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The Role of Trade Openness, Financial Development and Institutional Quality in the Environmental Performance of a Developing Country: Evidence from Nigeria

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Abstract

The natural resources of Nigeria face rising threats from deforestation and pollution and resource extraction and land degradation. Climate change makes these problems worse which demonstrates the critical need to enhance environmental quality for sustainable development. The identification of factors that influence environmental performance stands as essential to stop additional resource depletion. The research analyses how economic growth together with population growth alongside trade openness and financial development and governance affect environmental performance in Nigeria. The ARDL model applied to annual data from 1995 to 2022 shows economic growth together with trade openness produce substantial environmental performance benefits in the short term. Financial development produces positive effects on environmental performance, but the results lack statistical significance. The positive effects of institutional quality on environmental performance appear over time thus demonstrating the requirement for enhanced governance systems to obtain stable environmental results. Environmental performance experiences negative effects in the short term from population growth. The results show that long-term environmental performance benefits from both financial development and institutional quality improvements. Environmental performance faces substantial negative consequences because of economic growth. Nigeria needs to develop its financial sector together with institutional frameworks while controlling population growth to achieve sustainable environmental outcomes.

Keywords: Environmental performance, economic growth, governance, trade openness, Environmental Performance Indictor (EPI)

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1. Introduction

Environmental performance is simply a matter of how systems, nations, or groups manage their impact on the planet. That means decreasing greenhouse emissions, mitigating climate change, being smart about resources, and waste management through reducing, reusing, and recycling. It also means minimizing air, water, and land pollution and conserving plants and animals (Sachs et al., 2022). It is a serious problem internationally because countries try to balance economic development with preserving nature. Jahanger et al. (2024) assert that it is extremely hard for most countries to grow the economy without killing the environment. It is especially critical in Nigeria because the country's population is growing at a fast rate, cities are enlarging, and industries are forming. All this puts enormous pressure on the environment (Akadiri et al., 2022). This has resulted in problems like deforestation, contaminated water, and land degradation, which climate change amplifies (Ogundipe, 2020).

In order for Nigeria to grow in a way that is sustainable, they need to pay attention to a variety of important factors, such as greenhouse gas emissions and other measures of a healthy environment. Metrics like carbon dioxide emissions and ecological footprint tell a lot about environmental effects, but they only paint half the picture. Other studies have analysed information about carbon emissions (Aiyetan & Olomola, 2017; Lin et al., 2015; Ogundipe et al., 2020; Rafindadi, 2016), but these statistics do not tell us about the volume of natural resources used and consumed. The ecological footprint mainly shows what is being consumed but not where the resources come from (Dam & Sakodie, 2023). Due to this, in this study, the Environmental Performance Index (EPI) was used to gain a better understanding. The EPI is a way of comparing and ranking countries based on how well their ecosystem is performing and how good their environment is. It gives a more complete picture of a country's environmental performance. This study utilizes the EPI index in its analysis of the impacts of trade, money growth, and policy on Nigeria's environmental record.

It uses a different technique called Autoregressive Distributed Lag (ARDL). The EPI is an esteemed method of measuring the development of a country in terms of the environment. In contrast to past studies that are concerned with, for instance, carbon footprint or ecological footprint, this study gives a clearer understanding of Nigeria's environmental sustainability development. It assists in determining the major areas to be addressed and serves as a basis for developing better plans to enhance the environment.

Here is the organization of the paper: Section 2 is a summary of what others have found on this topic. Section 3 explains the model and methodology used. Section 4 presents the results and their implication. Section 5 concludes by explaining why the findings are important and offers suggestions for future research.

2. Review of Literature

Determinants of environmental sustainability studies are all in line with the roles that trade openness, financial development, and governance have in shaping environmental outcomes, with variations arising in terms of regional economic systems and the ability of governance. In Nigeria, Mesagan and Nwachukwu (2018) found that while income levels and financial development benefited environmental quality, they exerted pressure through increased CO_2 emissions and energy requirements, though not in two-way causation with the environment. Scaling this to South Asia, Bhutta et al. (2022) observed that although financial development boosted economic activity, it was not sufficient to check emissions alone, emphasizing the importance of governance frameworks supporting green finance and green investment. These findings suggest a need to balance financial growth with environmentally friendly growth-friendly policies. Conversely, the nexus between trade openness and the environment is complex. Wang et al. (2021) found that openness to trade significantly raised emissions in oil-dependent African nations like Nigeria by raising extraction-based pollution, while non-oil economies experience relatively lesser environmental impacts. Ogundipe et al. (2020) corroborated this with evidence of a direct link between Nigeria's fossil fuel reliance and higher emissions, showing that in the absence of sustainable trade practices, openness is bound to widen environmental degradation for resource-dependent economies.

