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Evaluating the Validity of Environmental Kuznets Curve Hypothesis: Empirical Evidence from Nigerian Economy

Ozigbu, Johnbosco
Ph.D Candidate Department of Agricultural and Applied Economics, Rivers State University, Port Harcourt, Nigeria.
Corresponding Author: Ozigbu, Johnbosco

Abstract: In this paper, the relationship between economic growth and environmental degradation is examined with primary objective of verifying the applicability of the Environmental Kuznets Curve Hypothesis in Nigeria. The empirical model followed the Grossman-Krueger traditional model with some improvements due to the introduction of technological progress and international trade as part of the predictors. The level of environmental degradation was measured using per capita carbon dioxide emissions. The Autoregressive distributed lag (ARDL) model/bounds cointegration test formed basis for the data analysis. It was observed from the results that the growth-carbon dioxide emissions nexus depicts and invested U-shape. This aligns with the hypothesis of the Environment Kuznets Curve. It was further found that technological progress is helpful in reducing environmental degradation and by so doing improves environmental quality. On the basis of the findings, it is recommended that government should pursue sustainable growth policies that offer opportunities for rapid and sustained economic growth without detrimental effects on the environment quality.

Keywords: Environmental Degradation, Environmental Kuznets Curve, economic growth, carbon dioxide emission, Technological progress and International Trade.

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I. INTRODUCTION

With the growing incidence of climate change, policymaking has focused attention on promoting green economy that supports growth while de-risking environmental degradation. This has received widespread recognition in both economics and other fields of human endeavor. As a well-known fact, the human environment is an important factor in for economic growth and development. There is a relationship between income growth and environmental quality as reported by the World Bank World Development Report in 1992. Before then, interest in the relationship between environmental quality and economic growth had been in centre stage with the ground breaking findings of Grossman and Krueger (1991).

The basis for the renewed interest in the relationship between economic growth and the environment is the need to protect, and conserve as well as improve the quality of human life through sustainable development. According to the Grossman-Krueger Environmental Kuznets Curve (EKC) hypothesis, there is no cause for alarm: environmental problem should be secondary. Economic growth is the principal concern; the environment will automatically be taken care off after attaining certain level of income.

In spite of the level of income that have attained in the developed and developing economies, environmental challenge is still critical. In Nigeria, the natural environment is being irreparably destroyed. There is, therefore, the need to re-examine the relationship between economic activities and environmental quality in Nigerian economy so that appropriate step can be taken to mitigate the negative consequences of economic activities on the environment. The objective of this paper, therefore, is to empirically investigate the validity of the Environmental Kuznet Curve (EKC) in Nigeria.

The findings of the study will be more informative about the relationship between economic growth and the environment and as a guide for sustainable development policies in Nigeria. The remaining part of the paper is structured as follow: section two (2) presents a brief literature review of the previous finding on theme of this study. Section three (3) presents the method of the study. Section four (4) present the empirical results and discussed the findings; while section five(5) is devoted to conclusion and recommendations from the study.

II. LITERATURE REVIEW

2.1 Conceptual Framework

The Environmental Kuznets Curve (EKC) is a theoretical concept which explains the relationship between economic growth and environmental quality. The EKC is originally attributed to Simon Kuznets (1955) who observed that the relationship between economic growth and income inequality is an inverted U-shaped curve. This implies that as income increases, inequality increases up to a point where it begins to fall. Grossman and Krueger (1991) examined the relationship between economic growth and environmental quality using three air pollutant of CO2, SO2 and smoke and data from 42 countries. They observed that two out of the three pollutants increases at low income level and decreases at high national income level. Therelationship between income growth and environmental quality has the same shape as the Kuznets Curve. Hence, the curve is named after Kuznets as Environmental Kuznets Curve, relating it to environmental quality, rather than income inequality, and as the hypothesis as the Environmental Kuznets Curve Hypothesis. The Environmental Kuznets Curve has received a lot of attention in empirical literature. However, evidence for the existence of the EKC hypothesis is at best mixed in both developed and developing economies. Some of empirical studies include:

