Institutional Quality and Environmental Degradation Linkage: Asymmetric Approach for Nigeria

Tope J. Ojo[1], Oluwaseyi A. Adelowokan[1], Muideen A. Adebiyi[2], Oluwatomisin Omojuwa[1] and Elizabeth O. Egbukichi[2]

[1] *Department of Economics, Olabisi Onabanjo University, Ago-Iwoye, Nigeria*

[2] *Department of Economics, University of Lagos, Akoka, Nigeria*

Abstract

This study delves into the nexus between institutional quality and environmental degradation in Nigeria from 1985 to 2022 using the Nonlinear Autoregressive Distributed Lag (NARDL) model. Time series data from the World Development Indicators was analyzed. The findings indicate a significant short-term and long-term impact of urbanization on CO_2 emissions, with increases of 0.075 and 0.834 units, respectively, for each percent rise in urbanization. Urbanization in Nigeria, driven by proximity to industries and inadequate public transport, has led to increased emissions from private vehicles, exacerbating environmental degradation. Energy consumption was found to have a substantial effect on emissions, with a 1.294 unit increase in the short term for each percent increase in energy use, reinforcing the positive correlation between energy consumption and carbon emissions. The analysis revealed that institutional quality and financial development significantly impact environmental outcomes. Improved institutional quality reduces long-term emissions despite short-term increases, whereas declining institutional quality leads to higher long-term emissions. Financial development policies aligned with environmental goals can mitigate negative impacts on emissions. The study recommends as follows: enhancing institutional quality, promoting sustainable urbanization, transitioning to renewable energy, integrating environmental considerations into financial policies, and prioritizing energy efficiency and also fostering sustainable development in Nigeria.

Keywords: Environmental, Energy Consumption; Financial Development; Institutional Quality

JEL Classifications: E44, K32, O13, O17

Introduction

Nigeria is a country with acute institutional and environmental challenges. On the one hand, the issue of low institutional trust, corruption, and bureaucratic bottlenecks associated with the government has been at the center of academic and policy discussions (Adedeji & Eboh, 2019). Some of these have been reported as rampant and systemic challenges, ranging from military-era looting, money laundering, and abuse of office (Oyebode & Durojaye, 2021). Thus, the issue, if not properly addressed, could hamper the implementation of good environmental policy, which is key to sustainable development (Matlala & Ncube, 2021). Given the apparently poor institutional setting and environmental health in most developing countries, a scientific exploration of the existing nexus between these variables is important. Hence, this paper examines the relationship between institutional quality and environmental degradation in Nigeria. More so, Environmental threats are escalating rapidly as a result of continuous population growth, industrialization, and rising economic activity. As more people inhabit the planet, natural resources are strained, leading to increased pollution and habitat destruction. Industrial expansion contributes to higher emissions, while economic growth drives greater consumption and waste generation, exacerbating environmental degradation (Yu et al., 2020).

A second strand of argument suggests that the state of governance is of utmost importance in the determination of the pressure-exposure relationship. Improved governance is central in reducing environmental problems because regulation and controlling the costs of policies that promote sustainable outcomes are legitimate concerns for policymakers (Matlala & Ncube, 2021). The state of governance implies the institutional structures and systems set in place for decision-making, resource allocation, conflict resolution, the rule of law, and sanction systems (Reddy, 2018). Apart from pure compliance with formal and informal rules, a big part of governance improvement is about empowerment and enhanced capacity (Adebayo & Olaniyi, 2021). For example, developing states often need to re-establish a legal system and judiciary, rebuild public administration, or improve budgetary management to minimize corruption effectively (Ojo & Olowu, 2023).

These reforms take time and resources to implement. Building institutions to manage the environment is a very slow and sensitive process where small changes at the start can affect ignoring environmental issues towards disaster (Gaventa & Barrett, 2021). This last argument is very plausible in the context of Nigeria, where the reliance on oil and politics has created a serious problem of environmental degradation in the oil-producing areas (Adedeji & Eboh, 2019). There are, however, few critical notes and gaps in the institutional theory of the environment. There is a need to overview the theory in a wider context, looking at other development and capacity issues provided by the newest literature (Mansuri & Rao, 2018). While some development literature is specifically about the environment, a larger literature consisting of many approaches and case studies is concerned with how institutions deliver food security, poverty reduction, meet basic needs, and food consumption, among others (Zimmerman, 2020). Although some literature has referred to the 'secondary' impacts, the environmental costs, very few encompass a more comprehensive sustainability definition (Arnstein, 2019). Social science, and especially economic literature on institutions, suggests they are important and that building them is about processes of empowerment, networks, and capacity to adjust actions to avoid further impacts (Oyebode & Durojaye, 2021). The roles and impacts are socio-culturally and context-specific (Bakare et al., 2021). In sum, while research has focused on the causes and effects of environmental degradation, a significant outgrowth of this concern has been an exploration of institutional factors shaping it (Salawu et al., 2024). Evidence-based research and theoretical analysis place institutions at the center of the analysis on environmental change and degradation (Alabi & Ilesanmi, 2022).

