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Decoupling Economic Growth Strategy and Environmental Quality in Nigeria

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Abstract
This study examined the effect of decoupling economic growth strategy on environmental quality in Nigeria. Data were collected from the Central Bank of Nigeria (CBN) statistical bulletin and World Bank indicators. This study adopted the ordinary least squares (OLS) method-based Autoregressive Distributed Lag (ARDL) model to estimate the effects of decoupling economic growth on environmental quality. The results of the ARDL estimates revealed that total decoupling index (TDI), fossil fuel energy consumption (FEC), renewable energy consumption (REC) and natural resource depletion (NRD) were all rightly signed. This indicates that in the long run, fossil fuel energy consumption (FEC) and natural resource depletion (NRD) reduce environmental quality (EQL) in Nigeria. On the other hand, total decoupling index (TDI) and renewable energy consumption (REC) have positive and significant effects on environmental quality. The policy implication is that there is a need for an energy transition from fossil fuels to renewable energy that is environmentally friendly. Also, efficient use of energy could increase economic growth and improve environmental quality. Based on the conclusion and findings of the study, it is recommended that the government should strictly enforce the environmental laws and regulations in Nigeria. This will help to mitigate the environmental effects of economic growth on the environment. There is a need for an energy transition from fossil fuels to renewable energy that is environmentally friendly. A shift away from intensive use of fossil fuels to renewable energy sources will encourage decoupling, economic growth that increases economic growth while minimizing environmental damage. This transition will enhance environmental quality in Nigeria.

Keywords: Decoupling, Economic growth, Environmental quality, CO2, Water quality

Introduction

The attainment of rapid and sustained economic prosperity, while at the same time protect and preserve the environment without making future generations worse off, is one of the development challenges facing industrialised and less developed countries (LDCs) today. As the industrialised or developed economies pursue policies of 'green growth', the developing and less developed economies target rapid growth in order to industrialise. There is a theoretical relationship between economic activities geared towards growth and development and the natural environment called the "Environmental Kuznets Curve (EKC)" which was popularised by Grossman and Krueger (1995). According to EKC, an inverted U-shaped relationship exists between the growth of per capita income and pollution concentration in the natural environment (environmental degradation). The theory supports the view that as low- and middle-income countries seek to industrialise, there is intensive use of resources for production, which inevitably leads to the release of contaminating substances into the environment, with its attendant rise in pollution in the early stages of economic growth; and as the national income continues to increase to a certain point, the level of pollution tends to decline. The decline in the level of pollution is due to green growth or decoupling growth policies.

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Also, the materials balance model (MBM) developed by Kneese et al. (1970) supports the relationship between economic activity and the natural environment. It introduced two flows in the flow of economic activities. These are the flow of resources and the flow of residuals. The flow of materials or natural resources runs from the environment to the economy. This flow explains how economic activities draw from the natural environment. The second flow is the flow of residuals. This is a flow from the economy to the environment. It explains how raw materials entering the system are eventually released back to nature as by-products or residuals. Residuals are the amount of pollutants remaining in the environment after natural or technological processes have occurred. They are gases released to the atmosphere, liquid chemicals discharged into water bodies, industrial wastewaters and solid residuals in the form of municipal trash and certain hazardous wastes, which pose a serious threat to human health and ecology. On the contrary, the cyclical or closed materials flow (Cradle to Cradle) developed by Gibbons (1992) suggests that product design, manufacturing processes, and energy use should be modified to achieve a cyclical or closed flow of materials. This model considered a "cradle –to – cradle" flow. It suggests a much broader approach to environmental protection than controlling residual waste after they have been generated. Waste prevention, energy and resource efficiency, and design for reuse or recycling are among the options suggested by this paradigm.

