EUROPEAN ACADEMIC RESEARCH
Vol. VI, Issue 12/ March 2019

Impact Factor: 3.4546 (UIF)
DRJI Value: 5.9 (B+)

ISSN 2286-4822
www.euacademic.org

Investigating the Environmental Kuznets Curve (EKC) Hypothesis in Nigeria

NURA SANI YAHAYA
MOHD RAZANI B MOHD JALI
RAJI JIMOH OLAJIDE
School of Economic, Banking, and Finance
Sintok, Kedah, Universiti Utara Malaysia

Abstract
This study examined relationship between GDP percapita, GDP square, FDI and Carbon dioxide emissions with emphasis of analyzing the EKC in Nigeria, over the period from 1981- 2014 by employing Autoregreesive Distributed Lag (ARDL) Bound testing technique. The empirical analysis of this study reveals that there is long-run association among the variables, while, the short-run analysis shows that none of the variable is significant in explaining Carbon dioxide emissions. The long-run analysis shows that GDP percapita is positive and significant in determining CO_2 emissions, however, square term of GDP reduce CO_2 emission. Moreover, the result indicates the presence of EKC hypothesis in Nigeria. Therefore, the study recommends the adoption of advanced environmental policies, such as the green technology policy for better and clean environment in the study area.

Key words: CO_2 emissions, EKC hypothesis, economic growth, FDI, ARDL

1. INTRODUCTION

The global environmental pollution linked to the increased CO_2 emission and the need to achieve sustainable development have recently influenced international economies to considerably

reduce emission of CO_2 (Kojima and Bacon 2009). Various studies have establish the fact that developing countries contributed large portion of CO_2 emissions as a results of rapid economic development (Al-Mulali *et al.,* 2015; Dogan & Turkekul, 2015; Katircioğlu, 2014). Moreover, the beginning of industrialization in 1970s, economic growth, consumption of energy and the foreign direct investment (FDI) are at increasing level that caused serious threats to environment. The major problem here is that economic progress induce high use of energy, such as oil, coal and natural gas which increased CO_2 emissions that are the main cause of global warming (Jebli, Youssef, and Ozturk 2017).

The process of globalization has become advantage for emerging nations to foster their economic progress through production and investment that also uplift the amount of environmental pollution (Ahmed and Long 2013; Katircioğlu 2014). In recent literature, studies have shown that Environmental Kuznets curve (EKC) is best known hypothesis that explain the effects of rapid economic growth on environmental degradation. The theory stated that at first stage of economic development, environmental pollution tends to increase until it reaches a point in which further increase in economic growth reduces environmental pollutions (Kuznets 1955; Dinda 2004). Therefore, for better policy making to achieve sustainable development, it become necessary to know the relationship between economic development and environmental condition of developing economies.

In Nigeria the level of CO_2 emissions have been increasing over the past decade. For instance the in 2000 there was a record of 76,057. 25 kiloton. In 2010 the level of CO_2 rose to 91,517.319 and also increased to 96, 280.752 in 2014 (WDI 2017). Therefore, it indicates an improvement in the expulsion of CO_2 emissions. Moreover, Nigerians Growth Domestic Product has been improving over the years with an average growth rate of 5.7 percent since 2006 until 2016. The country

recorded total value of $2.578 billion GDP in 2000 and increase to $ 3.366 billion in 2010. The value of GDP in 2014 rose to $ 3.5080 billion (WDI 2017). The situation above shows a progress in economic growth in Nigeria which could be the reason of high level CO_2 emissions. However, the question here is that do Environmental Kuznets curve (EKC) exist in Nigeria? Therefore, this study empirically investigates the presence of EKC hypothesis in Nigeria.

2. LITERATURE REVIEW

Many studies have investigated the EKC hypothesis in both developed and emerging countries. For example, studies such as Khalid (2013) for Pakistan, Baek and Kim (2013) for Korea, Katircioğlu (2014) for Singapore, Lau, Choong and Eng (2014) for Malaysia, Al-Mulali, Saboori and Ozturk (2015) for Vietnam are based on single country analysis. While other regional studies such as Li, Wang and Zhao (2016) for 28 provinces of china, Gao and Zhang (2014) for 14 Sub Saharan African countries, Nasreen and Anwar (2015) for 57 high, middle and low income countries, Omri, Daly, Rault, and Chaibi (2015) for 12 MENA countries, Jebli *et al*., (2017) for 25 OECD countries.

