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EFFECT OF CARBON DIOXIDE EMISSIONS ON ECONOMIC GROWTH IN NIGERIA

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Abstract

Many studies have been conducted on carbon emission and economic growth, however little has been done to examine the relationship using ARDL in Nigeria. This study examines the impact of carbon emission and economic growth on Nigeria using the Autoregressive Distributed Lag (ARDL) bounds testing technique to analyse annual data. In addition, the study controls for FDI, openness, credit and domestic investment. The result of the bounds test to cointegration indicates that there is a long run relationship between the variables. The results of the estimation show that rising carbon emission has a significant and positive effect on economic growth. In addition, openness and credit have a significant and positive effect on economic growth, while FDI and domestic investment have a negative and significant effect on economic growth. Based on these findings, this study makes the following recommendations. First, government should take appropriate steps to increase production in order to raise economic growth in Nigeria. Second, government should employ policies to curb environmental degradation. In addition, government should employ policies to promote openness to trade and encourage the banking sector to make credit available for the private sector in the economy of Nigeria.

Keywords: Carbon Emission; Economic Growth; Nigeria.

Introduction

The relationship between economic growth and environmental pollution resulting from carbon (CO2) emission has remained a topical issue among different researchers and economies owing to the current global warming crises (Isola & Mesagan, 2014). Toxins emitted into the environment from fossil fuels have intensified renewable energy production and consumption (Ameyaw & Yao, 2018). The IPCC predicts that in a business-as-usual scenario the mean global surface temperature will increase by 4oC or more above pre-industrial levels by the end of 21st century (IPCC, 2014).

Securing the environment from emissions and environmental change issues looming many countries, several Nations have either enacted their own policies or have partnered with other countries in implementing forefront of contemporary issues for most economies around the world (Jayaraman, 2016). Among the climate change policies is the 21st Conference of Parties (COP 21) of the United Nations Framework Convention on Climate Change (UNFCCC) agreement on global climate change governance where by each member country plans and reports its own contributions aimed at mitigating global warming. An initiative entitled The Africa Renewable Energy Initiative (AREI) is tasked to deliver 300 Giga watts (GW) of renewable energy in 2030 and 10 GW by 2020. The Sustainable Energy Fund for Africa (SEFA) which is a multi-donor trust fund anchored in a commitment of \$60 million by the governments of Denmark and the United States to support small and medium-scale renewable energy and Energy Efficiency (EE) projects in Africa.

Despite effort made by different countries to secure the environment from emissions and environmental change, emissions from liquid and gas have been raising. The increase in emissions in the world in general and the developed countries in particular was associated with a general global warming. Toxins emitted into the environment from fossil fuels have intensified renewable energy production and consumption (Ameyaw & Yao, 2018). Therefore, this study investigates the impact of carbon emissions on economic growth in Nigeria.

Nigeria, like many other resource-based countries is faced with the challenge of diversifying her production and export base. In the field of energy, the power produced and consumed by conventional and exhaustible resources (fossil fuels) is considered a major threat to the environment (Ameyaw & Yao, 2018) Nigeria being the largest emitter of CO2 emissions. In Nigeria, several empirical studies have been investigated on the role of CO2 emissions on economic growth. Studies on the relative roles of different CO2 emissions on economic growth in Nigeria produced mixed findings (Akpan & Akpan, 2012; Alege, Adediran & Ogundipe, 2016; Ameyaw & Yao, 2018; Ejuvbekpokp, 2015; Muftau et al., 2014; Mesagan, 2018). Akpan and Akpan (2012), Muftau et al. (2014) and Mesagan (2018) found positive relationship between emissions on economic growth in Nigeria. Ameyaw and Yao (2018) Alegeet el. (2016) concludes that there is a unidirectional causal relationship between the variables of interest. Ejuvbekpokp (2015) reported a positive relationship between emissions on economic growth in Nigeria**.** All this suggests further studies on the impact of emissions on economic growth in Nigeria**.** However, most the reviewed studies used theoretically based models and different methods of analysis. To the best of literature review, none of the studies used ARDL in Nigeria. Therefore, this study fills a gap by estimating the C02 emissions and economic growth nexus in Nigeria, using developed ARDL bounds testing technique-based approach.