2.2 Empirical Literature

Egbetokun, Osabuohien, and Akinbobola (2018) examined the role of institution in the income – pollution relationship in attaining turning point in the North and Southern African countries. The study used three measures of air quality, CO2, SO2 and suspended particulate matter (SPM) and the Generalized Method of Moment to ascertain the role of institution in attaining turning point of the EKC .the result indicated that the two regions did not attain the level of income per capita capable of turning the EKC around for CO2 and SO2, but not for SPM. They concluded institutional quality should be strengthened in the two regions

Asante (2016) investigated the relationship between, CO2 emission, economic growth, energy used and openness to trade in Ghana. He used annual time series data between 1980 and 2011 and the Hendry Error Correction Model and Granger causality test. The result suggests along run relationship between income and CO2 emission that supports the presence of Environmental Kuznets Curve.

Omotor (2016) examined the relationship between per capita income and environmental degradation in the ECOWAS countries using two indicators of environmental quality of CO2 and SO2 emission. The results from both the fixed and random effect models support the existence of the Environmental Kuznets Curve in the ECOWAS region for both CO2 and SO2

Waluyo and Terawaki(2016) examined whether there is inverse relationship between environmental quality and economic growth in Indonesia between 1962 and2007. They used annual time series data and the Auto-Regressive Distributed Lag/Bound testing co-integration approach.. The result supports long run inverted U-shape relationship between environment quality and economic growth.

Jula ,Dumitrescu, Lie, and Dobrescu(2015) examined the relationship between economic growth using GDP per capita as a proxy and CO2 emission between 1960 to 2010 in Romania. The empirical analysis prove the existence of an inverted U-shape curve and supports the EKC theory in Romania.

Bailardi (2015) explored the relationship between per capita income ant three air pollutants in the 20 regions of Italy. His model included a variable for technological innovation. The results supported the existence of U-shaped curves for the three pollutants and also confirms the influence of technological progress on the U-shape curve.

Alege and Ogundipe (2013) studied the relationship environmental quality and economic growth in Nigeria from 1970 to 2011. They used fractional co-integration analysis approach. They used a cubic equation model which contain CO2 emission as proxy for environmental quality, while GDP, openness to trade, institutional quality, and population density are the explanatory variables. The result could not find any support for the EKC in Nigeria. However, the result revealed that weak institution and trade openness and high population density accentuate environmental degradation.

Elgin and Oztunali(2012)investigated the relationship between size of the informal sector as percentage of the Gross Domestic Product (GDP)and carbon dioxide emission in Turkey from 1950 to 2009. They study used annual time series data and cointegration regression analysis techniques. The result showed evidence of an inverted U- shape curve. They recommended policy to control pollution and use of energy.

Bello and Abimbola (2010) used ordinary least square regression analysis to examine the whether EKC exist in Nigeria from 1980 to 2008. Findings from the study revealed that there is a U-shaped relationship between CO2 emission and economic growth in Nigeria. They concluded that CO2 emission in Nigeria is not fueled by economic growth.

Apergis and Payne(2009) used annual time series data and panel data Vector Error Correction analysis techniques to examine the relationship between out and CO2 emission in six Central American countries. The result validates the existence of the Environmental Kuznet Curve (EKC) in the six countries

Kamande (2007) examined the relevance of the Environmental Kuznet Curve in Kenya between 1960 and 2006 using a quadratic equation model which contains CO2 as the dependent variable, GDP and GDP-square as the independent variables. The analysis did not find any evidence for the inverted U-shape curve in Kenya. He concluded that environmental conservation should not be left to economic growth, but delbrate effort should be made to ensure clean environment.

III. MATERIALS AND METHODS

3.1 Model Specification

Interest in Environmental Kuznets Curve (EKC) started with the pioneering studies of Grossman and Krueger (1991). The EKC captures the relationship between economic growth and environmental degradation. Standard EKC model uses quadratic function of income level. The standard EKC estimates there relationship between income level and the environment using any of the four environmental variables of carbon dioxide per capita emission, nitrous oxide emission, annual mean temperature, and annual mean rainfall. The model specification assumes that environmental pollution is a steady function of income level and square income level.