The connection among GDP and CO_2 emissions with emphasis on testing the presence EKC hypothesis. For instance, Shahbaz et *al*., (2014) examine the link among GDP and carbon dioxide emission in Romania and EKC hypothesis was valid. Apergis and Ozturk (2015) employ GMM technique to study the presence of EKC hypothesis in Kenya over the period 1980 to 2012. The result shows no proof of EKC hypothesis in Kenya. Furthermore, Al-Mulali *et al.,* (2015) examined the impact of GDP, energy use and financial progress on carbon dioxide emissions in developing economies over the period 1980 to 2010. The result confirms the occurrence of EKC in the study areas. Kasman and Duma

(2015) used FMOLS technique to analyze the association among energy use, GDP, CO_2 emissions, trade openness and urbanization in new EU member countries for the period 1992 to 2010. The finding endorse the EKC hypothesis in the countries. Recently, Jebli, Youssef and Ozturk (2016) analyze the association among per capita carbon emissions, and GDP in 25 OECD countries for the period 1980 to 2010. The result reveals the existence of EKC hypothesis.

However, previous studies have concentrated on investigating the EKC hypothesis in developed countries, very few studies investigated the EKC hypothesis in emerging countries particularly in Nigeria. For example, Onafowora and Owoye (2014) use ARDL approach to analyze the association among GDP, population, energy use, trade and Carbon dioxide emissions in industrialized and emerging countries on the EKC hypothesis. Moreover, based on the above discussions this study will investigate the presences of EKC hypothesis in Nigeria. This is for the fact that Nigeria became fast growing economy in the last decade among other African countries, which may increases CO_2 emissions. Therefore, this necessitate the need to investigate the existence of EKC hypothesis for better policy making.

3. DATA AND METHODS

3.1 Data

This study, used time series data from 1981-2014 and world development indicator is the source of data. The measurement of the variables are CO_2 emissions (kiloton), GDP percapita (current USD), square of GDP percapita (current USD), FDI inflow (percentage of GDP). All the variable are changed to their natural log for easy interpretation. The characteristics and nature of the data used in this study are presented in table 1. $LGDP^2$ has the highest mean value among the explanatory variables. The mean value of $LGDP^2$ is greater than the mean

value of FDI by 6.72, indicating that $LGDP^2$ has the highest variation among the independent variables.

Table 1: Descriptive statistics of variables

Variables	Min	Max	Mean	SD
LCO2	10.5	11.6	11.09	0.38
LGDP	2.18	3.50	2.73	0.37
$LGDP^2$	4.78	12.30	7.61	2.17
LFDI	-0.41	2.38	0.89	0.62

Source: Author estimation, 2018

3.2 Model specification

3.2.1 Unit root

To identify the stationarity and order of integration of the variable this study applies Augmented Dickey Fuller (ADF). These are further confirmed by using Phillip Perron (PP) tests. The ADF is express on the following equation:

$$\Delta Z_t = \beta + \theta_{yt-1} + \beta T + \sum_{j-1}^{k} \vartheta_j \Delta Z_{t-j-1} + \varepsilon_t \qquad (1)$$

Z denotes the series at period t, ß specifies the coefficient k represent the lags, and ε_t is the error term. Therefore, the decision rule for rejecting the null hypothesis (H_o) is when the ADF value fall below the critical value. The conclusion here is that there is presence of unit root in the series. However, the decision for not rejecting H_o is that, when the ADF value is more than the critical value. It implies that there is absence of unit root in the series.