Having established the problem, the following research questions have been raised. What is the effect of CO2 emissions on economic growth in Nigeria? Is there a causal relationship between of CO2 emissions and economic growth in Nigeria? The broad objective of the study is therefore to examine the effect of CO2 emissions and economic growth in Nigeria.

Literature Review

Empirical literature on the relationship between economic growth and carbon emissions are limited, particularly in relation to Nigeria. But a number of empirical investigations linking CO2 emissions and economic growth have been assessed. For instance, Azam, Khan, Abdullah &Qureshi (2015) analyzed the impact of CO2 emissions on economic growth from selected higher CO2 emissions economies namely China, USA, India, and Japan over the period spanning between 1971 and 2013, using the panel fully modified ordinary least squares (FMOLS) method. The results reveal that CO2 emissions have negative impacts on economic growth.

Abouie-Mehrizi et al. (2012) conducted a study on the effect of population growth, urbanization and economic growth on CO2 Emissions in Iran. In the study, equivalence relation of five variables: CO2 emissions, the intensity of energy use, gross domestic product growth rate, urban population and growth population, and their influences on each other in Iran for years 1973 to 2008 were analysed. The results showed that variables of energy use, gross domestic product growth rate, urban population and population growth have positive effect on CO2 emissions.

Seetanah and Vinesh (2012) studied the relationship between carbon emissions and economic growth in Mauritius. Their analysis suggests that the carbon dioxide emission trajectory is closely related to the GDP time path. The study also showed that emissions elasticity on income increased over time. Their test of the Environmental Kuznets Curve for 1975 to 2009 did not prove the existence of its ‘U’ shape for Mauritius leading them to conclude that Mauritius could not curb its carbon dioxide emissions in the last three decades.

Granados and Carpintero (2012) embarked on a study on carbon emissions and economic growth from a global perspective. The article attempts to improve understanding of the link between carbon emissions and economic activity in four ways. They discussed the limitations of panel data estimations used in previous studies for testing the EKC for emissions. By employing long time series for a number of high, mid and low-income countries they showed that the existence of an EKC for carbon emission is very doubtful.

Safdari *et. al.* (2013) carried out an investigation on whether carbon emission increased the Iranian economic growth. They found that in recent decades, damages of environmental effects increased and that those damages were due to different factors like population growth, economic growth, energy consumption and industrial activities. The paper investigates the environmental effects of energy consumption and economic growth in Iran and found that a mutual causality exists between the Iranian economic growth and volume of carbon emission.

Mohammadi and Mohammadi (2013) studied the impact of population and energy consumption on the environment. The study investigates the causal relationship between value of petroleum exports and GDP per capita in 13 OPEC countries over the period 2003-2011. The results of panel co-integration tests showed that value of petroleum exports and GDP per capita have a stable long-run equilibrium relationship. We find that for all members of the panel. They also found that there is homogenous causality from value of petroleum export to GDP per capita and vice versa, for all members of the panel.

Ayadi (2014) conducted a study on economic integration, growth and the environment in Africa using Nigeria as a case study. Economic integration was lauded as a way of increasing world output based on the economies of scale property and exchange of technology, ideas and information. The study identified trade and foreign direct investment as the two major channels through which integration impacts growth. The study which explores the contributions of both found that economic growth and foreign direct investment into Nigeria significantly fuelled pollution while trade is beneficial both in the short and long run.

Also, Mesagan (2015) studied the relationship between carbon emission and economic growth in Nigeria from 1970 to 2013 using Error correction model. The findings show that economic growth has positive impacts on carbon emission in the country. Similarly, Alege et al. (2016) investigated the direction of causal relationships among emissions, energy consumption and economic growth in Nigeria for the period 1970-2013, using the Johansen maximum likelihood cointegration tests. The authors indicate an existence of unidirectional causation running from CO2 emissions to gross domestic product (GDP) per capita.