The environment is structured into three major components: air, water, and land. These components of the natural environment are essential for the life of humans, animals, and plants. The role of air and water in human existence cannot be overemphasized. While air is highly needed for the breath of life, water is used for industrial production and household consumption. Air and water pollution are mainly the result of human activity, often referred to as anthropogenic contamination. Pollutions resulting from anthropogenic contamination are substances released from industrial and economic activities in the form of gases (Particulate matter-PM10 and PM2.5, Sulfur dioxide-SO_2, Carbon monoxide-CO, Carbon dioxide-CO_2, Nitrogen dioxide-NO2, etc.). In Nigeria, oil and gas production is the mainstay of the economy since the early 1970s. The oil and gas sector accounts for about 35 per cent of gross domestic product, and petroleum export revenue represents over 90 per cent of total export revenue (OPEC, 2015). According to the Nigerian National Petroleum Corporation (NNPC, 2017), "With a maximum crude oil production capacity of 2.5 million barrels per day, Nigeria ranks as Africa's largest producer of oil and the sixth largest oil producing country in the world. Nigeria appears to have a greater potential for gas than oil. Nigeria's gas production in the year 2000 was approximately 1,681.66 billion scf; 1,371.5 billion scf was associated gas, and the remaining 310.16 billion was non-associated gas. Gas flaring in oil rigs and wells contributes significantly to greenhouse gases in our atmosphere (Ayoola, 2011). Nigeria's gas flaring is associated with the exploration and exploitation of crude oil in the Niger Delta region of the country. Despite the environmental awareness at the national, regional, and global scale, environmental protection laws enacted by the government and its agencies, as well as the enforcement of the various laws, policies, and regulations on the environment, degradation of the environment seems unabated, thereby reducing the quality of the environment. It should be recalled that the previous research efforts on the relationship between economic growth and environmental quality in Nigeria concentrated on CO_2 emissions as a measure of environmental quality. For instance, the works of Chuku and Akpan (2011), and Akomolafe et al. (2015) studied the relationship between economic growth and environmental quality in Nigeria using CO_2 emission as an environmental indicator. Gas flared at the national scale is a better indicator for environmental quality because it contains other gaseous substances like SO_2, NO_2, and CO, which are neglected by earlier studies. This study tends to close the gap as it considers the relationship between decoupling economic growth and environmental quality in Nigeria.

Hennicke (2014) sees decoupling economic growth as delinking economic growth from resource use and from environmental impacts. *It* signifies a strategic shift where economic prosperity advances independently from environmental degradation and resource depletion. Decoupling economic growth refers to the process of increasing Gross Domestic Product (GDP) while simultaneously reducing resource consumption and environmental degradation. It seeks to break the traditional, direct link where economic expansion inherently demands higher levels of pollution or raw material extraction. This transition relies on technological innovation, circular economy models, and improved resource efficiency to ensure societal prosperity does not come at the expense of planetary health. Economic growth decoupling is classified as either relative or absolute. It is relative decoupling when economic growth continues, but environmental pressures or resource use grow at a slower rate than the economy itself. In this scenario, efficiency improves, but the total impact on the environment may still be increasing. On the other hand, it is absolute decoupling where the economy grows while the total environmental impact or resource consumption stays the same or actually decreases.