There is a general believe that international trade has significant effect on the environment. The pessimist opine that international trade depletes natural resources, raise the emission of CO2 and cause more environmental degradation (Copland & Taylor,2001; Chaudhuri & Pfaff,2002) . To capture this concern, trade openness is added to the standard model. Different studies have demonstrated the importance of technology to the inverted U curve. For example, Andreoni and Levinson(2001) pointed that the inverse U-shape relationship between income and environmental degradation depends on technological level. The observed inverted U-shape relationship in the EKC is a result of convergence to sustainable growth path when technology is taken into consideration.

In the light of the importance of international trade and technology to the relationship between income and the environment, the standard ECK is expanded to include trade openness and technological variable. Thus, the expanded EKC function could be expressed as follows:

$CO_2 = f($ GDP, GDP^2, TO,TECH)

3.1

The implicit function could be transform into double log econometric model as

$$\ln CO2 = \beta_0 + \beta_1 \ln GDP\text{i} + 2\beta_2 \ln GDP + \beta_{3 \ln TO} + \beta_{4 \ln TECH} + \epsilon$$

3.2

Where CO_2 is carbon dioxide emission per capita proxy for environmental degradation, GDP is income per capita, TO is trade openness, and TECH is level of technology. $\beta_0$is constant term,β_1 , β_2,$\beta_{3\ and\ }$, β_4 are elasticity coefficients; and ϵ is the error term.

3.2Definition and Measurement of Variables

i. **Carbon Dioxide (CO_2)**: Carbon dioxide (CO_2) is the dependent variable. Defining a relevant measure of environmental and natural resources quality is important issue in empirical. There is no consensus among researchers on one comprehensive measure of environmental quality. Rather, the tradition has been to derive the EKC for each measure of environmental quality .However, most studies have focused on measures of ambient air quality at the national level (Grossman & Krueger;1995; Selden &Song,1994; World Bank,1992).three variable are mostly used as proxy for air pollution at the national level; namely, sulphur dioxide, nitrogen dioxide, and carbon dioxide. The study adopts the use of carbon dioxide. The definition follows that of the World Bank. Carbon dioxide emission measures the emission from burning of fossil fuel and manufacturing of cement. It includes carbon dioxide release through burning of solid, liquid fuel as well as gas flaring. It is measured in metric tons per capita. Emission per capita is the emission per unit person.

ii. Income Level (GDP): income levelis among the important factors contributing to the output of carbon dioxide. The level of economic activities (production and consumption) has important bearing on the environment. The level of income used in this study is the real Gross Domestic Product (GDP) per capital. The real GDP per capita is the monetary value of the final output of goods and services produced within the geographical boundary of a country, irrespective of who owns the factor of production, during a specific period of time, usually one year it is calculated at gross and in constant price, in this case, at 2011 constant price in the United states dollar .the income level used in the study is the real GDP per capita which real GDP divided by the total population. Income level is included in two forms: in level and at quadratic form. The level form captures the relationship between income level and environmental degradation at low income level; while the quadratic form is used to capture the relationship between income and environmental pollution at higher income level and to illustrate the presence or absence of the Environmental Kutznet Curve (EKC).

Consequently, the *a priori* expectation for income is as follows:

$\beta_1 .>0$ $\beta_{2,}<0$ $.\beta_1 .>0$ $and\ \beta_{2,}<0$ indicate inverted U- shape curve and confirms the presence of EKC. it implies that environmental pressure falls as income raises.

Trade Openness (TO): trade openness is a major determinant of pollution and environmental degradation. it is also a significant factor in for technological diffusion and adoption .basically, trade openness refers to the degree to which international transactions takes place in a country. It indicates how liberalized and open an economy is. Trade openness is measured as the ratio of the sum of export and import to GDP. The literature is not conclusive on the sign of this variable. The *a priori* expectation for this variable is β_1.>0 or β_1<0
Technology Progress (TP): technology is the body of knowledge devoted to creating tools processing action and extraction of materials (Wikipedia, meaning of technology, n.d) It is the practical application of knowledge in a particular area. Technological progress is proxy by energy intensity.