A number of different theoretical perspectives outline the relationship between institutional quality and the speed and scope of environmental degradation (Zimmerman, 2020). These theories, while constructed to account for different urgencies, come with complementary implications for understanding the relationship (Mansuri & Rao, 2018). At one end of the spectrum are models constructed to reconcile economic-environmental interdependence while focusing on economic growth (Matlala & Ncube, 2021). These models generally speak on the interactions among economic performance, governance, and the environment (Adedeji & Eboh, 2019). On the one hand, institutions are able to affect growth and, thereby, can have an indirect effect on the environment by shaping the monetary outlay for which it is possible to opt (Bakare et al., 2021). Flaws in this case could lead to environmentally detrimental policy decisions, lack of investment, and pollution abatement, as well as theft and corruption (Ojo & Olowu, 2023).

More environmentally oriented perspectives engage in indirect mechanisms affecting these relationships (Zimmerman, 2020). Others, which emphasize more directly environmental aspects, theorize that the drivers of environmentally friendly decisions are also a function of institutional setup (Mansuri & Rao, 2018). Institutions affect policy to regulate resource turnover, transfer resource rights, as well as the structure of regulatory enforcement, and target prioritarian compensatory mechanisms (Bakare et al., 2021). The effect of power sharing on the environment depends critically on the level of social capital and corruption in a society (Matlala & Ncube, 2021). Focusing specifically on the interaction between environmental degradation and institutions, some studies construct large theories based on a mixture of neoclassical growth theory and applied microeconomics (Adedeji & Eboh, 2019). They show that degradation levels affect the stock of public physical capital over and above changing the net price of traditional physical assets (Ojo & Olowu, 2023). Decomposition leads to further policy implications discussing how the governance system affects the effectiveness of public investment considering these qualifiers (Reddy, 2018). Regional experiences concerning relationships in focus depend upon the specific governance systems and institutional backgrounds (Adebayo & Olaniyi, 2021). The objective of this research is to get a full understanding of this critical issue, which would be beneficial in the process of generating solutions that are more realistic. This study is divided into five sections. These include introduction, related literature review, methodology, data presentation and discussion of results and conclusion and policy recommendation.

Literature Review

Environmental factors have received a lot of attention in recent studies for their potential impact on an institution's quality. How well institutions maintain law and order, safeguard individual property rights, and prevent corruption is what we mean when we talk about institutional quality. The term "environment" is used to describe the whole natural universe, including all ecosystems, air, water, and land. There is a strong correlation, according to many researchers, between environmental quality and institutional quality. In their study of developing countries, Xaisongkham and Liu (2022) look at the relationships between sector-specific employment trends, environmental quality, and institutional quality. In order to find out how macroeconomic variables affect CO_2 emissions; the authors used a balanced panel that covered 2002–2016 using two-step system GMM estimators. The results show that better institutional frameworks are the main cause of the dramatic increase in environmental quality in poor nations. If these nations are able to improve their environmental conditions and decrease their carbon emissions, it will be largely due to the effectiveness of their governments and the rule of law. Furthermore, retesting the Kuznets theory has shown that it may be applied to developing nations. It follows that environmental quality declined with increasing population, peaked at a certain point, and then started to improve thereafter. This study's results shed light on the environmental situation

in developing nations and the correlation between high-quality institutions and job prospects in different industries.
Li et al. (2022) use a non-linear approach to study the interrelationships among G7 nations' institutional quality, FDI, economic development, trade openness, and environmental sustainability. The study found that from 1986 to 2022, these factors had diverse impacts on environmental sustainability across the G7 nations. Significant decreases in CO2 emissions were observed in the US, UK, Germany, France, Italy, and Japan as a consequence of enhanced institutional quality. In France, the environment is negatively affected by the same variable, which is both utterly minor and harmful. The paper posits that the G7 nations can attain environmental sustainability by implementing policies that are both regionally distinct and consistent.

A study of 69 developing nations' experiences with globalisation, democracy, and autocracy was carried out by Jahanger et al. (2022). Findings indicate a negative association between carbon emissions and democracies and a strong positive correlation between autocracies and carbon emissions. One possible explanation is that democratic administrations are more willing to implement environmental regulations because they value public opinion more highly. Autocratic governments put the pursuit of profit above environmental conservation. Globalisation exacerbates environmental degradation by raising industrial and transportation-related carbon emissions. This research adds to the current environmental body of knowledge by focusing on the institutional framework of an economy.

