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A Time-Series Analysis Of Insurance Sector Density And Environmental Quality In Nigeria

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ABSTRACT: Nigeria is a high-polluting country, hence, carbon emissions from diverse sources tend to affect the quality of the environment. However, a high density of insurance companies in an area can lead to better risk management practices, including incentivizing policyholders to adopt environmentally-friendly measures that reduce carbon emissions. As a result, the study uses the ARDL Bounds testing framework to look at how the density of the insurance business has affected environmental quality in Nigeria from 1990 to 2021. The ARDL technique is used to look at the relationship between the research variables across the short and long run. The study showed that insurance sector density energy and renewable energy consumption increase environmental quality in Nigeria by reducing CO2 emission. The study also demonstrated that Nigeria's expanding economy (in terms of trade and economic growth) increases CO2 emission, thus affecting the quality of the environment. As a result, Nigerian government authorities should keep supporting insurance sector reforms to improve environmental quality, and insurers should reward people and businesses that use renewable energy sources and discloses their carbon emission activities. Policymakers must develop plans to increase the usage of renewable energy sources. The impact of trade openness on CO2 emission in Nigeria must be kept to a minimum, thus policymakers must establish and continuously monitor a stringent environmental regulatory framework. Furthermore, economic growth reduces environmental quality in Nigeria, thus policies such as pollution control, waste management, resource conservation, and sustainable production practices which are geared towards strengthening and enforcing environmental regulations to mitigate the negative impacts of economic activities on the environment.

KEYWORDS: Carbon emission; Environmental quality; Insurance density; Nigeria.

I. INTRODUCTION

Developed and developing countries now prioritise environmental quality issues (Alola, Bekun, & Sarkodie, 2019). Environmental sustainability represents all actions and procedures that support long-term economic growth while having a minimal negative influence on society (Balcilar et al.,2002). The insurance market, like the stock and banking markets, is essential to a country's financial (economic) development (Appiah-Otoo & Acheampong, 2021). The insurance industry's significant impact on economic activities and investment has led to an increase in energy consumption as well as a detrimental effect on ecological sustainability (Pata & Samour, 2023). Insurance sector development is essential for economic growth (Balcilar et al.,2018). Nigeria is a high-polluting country, hence, carbon emission from diverse sources tend to affect the quality of the environment. However, a high density of insurance companies in an area can lead to better risk management practices, including incentivizing policyholders to adopt environmentally-friendly measures that reduce carbon emissions. The growth of the insurance sector has given consumers and businesses a vital way to protect themselves from risks and uncertainties, particularly in recent years when they have had to deal with a variety of issues (Peleckien, et al., 2019). In the case of Nigeria, the insurance sector has been growing steadily over the years, but still faces challenges in terms of low penetration and awareness. A sound insurance sector benefits the other players in the financial system because they can benefit from the funds generated by insurance premiums (Din et al., 2017).The rise of the insurance industry has, however, played its most crucial role in lowering business risk (Li, Ozturk, Ullah, Andlib, & Hafeez, 2022). Another crucial element in fostering economic growth is risk-free business continuity, which insurance helps to improve. For both individuals and enterprises, insurance offers risk-free wealth and income (Senol et al., 2020; Cummins & Rubio-Misas, 2021). Insurance also helps businesses run more smoothly and perform better. As people and businesses confront

more challenges and uncertainties, the necessity to defend against risk is becoming more crucial (Apergis &Poufinas, 2020). Insuring oneself helps an individual to reduce risk in his or her daily lives. They are able to maintain risk-free income in this way (Li et al., 2022). They buy a variety of goods and services with their earnings. People gradually purchase durable products as their living standards rise and to improve their quality of life. Personal vehicles, cell phones, air conditioners, refrigerators, and other energy-intensive products fall under this category. However, these products lead to a rise in CO2 emissions as well as an increase in energy usage. Consequently, the growth of the economy and by extension growth of the insurance industry could reduce environmental quality. Meanwhile, the density of the insurance industry will be positively associated with environmental quality if individuals use and invest in cleaner technology. As a result, depending on people's taste and the structure of the economy, operations in the insurance sector may either promote or degrade environmental quality. However, no Nigerian studies have yet taken into account the insurance sector of the financial system, which may result in an underestimation of the financial industry's overall influence on CO2 emissions. Thus, the current study adds to the body of knowledge because no other studies have examined how insurance density affects environmental quality in Nigeria using CO2 emissions as a proxy for environmental quality. Based on the researcher's knowledge, this study is the first to assess how Nigeria's insurance market affects the country's environmental quality.