3.3 Nature and sources of Data

The data employed for the analysis are secondary in nature and consist of annual time series of the CO_2 emission per capita, GDP per capita, trade openness index, and energy consumption per capita. Data were sourced mainly from the World Bank's world development indicator on the internet. Supplementary materials were collected from the central bank of Nigeria statistical bulletin (various issues)

3.4 Estimation Techniques

The study adopts the Auto-Regressive Distributed Lag (ARDL) econometrics regression techniques to developed byPesaran, Shin and Smith (2001) to analyze the data. The independent variables GDP, GDP^2, TO and TECH were regressed on the dependent variable.

i. Unit Root Test

Maddala (2007) observed that time series data are fraught with unit root. Ignoring unit root and running regression with the data will lead to spurious regression (Granger& Newbold,1974).therefore, it is advisable in empirical studies to examine the unit root properties of the data before applying them in regression analysis. The unit root test adopted in the study is the Augmented Dickey-Fuller approach.(Dickey &Fuller,1987). There are tree strands of the test. The study adopts the complete version with constant and trend. The ADF with constant and trend is stated thus:

$$\Delta Y = \beta_0 + \beta_1 t + \sum_{t=1}^{t=n} \rho Y_{t-1} + \sum_{t=1}^{t=n} \Delta Y_{t-1} + \epsilon \qquad 3.3$$

The hypotheses for test are:
H_0: ρ= 0 Y has unit root
H_1; ρ<0 Y has no unit root.
The test was carried out at 0.05 levels of significance.

ii. Co-integration Test

Co-integration is a necessary condition for stationarity among variables that are integrated. Co-integration test is a necessary step for checking if the relationship among the variables can be expressed in a meaningful empirical model. There are several co-integration analysis techniques. However, Pesaran, Shin and Smith (2001) developed technique for examining co-integration among variables. The Pesaran et.al cointegration technique is called ARDL/Bound test approach.the ARDL/ Bound testing approach has some advantages over the traditional approaches such as the Engle-Ggranger (1987), Johansen (1988) and Johansen and Juselius(1990).one advantage of the ARDL/ Bound test approach is that it can be applied in case of mixed order of integration that is order 0, and 1; It breaks down in the presence of order Secondary ,it is efficient in small sample .it requires one equation set up for both long run and the short run and does not need separate unit root test apart from guiding against I(2) series.

The afore stated advantages, and having small size are the factor which made ARDL/Bound testing approach the most suitable approach for this study. The ARDL/Bound testing model for the study can be specified As follows:

The Bound test provides information on the long-run coefficient of variables. The Bound test F-statistics test, which is generated by Wald test, is compared with critical upper and lower values of Pesaran, et al.(2001) table at 5% probability level. The Pesaran table provides lower I (0) and upper I (1) critical bounds. The null-hypothesis is rejected if the F-statistic is higher than the upper critical bound and it is accepted if the F-statistics is lower than the lower critical bound. The test will be inconclusive if the F-statistics is between lower and upper critical bound

iii. Model Diagnostic Test

Testing the basic assumptions of the Ordinary Least Square (OLS) is important in empirical studies. The important assumptions that may affect the estimates include residual distribution, autocorrelation, and heteroskedasticity.

Normality Test: the Jacque-Bera(JB) test of normality approach was employed at 0.05 level of significance. The test examines the distribution of the estimated residuals under the null hypothesis that the residuals are normally distributed.

Autocorrelation: autocorrelation test examines the estimated residuals if they are correlated; that is, if there is any correlation between successive term. Autocorrelation in the residuals affect the efficiency of the estimates. In the presence of autocorrelation, the parameter estimates are no longer ''BLUE''. the standard error is affected and hypothesis testing becomes misleading .the Breusch-Godfrey (BG)test techniques was adopted for this test at 0.05 level of significance. The BG test approach test the null hypothesis that there is no autocorrelation in the error terms.