Antweiler et al (2001) study corroborates that trade can encourage environmental benefits through a "technique effect," since cleaner technologies become available, thus enhancing production practices. However, the "scale effect" generated by trade, which boosts production, could possibly boost environmental degradation, especially for the economies that exploit abundant natural resources (Le et al., 2016). In Nigeria, Omoke et al. (2021) believes that quality institutions and good governance may channel the dividends of openness to trade into growth-inducing activities.

Financial development, a key driving force, has the capacity to bring about environmental sustainability through investments in cleaner technologies and sustainable operations. Asserted by Zaidi et al. (2019), very developed financial systems enhance innovation and enable firms to invest in cleaner technologies, hence improved environmental performance. Financial development can also drive industrial growth, and in turn contribute to environmental degradation when factors of sustainability are overlooked (Al-Mulali et al., 2015).

Governance plays a vitally important role in the environmental sphere because it has the ability to impact the efficiency of policies and regulations in controlling the consumption of resources. Strong institutions generate transparency, policy consistency, and enforcement ability, all of which are basis to safeguard the environment (Baloch et al., 2018). Poor governance, however, typically results in regulatory failure, unequal resource distribution, and environmental degradation in poor governance systems of nations (Acheampong & Dzator, 2020). Institutional reforms that advance governance and accountability

are thus pivotal in balancing economic ambitions with the protection of the environment. Governance and institutional quality have been identified as central to reversing the adverse effects of trade and financial growth on environmental performance. For instance, Ali et al. (2019) found that quality institutions in developing countries significantly suppress emissions through greater environmental governance. Similarly, Acheampong and Dzator (2020) found that within sub-Saharan Africa, governance aspects like regulatory quality and rule of law significantly promote environmental quality but most importantly so in British or French legal tradition countries.

These findings suggest that institutional interventions' effectiveness can potentially be influenced by past governance systems. Didia et al. (2022) also supported this, observing that certain governance variables like political stability could not demonstrate any noticeable effect, whereas others like government effectiveness and rule of law impacted environmental performance significantly, suggesting that certain governance advancements can contribute to direct environmental effects. Ahmed et al.(2000) showed in their paper that high-quality institutions can counteract the ugly environmental aspects that come along with money and trade growth. In essence, they argued that high-quality governance can render it more sustainable by tackling the environment's drawbacks from financial growth. Bhutta etal. (2000) said something similar: green technology and renewable energy do well if governance exists to enable them. Hence, for Nigeria, having laws that promote green finance and technology research would be of significant assistance in minimizing the environmental problems arising from money and trade growth.

3. Methodology

3.1 Theoretical Framework

This study is grounded in the Environmental Kuznets Curve (EKC), which examines the interplay between environmental management, economic growth, and institutional quality. The EKC hypothesis posits an inverted U-shaped relationship between environmental harm and economic growth (Grossman & Krueger, 1991). In the initial phases of economic growth, environmental damage and pollution typically increase. However, once a certain income level per capita is achieved, this trend begins to reverse. As economies continue to grow, we start to see improvements in environmental conditions.

3.2 Model Specification

Following Didia et al. (2022), we specified the model for this study as

$$EPI_t = a_0 + \beta_1 TOP_t + \beta_2 FD_t + \beta_3 POP_t + \beta_4 GDP_t + \beta_5 IQ + \varepsilon_t \quad (1)$$

This model is different from Didia's because it includes a variable for financial development and leaves out the debt variable. The main thing it tries to measure is environmental sustainability,

using the Environmental Performance Index (EPI) as the main outcome. In this model, economic growth is shown through per capita GDP. Globalization shows how hard countries try to stay competitive in international trade. Social factors look at environmental pressures that come from population changes or how crowded an area is, like population density. Institutional quality includes things like government stability, law and order, political stability, how accountable the government is, and how well corruption is controlled. All these together show how effective an institution is.