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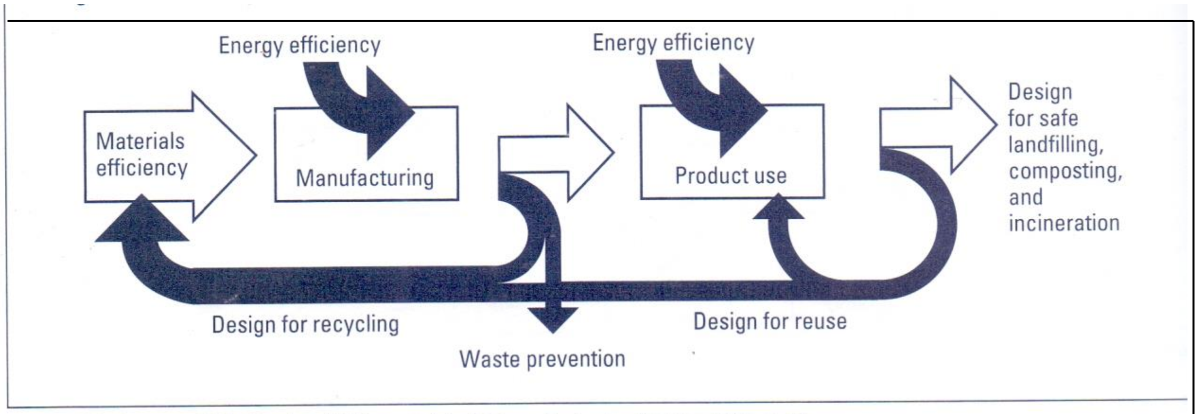
Environmental quality is a multifaceted concept that covers a wide range of elements, including the cleanliness of the air and water, the level of noise in an area, the availability of green spaces, and the presence of harmful substances. It serves as an indicator of how conducive and sustainable an environment is to both human and ecological well-being. While there isn't a single, universally accepted definition of environmental quality, it is generally recognised as the condition of the environment concerning its impact on human and ecological health. Environmental quality is typically evaluated through various measures, such as the levels of air and water pollution, the presence of hazardous waste, and the overall health of ecosystems. It is on this note that, according to Thomas and Collan (2007), "environmental quality is the process by which a society reduces anthropogenic contaminations to an acceptable level. Anthropogenic contaminations are human-induced pollutants. The acceptable level of human pollution will be different for different contaminants; however, certain factors are considered in making the determination. Prominently, factors like gains to human health and ecosystems, expenditure needed to achieve the reduction, availability of technology, and the relative risk of a given environmental hazard are considered. Thomas and Collan (2007) further described environmental quality as 'a set of properties and characteristics of the environment, either generalised or local, as they impinge on human beings and other organisms. It is a measure of the condition of an environment relative to the requirements of one or more species and/or to any human need or purpose'. Environmental quality is a general term which can refer to varied characteristics that relate to the natural environment as well as the built environment, such as air and water purity or pollution, noise and the potential effects which such characteristics may have on physical and mental health. It is defined as the strengths and/or weaknesses of the resource components of the environment.

Ghanem (2018) defined environmental quality as "the degree to which natural resources like land, air, and water are free from contaminants and damage caused by human activities". This definition underscores the idea of preserving the purity of natural resources. Rasool *et al.* (2024) see environmental quality as "the condition of the environment concerning its impact on human and ecological health". This broader definition encompasses not only the absence of pollutants but also the presence of elements that enhance human and ecological health, such as access to green spaces. To Salami (2021), "environmental quality is the state of the environment in terms of its ability to provide the resources and services that humans depend on". This definition highlights the critical role of ecosystems in human well-being and underscores the need to safeguard them to maintain environmental quality. In summary, these perspectives on environmental quality indicate that it is a multifaceted concept involving various aspects. Environmental quality is crucial for both human and ecological health. This study therefore defines environmental quality as the reduction of anthropogenic contamination to a level acceptable by society based on global standards.

This study is anchored on the Cyclical or Closed Materials Flow (Cradle to Cradle) developed by Gibbons (1992). This model suggests that product design, manufacturing processes, and energy use should be modified to achieve a cyclical or closed flow of materials. This model considered a "cradle –to – cradle" flow. It suggests a much broader approach to environmental protection than controlling residual waste after they have been generated. Waste prevention, energy and resource efficiency, and design for reuse or recycling are among options suggested by this paradigm. In sum, the key implication of a cyclical system is that economic activity can be altered throughout the cycle of production and consumption to achieve a reduction in the associated environmental impacts and improve environmental quality. To put the notion of a cyclical materials flow into practice, a life cycle assessment (LCA) can be undertaken. This is an analytical tool that examines the environmental impact of a product by evaluating all stages of a product or process from raw materials extraction to final disposal. Once done, improvements can be made to lessen environmental risk. The Closed or cyclical material flow is illustrated in Figure 2.1

Figure 2.1: The Closed System of Materials Flow



Source: U.S. Congress, OTA (October 1992), as cited in Gibbons (September/October 1992), p. 31.