Makhdum et al. (2022) studied the connections between China's institutional framework, natural resources, renewable energy usage, financial development, ecological footprint, economic growth, and other variables from 1996 to 2022. Panel data analysis was used to conduct this inquiry. The writers reasoned that the health of their institutions greatly affects the environment's capacity to endure and thrive. There is little correlation between the natural resources variable and GDP growth, despite the fact that it favours environmental sustainability. Using renewable energy sources has a good effect on both the growth of the economy and the protection of the environment. While economic expansion is good for the environment, economic development is bad for sustainability. The validity of the findings is greatly increased by performing robustness testing using a variety of model specifications and estimation techniques. Improving environmental quality is influenced by both institutional governance and efficacy. We cannot overlook

the effects of climate change and the availability of resources from nature if we wish to determine whether a location is environmentally sustainable.
As opined by Adebayo et al. (2021) that, factors like economic growth, growing urbanisation, development of finance, and energy use affect carbon emissions in Latin American nations. Information gathered for the study spans the years 1980–2017. The results suggest that rising energy use, urbanisation, and economic growth all contribute to lower emissions. The relationship among, environmental sustainability, financial development and institutional quality was studied by Ahmed et al. (2020) using time series data covering the years 1996 to 2018. By analysing the relationships between trade openness and environmental sustainability, while also factoring in the quality of institutions and the level of financial growth, they significantly advanced research on the relationship between commerce and the environment. The fact that this study just looked at trade openness using IQ and FDI as explanatory factors is one of its weaknesses. There is a limitation here. The scientific community often acknowledges in the study literature that important elements can be overlooked, leading to misleading regression.

Environmental quality and institutional quality are closely related, and this article examines the policy and practical consequences of this relationship in great detail. Few studies have looked at the imbalanced relationship between Nigeria's economic growth and the quality of its institutions as it relates to pollution. These analyses have also factored in other important macroeconomic factors. Included in this category are variables such as gross domestic product, energy consumption, urbanisation, and forest area. The identified gap is being filled in by this study.

This study hinges on environmental Kuznets Curve (EKC). The hypothesis of the Environmental Kuznets Curve proposes a non-linear correlation between economic progress and the deterioration of the environment. It suggests that initially, as the economy grows, environmental degradation also increases. However, once a certain income threshold per person is reached, the pattern reverses, resulting in enhanced environmental quality as income levels continue to rise. However, the study argues that strong institutions can improve environmental outcomes by enforcing regulations, reducing corruption, and promoting sustainable practices. By integrating the EKC hypothesis with institutional quality, the study develops a comprehensive framework to examine the asymmetric effects of institutional quality on environmental degradation.

Research Methodology
To better understand the relationship between CO_2 emissions and macroeconomic variables that could explain them, an econometric model was built. When building the framework, the work of Makhdum et al. (2022) was used as a reference point. The asymmetric relationship between the variables under investigation is evaluated using the NARDL approach. The following figure shows the non-linear model of the inquiry.

Thus, the non-linear model of this research is presented in the following manner:

$$\begin{aligned} CO_t &= \delta_1 + \delta_2 INQ_t + \delta_3 FDE_t + \delta_4 GDPPC_t + \delta_5 GDPPC_t^2 \\ &\quad + \delta_6 FOA_t + \delta_7 URP_t + \delta_8 ECO_t + \mu_t \end{aligned} \tag{1}$$

Where, CO_2 = Carbon Emissions, lnGDPPC = GDP in Per Capita form, $\ln GDPPC^2$ = Squared GDP per capita, lnECO = Energy Consumption, lnFDE = Financial Development, lnURP = Urban Population and lnFOA = Forest Area. In exploring the impact of institutional quality on carbon emissions, researchers have employed various econometric techniques. Numerous academic studies, such as those by Ozturk and Acaravci (2013), Farhani et al. (2014), Shahzad et al. (2017), and Mirza and Kanwal (2017), have utilized the Autoregressive Distributed Lag (ARDL) estimation method. Abbasi and Riaz (2016) used an advanced version of the Vector Autoregression (VAR) methodology, whereas Shahbaz et al. (2017) employed panel cointegration methods. In their study, Amulali and Sab (2012) utilized the Engle and Granger cointegration methodology. Other researchers like Farhani and Solarin (2017), Fotros and Maaboudi (2010), and Ertugrul et al. (2015) have applied a range of techniques, including Granger causality, Bayer-Hanck cointegration, GMM, and VECM approaches. Many of these studies focus on the relationship between macroeconomic variables and carbon emissions, utilizing the aforementioned methods. Notably, none of these studies have applied a non-linear ARDL model to analyze the relationship between institutional quality and environmental degradation specifically in Nigeria. Additionally, the study conducted pre-estimation tests (Unit Root Test), which revealed different orders of integration, before proceeding with the ARDL bounds test to examine the long-run relationship. Therefore, NARDL estimation technique was employed to analyse the study.