Heteroskedasticity.theheteroskdasticity test examines the variance of the error terms over time. if the variance is constant, then it is homoskedastic; otherwise, it is heteroskedastic. Heteroskedasticity like autocorrelation affects the efficiency of the parameter estimates and therefore affect the standard error. Hypothesis testing in the presence of heteroskedasticty be misleading. The Breusch –Pgan- Godfrey(BPG) test of heteroskedasticity was employed at 0.05 levels under the null hypothesis that the variance of the error terms are constant over time.

Multicollinearity Test: Correlation Matrix Analysis

Before combining variables in a multiple regression model,it is important to examine the data for multicollinearity problem. Multicollinearity among variables in a model will make unique estimates of the model parameters impossible. In the correlation matrix techniques for detectingmulticollinearity,the researcher examines the pairwise correlation coefficient between any two variables in the model. If the pairwise correlation coefficient between any two is greater than 0.99, then there is evidence of multicollinearity among the variables in the model. Parwise correlation coefficient less than 0.99 prove there is no reason to suspect the problem of multicollinearity among variables in the model

IV. RESULTS AND DISCUSSION

This section presents and discussed the empirical results of the data analysis. The data collected for the study was analyzed with the aid of E-view 9.0. The results are presented and discussed below.

4.1 Descriptive Statistics

Table 1: Summary of descriptive statistics

C	CO2	GDPC	TECHP.	GDPcSQ	TO
Mean	0.598883	1271.037	102.8056	2391587.	50.23162
Median	0.588790	881.9867	91.43474	777900.6	52.79000
Maximum	0.873822	3221.678	156.7330	10379210	81.81000
Minimum	0.325376	270.0636	50.87268	72934.35	20.72000
Std. Dev.	0.171221	893.0894	28.72854	2865135.	16.88222
Skewness	-0.067216	0.673439	0.435906	1.218167	-0.209358
Kurtosis	1.850094	2.048460	2.060579	3.441431	2.063904
Jarque-Bera	2.066383	4.192577	2.532291	9.451318	1.621215
Probability	0.355869	0.122912	0.281916	0.008865	0.444588
Sum	22.15869	47028.38	3803.808	88488730	1858.570
Obs	37	37	37	37	37

Source: Author's computation from E-viewssoftware

The results of the descriptive statistics presented in table 1 above show that there are 37 observations in the model . The mean of CO_2 during the period under review is 0.5988 while its maximum and minimum values are 08738 and 0.3253 respectively. The median value is .05788. the mean is not significantly different from the mean the standard deviation value for CO2 is 0.17122 which shows that the data is not widely spread. They cluster around the mean value. The mean value for GDPc, Energy Use(EU) GDPc-SQ, and Trade Openness are $1271.037, 102.80KW per capita,239158.7 and 50.23 respectively. The maximum values of Gross Domestic Product per capita is $3221.67 while the maximum value of energy use per capita is156.733 kwh. GDPcSQ had maximum value of 10379310 and minimum value of 72934.5 durimg the 37 years period of the study. The maximum value of trade openness was 81.81 while the minimum value was 20.7200. the standard deviation of GDPc ,EU,GDPcSQ, and TO show that they are clustered around the mean values.The skewness values of CO2, and TO are -0.17122 and- 0.20935 respectively. They are negatively skewed; but not much different from zero and therefore could be taken as normal GDPc and EU have skewness value of 0.6734 and 0.4359. they are positively skewed, but their values are not quite different from zero which is the value for normal distribution. Thus, they could be taken as normal. The kurtosis values of CO2, GDPc , EU, AND TO are all less than 3.00 which is the value for normal distribution. They are platykurtic, that is, they have flatter top

than the normal distribution. GDPSQ has kurtosis value greater than 3.00. it is therefore leptokurtic: it distribution has peak top than the normal distribution.theJaque –Bera statistics show that all the distribution of CO2,GDPc, EU and TO are normal ;while GDPSQ does not have normal distribution