Policy makers in the oil and gas, environmentalists, researchers among others will find the outcome of this study beneficial.

2. REVIEW OF LITERATURE

Conceptual Review

ENVIRONMENTAL QUALITY (CO_2E)

Environmental quality is defined by carbon dioxide (COE) present in the environment. It is represented by carbon dioxide emission measured as metric tons per capita. It determines the overall health and condition of the natural environment including air, water, soil, ecosystem and biodiversity. It is a measure of the degree to which the environment can support various life forms, maintain ecological balance and sustain human well-being without causing significant harm to the planet or its inhabitants (Zhang et al, 2022).

INSURANCE SECTOR DENSITY

Insurance sector density refers to the presence and relative size of the insurance industry within a specific region or country (Zheng, Liu & Deng, 2009). It is measured as the ratio of insurance premiums to the Gross Domestic Product or the number of insurance companies relative to the total population (Ma & Pope, 2008). Insurance density offers insight into the level of insurance activities in a particular market. It has implication for economic stability, financial protection and overall risk management (Cummins, Rubio-Misas, & Vencappa).

GROSS DOMESTIC PRODUCT

GDP is economic growth is an increase in the size of a nation's economy over a period of time. It is measured by the total production of goods and services in the economy as proxied by the Gross Domestic Product (GDP). It is driven by accumulation of capital stock, advancement in technology and increase in labour productivity.

TRADE OPENNESS

Trade openness measures the extent to which a nation is engaged in the global trading system. It is the sum of exports and imports as a share of gross domestic product (Mishra, 2007)

RENEWABLE ENERGY CONSUMPTION

Renewable energy consumption. This is the sum of energy consumption from all renewable sources in the end-user sectors. These resources include wind, solar, liquid biofuels, biogas geothermal marine and waste. This represents energy use measured by Kilogram of oil equivalent per capital.

Empirical Review

The instrumental variable generalised method of moments technique was used by Appiah-Otoo and Acheampong (2021) to assess the effects of the development of the insurance sector on environmental quality in the BRICS countries between 2000 and 2016. In BRICS countries, it was discovered that the growth of the insurance industry improves environmental quality. Additionally, environmental quality is positively influenced by factors such as population size, trade openness, and energy consumption, whereas environmental quality is negatively affected by economic growth. Altarhouni, Danju, and Samour (2021) used the bootstrap Autoregressive Distributed Lag (ARDL) test to analyse how the expansion of the insurance industry affected environmental degradation. The findings demonstrated that usage of non-renewable energy and economic growth reduced CO_2 emissions. This suggests that as the economy grows and more nonrenewable energy sources are consumed, the levels of CO_2

emissions increase. The study also showed that Turkey's carbon emissions were positively impacted by the growth of the insurance market.

In BRICS economies from 1991 to 2018, Rizwanullah, Nasrullah, and Liang (2022) investigated the asymmetries in how the insurance sector developed and how it affected environmental quality. The findings of the non-linear autoregressive distributed lag (NARDL) approach indicated that South Africa's CO_2 emissions has a negatively significant relationship with insurance development, whereas Russia and China's insurance development increases CO_2 emissions. In addition, declining non-life insurance development lowers CO_2 emissions in China, India, and Russia, with positive long-term effects in South Africa.