Furthermore, Ouoba (2017) employs ARDL to investigate the CO2 Emissions and Economic Growth in the West African Economic and Monetary Union (WAEMU) Countries over the period 1970-2010. The results indicate that there is no long term relationship between CO2 Emissions and Economic Growth for the panel of 8 countries of the WAEMU. Similarly, the co-integration exists only in Benin, Mali and Togo. The results confirm the validity of a quadratic carbon Kuznets curve only in Mali. In the same region.

Bekar (2018) investigated the relationship between CO2 emission and economic growth in the Turkey during the period 1977- 2014, using Toda-Yamamoto and Dolado-Lütkepohl VAR causality analyses. The findings indicate that an increase in CO2 emissions leads to an increase in GDP.

Moreover, Ameyaw and Yao (2018) analyzed the relationship between gross domestic product (GDP) and CO2 emissions in Five West African countries covering the period of 2007–2014 using panel technique. The results revealed that, there exists a unidirectional causality running from GDP to CO2 emissions. Also, Muftau, Iyoboyi and Ademola (2014) examined the relationship between CO2 emission and economic growth, using a Fixed Effects panel regression Model for West African countries over the period 1970-2011. The results revealed that there is positive relationship between CO2 emission and economic growth in the region.

The study differs from the previous literatures on C02 emissions and economic growth in Nigeria. Firstly, to the best of the literature evidences available, none of the studies in the past has examine the relationship between carbon emission and economic growth using recently develop method (ARDL) of estimation in Nigeria (see Ejuvbekpokp, 2014; Mesagan, 2015). For instance, Ejuvbekpokp (2014) should not have used the OLS method because it is an obsolete technique for analysis. Furthermore, Mesagan (2015) did not conduct post estimation tests such as serial correlation and stability tests to ensure that the estimates were free from these problems. In addition, Alege (2005) did not perform any diagnostics test in their study. As argued by Abubakar and Kassim (2016), in order to ensure the model is well fitted and to enable the results be relevant for policy formulation, diagnostic tests are required. Therefore, this study fills a gap by estimating the C02 emissions and economic growth nexus in Nigeria. Using recently developed ARDL bounds testing technique and conducting all the important tests (diagnostic tests).

Theoretical Framework

The Environmental Kuznets Curve (EKC) hypothesis states that there is an inverted U-shape relation between environmental degradation (carbon emission) and income per capita, with pollution or other forms of degradation intensifying in the early stages of economic development and falling in the latter stages. The EKC is named after an economist known as Kuznets, who hypothesized that the relationship between the level of income and environmental pollution takes the form of an inverted U-shape curve. The basic initiative behind EKC is that as a country's industrialization process increases, extraction of resources increases as income increases, thereby raising the pollution levels. As income continues to rise over time, people start becoming conscious of environmental quality and now become willing and able to afford cleaner energy. Subsequently forcing pollutant emissions to decline after a certain period. This is how the inverted U-shape is realised.

As employed by David Stern in 2003, the functional relationship can be expressed as:

$$(E/P)_t = f(GDP/P)_t \text{ ………………………… } (1)$$

Equation (1) can be explicitly written as:

$$\ln(E/P)_t = \alpha + \gamma_t + \beta 1 \ln(GDP/P)_t + \beta 2 (\ln(GDP/P))^2{}_t + \varepsilon_t \qquad (2)$$

Where E is emissions, P is population, and ln indicates natural logarithms. The first two terms on the RHS are intercept parameters, while subscript, 't' is the number of years. The assumption is that though the level of emissions per capita may differ over countries at any particular income level the income elasticity is the same in all countries at a given income level.

However, for the purpose of empirical modelling in this study, the explanatory variable which is output growth (GDP), will be represented with the real gross domestic product and emissions E will be represented with carbon (CO_2) emission. This is to enable us see clearly the effect of income on carbon emission.

Equation (2) can now be written in a functional form as:

$$CO_2 = f(GDP) \text{ …………….. } (3)$$

Where CO_2 stands for carbon emission and GDP stands for real gross domestic product.