4.2 Multicollinearity Test Results: Correlation Matrix Analysis

Results of the pair-wise correlation matrix analysis of the variables in the model are presented below in Table 2

Table 2: Correlation matrix

	CO2	GDPC	TECHP	GDPSQ	TO
CO2	1				
GDP_C	0.22433	1			
EU	-0.15496	0.7262	1		
GDPcSQ	0.10288	0.87731	0.73718	1	
TO	-0.28899	-0.26491	-0.20938	-0.26303	1

Source: Author's computation from E-views software

From the result of the correlation matrix result presented, none of the pair- wise correlation coefficient is greater than 0.90. Hence, there is no reason to suspect the problem of multicollinearity among the variables. The variables can, therefore, be combined in a multiple regression model

4.3 Unit Root Test

It is important to test the variables data for unit root. The unit root test approach adopted is the Augmented Dickey-Fuller approach at 5% probability level. The result of the test is presented in table 3.

Table 3: ADF unit root test results

Variable	Level	1st difference	P-value	Order of Integr.
CO2	-1.9935	-6.8841	0.0000	I(1)
GDPc	-2.8270	-3.5198	0.0512	I(1)
TECHP.	-2.7193	-8.0836	0.0000	I(1)
GDPcSQ	-0.8548	-3.7012	0.0315	I(1)
TO	-0.7958	-8.2996	0.0000	I(1)

Source: Author's computation from E-views software

From the unit root test results shown in Table 3 above, none of the variables is stationary at level; that is, all the variables have unit root. After 1st differencing, all the variables became stationary. The variables are therefore integrated of order 1 or they are I(1) series.

4.4 ARDL/ Bound Co-Integration

The cointegration test result is summarized in 4.

Table 4: Bounds test cointegration test result

Test Statistic	Value	K
F-statistic	10.71336	4
Critical Value Bounds		
Significance	I0 Bound	I1 Bound
10%	2.45	3.52
5%	2.86	4.01
2.5%	3.25	4.49
1%	3.74	5.06

Source: Author's computation from E-views software

From table 4, the empirical F-statistic (10.7134) is greater than the upper Bound at 5%. It therefore implies that the variables have long run relationship. The result therefore proved that the variables are co-integrated and have a stable long run relationship. Having seen that there is long run relationship among the variables in the model, the analysis proceeded to presenting the long run coefficients.

4.5 ARDL Estimates

The long run coefficients are presented in table 5

Table 5: Long run estimates

Variable	Coefficient	Std. Error	t-Statistic	Prob.
$In\text{GDP}c_{t-1}$	0.000440	0.000115	3.828681	0.0011
$In\text{TECH}P_{t-1}$	-0.015233	0.002671	-5.702951	0.0000
$In\text{GDPcS}Q_{t-1}$	-0.000318	0.000110	-2.890909	0.0010
$In\text{T}O_{t-1}$	-0.000379	0.001769	-0.214323	0.8326
C	1.625624	0.232498	6.992002	0.0000

Source: Author's computation from E-views software

The long run coefficients of the model in Table 5 show that the relationship between income proxy by Gross domestic product per capita and environmental degradation is positive and statistically significant. The sign of the income coefficient conform to the *a priori* expectation for the variable. The result is in line with the findings of Omotor(2016) which found positive and statistically significant relationship between income and CO2 emission in Nigeria. The finding, however, contradicts the result of Egbetokun et al.(2018) which found positive but statistically insignificant relationship between income and CO2 emission in the North and Southern African Region countries.The relationship between incomes square (GDP^2) which tests the validity of the Environmental Kuznet Curve Hypothesis is negative and statistically significant. The sign of the income square coefficient is in line with the *a priori* expectation and is an evidence of the presence of inverted U-shape curve (Environmental Kuznets Curve is confirmed). What this result implies is that Kuznet Environmental Curve is a reality in Nigerian economy. The result supports the results of Lean (2010) and Asante (2016) which found evidence in support of the EKC in Pakistan and Ghana respectively. However, He and Richard could not find any evidence in support of the EKC in Canada.

