ensuring the well-being and longevity of individuals. In recent years, there has been increasing interest in understanding the impact of renewable energy consumption on various aspects of human welfare, including environmental sustainability, economic development, and particularly public health and life expectancy. This intersection between renewable energy consumption and its influence on public health and life expectancy holds significant implications for sustainable development and warrants in-depth investigation and analysis.

Renewable energy consumption, such as solar, wind, hydro, and biomass energy, offers the potential to address energy deficits in a sustainable and environmentally friendly manner (Hussain, et al, 2023). Ibrahim, et al (2023) opine that by reducing reliance on fossil fuels and promoting clean energy alternatives, Nigeria can mitigate the adverse health effects associated with air pollution and improve overall public health outcomes. Life expectancy, on the other hand, reflects the average number of years a person is expected to live, serving as an important indicator of a population's overall health and well-being. By improving life expectancy, Nigeria has the opportunity to enhance the overall quality of life for its citizens and make significant strides towards achieving the Sustainable Development Goals (SDGs). Increasing life expectancy reflects improvements in healthcare, living conditions, nutrition, and other social determinants of health.

Nigeria, as a rapidly developing country, faces significant challenges in both renewable energy adoption and improving life expectancy. In terms of renewable energy, while the country has substantial renewable energyresources, such as solar, wind, and hydro, their utilization remains relatively low due to various factors, including limited infrastructure, inadequate financing mechanisms, and policy inconsistencies (Echendu, Okafor, & Iyiola, 2022; Amir & Khan, 2022 ; Bekirsky, et al, 2022). Similarly, Nigeria's life expectancy has been below the global average, influenced by factors like inadequate access to quality healthcare, prevalence of infectious diseases, and socio-economic disparities (Sanders, 2023; Pencil, 2023). To address these issues, the Nigerian government has implemented policies and initiatives to promote renewable energy deployment, including the Renewable Energy Master Plan and the National Energy Policy. Additionally, efforts have been made to improve healthcare infrastructure, expand health insurance coverage, and enhance primary healthcare services to enhance life expectancy. However, challenges remain in achieving widespread renewable energy adoption and significantly improving life expectancy, necessitating further policy interventions and targeted investments to bridge the gaps and accelerate progress towards sustainable energy and better health outcomes in Nigeria.

While numerous studies have investigated the relationship between renewable energy consumption and life expectancy using different methodologies, many of them have made the assumption of symmetry in the process (Ibrahim, Ajide, & Omokanmi, 2021; Sharma, Sinha, & Kautish, 2021). However, the existing literature has put forth several explanations for the possible presence of nonlinearity or asymmetry in the renewable energy consumption and life expectancy. One plausible reason is the phenomenon of asymmetric hedging. However, the impact of renewable energy consumption on life expectancy may not be uniform or symmetrical. Various factors, including socio-economic disparities, infrastructure challenges, and geographic variations, can contribute to the asymmetry in the relationship (Martin, Martinelli, & Clifton, 2022; Lee, Olasehinde-Williams, & Ibikunle, 2022). Understanding these asymmetries is crucial for designing effective policies and strategies to maximize the benefits of renewable energy consumption on life expectancy in Nigeria.

Given the aforementioned factors, assuming a symmetric relationship in the estimation of renewable energy consumption and life expectancy might lead to misleading conclusions. Therefore, this study aims to explore the potential impact of nonlinearity in renewable energy consumption on life expectancy to provide new insights into this issue. Specifically, the objective is to examine the short-run and long-run asymmetric relationship between renewable energy consumption and life expectancy in Nigeria and on the basis juxtapose whether the negative effect outweighs the positive effect or vice versa. By considering the possibility of nonlinearity, this paper aims to enhance our understanding of the dynamics between renewable energy consumption and life expectancy in Nigeria.