Explicitly, equation (3) can be written as:

$$CO_2 = \alpha + \beta(GDP) + \varepsilon \text{ ………………..} (4)$$

Model Specification

The general economic growth model including variable of interest (carbon emission) and other important determinants of economic growth such as FDI, OPN. CREDIT and INV is specified below;

$$\mathrm{GDP_t} = \partial_0 + \partial_1 \mathrm{C02_t} + \partial_2 \mathrm{FDI_t} + \partial_3 \mathrm{OPN_t} + \partial_4 CREDIT_t + \partial_5 \mathrm{INV_t} + \varepsilon_t \qquad (5)$$

Description of Variables and Source of Data

Economic growth (GDP) which is dependent variable is measured as real GDP at market prices based on constant local currency (WDI, 2018).

Carbon dioxide emissions from solid fuel consumption refer mainly to emissions from use of coal as an energy source (WDI, 2018).

Domestic credit (CREDIT) to private sector by banks (WDI, 2018).

Trade in services is the sum of service exports and imports divided by the value of GDP, all in current U.S. dollars (WDI, 2018).

Investment is proxied by Gross fixed capital formation (formerly gross domestic fixed investment) (WDI, 2018).

FDI It is the sum of equity capital, reinvestment of earnings, other long-term capital, and short-term capital as shown in the balance of payments (See WDI, 2018).

The time series properties of the data were checked for stationarity through the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) unit root tests before estimating the growth equation. In order to ascertain the goodness of fit and model adequacy, our specification was also subjected to diagnostic and stability tests. The autoregressive distributed lag (ARDL) bounds test to cointegration proposed first by Pesaran and Shin (1999) and advocated by Pesaran, Shin, and Smith (2001) were employed for the estimation of the growth equations.

This is based on the premise that it shows the short-run and long-run dynamics of the variables for estimation.

Therefore, the general ARDL model is specified as;

$$\begin{aligned}\Delta\ln(\mathrm{GDP})_t &= \partial_0 + \partial_1 L(\mathrm{GDP})_{t-1} + \partial_2 \mathrm{L(C02)}_{t-1} + \partial_3 \mathrm{L(FDI)}_{t-1} + \partial_4 L(\mathrm{OPN})_{t-1} + \partial_5 L(\mathrm{CREDIT})_{t-1} \\ &+ \partial_6 \mathrm{L}(INV)_{t-1} + \sum_{i=1}^{n} \beta_i\, \Delta \mathrm{L(GDP)}_{t-i} + \sum_{i=0}^{h} \beta_2\, \Delta \mathrm{L(C02)}_{t-i} + \sum_{i=0}^{j} \beta_3\, \Delta \mathrm{L(FDI)}_{t-i} \\ &+ \sum_{i=0}^{c} \beta_4\, \Delta \mathrm{L(OPN)}_{t-i} + \sum_{i=0}^{g} \beta_5\, \Delta \mathrm{L(CREDIT)}_{t-i} + \sum_{i=0}^{m} \beta_6\, \Delta \mathrm{L}(INV)_{t-i} + e_t \dots\dots\dots\dots\dots\dots (6)\end{aligned}$$

Since we established long run relationship among the variables, now a long-run model is estimated as represented below:

$$\begin{aligned}\mathrm{L(GDP)}_t &= \partial_0 + \sum_{i=0}^{b} \beta_2\, \mathrm{L(C02)}_{t-i} + \sum_{i=0}^{k} \beta_3\, \mathrm{L(FDI)}_{t-i} + \sum_{i=0}^{v} \beta_4\, \mathrm{L(OPN)}_{t-i} + \sum_{i=0}^{k} \beta_5\, \mathrm{L(CREDIT)}_{t-i} \\ &+ \sum_{i=0}^{u} \beta_6\, \mathrm{L}(INV)_{t-i} + e_t \dots\dots\dots\dots (7)\end{aligned}$$

In order to get the short-run coefficients, an error correction model (ECM) is estimated. The ARDL specification of the ECM is represented as;

$$\begin{aligned}&= \partial_0 + \sum_{i=0}^{h} \beta_2\, \Delta \mathrm{L(C02)}_{t-i} + \sum_{i=0}^{j} \beta_3\, \Delta \mathrm{L(FDI)}_{t-i} + \sum_{i=0}^{c} \beta_4\, \Delta \mathrm{L(OPN)}_{t-i} + \sum_{i=0}^{g} \beta_5\, \Delta \mathrm{L(CREDIT)}_{t-i} \\ &+ \sum_{i=0}^{m} \beta_6\, \Delta \mathrm{L}(INV)_{t-i} + e_t \dots\dots\dots\dots\dots\dots . (8)\end{aligned}$$