The Phillip Perron (PP) test uses the Kemel Newey-West statistics that have an advantage of correcting higher order autocorrelation and likely problem of heteroscedasticity in the series. The PP test is express on the following equation:

$$\delta^2 = T^{-1} \sum_1^T \bar{e}_r^2 + 2T^{-1} \sum_{t-1}^{l} w(t,l) \sum_{r=t+1}^{l} \bar{e}_t \, \bar{e}_{t-1} \qquad (2)$$

Where w(r, l) = 1[t/ (1+l)] and l is lags. If the PP value fall below the critical value, the decision here is that null hypothesis cannot be rejected and it is concluded that there is presence of

unit root in the series. However, in the case PP value is above the critical value, it implies that the null hypothesis is rejected and the conclusion is that unit root is not in the series.

3.2.2 Model for empirical analysis

The study used a modified version from Dinda (2004) for demining the EKC hypothesis as expressed below:

$$CO_2 = f\ (GDP, GDP^2, FDI)$$

Where: CO_2, GDP, GDP^2, FDI, represent Carbon dioxide Emissions, GDP percapita, square term of GDP percapita and foreign direct investment. Therefore, To know the long run association on the variables and the existence of EKC hypothesis, this study uses autoregressive distributed lag bounds (ARDL) technique, introduced by Pesaran *et al*., (2001). The technique is used irrespective of the variables order of integration that is whether they are I(1), I(1) or are mixed. Hence is the appropriate method for this study. In addition, the variables are transformed to the natural log and the model is expressed as:

$$\Delta LCO_{2t} = \beta_0 + \sum_{j=1}^{n} \beta_1 \Delta LCO_{2t-j} + \sum_{j=0}^{n} \beta_2 \Delta LGDP_{t-j} + \sum_{j=0}^{n} \beta_3 \Delta LGDP^2{}_{t-j} + \sum_{j=0}^{n} \beta_4 \Delta LFDI_{t-j} + \alpha_1 LCO_{2t-1} + \alpha_2 LGDP_{t-1} + \alpha_3 LGDP^2{}_{t-j} + \alpha_4 LFDI_{t-1} + \varepsilon_t$$

Where ε represent the error term, t specifies the time trend and Δ denotes the first difference operator. Akaike information criteria (AIC) is the basis of lag selection criteria. The rule for making decision on the long-run is built on the F statistic. The null hypothesis stated that H0: $\beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = 0\ \beta_i = 0$ while the alternative hypothesis is that H1: $\beta_1 \neq \beta_2 \neq \beta_3 \neq \beta_4 \neq \beta_5 \neq 0$. Therefore, based on the criteria made by Pesaran *et al*., (2001) that the decision for rejecting the null hypothesis (H_o) is that if F-statistics is larger than the value of the upper bound. The conclusion here is that there is presence of cointegration among the variables. However, the decision for not rejecting the

H_o is when the F-statistics value is lower than the value of lower bound. This shows that there is absence of cointegration on the variables.

4. RESULT AND DISCUSSION

The present study uses ADF and PP test to identify the order of integration and stationarity of the data. Similarly, ADF test was computed on Schwarz information criterion (SIC) while the PP test was on Newey west bound criterion. Table 2 presents the unit root tests results. The result indicates that only two variables are found to be stationary at level while others are found to be stationary at first difference in ADF and PP tests.

Table 2: Results of Unit Root test

Variable	ADF		PP		ADF		PP	
	LEVEL		LEVEL		First Diff		First Diff	
LCO_2	-1.794699	(0.6844)	-1.163269	(0.6782)	-5.541154 *	(0.0004)	-5.556751	(0.0001)
LGDP	-2.351861	(0.3963)	-3.799074	(0.0293)	-6.664580 *	(0.0000)	-	
$LGDP^2$	-2.140453	(0.5054)	-2.774805	(0.2159)	-2.140453 *	(0.0406)	-13.08501	(0.0000)
LFDI	-3.501543*	(0.0143)	-2.630993	(0.0971)	-		-9.873289	(0.0000)

*Notes: * represents statistically significance at 1 percent level. Figures in parenthesis represent probability.*
Source: Author estimation, 2018

Table 3 shows the bound test result. The result indicates that there is presence of long-run association since F-statistic is grater than the upper bound critical values at 5 % level.