Lv and Li (2021) used spatial econometric models to investigate the relationship between financial development and CO_2E for 97 nations between 2000 and 2014, and found that financial development spurs CO_2E. The relationships between urbanisation, renewable energy, and ecological footprint in Colombia, Indonesia, Vietnam, Egypt, Turkey, and South Africa (CIVETS) were examined by Nathaniel, Nwodo, Sharma, and Shah (2020). Using the augmented mean group estimator, panel co-integration, and causality tests, the findings showed that renewable energy and trade openness improve environmental quality. However, in the CIVETS nations, urbanisation and the use of non-renewable energy sources are the main causes of environmental deterioration. Environmental degradation is slowed down by economic expansion in Colombia, South Africa, and Turkey, but it accelerates it in Egypt, Indonesia, and Vietnam.

According to Wang *et al.*'s (2020) examination of the relationships between CO_2E, financial development, the use of renewable energy sources, and technological innovation for the N-11 countries from 1990 to 2017, financial development results in an increase in CO_2E. Acheampong (2019) explored the relationship between financial development and CO_2emissions in 46 sub-Saharan African countries between 2000 and 2015. It indicated that certain aspects of the financial sector, such as a large money supply, domestic financial sector lending to the private sector, and domestic bank credit to the private sector, had a positive impact on CO_2E. Zaidi et al. (2019) discovered that financial development lowers CO_2E after unravelling the links between financial development, globalisation, and CO_2 emissions for 17 APEC nations over the period 1990 to 2016.

Research Gap

Based on the literature survey, extant studies have determined how financial development impacts environmental quality; these studies have employed indicators from the banking and stock markets. However, the development of the insurance sector as an integral part of financial development has not received much attention up to this point. Therefore, how insurance consumption can influence carbon dioxide emissions has remained unexplored in Nigeria. This study fills the gap by applying the ARDL framework to estimate the impact of insurance sector density on environmental quality in Nigeria from 1990 to 2021.

3. DATA AND METHODOLOGY

The *ex-post facto* research design is used in this study to gather data for the years 1990 to 2021. The study's model is defined based on evidence from literature. The model is specified as follows:

$CO_2E = f$ (ISD, GDP, OPEN, EYC) …….. (1)

It is stated in its econometric form as:

$CO_2E_t = \beta 0 + \beta_1 ISD_t + \beta_2 GDP_t + \beta_3 OPEN_t + \beta_4 EYC_t + U_t$ …….. (2)

Where; ISD refers to insurance sector density, GDP is economic growth, OPEN stands for trade openness, and EYC refers to renewable energy consumption. B_1– β_5 are the parameters to be estimated, while μ stands for the unobserved factors that influence environmental quality. B_0 stands for the intercept of the model. This study expects that right-side variables exert a positive or negative influence on environmental quality.

In this study, the error correction model (ECM) and the co-integration framework are utilised. To ascertain series stationarity, the augmented Dickey-Fuller unit root test is utilised, and the Auto-Regressive Distributive Lag Model (ARDL)bounds testing approach is employed to ascertain the long-and short-term effects of the explanatory factors on environmental quality in Nigeria. In addition, several post-estimation tests, such as tests for serial correlation and heteroscedasticity, tests for the series' normality, tests for model misspecification, and tests for structural stability, are utilised to evaluate the validity of the results. Table 1 presents a description of the variable and its measurement.

Table 1. Variable Description

Variables	Definition	Measurement	Source
Environmental quality	CO_2E	CO_2emission measured as metric tons per capita	World Development Indicators Database
Non-life insurance development	ISD	Non-life insurance premiums as % of total population	Global Financial Development Database
Economic growth	GDP	GDP per capita is gross domestic product as a share of total Population	World Development Indicators Database
Trade openness	OPEN	The sum of export and import as a share of economic growth	World Development Indicators Database
Energy consumption	EYC	Energy use measured Kilogram of oil equivalent per Capita	World Development Indicators Database

Source: Literature review

4. RESULTS AND DISCUSSION

Summary Statistics

Table 2 provides a detailed description of the study's variables. The sample's mean and standard deviation, as well as its minimum and maximum values, are given.

Table 2. The Summary Statistics

VARIABLE	MEAN	STD. DEV	MIN.	MAX.
CO_2E	1.328	0.857	1.625	4.101
ISD	0.218	1.515	-2.752	2.891
GDP	7.031	0.683	2.623	3.926
OPEN	0.138	1.735	3.082	5.725
EYC	0.251	0.311	0.072	2.166

Source: Author's computation, (2023).