The paper is structured as follows: Section 2 provides a literature review on the impact of renewable energy investment on life expectancy, highlighting the existing research gap regarding the asymmetrical impact. Section 3 outlines the methodology used in the study. Section 4 presents the results and discusses the findings, focusing on the relative magnitude of positive and negative effects. Finally, Section 5 concludes the paper by summarizing the main findings and offering policy recommendations.

Literature Review

Renewable energy refers to energy derived from natural sources that are replenished continuously or at a rapid rate, such as sunlight, wind, water, geothermal heat, and biomass (Xu & Ullah, 2023). Unlike non-renewable energy sources like fossil fuels, which are finite and deplete over time, renewable energy sources are naturally replenished and considered sustainable and environmentally friendly. Wang & Lee, (2022) sees it as the utilization of energy derived from renewable sources, which are naturally replenished and have a minimal impact on the environment. It involves harnessing energy from sources such as sunlight, wind, water (hydroelectric power), geothermal heat, and biomass. Renewable energy consumption is an important aspect of sustainable development and efforts to mitigate climate change.

Theoretical Framework

This study anchors on the environmental Kuznets curve (EKC) hypothesis The EKC hypothesis suggests that the relationship between economic development and environmental quality follows an inverted U-shaped curve. In the context of renewable energy consumption and life expectancy, this implies that the initial transition to renewable energy sources may have some negative effects on life expectancy due to the challenges associated with shifting from traditional energy sources. However, as the renewable energy infrastructure becomes more established and sustainable, the positive impacts on environmental quality and public health can outweigh the initial negative effects, ultimately leading to an improvement in life expectancy.

Empirical Review

Polcyn et al. (2023) examines the effects of health expenditure, energy consumption, CO2 emissions, population size, and income on health outcomes in 46 Asian nations from 1997 to 2019. To account for cross-sectional dependence and slope heterogeneity among the Asian nations, the researchers employed cross-sectional dependence (CSD) and slope heterogeneity (SH) tests. Traditional estimation methods were deemed inappropriate based on the results of these tests, leading to the utilization of a new panel method called the inter autoregressive distributive lag (CS-ARDL) model. Additionally, the study's findings were cross-checked using the common correlated effects mean group (CCEMG) method and augmented mean group (AMG) method. The CS-ARDL analysis revealed that higher rates of energy use and healthcare spending contribute to better health outcomes in Asian countries in the long run. However, the study found that CO2 emissions have a detrimental effect on human health. The impact of population size on health outcomes was negative in the CS-ARDL and CCEMG methods, but positive in the AMG method, with only the AMG coefficient being statistically significant.

Younus, Khursheed, and Afzal (2022) conducted a study examining the characteristics of life expectancy and its relationship with economic progress, energy use, and carbon dioxide (CO2) emissions across Asia and Africa from 2000 to 2018. Using the panel quantile regression model, the study assessed life expectancy across various quantile ranges. The analysis revealed a strong connection between CO2 emissions and life expectancy across all quantiles. The impact of economic progress on life expectancy was negative, except for the highest quantile (0.95). Additionally, there was a negative and significant association between hydroelectricity usage and life expectancy in the lower and higher quantiles, except for the highest quantile. On the other hand, petroleum and other liquid consumption showed positive impacts on life expectancy in the low, medium, and higher quantiles.

Majeed, Luni, and Zaka (2021) investigated the relationship between renewable energy and human health in 155 economies. To explore this link, the researchers employed panel techniques including pooled ordinary least squares, random effects, fixed effects, two-stage least squares, and generalized method of moments. The empirical findings of the study supported the notion that the use of renewable energy has a positive impact on human health. Specifically, the results indicated that the adoption of renewable energy sources is associated with an increase in life expectancy and a decrease in the mortality rate. This suggests that clean energy contributes to better health outcomes by helping to control chronic diseases and reducing the incidence of tuberculosis. Furthermore, the study concluded that factors such as economic growth, trade, and urbanization also play a role in shaping health outcomes. These findings highlight the multifaceted nature of the relationship between energy consumption, economic factors, and human health.