Narayan and Narayan (2010) argued that to solve the problem of multicollinearity, varying variance and to calculate elasticities, short-run and long-run income elasticities should be compared by adopting a linear model. Hence, the natural logarithm of all variables was taken to avoid multicollinearity, heteroscedasticity and to obtain the elasticities of the variables using a double logarithmic model.

$$lnEPI_t = a_0 + \beta_1 lnTOP_t + \beta_2 lnFD_t + \beta_3 lnPOP_t + \beta_4 lnGDP_t + \beta_5 IQ + \varepsilon_t \quad (2)$$

EPI, which is the dependent variable, measures how sustainable the environment is. Trade openness is shown by TOP. FD stands for financial development. Social factors include things like population size (POP) that put pressure on the environment. IQ stands for institutional quality, which is measured by government stability, law and order, democratic accountability, and how well corruption is controlled. Economic growth is shown by the growth rate of per capita GDP. a_0 is the starting point or slope, Î²_1 to Î²_6 are the coefficients, "t" shows the years of the study period, and Îµ_t is the error or disturbance term.

3.3 Estimation Technique

The estimation technique employed here is the autoregressive distributed lag. Autoregressive distributed lag (ARDL) is a least squares regression which adds the lagged independent variables and the lagged explanatory variables. The technique can allow the short-run and long-run impacts to be explored and is also appropriate for looking at how the variables interact given the time series nature of the data. The ARDL linear representation of Equation 2 is thus:

$$\Delta lnEPI_t = a_0 + \sum_{k=1}^{n} \gamma_k \, \Delta lnEPI_{t-k} + \sum_{k=0}^{P} \eta_k \, \Delta lnTOP_{t-k} + \sum_{k=0}^{p} \theta_k \, \Delta lnFD_{t-k} + \sum_{k=0}^{p} \lambda_k \, \Delta lnPOP_{t-k} + \sum_{k=0}^{p} \partial_k \, \Delta lnIQ_{t-k} + \sum_{k=0}^{p} \delta_k \, \Delta lnGDP_{t-k} + a_1 \, lnEPI_{t-1} + a_2 lnTOP_{t-1} + a_3 lnFD_{t-1} + a_4 lnPOP_{t-1} + a_5 lnIQ_{t-1} \, a_6 GDP_{t-1} + \epsilon_t \quad (3)$$

3.4 Data

The research intensively examined the effect of trade openness, financial growth, and institution quality on environmental performance in Nigeria. The quantitative approach was used, and data were examined from 1995 to 2022. Environmental Performance Index (EPI) was the focal issue. The research had several factors as independent variables: economic growth represented by Gross Domestic Product (GDP), financial development represented by a financial development index, trade openness represented by a proportion of GDP, population size in terms of the total number of individuals, and institutional quality represented by an index consisting of four key determinants. The EPI consists of 40 environmental indicators, covering such areas as Climate Change (PCC), Environmental Health (HLT), and Ecosystem Vitality (ECO) (Wolf et al., 2022). Data from institutions were retrieved from International Country Risk Guide by The PRS Group and subjected to Principal Component Analysis with eigenvalues. The rest of the variables were retrieved from the World Bank's World Development Indicators Database.

4. Results

The descriptive statistics in Table 4.1 show that environmental sustainability (LNEPI) had a mean value of 3.59, with relatively low variation, indicating stability over the observed period. Per capita GDP (LNGDP) had a mean of 7.62, with moderate variability, while population (LNPOP) was relatively stable around its mean of 18.85. Trade openness (LNTO) varied more widely, suggesting fluctuations in trade policies. Institution (IQ) had a mean of 1.142 and a standard deviation of 0.959, showing moderate variability, with values ranging from a minimum of 0.02 to a maximum of 4.21. Financial development (LNFD) had negative mean value of -1.60 on average, likely suggesting a lower level of financial services accessibility or integration.

The numbers in Table 4.1 show that environmental sustainability (LNEPI) had an average score of 3.59, with not much change over time, meaning it stayed pretty stable. Per capita GDP (LNGDP) averaged

7.62, with some ups and downs, while population (LNPOP) stayed close to its average of 18.85. Trade openness (LNTO) changed more, which might mean trade policies were shifting. Institution (IQ) had an average of 1.142 and a spread of 0.959, showing some variation, with the lowest value being 0.02 and the highest being 4.21. Financial development (LNFD) had an average of -1.60, which might mean that financial services were not very accessible or well connected.