Alehile et al. (2024) used an autoregressive distributed lag (ARDL) estimation approach to examine the relationship between environmental quality and sustainable development in Nigeria using quarterly data from 2000 to 2021. The study used CO_2 emissions, forest area, natural resource depletion (NRD), capital, and labour on sustainable development (SD) from both short- and long-term perspectives. The findings demonstrate that CO_2 emissions negatively affect SD, emphasising the importance of strong environmental legislation. In contrast, forest areas have a beneficial impact on SD, emphasising the necessity of environmental preservation. Lagged and contemporary NRDs show trade-offs between resource use and long-term prosperity. Capital emerges as a key engine of SD. However, this study finds that factors like labour lack statistical significance in explaining variations in SD. These insights provide valuable guidance for policymakers aiming to balance economic growth with environmental sustainability. The study recommends the implementation of stringent environmental policies to curb CO_2 emissions and emphasises the need for responsible resource management practices to mitigate the adverse effects of NRD. Olayode (2019) investigated the association between GDP, energy consumption and CO2 emission and examined the role of decoupling CO2 from GDP and energy consumption in reducing climate change in six ECOWAS countries. The study made use of data on real GDP per capita, energy consumption per capita, and CO2 emission for Benin, Côte d'Ivoire, Ghana, Nigeria, Senegal and Togo between 1970 and 2015 and panel autoregressive distributed lag (PARDL). It was revealed that there was evidence of a strong and positive association between CO2 and energy and growth for all six countries. In addition, the growth hypothesis held in the entire region in the long run, while it supported the evidence of the conservation hypothesis in the short run. The main implication of these findings is that it is better to implement conservation policies in these countries in the short run, but may be harmful to growth in the long run. Increased decoupling of CO2 from energy consumption was found to lead to higher energy intensity, thereby validating the energy rebound effect in these countries. However, increased decoupling of CO2 from economic activity was found to reduce energy intensity in the entire region in the long run. It is recommended that the need to pursue greater growth in these countries ought to factor in the link between energy and growth and between energy and CO2 emission, as well as the limitation of conservation as a reliable long-term strategy for curbing CO2 emission. Akomolafe et al (2015) studied trade openness, economic growth, and environmental concern. The study used Vector Error Correction Mechanism (VECM) and co-integration techniques. Their results confirm the existence of the Environmental Kuznets curve in Nigeria. Also, there is a positive relationship between ruralization and environmental pollution both in the short and long run. However, there is a negative relationship between urbanisation and pollution in the long run, but positive in the short run.

Aguegboh and Madueme (2014) examined the causal relationship between energy consumption and economic growth. The study employed systematic econometric methods, which include the Johansen cointegration test and vector autoregressive models (VAR) for the Granger causality test. They found a unidirectional causality running from oil consumption to GDP. The study also found that gas consumption Granger-causes GDP without feedback. The results of the study, however contradicted the neoclassical perspective that energy is not a limiting factor to economic growth in Nigeria. This seems to be a departure from other studies. Nnaji et al (2013) analysed the dynamic causal relationship among carbon emissions, energy consumption, foreign trade and economic growth in Nigeria for the period 1970 to

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2009 in a multivariate framework. The study employed an augmented form of Granger causality and the bounds testing approach to cointegration to test. The bounds test result indicated that economic growth is determined by energy consumption, carbon emissions, capital and foreign trade. The study also found a unidirectional causality running from energy consumption to economic growth; from energy consumption to carbon emissions; from carbon emissions to economic growth; from capital formation to economic growth; and from trade to economic growth. The empirical results of the study revealed that expansion in international trade increases CO2 emissions, which implies that foreign trade is harmful to environmental quality in Nigeria. Chuku and Ndifreke (2012) examined the relationship among energy consumption, trade, the environment and Growth. The study used a combined simultaneous approach. The results from the income equation and trade equation suggested that production activities are pollution-intensive and environmentally unfriendly. However, contrary to theoretical expectations, the emissions equation returned a U-shaped Environmental Kuznets Curve for Nigeria. The turning point of the U-shaped EKC relation for Nigeria was estimated at US $423.69 which lies comfortably within the sample range. Chuku and Akpan (2011), in their study of the relationship between economic growth and environmental quality, used autoregressive distributed lag model on time series data between 1960 and 2008 in Nigeria. They found no evidence of an inverted U-shaped relationship between CO_2 emissions and economic growth. Rather, they established an N-shaped relationship with a turning point of $77.27.