Osakede and Sanusi (2018) assessed the impact of fossil fuel and electricity consumption on life expectancy and infant mortality rates in Nigeria and South Africa. The researchers employed the Autoregressive Distributed Lag (ARDL) model, utilizing data from the World Development Indicators (WDI). Their findings revealed negative effects of fossil fuel consumption on both life expectancy and infant mortality rates in both countries, with stronger long-term effects observed in Nigeria. Additionally, negative effects of electricity consumption on health outcomes were identified in both countries, particularly in the short term. The study suggests that policy interventions should prioritize measures to discourage fossil fuel use for electricity generation, considering the environmental and health hazards associated with it, in order to improve health outcomes in Nigeria and South Africa.

Methodology

Data

The data used for this study are sourced from the World Bank Development Indicators. The data used are life expectancy at birth, total (years), renewable energy consumption (% of total final energy consumption), school enrollment, secondary (% gross), GDP per capita (current US$), urban population (% of total population) and inflation rate.

Model Specification

Most of the existing literature on the relationship between renewable energy consumption and life expectancy has primarily relied on conventional linear models (Sharma, Sinha, & Kautish, 2021; Rahman & Alam, 2022). However, recent research has demonstrated that variables in this context often exhibit nonlinear characteristics (Lee, et al, 2022; Hassan, Mahmood, & Yousaf, 2023). This presents a significant challenge in empirical studies since linear models can yield inconsistent and unreliable estimates when faced with nonlinearity.

The presence of nonlinearities further complicates the relationship between renewable energy consumption and life expectancy. The response of the independent variables to positive changes in renewable energy consumption may differ from their response to negative changes, making the association between renewable energy consumption and life expectancy more intricate. Motivated by the limitations of previous research, this study employs a nonlinear approach called the Nonlinear Autoregressive Distributed Lag (NARDL) methodology to examine the relationship between renewable energy consumption and life expectancy in Nigeria. This methodology allows us to address potential nonlinearities caused by various factors such as policy changes, technological advancements, regulations, and structural shifts.

To assess the impact of renewable energy consumption on life expectancy, we formulate the following linear equation:

$$lleb_t = \beta_0 + \beta_1 lrec_t + \beta_2 lgdpk_t + \beta_3 lsse_t + \beta_4 lurbn_t + \beta_5 linf_t + \varepsilon_t \quad (1)$$

Where $lleb_t$ stands for the log of life expectancy at birth, $lrec_t$ represent log of renewable energy consumption, $lgdpk_t$ log of per capita GDP, $lsse_t$ means log of secondary school enrolment, $lurbn_t$ log of urban population and $linf_t$ represent log of inflation, and ε_t is the error term.

In order to examine potential nonlinear relationships within the data series, we employ the Brock, Dechert, and Scheinkman (BDS) test. This test is a two-tailed test that assesses the null hypothesis of linearity. The rejection of this null hypothesis occurs when the BDS test statistic falls outside the lower and upper critical values (Prabheesh & Laila, 2020). The BDS test statistic is defined as follows:

$$BDS_{\varepsilon,m} = \frac{\sqrt{N}[C_{\varepsilon,m} - (C_{\varepsilon,m})^m]}{\sqrt{V_{\varepsilon,m}}} \quad (2)$$

Where $V_{\varepsilon,m}$ represents the standard deviation of $\sqrt{N}[C_{\varepsilon,m} - (C_{\varepsilon,m})^m]$.