Results of Stationarity Test

Unit Root Test

Before creating a regression model, it is essential to ensure that time series data are stationary. Stationarity is assumed based on constant observation of mean and variance. A unit root test determines if the model's variables are stationary at a single value (stationarity properties). Non-stationary data raises the likelihood of a spurious positive result in a regression (Wang & Hafner, 2018). The test verifies the integration order-I(d) for each variable, in addition to deciding the regression model to use for estimate. The augmented Dickey-Fuller Test of Unit Root confirms that the variables are stationary as a result. Table 3 displays the results of the unit root test.

Table 3. Augmented Dickey-Fuller Unit Root Test (ADF-URT) Results

Variables	Lags	Drift, trend	ADF statistic value	Conclusion
CO_2E	2	Drift	-2.1812**	I(1)
ISD	1	Drift, trend	-2.0327**	I(1)
GDP	1	Drift, trend	-1.1716**	I(1)
OPEN	2	Drift, trend	-2.6242**	I(0)
EYC	1	Drift	-2.5242**	I(0)

Source: Author's Computation, (2023).**Note:** ** denote the null hypothesis being rejected at the 5% significance level.

The variables are shown to be stationary at I(0) or I(1), respectively, by the ADF unit-root test. According to the results, usage of renewable energy and trade openness are stationary at level. This information refutes the opposing theory that the variables are unstable. This discovery gives the ARDL framework an estimation strategy that ensures the development of long-term relationships between variables. The bound testing approach to cointegration makes the assumption that all variables are I(0) and I(1), which also implies that they are mutually integrated.

ARDL Bounds Testing Approach for Co-integrating Relationship

To determine if the variables are linked in a long-run equilibrium, this study employs the ARDL paradigm that Pesaran and Shin (1999) first suggested, and which was later supported by Pesaran *et al.* (2001). The potential for a long-term relationship between the variables is examined using the lower and upper bound critical values of the ARDL bounds test. The null hypothesis of no co-integration is rejected when the estimated F-statistic exceeds the upper bound critical values, and vice versa.

Table 4. Results of the ARDL Co-integration analysis

F-statistics	**Asymptotic critical values**							
		10%	**5%**		**2.5%**		**1%**	
F-statistics 6.156**	**I(0)**	**I(1)**	**I(0)**	**I(0)**	**I(0)**	**I(1)**	**I(0)**	**I(1)**
	2.03	2.14	2.29	3.44	3.58	4.37	4.89	5.74

Source: Author's Computation, (2023). **Notes:** ** denotes null hypothesis is rejected at a 5% significance level. I(0) and I(1) signify lower bounds and upperbounds, respectively.

Table 4 displays the results of the ARDL bounds test which shows an F-test score of 6.156. At all levels of significance, the value exceeds the upper bound of the I(1) asymptotic critical values. As a result, the findings of this investigation offer compelling evidence refuting H_0, the theory that co-integration does not exist. At a 5% level of significance, the estimated F-statistic is greater than the upper critical bound. This demonstrates that there was co-integration between the variables from 1990 to 2021.This means that, in the case of Nigeria, the density of the insurance industry, energy consumption, economic growth, trade openness, and CO2 emissions are all co-integrated for a long-run relationship. The study's confirmation of a co-integrating relationship between the variables can be used to inform a dynamic model that accounts for both long- and short-term trends.

Results of the ARDL Regressions

The study produces both long- and short-run model coefficients. The estimation yields result that can be used to test the study's hypotheses. The results are summarized in Tables5 and 6.