Table 3: ARDL Bound test result

	1%		5%	
F-statistics	I(0)	I(1)	I(0)	I(1)
4.49	4.29	5.61	3.23	4.35

Source: Authors estimation, 2018

Table 4: Short Run and Long Run estimated Results based on the ARDL technique

S.R Regressors	Coefficients	SD Errors	t-Statistics	Prob
ΔLGDP	4.100111	2.940796	1.394218	0.1885
ΔLGDP²	-0.572165	0.515617	-1.109672	0.2889
ΔLFDI	0.023200	0.023653	0.980869	0.3460
ECT(-1)	-0.843592	0.213505	-3.951162	0.0019
L.R Regressors				
LGDP	7.341820**	2.432581	3.018120	0.0107
LGDP²	-1.184191**	0.414503	-2.856892	0.0144
LFDI	-0.060514	0.030087	-2.011297	0.0673
C	0.203879	3.517797	0.057956	0.9547

*Source: Authors' estimation, 2018; Notes: ** represents statistically significant at 5 percent level*

Table 4 presents the results of short run and a long run of the estimation. The short-run result indicates that the lag-L*GDP*, *LGDP²,* and *LFDI* coefficients are not significant in explaining the Carbon dioxide emissions in Nigeria during the period of the study. The adjustment towards long-run equilibrium is about 84.35 per cent, and it is significant at one percent. In the long run the LGDP and LGDP² coefficient are significant. A 1 per cent rise in GDP in Nigeria lead carbon dioxide emission to increase by 7 per cent. In the same vain, A 1 per cent increase in square term of LGDP lead to 1.18 per cent decrease in CO_2 emissions, this shows that further increase in GDP decreases level of CO_2 emissions and it is clearly proved the occurrence of EKC hypothesis in Nigeria. The EKC hypothesis is said to exist when we found economic growth and square term of LGDP are significant positively and negatively related to CO_2 emissions. This implies that at initial stage, economic growth increase environmental degradation until a certain level where further increase in economic growth reduces environmental degradation. The situation above indicates that environmental quality is associated with cost of economic growth. The negative relationship found between square term of GDP and environmental degradation in Nigeria signifies that at higher level of economic development policy maker are taking control

measure for reducing environmental pollution. This is in line with the agitation made by the United Nations that developing countries should consider mitigating the carbon dioxide emission for sustainable development. This finding is consistent with the result found by previous studies (Tang & Tan 2014; Sehrawat *et al*., 2015; Rafindadi, 2016) . Moreover, FDI is not significant in explaining CO_2 emissions in Nigeria.

Table 5 presents the post-estimation diagnostic checks. The estimated model shows that no Heteroskedasticity, serial correlation and the errors are normally distributed. Moreover, the study adopts the CUSUM and CUSUM square test to ascertain the stability of the model. Figure 1 and 2 shows that the model of the study is stable as the lines of CUSUM and CUSUM square are with in the 5 percent critical bound.

Table 5: Post Estimation Diagnostic Checks on the estimated model

Test Type	F-statistics	Probability	Result
Breusch-Pagan Test.	0.832226	0.6410	No Heteroskedasticity
Breusch-Godfrey Test	2.157081	0.1664	No Serial Correlation
Jarque-Bera	4.748737	0.09307	Normally Distributed