To detect the potential asymmetric impact of renewable energy consumption on life expectancy within a nonlinear framework, the time series $lrec_t$ is decomposed into two new series: a positive series and a negative series. This decomposition is conducted around a zero threshold value, and it is done in the following manner:

$$lrec_t = lrec_0 + lrec_t^+ + lrec_t^- \quad (3)$$

Where $lrec_0$, represents the initial renewable energy consumption value

$lrec_t^+ = \sum_{j=1}^{t} \Delta lrec_j^+ = \sum_{j=1}^{t} \max(\Delta lrec_j, 0)$, represents the partial sum process of positive changes in renewable energy consumption and $lrec_t^- = \sum_{j=1}^{t} \Delta lrec_j^- = \sum_{j=1}^{t} \min(\Delta lrec_j, 0)$ represents the partial sum process of negative changes in renewable energy consumption.

Following extant literature (Shah, et al, 2022; Wang, & Li, 2021), we specify an asymmetric long-run regression equation of the following form:

$$lrec_t = +\alpha_1^+ lrec_t^+ + \alpha_1^- lrec_t^- + \beta_2 lgdpk_t + \beta_3 lsse_t + \beta_4 lurbn_t + \beta_5 linf_t + \varepsilon_t \quad (4)$$

Where: '+' and '-' superscripts refer to the positive and negative changes and α_1^+ and α_1^- stand for the associated asymmetric long run parameters.

Results and Discussions

Descriptive Statistics

Table 1 presents the descriptive statistics for the variables used. The provided descriptive statistics pertain to various variables in Nigeria. These statistics offer insights into different aspects of Nigeria's development and societal indicators.

In Nigeria, the average life expectancy is 48.207 years, with a standard deviation of 2.504 years. This means that, on average, people in Nigeria can expect to live up to approximately 48 years. The minimum recorded life expectancy is 44.982 years, indicating that some individuals may have a lower life expectancy, possibly due to various factors such as healthcare accessibility and quality. The maximum value of 55.122 years suggests that there are individuals who live longer than the average life expectancy in the country. Regarding renewable energy consumption per capita in Nigeria, the average is 84.086 kWh. This indicates that, on average, each person in Nigeria consumes this amount of renewable energy annually. The standard deviation of 10.971 kWh suggests that there is some variability in the consumption levels among individuals. The minimum value of 30.3 kWh represents the lowest recorded consumption, while the maximum value of 92 kWh represents the highest recorded consumption, indicating the range of renewable energy utilization in Nigeria. Nigeria's GDP per capita is estimated to be 1490.943 USD. This figure represents the average economic output per person in terms of Nigeria's gross domestic product. The standard deviation of 645.405 USD suggests a considerable variation in the economic well-being of individuals within the country. The minimum recorded value of 270.028 USD indicates the lowest economic output, while the maximum value of 3200.953 USD represents the highest economic output, reflecting the diversity in economic conditions among Nigerians.

The urbanization rate in Nigeria is approximately 37.772%, based on the provided statistics. This indicates that approximately 37.772% of the country's population resides in urban areas. The standard deviation of 6.126% implies some variation in the distribution of urban and rural populations across the country. The minimum value of 21.97% suggests a lower urbanization rate in some regions, while the maximum value of 52.746% indicates a higher urbanization rate in certain areas of Nigeria. The inflation rate in Nigeria, measured by consumer prices, is reported to be 14.624% annually. This figure represents the average increase in consumer prices over a year. The standard deviation of 10.915% suggests some fluctuation and volatility in price levels. The minimum value of 5.388% indicates a relatively lower inflation rate, while the maximum value of 23.212% represents a higher inflation rate, indicating the price dynamics experienced by consumers in Nigeria. The mean gross enrollment ratio for secondary education is 27.326%, indicating the average percentage of the population enrolled in this level of education. The standard deviation of 10.563 suggests variability in enrollment rates across different regions or time periods, indicating a wider range of enrollment rates. The minimum value of 11.887% signifies the lowest recorded enrollment ratio, indicating relatively low rates of secondary education enrollment in certain areas or periods. Conversely, the maximum value of 56.205% represents the highest recorded enrollment ratio, suggesting that in specific regions or periods, a larger proportion of the population was enrolled in secondary education.