Table 5. Results of ARDL Model

Long-run analysis

Dependent variable = CO_2E		
Variable	Coefficient	T-Statistics
Constant	-4.0624	−1.8733[a]
ISD	1.0311	2.4893[c]
GDP	-0.6352	-3.2374[b]
OPEN	-0.4016	−1.5965[a]
EYC	0.2183	1.6043[b]
Diagnostic Test	Statistics	
R-squared	0.9392	
F-statistic	342.016[a]	
Durbin–Watson	1.8621	
χ2NORM	2.1733 (0.1712)	
χ2SERIAL	1.3813 (0.1678)	
χ2ARCH	0.4248 (0.3941)	
χ2WHITE	0.0291 (0.3737)	
χ2RAMSEY	0.0045 (0.8632)	

Source: Author's Calculation, (2023). **Notes:**a indicates 1% level significance. The significance level of 10% is denoted as b, while the significance threshold 5% is represented as c. Parenthesis are used to indicate the probability values. X2NORMstands for the normality test, χ2SERIALfor the LM serial correlation test, χ2ARCH for the autoregressive conditional heteroskedasticity, χ2WHITE for the white heteroskedasticity, and χ2RAMSEYfor the Ramsey Reset test.

ARDL Long Run Regression Estimates

This study presents the ARDL regression estimates for the long run modelin Table 5. The results show how the density of the insurance industry affects Nigeria's environmental quality. The results of the study demonstrated a positive and significant relationship between the density of the insurance sector and environmental quality. The coefficient value of insurance sector density is 1.0311. It implies that a unit increase in insurance sector density increases environmental quality level by 1.0311 units. As a result, the density of the insurance industry greatly improves environmental quality by lowering CO2 emissions. At $p<0.05$, the relationship between insurance sector density and environmental quality is significant. Economic growth has a negative and significant impact on environmental quality with a coefficient value of 0.6352, and the association between the two variables is significant at $p <0.1$. Thus, a unit increase in economic growth levels reduces environmental quality by 0.6352 unit.

With a coefficient value of 0.4016 ($p<0.01$), trade openness has a negative but significant impact on environmental quality; as a result, each unit increase in trade openness tends to lower environmental quality by 0.4016 units. A coefficient value of 0.2183 reveals that the use of renewable energy has a positive and significant impact on environmental quality. At $p<0.1$, this is significant. Environmental quality will therefore rise by 0.2183 units for every unit increase in the utilisation of renewable energy.

The model diagnostic and stability tests validate the study's regression findings. The investigation of serial correlation and homoscedasticity assumptions is carried out and based on the findings in Table 5, it was determined that there was no proof of higher-order serial correlation in the error term using the Breusch Godfrey LM Serial Correlation test. Furthermore, the White Heteroscedasticity test revealed homoscedastic errors (p-value = 0.3737>0.1). The model is accurately described, as shown by the Ramsey Reset test; the p-value is 0.8632, which is not statistically significant at the 10% level. Normality and LM serial correlation tests are also not statistically significant. The null hypothesis is accepted or rejected in these diagnostic tests based on the test statistic value and the p-value at a 10% significance level. The CUSUMSQ and CUSUM tests were created by Brown, Durbin, and Evans in 1975 to assess the structural stability of the long-run estimations. At a significance level of 5%, the CUSUMSQ and CUSUM statistics plots do not cross the critical value limit. This disproves the null hypothesis that the regression coefficients are unstable. The stability and diagnostic tests show that the results of the regression are valid.

Table 6. Results of ARDL Model

Short run analysis

Dependent variable = ΔCO_2E		
Variable	Coefficient	T-Statistics
Constant	-2.0617	−3.3263[a]
ΔISD	-0.1425	−2.3716
ΔGDP	0.1649	−4.3345[b]
ΔOPEN	0.1183	−2.7844[a]
ΔEYC	0.2462	−2.1926[b]
ECM_{t-1}	-0.9271	–7.5741[a]
Diagnostic tests		
$R^2$0.8421		
F-statistic 264.016		
Durbin–Watson 1.8439		
Test	F-Statistic	p-value
χ2NORM	2.84540.1537	
χ2SERIAL	1.63030.1845	
χ2ARCH	0.35930.4839	
χ2WHITE	0.01230.3261	

χ2RAMSEY	0.00030.8406

Source: Author's Calculation, (2023). The letter "a" denotes significance at the 1% level. b displays significance at a level of 10%, whereas c displays significance at a level of 5%.