Table 4.1 Descriptive Statistics and Correlation Analysis Result

		LNEPI	LNGDP	LNPOP	LNTO	IQ	LNFD
Mean		3.591801	7.623538	18.85422	3.575373	1.141974	-1.597144
Median		3.558684	7.707524	18.85554	3.671422	1.016064	-1.576104
Maximum		3.792744	7.893406	19.20249	3.975523	4.209850	-1.299291
Minimum		3.483514	7.264739	18.49938	2.794362	0.020111	-1.932236
Std. Dev.		0.080807	0.232316	0.217497	0.297658	0.958881	0.137390
Observations		28	28	28	28	28	28

Source: Authors' Computation

The analysis in Table 4.2 shows that LNEPI, which measures environmental performance, has a weak positive link with LNGDP (0.37) and LNFD (0.41). This suggests there is a slight connection between how well the environment is managed, economic growth, and financial development. IQ, which stands for institutional quality, is positively linked with LNEPI (0.62), LNGDP (0.58), and LNPOP (0.43). This means that better institutional quality is connected with higher levels of economic growth and population. LNTO, which measures trade openness, has mixed results. It is slightly positive with IQ (0.09), but it has a negative relationship with LNPOP (-0.66).

Table 4.2 Correlation Matrix

	LNEPI	LNGDP	LNPOP	LNTO	IQ	LNFD
LNEPI	1.00					
LNGDP	0.37	1.00				
LNPOP	0.13	0.92	1.00			
LNTO	0.21	-0.50	-0.66	1.00		
IQ	0.62	0.58	0.43	0.09	1.00	
LNFD	0.41	0.78	0.76	-0.39	-0.38	1.00

Source: Authors' Computation

Table 4.3 shows the results of tests to check if the time series data is stationary and how integrated the variables are. Using the Augmented Dickey-Fuller and Phillips-Perron tests, it was found that except for the logarithm of financial development, which is already stationary in its original form, all other variables became stationary after taking their first difference. The fact that the variables have different integration orders means that some standard estimation methods can't be used for the model. In this situation, the best way to estimate the model is by using the autoregressive distributed lags (ARDL) approach. Before that,

we need to run the ARDL bounds test for cointegration to check if there is a long-term relationship among the variables.

Table 4.3 Unit root test

Variables	ADF		PP		Conclusion
	Statistics	Prob.	Statistics	Prob.	Integration
LnEPI	-3.452022	0.0181	-3.438566	0.0186	I (1)
lnGDP	-4.541420	0.0008	-4.621057	0.0006	I (1)
lnIQ	-3.258745	0.0277	-5.244246	0.0001	I (1)
lnPOP	-3.627532	0.0431	-3.252211	0.0281	I (1)
LnFD	-3.762603	0.0356	-2.651610	0.0955	I (0)
IQ	-3.818965	0.0078	-3.734717	0.0095	I (1)

Source: Authors' Computation

Table 4.4 shows that the variables are connected in the long term. When looking at the table, the F-statistics from the linear ARDL model are greater than the upper limits for both 5% and 10% significance levels. This indicates there is a long-term relationship between the variables.

Table 4.4 ARDL Bounds Test

ARDL Bounds Test				
Sample: 1998 2022				
Included observations: 25				
Null Hypothesis: No long-run relationships exist				
Test Statistic	Value	K		
F-statistic	17.67398	5		
Critical Value Bounds				
Significance	I0 Bound	I1 Bound		
10%	2.26	3.35		
5%	2.62	3.79		

Source: Authors' Computation

Impact of Trade Openness, Financial Development, and Institutional Quality on Environmental Sustainability

The ARDL results in Table 4.5 offer critical insights into the determinants of environmental performance in Nigeria, aligning with key empirical findings. The short-run analysis highlights that economic growth had mixed effects on environmental performance. Specifically, a 1% increase in the previous year's economic growth significantly reduced current environmental performance by 0.70%, while a 1% increase in economic growth from two years ago enhanced it by 0.53%. The former finding resonates with Mesagan and Nwachukwu (2018) who observed that economic growth could negatively impact environmental quality in resource-dependent economies but may improve it when aligned with sustainability efforts.