Table 1: Descriptive Statistics

Variable	Mean	Standard Deviation	Minimum	Maximum
Life Expectancy	48.207	2.504	44.982	55.122
Renewable Energy Consumption per Capita (kWh)	84.086	10.971	30.3	92
GDP per Capita (USD)	1490.943	645.405	270.028	3200.953
Urbanization (% of Population)	37.772	6.126	21.97	52.746
Inflation, consumer prices (annual %)	14.624	10.915	5.388	23.212
School enrollment, secondary (% gross)	27.326	10.563	11.887	56.2054

Source: Author, 2023

Unit Root Test

The nonlinear ARDL (Autoregressive Distributed Lag) methodology allows for the inclusion of both levels and first differences of variables, as long as they are integrated of order 1 (I(1)). However, if any variable is integrated of an order higher than the first difference, the application of ARDL may not be reliable. Therefore, to ensure the suitability of ARDL, all variables were tested for stationarity using conventional unit root tests, namely the Augmented Dickey Fuller (ADF) and Phillips Perron (PP) tests. The results of these tests, presented in Table 2, indicate that none of the variables exhibit integration of an order higher than one. The variables exhibit a mixture of integrated of order 0 (I(0)) and order 1 (I(1)). While inflation is integrated at levels, all other variables are stationary at their first difference, which satisfies the requirements for ARDL and NARDL (Nonlinear ARDL) estimation.

However, it is important to note that traditional unit root tests may be prone to errors when the data series contains structural breaks. Failure to account for structural breaks can lead to incorrect rejection of the null hypothesis of a unit root. Therefore, a unit root test with structural breaks was conducted, and the results are reported in Table 3. The test employs a modified Dickey-Fuller equation that can accommodate structural breaks, and the obtained t-statistics are used to compare the parameter α to 1. The results, once again, confirm that none of the variables exhibit integration of an order higher than one.

Table 2: Unit root test results

	Level		1st Difference	
Variables	**PP**	**ADF**	**PP**	**ADF**
Llef	-1.538	-1.483	-4.012***	-4.213***
	(0.504)	(0.537)	(0.000)	(0.000)
Lrec	-2.313	-2.903	-6.177***	-6.177***
	(0.173)	(0.179)	(0.000)	(0.000)
Lgdpk	-0.919	-0.825	-6.546***	-6.783***
	(0.772)	(0.801)	(0.000)	(0.000)
lurbn	-2.988**	-1.723	-3.432***	-2.831***
	(0.044)	(0.412)	(0.000)	(0.001)
lsse	-1.197	-1.114	-6.640***	-6.655***
	(0.666)	(0.701)	(0.000)	(0.000)
linf	-3.472**	-3.598**	-13.473***	-6.731***
	(0.014)	(0.010)	(0.000)	(0.000)

*Note: (1) *,** and ** denotes significance at 1%, and 5% (2) The specification is constant and trend.*

Table 3: Unit root tests with structural breaks

	Level	First Difference
Variables		
Llef	-3.605	-3.622**
	(0.328)	(0.013)
lrec	-2.317	-6.932***
	(0.944)	(0.000)
lgdpk	-2.549	-9.852***
	(0.888)	(0.000)
lurbn	-4.318**	-12.187***
	(0.022)	(0.000)
lsse	-5.342**	-6.781***
	(0.022)	(0.000)
linf	-5.260*	-7.209***
	(0.020)	(0.000)

*Note: (1) *, ** and ***denotes significance at 10%, 5% and 1% respectively. (2) Dickey-Fuller min-t is the Break point selection criteria used. (3) Lag length method is F-statistic. (4) Specification is constant and trend. (2) innovation outlier break type is employed.*

Test for Non-linearity

To assess the potential nonlinearity in the relationship among variables, the BDS (Brock, Dechert, and Scheinkman) nonlinearity tests were conducted for all the variables. The BDS test is a statistical method used to examine the presence of nonlinear relationships. In this study, the BDS test was employed to test the relationship between renewable energy consumption, GDP per capita, urbanization, inflation rate and life expectancy at birth in Nigeria. The results of the BDS test are presented in Table 4. The findings indicate that the null hypothesis of independent and identically distributed (iid) residuals is rejected at a significance level of 1% for all the variables included in the analysis. This suggests that the data series exhibit nonlinear characteristics. Therefore, the results confirm the suitability and necessity of applying a nonlinear ARDL methodology to analyze the relationship among the variables in this study.