Shin et al. proposed the non-linear version of the ARDL estimation method in the year 2014. The study analyses the uneven impact of economic factors on carbon emissions by taking into consideration both the short-term and long-term impacts of the explanatory variables on the outcome variable. This allows for further analysis of the relationship between the two variables. The performance of the asymmetric methodology is superior to that of other methodologies such as the VECM and the ARDL (Shin et al., 2014). This is because the asymmetric methodology addresses the issue of multi-collinearity and takes into account both the positive and negative effects that changes in external factors have on response variables.

Below framework of NARDL for the model in this research work

$$\begin{aligned}
\Delta CO_{2t} &= \delta_0 + \phi CO_{2t-1} + \alpha_1 + INQ_{t-1} + \alpha_2 - INQ_{t-1} + \alpha_3 \\
&+ FDE_{t-1} + \alpha_4 - FDE_{t-1} + \alpha_5 + \ln GDPPC_{t-1} \\
&+ \alpha_6 - \ln GDPPC_{t-1} + \alpha_7 + \ln GDPPC^2_{2t-1} \\
&+ \alpha_8 - \ln GDPP_{2t-1} + \alpha_9 + \ln FOA_{t-1} + \alpha_{10} - \ln FOA_{t-1} \\
&+ \alpha_{11} + \ln URP_{t-1} + \alpha_{12} - \ln URP_{t-1} + \alpha_{13} + \ln ECO_{t-1} \\
&+ \alpha_{14} - \ln ECO - + \sum_{i=1}^{\sigma} \phi_1 \Delta CO_{2t-1} + \sum_{i=0}^{\sigma} \phi_2 \Delta INQ_{t-1} \\
&+ \sum_{i=1}^{\sigma} \phi_3 INQ_{t-1} + \sum_{i=1}^{\sigma} \phi_4 \Delta FDE_{t-1} + \sum_{i=1}^{\sigma} \phi_5 \Delta FDE_{t-1} \qquad (2) \\
&+ \sum_{i=1}^{\sigma} \phi_6 \Delta \ln GDPPC_{t-1} + \sum_{i=1}^{\sigma} \phi_7 \Delta \ln GDPPC_{t-1} \\
&+ \sum_{i=1}^{\sigma} \phi_8 \Delta \ln GDPP^2_{t-1} + \sum_{i=1}^{\sigma} \phi_9 \Delta \ln GDPPC^2_{t-1} \\
&+ \sum_{i=1}^{\sigma} \phi_{10} \Delta \ln FOA_{t-1} + \sum_{i=1}^{\sigma} \phi_{11} \Delta \ln FOA_{t-1} + + \sum_{i=1}^{\sigma} \phi_{12} \Delta URP_{t-1} \\
&+ \sum_{i=1}^{\sigma} \phi_{13} URP_{t-1} + + \sum_{i=1}^{\sigma} \phi_{14} \Delta \ln ECO_{t-1} + + \sum_{i=1}^{\sigma} \phi_{15} \Delta \ln ECO_{t-1} + \mu_t
\end{aligned}$$

Through the use of the NARDL technique, the link between variables is investigated in both the short term and the long term. For short-term relationships, the immediate influence of an explanatory variable on the variable that is being explained is represented by the symbol αt. On the other hand, for long-term relationships, the instantaneous impact is represented by the symbol θt. The symbol θt is used to denote the rate at which the independent variable exerts its effect on the dependent variable and reaches a state of equilibrium. To determine whether or not the variable was asymmetrical, we utilised the Wald test. The representation of long-term asymmetric association is denoted by the equation (θ

= θ – = θ +), whereas the representation of short-term asymmetric association is by the equation (α = α - = α +).

Thus, lnFDE denotes "financial development," lnECO is an abbreviation for "energy consumption," lnINQ is an abbreviation for "institutional quality index," lnOA is an abbreviation for "forest area," and lnURP is an abbreviation for "urbanisation." Choosing the lags for both of the variables that are being investigated is accomplished by the application of the Akaike information criteria, which is a statistical method that provides support for the best lag selection. Furthermore, in terms of economics, the explanatory factors are separated into two categories: negative partial sums, which highlight declines or negative changes in the independent variable, and positive partial sums, which call attention to increases or positive changes in the independent variable. The division in issue provides a comprehensive economic viewpoint, which makes it easier for the model to recognise and evaluate the effects of variations in the variables that are being analysed, whether such fluctuations are positive or negative. Achieving the Highest Level:

$$Y_t + = \sum_{i=1}^{t} \Delta Y_i + = \sum_{i=1}^{t} Max(\Delta Y_i, 0) \tag{3}$$

$$\mathrm{Y}_t - = \sum_{i=1}^{t} \Delta Y_i - = \sum_{i=1}^{t} Min(\Delta Y_i, 0) \tag{4}$$