Trade openness had a significant positive short-run effect, with a one-period lag increasing environmental performance by 0.057%. This finding contrasts with Ogundipe et al. (2020) who reported that trade liberalization in oil-exporting African nations often exacerbates emissions. However, the positive impact in this study suggests that Nigeria may benefit from trade openness through the adoption of environmentally friendly technologies or compliance with international environmental standards.

Table 4.5 Regression Results

ARDL Cointegrating And Long Run Form Dependent Variable: LNEPI; Selected Model: ARDL (1, 3, 2, 2, 1, 3); Sample: 1995, 2022; Included observations: 25				
Cointegrating Form (Short-Run Coefficients)				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNGDP)	-0.074814	0.211224	-0.354194	0.7336
D(LNGDP(-1))	-0.698788	0.174747	-3.998851	0.0052
D(LNGDP(-2))	0.529651	0.208235	2.543520	0.0385
D(LNPOP)	-35.563537	16.863055	-2.108962	0.0729
D(LNPOP(-1))	30.879656	23.576457	1.309767	0.2316
D(LNTO)	0.013907	0.018620	0.746874	0.4795
D(LNTO(-1))	0.056666	0.018159	3.120611	0.0168
D(LNFD)	-0.088477	0.047849	-1.849089	0.1069
D(IQ)	-0.020660	0.013148	-1.571394	0.1601
D(IQ(-1))	-0.001875	0.008349	-0.224517	0.8288
D(IQ(-2))	0.043830	0.011291	3.881743	0.0060
CointEq(-1)	-0.345667	0.067423	-5.126882	0.0014

Long-Run Estimates				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNGDP	-1.537673	0.452984	-3.394544	0.0115
LNPOP	0.525591	0.521667	1.007523	0.3472
LNTO	-0.169381	0.127633	-1.327103	0.2261
LNFD	0.631310	0.176585	3.575105	0.0090
IQ	0.238603	0.088303	2.702082	0.0305
C	7.644701	8.828946	0.865868	0.4153

Source: Authors' Computation

Conversely, population growth had a negative effect on environmental performance in the short term. An increase in population growth by 1% led to a decline of 35.5% in environmental performance. This supports findings by Wang et al. (2021), who quoted that population pressures exacerbated emissions, especially in resource-based economies. The results point to the challenge of controlling population growth towards environmental purposes. They also point to population dynamics being considered by environmental policies towards maximum reduction of ecological pressures.

Institutional quality (IQ) was shown to have a delayed but significant positive impact. An increase in institutional quality over the last two years resulted in a 0.044% increase in environmental performance. This backs findings by Didia et al. (2022) and Jilanguo et al. (2022), which emphasized that governance and institutional frameworks play an important role in lowering emissions and promoting green investments.

In the long run, financial development emerged as a significant driver of environmental performance, with a 1% increase contributing to a 0.63% rise in performance. This finding aligns with Bhutta et al. (2022), which noted that growth in the financial sector encouraged green investments, provided it was supported by strong institutional frameworks. Institutional quality also positively affects long-term outcomes; a 1% increase raises environmental performance by 23%. This supports Acheampong and Dzator (2020), who discovered that governance stabilizes environmental sustainability.

On the other hand, economic growth had a negative long-term impact. A 1% increase in economic growth led to a 1.54% decrease in environmental performance. This is consistent with Wang et al. (2021), who observed that growth driven by industry in developing economies often worsens environmental degradation. This stresses the need for sustainable growth strategies.

The error correction term (-0.3457) shows that 34.57% of any imbalance is corrected within one period, indicating a stable long-term relationship. This supports Ali et al. (2019), which stressed the

dynamic relationship between institutional structures and environmental sustainability. These results offer practical insights into how economic policies and governance can influence Nigeria's environmental outcomes, highlighting the need to balance growth with sustainability goals.