Table 4: BDS nonlinearity tests results

BDS Statistics				**Embedding dimensions**	
Variables	**m=2**	**m=3**	**m=4**	**m=5**	**m=6**
Llef	0.179***	0.287***	0.349***	0.379***	0.384***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Lrec	0.199***	0.337***	0.435***	0.498***	0.535***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Lgdpk	0.148***	0.257***	0.319***	0.350***	0.364***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
lurbn	0.204***	0.342***	0.438***	0.507***	0.559***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
lsse	0.142***	0.229***	0.279***	0.313***	0.321***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Linf	0.077***	0.122***	0.157***	0.177***	0.184***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)

Notes: (1) denotes significance at 1%. (2) m represents the dimension. (3) Reported statistics are obtained from the application of the Brock et al. (BDS, 1996) test on the residuals of a VAR model for the selected* *variables.*

Test for Asymmetry

Table 5 present the result for the test for asymmetry. The results indicate that the Wald test statistics for the null hypothesis of no long-run asymmetry and short-run symmetries in the NARDL-ECM (Nonlinear Autoregressive Distributed Lag - Error Correction Model) are rejected for all variables. The tests for long-run asymmetry reveal that renewable energy consumption, GDP per capita, urbanization, and inflation rate have asymmetric effects on life expectancy at birth in Nigeria. All of these results are statistically significant. The significant findings for both short-run and long-run symmetry and asymmetry provide support for the use of NARDL asymmetry as it detects nonlinearity and long-run asymmetry in the data.

Table 5:Long - and Short-run asymmetry

Test	F-Statistics	Prob.	F-Statistics	Prob.	F-Statistics	Prob.
WLRA	6.063***	0.000	7.801***	0.000	5.328**	0.013
WSRA	4.271***	0.056	4.284***	0.000	3.921**	0.045

*Note (1) ******and*** *** denote rejection, at the 1% and 5% significance levels respectively, of the null hypothesis of no asymmetry and symmetry. (2) WLRA and WSRA represent the Wald statistics for long-run asymmetry and long-run symmetry.*

Short Run and Long run Effect

Table 6 presents the results of a non-linear Autoregressive Distributed Lag (ARDL) model, examining the short-run and long-run effects of various variables on life expectancy. In the short run, the coefficients represent the estimated impact of changes in the independent variables on life expectancy. The variable "D(LREC_POS)" (positive changes in renewable energy consumption) has a coefficient of 0.062, and is statistically significant (t-statistic of 2.818, p-value of 0.020). However, "D(LREC_NEG)" (negative changes in renewable energy consumption) has a significant positive effect with a coefficient of 0.089 (t-statistic of 3.088, p-value of 0.004). Moreover, the lagged negative changes in renewable energy consumption, "D(LREC_NEG(-1))," also have a significant positive effect with a coefficient of 0.082 (t-statistic of 2.753, p-value of 0.010). These results indicate that negative changes in renewable energy consumption have a stronger impact on life expectancy compared to positive changes in the short run.

In the long run, the coefficients represent the estimated impact of the levels of the variables on life expectancy. Regarding renewable energy consumption, the variable "LREC_POS" (positive levels) has a coefficient of 0.092, indicating a positive effect, and it is statistically significant (t-statistic of 3.407, p-value of 0.002). However, "LREC_NEG" (negative levels) has a negative coefficient of -0.055, indicating a negative effect, and it is statistically significant (t-statistic of -3.056, p-value of 0.003). These results suggest that both positive and negative levels of renewable energy consumption have significant effects on life expectancy, but the positive effect appears to outweigh the negative effect in the long run.