Methodology

Model Specification

This study adopted and modified the model of Alehile et al. (2024) that examines the relationship between environmental quality and sustainable development in Nigeria. The Alehile et al. (2024) model is expressed as:

SD = f (CO2, NRD, FOREST, CAP, LAB) 1

The ordinary least squares (OLS) form of the equation is written as:

$SD = a_0 + a_1CO2 + a_2FOREST + a_3NRD + a_4CAP + a_5 LAB + Ut$ 2

The model is modified by introducing renewable energy consumption and changing the sustainable development indicator to water quality as a measure of environmental quality. This is because the water component of the environment (hydrosphere) is very essential to human life. This is presented as:

EQL = f (TDI, REC, FEC, NRD) 3

The ordinary least squares (OLS) form of the equation is written as:

$EQL = a_0 + a_1TDI + a_2REC + a_3FEC + a_4NRD + Ut$ 4

$a_1>0;\ a_2>0;\ a_3<0;\ a_4 <0;$

Where:

EQL = Environmental quality, measured in access to clean water

TDI = Total decoupling index, measured in ratio of CO2 emission change to relative GDP growth.

REC = Renewable energy consumption

FEC = Fossil fuel energy consumption

NRD = Natural resource depletion

a_0 = constant

a_1-a_4 = coefficients of the explanatory variables

u = error term

Variables of the Model

Dependent Variable:

(i) Environmental Quality (EQL): This is defined as the reduction of environmental contamination caused by man to a level acceptable by society. It is measured by the percentage of the population that has access to clean water. It is used as an index of environmental quality.

Independent Variables:

i. Total Decoupling Index (TDI): This is the ratio of CO2 emission change to relative GDP growth. It is the ratio of percentage change in CO2 emission or energy consumption to percentage change in GDP. It is expected to show a positive relationship with environmental quality (a_1>0),
ii. (Renewable Energy Consumption (REC): This is the amount of renewable energy such as solar, wind, hydro, etc consumed during productive activities in Nigeria. It is measured by the percentage of the

population that has access to renewable energy sources. It is expected to show a positive relationship with environmental quality (a_2>0),

iii. Fossil Fuel Energy Consumption (FEC): This is the energy from fossil fuels such as oil, gas and coal used in productive activities in Nigeria. It is expected to show a negative relationship with environmental quality (a_3<0)

iv. Natural Resource Depletion (NRD): This is measured in net reduction of forest cover where timber harvesting exceeds its natural growth. It is expected to show a negative relationship with environmental quality (a_4<0).

Estimation Procedure

This study obtained data from secondary sources such as journals, books, conference papers, Central Bank of Nigeria's (CBN) statistical bulletin, National Bureau of Statistics (NBS), World Bank publications, among others. The Augmented Dickey-Fuller (ADF) unit root test was used to test for the stationarity of the time series data used for the study. The result of the unit root test suggested the use of the ARDL estimation technique. Pesaran et al. (2001) opined that the ARDL approach to co-integration among the variables is the appropriate methodology when the unit root test indicates integration of both order zero and one, that is I(0) and one I(1). This makes the ARDL co-integration approach better than other cointegration methods. In analysing the ARDL Bound test, the F-statistic tests the joint null hypothesis that there is no long-run relationship between them. The study used EViews 10.0 to facilitate the estimation processes.