In this particular instance, the X_t is a representation of the independent variables GDPPC, GDPPC2, FDE, FOA, URP, INQ, and ECO. An investigation of asymmetric long-run cointegration is presented by Shin et al. (2014) in the form of a boundary test. Furthermore, this test serves as a full evaluation for the lagged of each and every regressor at the level where it is applied. When it comes to the boundary test, the t-statistic and the F-statistic act as the foundation. In the event that the null hypothesis is found to be incorrect, it might be deduced that the variables are bound to one another over an extended period of time. In the context of determining whether changes in explanatory factors are advantageous or detrimental, the long-period coefficients investigate the link between the variables that have been clarified and those that are just described. On the other hand, long-run coefficients that are non-linear were analyzed based on the following:

$$LG_i + = \alpha + / \rho \tag{5}$$

$$LG_i - = \alpha + / \rho \tag{6}$$

However, below equations were utilized for testing the multiplier effects:

$$Gf+=\sum_{i=0}^{f}\frac{\Delta CO2_{t+i}}{\Delta LNX_{t+}}, Gf-=\sum_{i=0}^{f}\frac{\Delta CO2_{t+i}}{\Delta LNX_{t-}}, Gf+=\sum_{i=0}^{f}\frac{\Delta CO2_{t+i}}{\Delta LNX_{sqt+}},$$
$$Gf-=\sum_{i=0}^{f}\frac{\Delta CO2_{t+i}}{\Delta LNX_{sqt-}}, Gf+=\sum_{i=0}^{f}\frac{\Delta CO2_{t+i}}{\Delta FDE_{t+}}, Gf-=\sum_{i=0}^{f}\frac{\Delta CO2_{t+1}}{\Delta FDE_{t-}},$$
$$Gf+=\sum_{i=0}^{f}\frac{\Delta CO2_{t+1}}{\Delta FOA_{t+}}, Gf-=\sum_{i=0}^{f}\frac{\Delta CO2_{t+1}}{\Delta FOA_{t-}}, Gf+=\sum_{i=0}^{f}\frac{\Delta CO2_{t+1}}{\Delta ECO_{t+}}, \quad (7)$$
$$Gf-=\sum_{i=0}^{f}\frac{\Delta CO2_{t+1}}{\Delta ECO_{t-}}, Gf+=\sum_{i=0}^{f}\frac{\Delta CO2_{t+1}}{\Delta URP_{t+}}, Gf-=\sum_{i=0}^{f}\frac{\Delta CO2_{t+1}}{\Delta URP_{t-}},$$
$$Gf+=\sum_{i=0}^{f}\frac{\Delta CO2_{t+1}}{\Delta INQ_{t+}}, Gf-=\sum_{i=0}^{f}\frac{\Delta CO2_{t+1}}{\Delta INQ_{t-}}$$

For f = 0, 1, 2, 3----, Where:

$$f \rightarrow \infty \text{ then } Gf+ \rightarrow LG_i + \text{and Gf } \rightarrow \text{LG}_\text{i} \quad (8)$$

The multipliers illustrate how the variable that is being explained reacts in an asymmetrical manner to a shock, which can be either positive or inverse, to the variable that is being clarified. This equation tracks the evolving dynamics within the system as it transitions from one primary equilibrium to a different equilibrium. These dynamics manifest when there is a change in the independent variable. Between 1985 and 2022, the study compiles essential data on carbon dioxide emissions (CO_2), GDP per capita, urban population, forest area, energy consumption, and financial development and was sourced from the WDI.

Presentation and Analysis of Results

Table 1: Estimation of Descriptive Statistics Result

Variables	Mean	Min.	Max.	S.D	Skew.	Kurk.	Obs.
CO_2	06887	0.5259	0.9187	0.1982	0.1890	2.3427	38
lnINQ	3.5284	2.2372	4.9716	0.5987	0.2839	3.2183	38
lnFDE	3.0269	2.6788	3.3545	0.2168	-3.8367	1.6856	38
lnGDPPC	6.5633	5.8455	7.3901	0.5017	0.1835	1.5573	38
$lnGDPPC^2$	42.459	33.205	55.621	6.6272	0.2417	1.5875	38
lnFOA	10.567	7.2786	10.817	0.6145	- 5.1387	27.981	38
lnURP	3.5341	3.4205	3.6154	0.0576	-0.1445	1.9018	38
lnECO	3.8714	3.7387	4.0631	0.0744	0.2235	2.2538	38

Note: Min = Minimum, Max = Maximum, S.D = Standard Deviation, Skew = Skewness, Kurt = Skewness, Obs. = Observations

Source: Author's Compilation (2024)

We conducted an analysis of the data series properties using descriptive statistics. As detailed in Table 1, the mean values are 0.68 for CO_2, 3.52 for LNINQ, 3.02 for LNFDE, 6.56 for lnGDPPC2, 43.45 for lnGDPPC2, 10.56 for lnFOA, 3.53 for LNURP, and 3.87 for LNECO. The maximum values for LNGDPPC2 and LNFOA are notably high, at 55.62 and 10.81, respectively. Most variables exhibit positive skewness, except for lnFDE, lnFOA, and lnURP. The standard deviation for lnGDPPC2 is the highest, indicating a significant variance from its mean.