Technological progress has a negative and statistically significant relation to environmental degradation. The sign of the variable coefficient conforms with the *a priori* expectation for the variable. This result also confirms the finding of Baiardi(2014) which observed negative relationship between technological progress and CO2 twenty regions of Italy. Lanz and Feng(2006) result also proved that the effect of technology is significant to the shape of the EKC and observed that EKC exists when technology is included in the model. The result contradicts the findings of Balin and Mumcu-Akan(2015) which found positive relationship between technological progress and CO2 emission in Turkey.The impact of trade openness on CO2 emission is negative and statistically insignificant. This is contrary to the *a* priori expectation for the variable. The relationship between trade openness and CO2 implies that the more free the economy is, the more open the economy is,the less the environmental degradation. The finding of this study contradicts the Pollution Heaven Hypothesis in Nigeria economy.

Table 6: Short run estimates

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D*In*(GDPC(-1))	0.000630	0.000168	3.755202	0.0013
D*In*(TECHP(-2))	0.004432	0.001325	3.344479	0.0034
D*In*(GDPSQ(-1))	-0.000000	0.000000	-4.182449	0.0005
D*In*(TO(-1))	-0.001931	0.001150	-1.678851	0.1096
CointEq(-1)	-0.655233	0.134115	-4.885612	0.0001

Source: Author's computation from E-views software

The short run results presented above show that GDP and GDP^2 are still positively and negatively signed respectively and equally statistically significant. Also, trade openness (TO) is negative and statistically insignificant in the short run. The Pollution Heaven Hypothesis is still not valid in the short run. However, technological progress is positively signed in the short run and statistically significant.

4.5.1 Model Diagnostic Test

The results of the model diagnostic tests are presented as follows:

Table 7: Breusch-Godfrey autocorrelation LM test result

F-statistic	3.766920	Prob. F(4,12)	0.1330
Obs*R-squared	17.81334	Prob. Chi-Square(4)	0.3213

Source: Author's computation from E-views software

The Breusch –Godfrey (BG)autocorrelation test result presented in table 7 above shows that there is no evidence of autocorrelation in the estimated error terms. The BG LM statistic value (Obs*R-Square) is 17.8133 .the p-vlue is greater than 0.05. hence, the null hypothesis is maintained at 0.05 levels .therefore implies that there is no evidence to suspect autocorrelation in the error terms.

Table 8: Heteroskedasticity

F-statistic	0.520331	Prob. F(14,19)	0.8916
Obs*R-squared	9.422897	Prob. Chi-Square(14)	0.8030
Scaled explained SS	3.750372	Prob. Chi-Square(14)	0.9968

Source: Author's computation from E-views software

The result of the Breusch-Pagan – Godfrey test of heteroskedasticity is presented in table 8. The result also supports the acceptance of the null hypothesis. The BPG LM statistic (Obs*R-Squared) is 9.4229. the probability of this value,thePob.Chi-square(14) is 0.8030 which is far greater than 0.05 critical value. Thus the null hypothesis is maintained at 0.05 level. It implies that the variances of the error terms are constant: there no evidence of heteroskedasticity in the error term.