Results

Unit Root Analysis

Unit root tests may not be mandatory when adopting the autoregressive distributed lag (ARDL) approach to model estimations. This is because ARDL can be applied on the variables whether they are integrated of order one, zero or both. However, it can produce spurious results if variables are integrated of I(2) or higher. So, to confirm if any of the variables is integrated of higher order, the Augmented Dickey-Fuller (ADF) unit root test was employed. The results of the Augmented Dickey-Fuller unit root test are presented and discussed in Table 1 as follows:

Table 1: ADF Unit Root Stationary Test

Variables	ADF Stat. at Levels	1% Crit. Value	5% Crit. Value	ADF Stat. at first Diff.	1% Crit. Value	5% Crit. Value	Order of integration
EQL	-0.982271	-3.621023	-2.943427	-3.469142	-3.615588	-2.941145	I(1)
TDI	-2.817282	-3.639407	-2.951125	-9.600312*	-3.615588	-2.941145	I(1)
REC	-1.277481	-3.610453	-2.938987	-8.996297*	-3.615588	-2.941145	I(1)
FEC	-5.121311*	-3.610453	-2.938987				I(0)
NRD	-1.451209	-3.610453	-2.938987	-3.878076*	-3.615588	-2.941145	I(1)

Source: Computed from EViews 10.0

Note: *(**) indicates (1%) and (5%) Significant Levels

The unit root test in Table 1 above shows that fossil fuel energy consumption was stationary at levels [that is, I(0)] at a 1% significance level. However, environmental quality, total decoupling index, renewable energy consumption, and natural resource depletion were stationary at first difference [that is, I(1)] at 1% significant levels. Therefore, the time series data used in this study were stationary.

ARDL Bound Test for Long Run Equilibrium

The suggestion of Pesaran et al. (2001) that the ARDL bound approach to co-integration among the variables is the appropriate methodology when the unit root test is integrated of order zero, that is, I(0) and one I(1) is still valid. This makes the ARDL co-integration approach suitable for this study because of the mixture of unit root results of I(0) and I(1). The result of the ARDL Bound test of the model is in Table 2.

Table 2: F-Bound Test for the Model

F-Bounds Test		Null Hypothesis: No levels relationship		
Test Statistic	Value	Signif.	I(0)	I(1)
F-statistic	8.219852	10%	2.2	3.09
K	4	5%	2.56	3.49
		2.5%	2.88	3.87
		1%	3.29	4.37

Source: Computed from E-view 10.0

The results for the computed Wald test (F-statistics) presented in Table 2 reveal that the calculated F-statistic of 8.219852 is higher than the upper bound critical values of 4.37 and 3.49 at 1% and 5% significance levels, respectively. Based on this result, it is concluded that a long-run cointegration relationship exists for the estimated ARDL model. Thus, the null hypothesis of no cointegration is rejected, implying long-run cointegration relationships amongst the variables in the model.

ARDL Estimates of the Long Run Regression

The result of the ARDL estimates of the long-run relationship in the model is in Table 3.

Table 3: ARDL Long Run Regression Estimates for the Model

Variable	Coefficient	Std. Error	t-Statistic	Prob.
FEC	-0.037600	0.044888	-0.837642	0.4105
TDI	0.034667	0.026701	1.298349	0.2065
REC	0.061533	0.024094	2.553836	0.0174
NRD	-0.022699	0.015322	-1.481467	0.1515
C	0.481299	0.416863	1.154575	0.2596

EC = EQL - (-0.0376*FEC + 0.0347*TDI + 0.0615*REC
-0.0227*NRD + 0.4813)

Source: Computed from E-view 10.0

The result of the long-run regression estimates presented in Table 3 indicates that total decoupling index (TDI), fossil fuel energy consumption (FEC), renewable energy consumption (REC) and natural resource depletion (NRD) were all rightly signed. This indicates that in the long run, fossil fuel energy consumption (FEC) and natural resource depletion (NRD) reduce environmental quality (EQL) in Nigeria. On the other hand, total decoupling index (TDI) and renewable energy consumption (REC) have a positive effect on environmental quality. However, while total decoupling index (TDI) is insignificant, renewable energy consumption (REC) has a significant effect on environmental quality. The policy implication is that there is a need for an energy transition from fossil fuels to renewable energy that is environmentally friendly. Also, efficient use of energy could lead to economic growth and improve environmental quality.