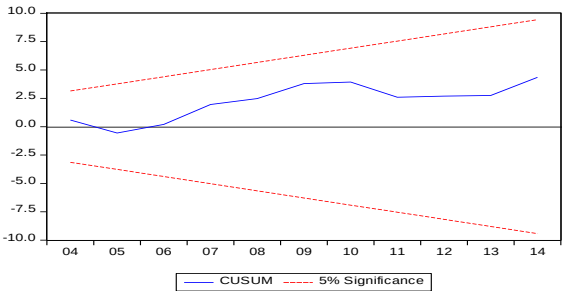

Figure 1: CUSUM Stability test

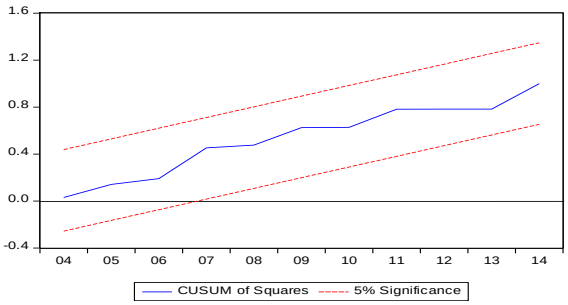

Figure 2: CUSUM square Stability test

5. CONCLUSION

This study investigates the presence of EKC in Nigeria by using ARDL technique. The short-run analysis of this study reveals that none of the variable is significant in explaining Carbon dioxide emissions. The long-run analysis indicates that GDP aggravates CO_2 emissions. However, further rise in GDP is associated with lower CO_2 emissions. This indicates that environmental Kuznets curve (EKC) hypothesis is valid in Nigeria, due to the fact that higher economic progress reduce CO_2 emission. The negative relationship that found to exist between CO_2 emissions and the square term of GDP is similar with the conclusion of previous studies (Tang & Tan 2014; Sehrawat *et al.*, 2015; Rafindadi, 2016). Although the present study has a broader scope of the period, however the limation here is that the data used for the analysis of this study ends at the year 2014. Because the data on CO_2 emissions used in this study was available only up to the year 2014. Finally, there is a need for future studies to consider other factors that may influence environmental quality.

6. RECOMMENDATIONS

Based on the result obtained in this study economic growth is significant and positively related to Carbon dioxide emissions, while further rise in GDP reduce Carbon dioxide emissions in

Nigeria. Moreover, this shows that rise in GDP is associated with environmental regulations in Nigeria, which has indicated the presence of EKC hypothesis. Therefore, this study recommends more sophisticated policy that ensures continuous reduction in carbon emissions for better and clean environment in Nigeria. For instance, adoption of green technology policy is very vital.

REFERENCES

1. Ahmed, Khalid, and Wei Long. "An Empirical Analysis of Co2 Emission in Pakistan Using EKC Hypothesis." *Journal of International Trade Law and Policy* 12, 2 (2013): 186–200. doi:10.1108/09574090910954864.
2. Al-Mulali, Usama, Behnaz Saboori, and Ilhan Ozturk. "Investigating the Environmental Kuznets Curve Hypothesis in Vietnam." *Energy Policy* 76. (2015): 123–31. doi:10.1016/j.enpol.2014.11.019.
3. Al-Mulali, Usama, Chor Foon Tang, and Ilhan Ozturk. "Estimating the Environment Kuznets Curve Hypothesis: Evidence from Latin America and the Caribbean Countries." *Renewable and Sustainable Energy Reviews* 50 (2015): 918–24. doi:10.1016/j.rser.2015.05.017.
4. Al-Mulali, Usama, Choong Weng-Wai, Low Sheau-Ting, and Abdul Hakim Mohammed. "Investigating the Environmental Kuznets Curve (EKC) Hypothesis by Utilizing the Ecological Footprint as an Indicator of Environmental Degradation." *Ecological Indicators* 48 (2015): 315–23. doi:10.1016/j.ecolind.2014.08.029.
5. Apergis, Nicholas, and Ilhan Ozturk. "Testing Environmental Kuznets Curve Hypothesis in Asian Countries." *Ecological Indicators* 52 (2015): 16–22. doi:10.1016/j.ecolind.2014.11.026.
6. Baek, Jungho, and Hyun Seok Kim. "Is Economic Growth Good or Bad for the Environment? Empirical Evidence from Korea." *Energy Economics* 36 (2013): 744–49. doi:10.1016/j.eneco.2012.11.020.