Table 2: Estimation of Unit Root Test (ADF) Results

	Mackinnon Critical Values to Reject Unit Root			
Variable	**Level I(0)**	**1st Diff. I(1)**	**5% level of Significance**	**Integration Order**
CO_2	-0.2951	-4.8674	-1.9523	I(1)
lnINQ	-1.4830	-3.9495	-1.9567	I(1)
lnFDE	-0.5627	-4.0454	-1.9565	I(1)
lnGDPPC	0.1765	-4.4552	-1.9545	I(1)
$lnGDPPC^2$	-4.8913	-	-1.9543	I(0)
lnFOA	2.9166	-	-1.9527	I(0)
lnURP	-0.5725	-4.3095	-1.9523	I(1)

Source: Author's Compilation (2024)

This table provides MacKinnon critical values, used to test for the presence of a unit root in the variables at both the level and the first difference. Determining the integration order of the variables, as established by these critical values, helps us understand their long-term behaviour and economic implications. Notably, the variables CO2, lnINQ, lnFDE, lnGDPPC, and lnURP exhibit negative values for their first differences (I(1)), indicating they are integrated of order 1. This implies that any shocks or changes to these variables will have a lasting impact on the system. In contrast, the critical values for lnFOA and the square of lnGDPPC (lnGDPPC2) show that these variables are stationary at the level (I(0)). This means that shocks to these variables are temporary and do not have long-term consequences, as they achieve stationarity without the need for differencing. Since variables like CO2, lnINQ, lnFDE, lnGDPPC, and lnURP are integrated of order 1, it can be inferred that changes in these variables have long-lasting effects, potentially impacting the economy over an extended period. Consequently, the effects of shocks or policy changes related to these variables could be significant in the long run. On the other hand, the fact that variables like lnGDPPC2 and lnFOA are integrated of order I(0) indicates that any shocks or changes they cause are transient and may not have a substantial long-term impact on the economy. Given that none of the variables are stationary at the second difference, we proceed with the estimation of the bounds test for cointegration owing to the fact that variables used for the study have different order of integration.

In this study, the F-Bound test is utilized to assess the null hypothesis, which posits no cointegration among the variables being studied. The F-statistic value is employed to test this hypothesis. When the F-statistic surpasses the upper bound critical value, it signifies a long-term relationship among all series examined. Conversely, if the F-statistic falls below the lower critical value, it indicates the absence of long-term cointegration among the variables under scrutiny. The findings of the F-Bound test are detailed in Table 3.

Table 3: Estimation of Bound Test Results

Significance Level (%)	**Critical Values**		
	Lower Bound	**Upper Bound**	**F-Statistics**
0.11	2.1	3.08	16.773
0.04	2.54	3.59	
0.0215	2.87	3.86	
0.02	3.28	4.33	

Source: Author's Compilation (2024)

According to the computed F-statistic, which value at 16.773, that is, significant at the 1% significance level, and we fail to accept the null hypothesis. The outcome indicates that there is a connection between the variables that exists over a long run of time. The statistical significance of the F-statistic indicates that there is a significant correlation between the variables over a long period of time at the present time.

Table 4: Estimation of Long Run Asymmetric, Institutional Quality & Carbon Emissions

	Lag Optimal: ARDL (2, 1, 1,2, 2, 1, 1,1,1) Response Variable: CO_2 Emissions	
Explanatory Variables	**Coefficient**	**t-value**
$lnINQ^+$	-0.006**	-2.465
$lnINQ^-$	-0.003***	-4.556
$lnFDE^+$	-0.002	-0.176
$lnFDE^-$	-0.465**	-2.339
lnGDPPC	0.683***	3.665
$lnGDPPC^2$	0.070*	1.567
lnFOA	-1.087***	-6.148
lnURP	0.834**	2.813
lnECO	1.294***	7.567

*Note: *, ** & *** refer to significance at 10%, 5%, and 1% level, respectively*
Source: Author's Compilation (2024)

Table 5: Estimation of Short Run Asymmetric, Institutional Quality & CO_2 Emissions

	Optimal Lag: ARDL (2, 1, 1,2, 2, 1, 1,1,1) Dependent Variable: Carbon Emissions (CO_2)	
Variables	**Coeff.**	**t-value**
D(CO_2(-1))	0.351***	3.243
D(lnINQ$^-$)	0.167**	4.951
D(lnINQ$^-$)	0.023*	2.706
D(lnINQ$^-$(-1)	-0.222*	0.060
D(lnFDE$^+$)	-0.005**	-2.155
D(lnFDE-)	0.0063	1.272
D(lnFDE$^-$(-1))	0.2013	0.575
D(lnGDPPC)	0.022**	2.096
D(lnGDPPC^2)	0.004***	3.234
D(lnFOA)	-0.893***	-6.817
D(lnURP)	0.075***	4.134
D(lnECO)	0.015***	2.574
ECT(-1)	-0.356**	-2.401
C	7.740***	6.040