ARDL-ECM Test for Short Run

Since the result of the ARDL Bound test in the model established that a long-run cointegration relationship existed among the variables, the ARDL-ECM test was carried out to adjust for the short run. The results obtained are in Table 4

Table 4: ARDL-ECM Test for the Model

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(FEC)	-0.000461	0.002219	-0.207636	0.8373
D(TDI)	0.006250	0.001612	3.877418	0.0007
D(TDI(-1))	-0.007578	0.002185	-3.468625	0.0020
D(TDI(-2))	-0.002921	0.001984	-1.472274	0.1539
D(REC)	0.002792	0.000841	3.318890	0.0029
D(REC(-1))	-0.003557	0.001097	-3.242841	0.0035
D(REC(-2))	-0.001715	0.000942	-1.820683	0.0811
CointEq(-1)*	-0.141989	0.021282	-6.671870	0.0000
R-squared	0.628626	Mean dependent var		0.003705
Adjusted R-squared	0.538984	S.D. dependent var		0.010030
S.E. of regression	0.006810	Akaike info criterion		-6.952043
Sum squared resid	0.001345	Schwarz criterion		-6.603736
Log likelihood	136.6128	Hannan-Quinn criter.		-6.829249
Durbin-Watson stat	1.945656			

Source: Computed from E-view 10.0

The result of the short-run dynamic for the model in Table 4 indicates that Adjusted R^2 is 0.538984. This implies that about 53.9% of the variation in environmental quality is explained by the independent variables in the model. It indicates a good fit. The DW-statistic of 1.945656 indicates that there is no serial correlation. The estimated coefficient for the error correction term reveals the adjustment to the short run. A value of -0.141989 for the ECM coefficients suggests a 14% speed of adjustment. This means that approximately 14% of the discrepancy in the previous year is adjusted for the current year.

Table 5: Models Diagnostic Test Results

Diagnostic Tests for the Model	F- test Results	Prob.	Decision
Ramsey RESET Test	0.056421	0.9555	Accept
Normality Test (Jarque-Bera)	0.717533	0.6985	Accept
Heteroskedasticity (Glejser Test)	1.454912	0.2094	Accept
Breusch-Godfrey LM Test	0.480759	0.6247	Accept

Source: Computed from E-view 10.0

Ordinary least squares is superior to the order estimator because of its BLUE (Best Linear Unbiased Estimate) properties. The BLUE properties of the OLS are ensured if the following assumptions are observed. The various F-Statistic results in Table 4 revealed that the Error term is normally distributed with a zero mean, there is Homoscedasticity (implying that the variance of the error term is constant irrespective of the period), no serial dependence of the error term and the model is correctly specified. Therefore, the null hypotheses of normality, constant variance of the error term, serial independence and functional form of the model were accepted. That is, the model estimated has an error term that is normally distributed with a constant variance, and that the error terms are serially independent. The Ramsey regression specification error test (RESET) statistic shows that the model is correctly specified (Gujarati, 2013).

Stability Tests

Pesaran et al. (2001) suggested that the stability of the estimated coefficient of the error correction model should also be graphically investigated. A graphical representation of the Cumulative Sum (CUSUM) and the Cumulative Sum of Squares (CUSUMSQ) of the Recursive Residual are also established. The cumulative sum (CUSUM) and cumulative sum of squares (CUSUMSQ) plots, which is shown in figure 1 and 2 respectively is a recursive estimation of the model that indicate stability in the coefficients over the sample period in the model.