7. Dinda, Soumyananda. "Environmental Kuznets Curve Hypothesis : A Survey." *Ecological Economics* 49, 4 (2004): 431–55. doi:10.1016/j.ecolecon.2004.02.011.
8. Dogan, Eyup, and Berna Turkekul. "CO2 Emissions , Real Output, Energy Consumption , Trade , Urbanization and Financial Development : Testing The EKC Hypothesis For The USA." *Environmental Science and Pollution Research* 23,2 (2015): 1203–13. doi:10.1007/s11356-015-5323-8.
9. Gao, Jing, and Ã Lei Zhang. "Electricity Consumption , Economic Growth, CO 2 Emissions Nexus in Sub - Saharan Africa : Evidence from Panel Cointegration." *African Development Review* 26, 2 (2014): 359–71.
10. Jebli, Mehdi Ben, Slim Ben Youssef, and Ilhan Ozturk."Testing Environmental Kuznets Curve Hypothesis: The Role of Renewable and Non-Renewable Energy Consumption and Trade in OECD Countries." *Ecological Indicators* 60 (2017): 824–31. doi:10.1016/j.ecolind.2015.08.031.
11. Asman, Adnan, and Yavuz Selman Duman. "CO2 Emissions, Economic Growth, Energy Consumption, Trade and Urbanization in New EU Member and Candidate Countries: A Panel Data Analysis." *Economic Modelling* 44 (2015): 97–103. doi:10.1016/j.econmod.2014.10.022.
12. Katircioğlu, Salih Turan. "Testing the Tourism-Induced EKC Hypothesis: The Case of Singapore." *Economic Modelling* 41 (2014): 383–91. doi:10.1016/j.econmod.2014.05.028.
13. Kojima, Masami, and Robert Bacon. "Changes in CO 2 Emissions from Energy Use."(2009)
14. Kuznets, Simon. "Economic Growth and Income Inequality." *The American Economic Review* 45, 1 (1955): 1–28.
15. Lau, Lin Sea, Chee Keong Choong, and Yoke Kee Eng. "Investigation of the Environmental Kuznets Curve for Carbon Emissions in Malaysia: DO Foreign Direct Investment and Trade Matter?" *Energy Policy* 68 (2014): 490–97. doi:10.1016/j.enpol.2014.01.002.
16. Li, Tingting, Yong Wang, and Dingtao Zhao. "Environmental Kuznets Curve in China: New Evidence from Dynamic Panel Analysis." *Energy Policy* 91 (2016): 138–47. doi:10.1016/j.enpol.2016.01.002.

17. Omri, Anis, Saida Daly, Christophe Rault, and Anissa Chaibi. "Financial Development , Environmental Quality , Trade and Economic Growth : What Causes What in MENA Countries." *Energy Economics* 48 (2015): 242–52. doi:10.1016/j.eneco.2015.01.008.
18. Onafowora, Olugbenga A., and Oluwole Owoye. "Bounds Testing Approach to Analysis of the Environment Kuznets Curve Hypothesis." *Energy Economics* 44 (2014): 47–62. doi:10.1016/j.eneco.2014.03.025.
19. Pesaran, M. Hashem, Yongcheol Shin, and Richard J. Smith. "Bounds Testing Approaches to the Analysis of Level Relationships." *Journal of Applied Econometrics* 16, 3 (2001): 289–326. doi:10.1002/jae.616.
20. Rafindadi, Abdulkadir Abdulrashi. "Revisiting the Concept of Environmental Kuznets Curve in Period of Energy Disaster and Deteriorating Income: Empirical Evidence from Japan." *Energy Policy* 94 (2016): 274–84. doi:10.1016/j.enpol.2016.03.040.
21. Samia, Sofia. "The Impact of Economic and Financial Development on Environmental Degradation." *Structural Change and Economic Dynamics* 32, 4 (2015): 485–502.
22. Sehrawat, Madhu, A.K. Giri, and Geetilaxmi Mohapatra. 2015. "The Impact of Financial Development , Economic Growth and Energy Consumption on Environmental Degradation: Evidence from India." *Management of Environmental Quality* 26, 5 (2015): 666–82. doi:10.1108/MEQ-05-2014-0063.
23. Tang, Chor Foon, and Bee Wah Tan. "The Impact of Energy Consumption , Income and Foreign Direct Investment on Carbon Dioxide Emissions in Vietnam." *Energy* 79 (2014): 447–54. doi:10.1016/j.energy.2014.11.033.
24. WDI. *World Development Indicators : Energy Dependency , Efficiency and Carbon Dioxide Emissions (2017)*.