*Note: *, ** & *** Denote significance at 10%, 5% & 1% level, respectively*
Source: Author's Compilation (2024)

The findings of the long-term asymmetric nexus are presented in Table 4, while the outcomes of the short-run asymmetric connection are presented in Table 5. This is in accordance with the confirmation of the long run series cointegration. The purpose of this study is to investigate the relationships, both long-term and short-term, that exist between carbon emissions, financial development, and the quality of institutions. All of the explanatory variables, with the exception of LNFDE-, are able to establish statistical significance only after a significant period of time has passed. In the near term, there is a relationship that may be considered statistically significant between D(LNFDE-) and D(LNFDE-(-1)).

The information shown in Tables 4 and 5 provides further evidence that the relationship between environmental deterioration (degradation) and institutional quality is asymmetrical, and this is true for both the long and the short run. Despite the fact that there is an immediate connection between carbon emissions and the positive impact of institutional quality, the results offer more proof to support the belief that there is a permanent negative association between the two; this relationship is detrimental. Specifically, it demonstrates that for every 1% rising in institutional quality (lnINQ+), there is a corresponding increase of 0.167 units in CO2 emissions in the short run and a decrease of 0.006 units in the long term. For every percentage point that the quality of the institution decreases, the amount of carbon dioxide emissions increases by 0.003 units over the long run and decreases by 0.023 units over the short term (lnINQ-). Alterations in institutional quality that are positive (lnINQ+) have a more significant impact on emissions in both the long and short run as compared to alterations in institutional quality that are negative (lnINQ-). The results are consistent with those of earlier studies carried out by Bernauer and Koubi (2009), Ibrahim and Law (2016), Ahmed et al. (2020), Mehmood et al. (2021), and other researchers. These studies show that there is an adverse association between the quality of an institution and the amount of carbon dioxide emissions, which ultimately results in increased environmental sustainability. Every one of the studies that came before it has made a case for the significance of institutional quality in the process of contributing to environmental sustainability.

In addition, we find that there is a large and inverse connection between environmental degradation and positive shocks to financial development (LNFDE+) in the short term, but that this connection is unimportant in the long run. Despite the fact that short-term CO2 emissions are barely visible, long-term CO2 emissions are seeing a huge increase as a result of negative shocks to financial development (LNFDE). The economy of Nigeria is subject to this phenomenon. Specifically, a one percent increase in financial development LNFD+ will result in a short-term decrease in CO2 emissions of 0.005 units, but a one percent decrease in financial development (LNFDE-) will result in an increase of 0.465 units in CO2 emissions. This is a more precise explanation of the relationship between the two variables. The findings of this study are consistent with the findings of research carried out by Tao et al., (2023) and Ahmed et al. (2020), which found that there is a negative association between financial development and emissions.

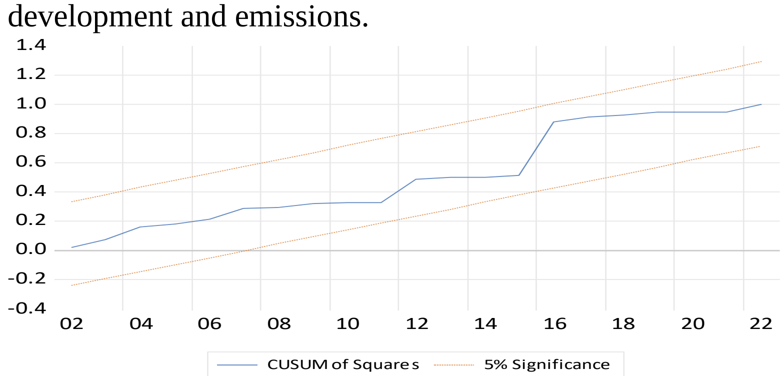

Fig. 1: Estimation of Stability Test

From the figure 1, we ensure the robustness of our analysis by testing the stability of the estimated equations' interrelationships presented in the empirical study. This process helps to eliminate concerns about potential outlier regressions within any of the sample groups. The stability test employed is the CUSUM of squares test. Figure 1 presents the results of this test for the equation used in the study. The CUSUM of squares lines lie entirely within the 5 percent significance bounds throughout the chart, indicating that the estimation is stable. Our model specification and estimation procedure fully account for the influences of structural breaks. Therefore, this stable estimate is reliable to formulate conclusion and policy recommendations. The analysis indicates that the errors exhibit a normal distribution throughout the period studied, with dispersion around the mean and an asymmetrical distribution of items. The Jarque-Bera normality test yielded a statistic of 0.550869 and a p-value of 0.759242, supporting the acceptance of the null hypothesis that the residuals follow a normal distribution.