The analysis reveals several key findings regarding the variables and their impact on life expectancy. The coefficient of 0.062 for GDP per capita (LGDPK) suggests a significant positive effect, indicating that higher economic prosperity, as measured by GDP per capita, is associated with increased life expectancy. Urbanization (LURBN) has a coefficient of 0.113, indicating a positive effect on life expectancy, although it is not statistically significant. Conversely, the inflation rate (LINF) shows a significant negative effect, with a coefficient of -0.008, indicating that higher inflation rates are associated with decreased life expectancy. Also, secondary school enrollment impacted positively on life expectancy and was significant. As presented, a percentage increase in secondary school enrollment tends to increase life expectancy by 0.042 percent.

The implication of these results for life expectancy suggests that in the short run, negative changes in renewable energy consumption have a significant positive impact on life expectancy, indicating a potential improvement. However, in the long run, while both positive and negative levels of renewable energy consumption have significant effects, the positive effect appears to be stronger. This implies that sustained reliance on negative changes or lower levels of renewable energy consumption may have adverse consequences for life expectancy.

Table 6: Non Linear ARDL Result

Short Run Coefficient				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
D(LREC_POS)	0.062	0.022	2.818	0.020
D(LREC_NEG)	0.089	0.029	3.088	0.004
D(LREC_NEG(-1))	0.082	0.030	2.753	0.010
D(LGDPK)	0.005	0.002	3.159	0.004
D(LURBN)	0.015	0.009	1.630	0.114
D(LSSE)	0.032	0.011	2.909	0.021
D(LINF)	0.011	0.003	3.666	0.001
CointEq(-1)	-0.130	0.016	-7.901	0.000
Long Run Coefficients				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
LREC_POS	0.092	0.027	3.407	0.002
LREC_NEG	-0.055	0.018	-3.056	0.003
LGDPK	0.062	0.009	7.132	0.000
LURBN	0.113	0.065	1.730	0.094
LSSE	0.043	0.012	3.583	0.000
LINF	-0.008	0.003	-2.653	0.013
C	1.314	0.085	15.400	0.000

Source: Author's computation 2023

Conclusions and Policy Recommendations

This study investigated the asymmetry impact of renewable energy on life expectancy in Nigeria. The study concluded that renewable energy consumption will help improve life expectancy in the long run as the positive effect outweighs the negative effect. These findings have significant policy implications. It is crucial to prioritize sustainable and renewable energy sources as a means to promote positive health outcomes and improve life expectancy. Governments should invest in renewable energy infrastructure, such as solar or wind power, while also considering potential negative consequences associated with certain aspects of renewable energy production. Policies and regulations should be implemented to mitigate any adverse effects and ensure that the positive benefits of renewable energy consumption are maximized. Furthermore, GDP per capita (LGDPK) has a significant positive effect on life expectancy, emphasizing the importance of economic development in promoting better health outcomes. However, the lack of statistical significance for urbanization (LURBN) suggests that its influence on life expectancy may be more nuanced. Additionally, the significant negative effect of inflation rate (LINF) highlights the adverse consequences of unstable economic conditions on life expectancy. From a policy perspective, these findings underscore the need for governments to prioritize economic growth and stability as key determinants of population health. Policies aimed at fostering sustainable economic development and controlling inflation should be implemented to support improvements in life expectancy. Moreover, urbanization policies should focus not only on physical infrastructure but also on ensuring access to quality healthcare, education, and other social determinants of health to maximize the positive impact of urbanization on life expectancy. Finally, it is recommended that the government takes measures to reduce the cost of education in order to encourage higher student enrollment.

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