Diagnostic Tests

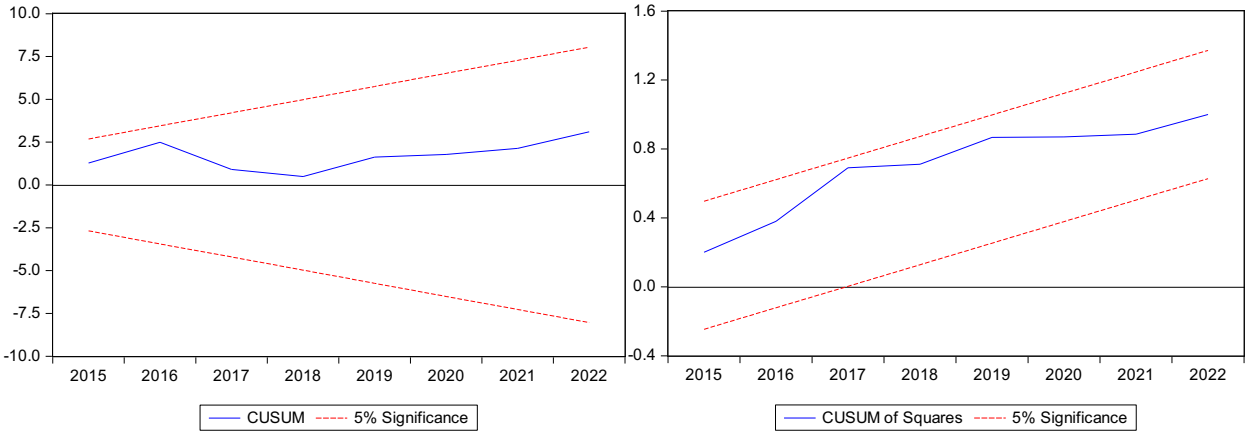
According to Table 4.6, the values of R-squared and adjusted R-squared in the model indicate that the explanatory variables respectively accounted for about 99% and 98% of the variations in environmental performance. The significant values of F-statistics (73.37928) obtained show that the independent variables are jointly significant. The Durbin-Watson statistic points to the absence of autocorrelation, meaning that the residuals were uncorrelated in the respective models. The insignificant values of the Jarque-Bera test reveal that the variables were normally distributed. Furthermore, the Breusch-Pagan-Godfrey test with insignificant F-statistic of 1.298036 from the ARDL model shows that the residuals were homoscedastic, that is, the residuals did not differ across all values of the exogenous variables. The CUSUM and CUSUMSQ plots in Figures 1 and 2 reveal that the long-run coefficients are stable since both of their plots stay inside the critical bounds.

Table 4.6 Diagnostic Test

Test	ARDL
R-squared	0.997282
Adjusted R-squared	0.983691
F-statistic (p-value)	73.37928 (0.000400)
Durbin-Watson	3.657183
Jarque-Bera (p-value)	0.467768 (0.79145)
Breusch-Pagan-Godfrey	1.298036 (0.3664)

Source: Authors' Computation

Figure 1. CUSUM AND CUSUM SQUARED TEST



5. Conclusion

This study investigates the impact of openness to trade, financial growth, and institutional quality on environmental performance in Nigeria. The ARDL methodology is used to describe short-run and long-run effects. The results show that economically, growth and openness to trade play a positive role in improving environmental sustainability in the short run. This suggests that Nigeria's engagement in the global economy would lead to more environmentally conscious behaviour, like the use of improved technology and respect for international environmental standards. Demographic expansion works against sustainability in the short run, as in showing the environmental stress created by an increasing population in Nigeria.

Institutional quality has a positive effect but with a delay, reflecting the importance of improving governance toward more appropriate and sustainable environmental results. Institutional performance improvement means that good governance and stable is necessary to preserve adequate environmental health. Institutional quality and financial development are the most essential long-term determinants of environmental performance. Institutional quality supports green investment and keeps environmental results at a fixed level. This means that financial development may not be enough to provide environmental advancements without proper governance to guide investment choices.

While it's clear that institutional quality and financial development influence environmental performance, their synergistic effect needs further investigation. This supports the notion that financial growth demands institutions that may maintain development. Good governance systems should be developed to improve environmental effects of financial growth in Nigeria. Stability, accountability, and transparencies caused by good governance are vital in achieving green finance and averting environmental risks. Governance and financial development are a pivotal area of study for future policy and research for Nigeria to link financial growth with environmental sustainability goals.

On the other hand, economic growth has a negative effect on environmental performance in the long run, showing the difficulty of balancing industrial growth with sustainability. Trade openness continues to have a positive long-term effect, suggesting that environmentally friendly trade practices and rules can help improve sustainability. However, these benefits depend on policies that link trade openness with ecological protection. These findings emphasize the need for Nigeria to focus on governance reforms and developing the financial sector to support sustainable growth. It's also important to have integrated trade policies and strategies for managing population growth to balance economic development with environmental protection.

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