Table 6: Estimation of Serial Correlation LM & Heteroskedasticity Test

Serial Correlation Test			
F-statistic	0.903973	Prob. F(2,19)	0.4217
Obs*R-squared	3.127942	Prob. Chi-Square(2)	0.2093
Heteroskedasticity Test			
F-statistic	1.100574	Prob. F(14,21)	0.4102
Obs*R-squared	15.23536	Prob. Chi-Square(14)	0.3623
Scaled explained SS	6.228770	Prob. Chi-Square(14)	0.9604

Source: Author's Compilation (2024)

Table 6 equally indicates that the estimated correlation is statistically insignificant. This suggests that we fail to reject the null hypothesis of no correlation among the study variables used. The absence of correlation shows that the variables are suitable and appropriate for estimation. It is crucial for the data to be free from correlation because the presence of correlation could lead to spurious results in the analysis. On the other hand, the estimation of heteroskedasticity in the study variables, it was found that the model does not exhibit any signs of heteroskedasticity. This indicates that the estimation is precise and suitable for analysis.

According to the results of our research, a 1% rise in urbanisation results in a 0.075 and 0.834 unit increase in CO_2 emissions with respect to the short term and the medium term, respectively. In agreement with the findings of Liddle (2014), Poumanyvong and Kaneko (2010), Bekhet and Othman (2017), Pata (2018), and

Alam et al. (2007), we have demonstrated that our findings are consistent. In contrast to the findings of Ali et al. (2017) and Sharma (2011), these findings reveal a contradiction. The rate at which Nigerians are urbanising has been steadily increasing ever since the country was established, and this trend has intensified over the course of the last several decades. Approximately 60% of Nigerians are currently residing in metropolitan areas. The proximity of large industries to cities is one of the primary reasons why people move to urban areas in search of better job prospects. People who live in cities in Nigeria prefer to use private transportation because the country's transportation infrastructure is inadequate. This preference has resulted in a considerable increase in the amount of emissions produced by automobiles, which has contributed to a worsening of the environmental conditions in the country. There is a direct correlation between urbanisation and the production of carbon emissions, which ultimately leads to a worsening of environmental conditions in Nigeria.

Considering that Nigeria is still considered a developing nation, its economy is currently seeing fast expansion. The amount of energy that is necessary for manufacturing, transportation, and industry is increasing as a result of this rapid growing situation. As a further point of interest, the underutilization of environmentally friendly energy sources by Nigerians contributes to a rise in these emissions. According to the findings of our analysis, we found that a one percent increase in energy consumption leads to carbon emissions of 1.294 units in the short term and 0.015 units in the long run. According to Khan et al. (2019), Oh & Bhuyan (2018), Abbasi and Riaz (2016), Ertugrul et al. (2015), Al-mulali and Sab (2012), and other studies, our data provide credence to the idea that there is a positive correlation between the consumption of energy and the emission of carbon. The utilisation of renewable energy has a detrimental effect on carbon emissions, as stated by Dogan and Seker (2016), but the use of non-renewable energy has a beneficial effect on carbon emissions. As can be shown in Table 5, there is a negative correlation between the coefficient and the speed of adjustment (ECT). The fact that the variables have been co-integrated for a considerable amount of time is demonstrated by the fact that the ECT value is 0.356. The short-term shocks that are linked with environmental degradation can be accounted for by explanatory variables to the extent of 35%.

Conclusion and Policy Recommendations

This study investigates the long-term and short-term relationships between carbon emissions and institutional quality in Nigeria. The results confirm the cointegration of the long-run series, revealing asymmetrical relationships between environmental degradation and institutional quality in both the long and short term. Specifically, positive changes in institutional quality lead to an initial increase in CO2 emissions but result in long-term reductions. Conversely, negative changes in institutional quality show minor short-term decreases and long-term increases in emissions. Additionally, the study finds a significant inverse relationship between environmental degradation and positive shocks to financial development in the short term, which becomes insignificant in the long run. The analysis also highlights the impact of urbanization and energy consumption on CO2 emissions, showing a direct correlation with increasing emissions. These findings underscore the importance of strong institutional frameworks and sustainable financial development in mitigating environmental degradation.

On the other hand, this study with the following recommendation: to enhance institutional quality by enforcing stringent environmental laws, protecting property rights, and promoting transparency and accountability. This will help mitigate long-term CO2 emissions and ensure sustainable development. Encourage positive financial development practices that reduce short-term CO2 emissions. Implement policies that support sustainable financial growth, reducing the adverse impacts of negative financial shocks on the environment. Develop and implement comprehensive urban planning strategies to manage the rapid urbanization in Nigeria. Encourage public transportation and sustainable infrastructure to reduce CO2 emissions from private vehicles. Increase investment in renewable energy sources to decrease reliance on non-renewable energy, thereby reducing carbon emissions. Promote policies that incentivize the use of clean energy technologies and to foster public engagement in environmental decision-making processes. Encourage community involvement in sustainability initiatives to improve environmental awareness and accountability

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