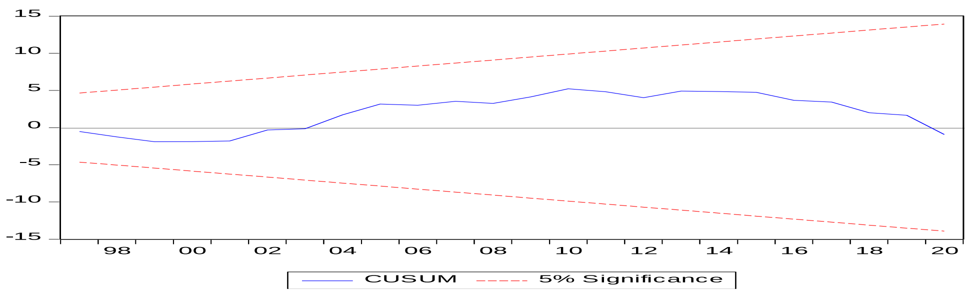

Figure 1: Cumulative Sum for the Model

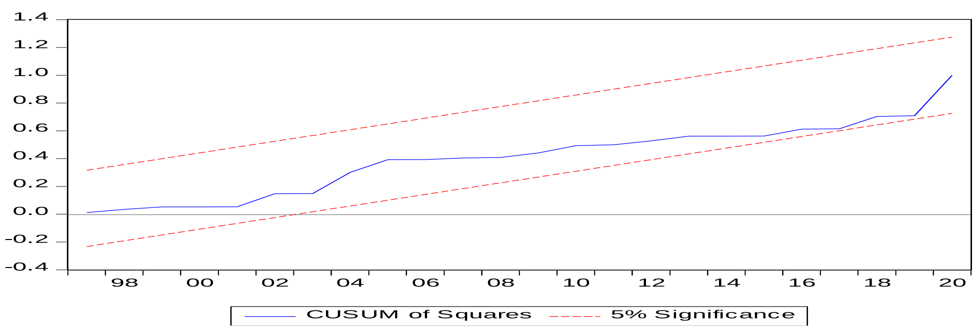

Figure 2: Cumulative Sum Square for the Model

Discussion

This study examined the effect of decoupling economic growth strategy on environmental quality in Nigeria. The results of the autoregressive distributed lag (ARDL) model estimated revealed evidence of a positive and significant effect of total decoupling index (TDI) and renewable energy consumption (REC) on environmental quality in Nigeria. Fossil fuel consumption (FEC) and natural resources depletion (NRD) indicate a negative effect on environmental quality in Nigeria. The implication of this finding on policy is that a transition from fossil fuels to renewable energy sources will improve environmental quality in Nigeria. This finding is in line with the earlier finding of Alehile et al. (2024) that established a negative effect of carbon dioxide emissions on sustainable development in Nigeria. Also, our finding lends credence to the work of Olayede (2019), which established that an increase in GDP growth is often accompanied by increased carbon dioxide emissions in selected ECOWAS countries, including Nigeria.

Conclusion

This study examined the effects of decoupling economic growth on environmental quality in Nigeria. This study adopted the ordinary least squares (OLS) method-based Autoregressive Distributed Lag (ARDL) model to estimate the effects of decoupling economic growth on environmental quality. The results of the ARDL estimates revealed that in the long run, fossil fuel energy consumption (FEC) and natural resource depletion (NRD) reduce environmental quality (EQL) in Nigeria. Also, total decoupling index (TDI) and renewable energy consumption (REC) were expected to promote environmental quality. The policy implication is that there is a need for an energy transition from fossil fuels to renewable energy that is environmentally friendly. An efficient use of energy could lead to economic growth while improving environmental quality in Nigeria.

Recommendations

Based on the conclusion and findings of the study, it is recommended that:

i. The government should strictly enforce the environmental laws and regulations in Nigeria. This will help to mitigate the environmental effects of economic growth on the environment.
ii. There is a need for an energy transition from fossil fuel to renewable energy that is environmentally friendly.
iii. A shift away from intensive use of fossil fuels to renewable energy sources will encourage decoupling economic growth that increases economic growth while minimising environmental damage. This transition will enhance environmental quality in Nigeria.

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