Result Discussion

Results of Unit Root Test

In order to investigate the time series properties, unit root test is conducted to determine the stationarity property of the data and the order of integration. The Augmented Dickey Fuller and Phillips-Perron tests of unit root test are employed in the Study. The results of unit root test reported in Table 1 indicated that, the variables LGDP, LnC02 and LOPN, LCREDIT have unit root at their levels, but after taking the first difference, the unit root in the variables disappeared and they became stationary. Therefore, they are cointegrated with order one I (1). With the exception of LFDI and LINV variables which have no unit root at levels at 1% and 10% level, respectively.

Table 1: Results of Unit Root Test

	ADF		PP		
Variables	Level	First difference	Level	First difference	Stationarity status
LGDP	-0.8544	-3.6802**	-0.1949	-3.6802**	I(1)
LC02	-2.6480	7.5095***	-7.5095	12.2364***	I(1)
LFDI	3.6552***	…………	3.6552***	…………..	I(0)
LOPN	-2.0216	7.2567***	-2.3135	-7.3561***	I(1)
LCREDIT	-1.5227	-4.8109***	-1.6371	-16.3500***	I(1)
LINV	-2.8879*	………..	-2.8978*	………….	I(0)

Source: Author's Computation

Bounds Test Approach for Cointegration

Upon verifying the stationary status of the variables, the cointegration test is then conducted using the bounds testing approach. The results are presented in Table 2. The findings show that in all the models involving the variables, and the calculated F-statistics of (23.10816) are greater than the 1% upper critical bound value. This means that long run relationship exists between emission, exchange rate, openness, investment, FDI and GDP

Table 2: Results of Bounds Test

Dependent variables		Function				F Statistics	
LGDP		f (LGDP/LC02, LFDI. LCREDIT, LINV,LOPN)				23.10816***	
Critical Value Bounds							
10%		5%		2.5%		1%	
I(0)	I(1)	I(0)	I(1)	I(1)	I(0)	I(1)	I(0)
2.08	3.00	2.39	3.38	2.70	3.73	3.06	4.15

Source: Author`s calculation. ******* denotes statistical significance at 1% level

Having established that a long-run relationship exists among the variables, the next step is to estimate the long-run and short-run relationships.

Results of Selected Short run Model

The result of the short run is reported in Table 3. The optimal lag-length suggested by the Akaike Information Criterion (AIC) is (1,4,4,4,4,4). The results reveal that there is a short run positive and significant relationship between emission and economic growth at the 1% level. A 1% increase in carbon emission leads to a 0.018% increase in economic growth in the short run.

Also, the empirical findings show that, FDI has a negative and significant impact on economic growth at the 1% level in the short run. 1% increase in FDI leads to a 0.006 decrease in economic growth in the short run. In addition, trade openness has a statistically significant and positive relationship with economic growth at the 1% level. A 1% increase in trade openness leads to a 0.112% increase in economic growth in the short run.

Table 3: Results of Short run Model

Panel A: Short-run Coefficients - Dependent variable is ln GDP				
Regressor	Coefficient	Standard Error	T-Ratio	Prob.
ΔLC02	0.018	0.005	3.767	0.009
ΔLC02-1	-0.053	0.006	-8.797	0.000

ΔLC02-2	-0.035	0.005	-6.513	0.000
ΔLC02-3	-0.013	0.004	-3.116	0.020
ΔLFDI	-0.006	0.002	-2.913	0.027
ΔLFDI-1	0.038	0.003	12.360	0.000
ΔLFDI-2	0.033	0.003	11.890	0.000
ΔLFDI-3	0.017	0.002	7.221	0.000
ΔLOPN	0.112	0.010	10.936	0.000
ΔLOPN-1	-0.039	0.007	-5.313	0.002
ΔLOPN-2	0.014	0.020	1.507	0.184
ΔLOPN-3	-0.014	0.009	-1.499	0.185
ΔLCREDIT	0.096	0.011	8.786	0.000
ΔLCREDIT1	-0.103	0.013	-7.956	0.000
ΔLCREDIT2	-0.099	0.015	-6.415	0.000
ΔLCREDIT3	-0.071	0.011	-6.310	0.000
ΔLINV	-0.097	0.017	-5.706	0.001
ΔLINV-1	0.083	0.020	4.240	0.005
ΔINV-2	-0.053	0.016	-3.339	0.016
ΔINV-3	-0.061	0.016	-3.948	0.006
CointEq-1	-0.326	0.018	-17.987	0.000