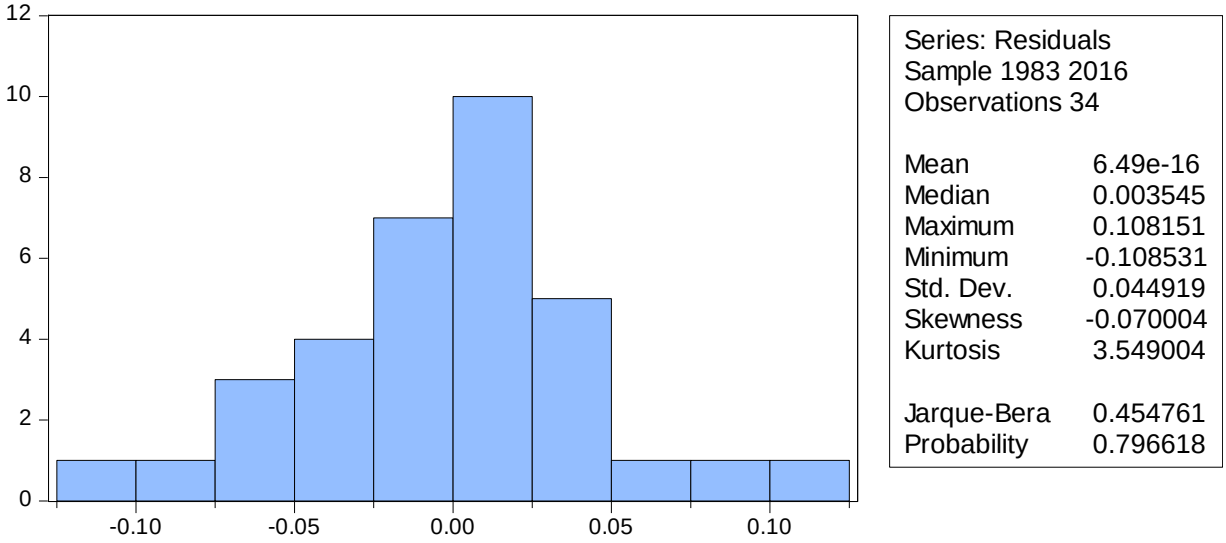

Figure 1: Normality test result

Source: Author's computation from E-views software

The Jaque-Bera test of normality result in figure 4.1 above reveals that the distribution of the residuals is normal. The JB statistics is 0.4547 with probability value of 07966. Therefore, the null hypothesis of normal distribution is maintained at 0.05 levels.

V. CONCLUDING REMARKS

The study sought to examine the validity of the Environmental Kuznet Curve (EKC) hypothesis in Nigeria over the period 1980 to 2017 using carbon dioxide emission per capita as a proxy for ambient air quality and a measure of environmental quality. The analytical technique was anchored on the Grossman and Krueger (1991) model expanded to accommodate the role of international trade and technological progress on the Environmental Kuznet Curve. The result suggested that there is evidence of the Environmental Kuznet Curve and therefore supported the EKC hypothesis in Nigeria. The result also revealed that technological progress reduces environmental quality degradation. The result, also, did not support the Pollution Heaven Hypothesis.The implications from the findings of the study are that economic growth would not pose any challenge to environmental quality in Nigeria. The implication of this study, however, may not apply to other measures of environmental quality such as sulfur, and nitrogen oxides and some natural resources extraction. Therefore, effective environmental policies are necessary for sustainable development.

The impact of technological progress on environmental quality implies that improving the rate of technological progress will reduce pressure on the environment and natural resources. The Green Energy policy initiative is a step in the right direction. The policy initiative has huge potential for environmental sustainability However, it is, equally, noteworthy, that the government has not been doing enough in creating incentives that will shift the current energy mix towards the Green Energy pole .investment in alternative energy technologies from both the private and public sectors and the speed of adoption are quite dismal. Appropriate institutional

framework is necessary for harnessing technology and technological progress as a strategy for sustainable environment and economic growth.

The absence of enough evidence in support of the Pollution Heaven Hypothesis should not be taken for granted. Environmental degradation is usually caused by stock and fund pollutants. These pollutants have intergenerational dimensions: there is interdependency between current and future pollution levels. The damage inflicted on the environment in the future is a function of the current action. Free market will not protect our environment and natural resources. Trade liberalization, by removing all tariff and none-tariff barriers, will create incentive to Pollution Heaven. Trade openness should have environmental concern. Economic growth is not a problem to the environment and natural resources. Raising the standard of living in the economy is one surest means of addressing environmental problems in Nigeria. For now, effort should be concentrated at raising the per capita income. However, sustainable economic growth policies should be pursued to engender growth with minimal impact on the environment.

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