ARDL Short Run Regression Estimates

The next stage is to look into their short-term dynamics after determining the long-term effects of trade openness, energy consumption, insurance sector density, and economic growth on CO_2 emissions. This studyused the error correction model (ECM) to achieve its short-term dynamic estimates and Table 6 presents the findings. According to the study, the density of the insurance industry lowers environmental quality, but this effect is statistically non-significant. Economic growth and CO_2 emissions are proven to have a positive and significant link. CO_2 emissions increase by 0.1649 units for every unit increase in GDP. Trade opening up raises CO2 emissions, which lowers Nigeria's environmental quality. Consumption of renewable energy has a positive and statistically significant effect on CO2 emissions. The ECM_{t-1} term estimate is negative and significant at the 1% level, supporting the long-term correlation between the density of the insurance industry, the consumption of renewable energy, economic growth, trade openness, and CO2 emissions. According to the estimate of ECM_{t-1} term, which is -0.9271, annual changes in CO_2 emissions are adjusted by 92.71%. It is a sign that the Nigerian economy will respond quickly and significantly to any shock to the CO_2 emission model. According to the outcomes of tests such as normality of residual term, LM for serial correlation, ARCH test, white heteroskedasticity, and specification, the short-run model has successfully passed all diagnostic evaluations. There is no issue with serial correlation, and the same conclusion is made with white heteroskedasticity as well as autoregressive conditional heteroscedasticity. The short run model fits well, and the residual term is normally distributed. According to the findings of stability tests like the CUSUM and CUSUMsq tests, the critical boundaries are not surpassed at the 5% level. This demonstrates the accuracy and consistency of the ARDL estimates.

Discussion of Results

The study discovered that long-term CO_2 emissions are positively impacted by the use of renewable energy and economic growth. Additionally, the results supported findings from studies by Appiah-Otoo and Acheampong (2021) and Samour et al. (2022) indicating the density of the insurance sector has a positive impact on Nigeria's carbon emission levels. However, Rizwanullah et al. (2022) discovered that the growth of the insurance industry has a detrimental impact on the environment. This study discovered a negative relationship between environmental quality and economic growth. This suggests that economic growth that results from industrialization and urbanisation encourages the extraction of natural resources, and even their consumption, which can then lead to environmental degradation and a decline in environmental quality. It also showed that trade openness reduces environmental quality; thus, Nigeria which has a less stringent environmental regulations makes it easy for many foreign businesses to shift pollution from where they experience stricter regulatory environments through their investments in Nigeria. The empirical findings showed that using renewable energy improves the environment. Carbon dioxide emissions are decreased as a result of the replacement of fossil fuel-based energy generation for renewable energy. Renewable energy also helps to protect biodiversity and the natural ecosystem, thus stimulate environmental quality and contributing to a more sustainable future. This is similar to the empirical results of Rafindadi (2021).

5. CONCLUSION AND POLICY RECOMMENDATIONS

Using the ARDL Bounds testing framework, this study looked at the impact of insurance sector density on environmental quality in Nigeria from 1990 to 2021. The empirical results demonstrated through co-integration tests, using the control variables of renewable energy usage, economic growth, and trade openness, validate the long-term association between insurance sector density and environmental quality. The study found that insurance sector density and renewable energy consumption increase environmental quality in Nigeria. Meanwhile, trade openness and economic growth decrease environmental quality; thus, increasing carbon emissions.Nigerian policy makers should support insurance sector reforms to encourage the reduction of carbon emissions, and insurers should provide incentives to people and companies that use renewable energy sources in addition to disclosing their carbon emission activities. Environmental quality is improved by the use of renewable energy, so policymakers must put plans in place to further expand the use of these sources. Given that trade openness lowers environmental quality, therefore, it is important to must create and oversee a strict environmental regulatory framework to lessen Nigeria's trade openness' impact on carbon emissions. When developing policies and strategies for reducing carbon emissions in Nigeria, policymakers should take the environmental degradation effect of trade openness into account. Furthermore, given that economic growth reduces environmental quality in Nigeria, thus policies such as pollution control, waste management, resource

conservation, and sustainable production practices which are geared towards strengthening and enforcing environmental regulations to mitigate the negative impacts of economic activities on the environment.

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