Source: Researcher's calculation. Δ is the first difference operator

Furthermore, domestic credit has a positive and statistically significant effect on economic growth in the short run at the 1% level. A 1% increase in domestic credit result increase economic growth by a 0.096% in the short run. Furthermore, investment was found to have a negative and significant effect on economic growth in the short at the 1% level. A 1% increase in domestic investment causes economic growth to decrease by a 0.097%.

The results also indicate that adjustment from the short run to the long run is taking place as suggested by the negative and statistically significant one-lagged error correction terms. This suggests 67% of the deviation from equilibrium is corrected within one year.

Results of Selected Long run Model

The long run results reported in Table 4 show that some variables have a positive and statistically significant effect, while others have a negative effect on economic growth. The result illustrates that emission has a positive and significant effect on economic growth at the 1% level in the long run. A 1% increase in carbon emission causes economic growth to increase by 0.28%.

Moreover, FDI has a negative impact on economic growth at 1% level in the long run. A 1% increase in FDI inflow leads to a 0.16 % decrease in economic growth. Also, trade openness has a positive and significant effect on economic growth at the 1% level in the long run. A 1% increase in OPN causes economic growth to increase by 0.51%.

Table 4: Results of Long Run Model

Panel B: Long-run Coefficients - Dependent variable is LGDP				
Regressor	Coefficient	Standard Error	T-Ratio	Prob.
LC02	0.279	0.094	2.984	0.025
LFDI	-0.159	0.035	-4.595	0.005
LOPN	0.507	0.103	4.911	0.003
LCREDIT	0.817	0.107	7.624	0.000
LINV	-0.690	0.165	-4.171	0.006
C	9.737	0.389	25.004	0.000

Source: Researcher's calculation

In addition, credit to private sector also has a positive and significant effect on economic growth at the 1% level in the long run. A 1% increases in CREDIT impact a 0.82% increase in economic growth. Furthermore, domestic investment has a negative and significant effect on economic growth at the 1% level in the long run. A 1% increase in INV leads to a 0.69% decrease in economic growth.

Results of Diagnostic Tests

Diagnostic tests were conducted to check for the presence of serial correlation to detect the evidence of serial correlation, heteroscedasticity, functional form misspecification and normality of the error terms. The results of the diagnostic test are presented in Table 5. The Jacque-Bera statistic with value 0.3006 and Probability value of 0.8604indicates that there is no problem of non-normality. We therefore accept the null hypothesis that the residual is multivariate normal and conclude that the residual of the model is normally distributed. Also, the test statistics for heteroscedasticity is 0.8763 with a probability value greater than 5%. Hence, we accept the null hypothesis that there is no heteroscedasticity in the error terms. This is desirable for the study because it signifies that there is no heteroscedasticity problem in the model and that the variance of the residual terms is homoscedastic.

Table 5: Results of Diagnostic Tests

Test Statistic	Results
Serial Correlation: CHSQ(2,4)	0.3522[0.0012]
Functional Form: Reset F-stat(1,5)	0.7436[0.4279]
Normality: Jarque-Bera	0.3006[0.8604]
Heteroscedasticity: CHSQ(26,6)	0.8763[0.6308]

Source: Researcher's calculation

Furthermore, the Ramsey Reset F-statistic is 0.7436 with a probability of 0.4279. This finding illustrates that there is no problem of misspecification in the estimated model. However, the serial correlation test result demonstrates the existence of serial correlation among the errors.

Results of Stability Test

The stability of the long-run parameters was tested using the cumulative sum (CUSUM) and cumulative sum of squares (CUSUMSQ). The plots of these tests are presented in Figure 1 and Figure 2. It can be seen that the plots of CUSUM and CUSUMSQ are within the critical bounds. This implies that the estimated parameters and model are stable over the long run. Therefore, growth model can be used for policy decision making purpose.

Figure 1: CUSUM

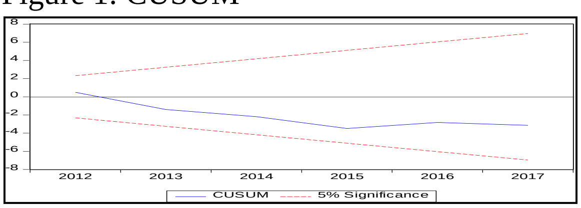
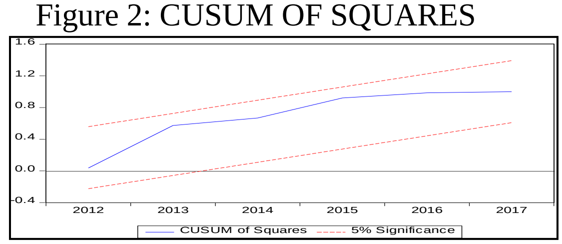


Figure 2: CUSUM OF SQUARES



Source: Researcher's computation

Results of Granger Causality Test

In order to conduct the causality test, we employed the Granger causality statistic. According to Granger (1969), variable A is said to "Granger-cause" B if and only if B is better predicted by using the past values of A than by not doing so with the past values of B being used in either case. In other words, if a scalar A can help to forecast another scalar B, then we say that A Granger causes B. The Table 6 depicts the results of the Granger causality analysis. Here, we establish that if the probability values are less than 5% significance level, then there is evidence of a Granger causality relationship. From our analysis, we conclude that there exists a unidirectional causal relationship running from LGDP to CO2 emissions. However, there exists no causal relationship between LCO2 emissions and LGDP.

Table 6: Results of Granger Causality

Null Hypothesis	lags	Chi sq	Prob.	Conclusion
LGDP Does Not Cause LC02	1	594.1064	0.00	Reject Null Hypothesis
LC02 Does Not Cause LGDP	1	0.007075	0.933	Reject Null Hypothesis

Source: Researcher's calculation

Conclusion and Recommendations

This study employed the ARDL technique to examine the relationship between C02 emission and economic growth in Nigeria. The empirical findings revealed that there is a cointegrating relationship between C02 emission and economic growth along with other control variables considered in the research. The results demonstrate that increasing C02 emission is associated with an increase in economic growth both in the long run and the short run.

The study revealed that for Nigeria to be able to control carbon emission and ensure a safer environment for its citizens, it must be able to promote green growth economy (i.e. by ensuring that gross domestic product is increasing but through less effluent discharging technology). This is sequel to the fact that if GDP is allowed to grow uncontrollably or better still, if it is allowed to grow without due consideration for efficient production technology, it will imply that carbon emission will also increase uncontrollably especially in the earlier period, since there is positive relationship between real GDP and carbon emission of the first period, as suggested by the error correction model result.

In the same vein, more policies, laws and institutions should be established to control emission in our nations. It is confirmed in our analysis that trade openness is an important variable that propelling carbon emission in Nigeria. This call for frantic effort on the part of policy makers in the country to put in place measures that guide against the dumping of environmentally unfriendly products into the country. Although FDI was found to have a negative effect on Nigeria`s economy, this trend can be rewarded if can employ policies that ensure the foreign investment are used for productive investment or activities rather than boosting both local and import consumption.

In addition, government should employ policies which ensure that Nigerian benefit more from trade. The more the country`s borders are open all things being equal the more increase in economic growth.

Furthermore, the monetary authority should employ appropriate monetary policy so that more credit will be readily available for both foreign and domestic investors to source. An increase in the availability of the credit will lead to an increase in investment and as a result increase economic growth. Although, domestic investment seems not to have impact positively on growth government should put in place measures that promote an investment friendly atmosphere. This in turn will boost production of Goods and Services and enhance economic growth.

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