Lapai Journal of Economics; Volume 4, No.2; 2020
Print ISSN: 2659-028X
Online ISSN: 2659-0271
Published by Department of Economics, IBB University Lapai, Niger State, Nigeria

Electricity production, Economic Growth and Environmental Quality in Nigeria

Ismail Aliyu Danmaraya[1], Muhammad Bilyaminu Ado[1], Aminu Muhammad Umar[2] & Maryam Ali Muhammad[3]

[1]*Department of Economics, Yusuf Maitama Sule University, Kano*
[2]*Department of Economics, Nigerian Army University, Biu, Borno State, Nigeria*
[3]*Department of Arts & Social Sciences Education, Yusuf Maitama Sule University, Kano*

Correspondence Email: ismail.danmaraya@aun.edu.ng

Abstract
The objective of this study is to investigate the impact of electricity production and economic growth on environmental quality in Nigeria. The study used the Autoregressive Distributed Lags (ARDL) Model for the period of 1980-2015. The study established the existence of long run association among the variables. It further revealed that in the long run, electricity production and economic growth positively influence environmental quality in Nigeria. Therefore, the study recommends policies that will enhance clean energy production in Nigeria.

Keywords: CO_2 *Emissions, Electricity Production, Economic Growth, Autoregressive Distributed Lag*
JEL Classification: P28, Q43, Q47

1. Introduction

The persistent rise in the global discharges of CO2 emissions and the likely undesirable consequences of this practice on the global atmosphere attracts the attention of policy makers at an international level to debate on the contribution of various countries to thetotal emissions and the efforts put forward by these countries to contract these emissions (Kojima and Bacon, 2009). The global CO2 emissions had risen from about 21bn tons in 1990 to about 29.4bn in 2008, representing about 40 % increase over the same period (Tang and Tan, 2014). Moreover, it is argued that if necessary action is not taken to cut down the concentration of CO2 emissions in the atmosphere, by the year 2035, it will be two times its amount from its pre-industrial level which may cause a short run increase in the global average temperature by more than 2oC and a higher probability of rising such temperature by more than 5oC in the long run (Tiwari, 2011). That is why most of the developed industrialized nations have committed to cut down their CO2 emissions significantly by the year 2020 (Kojima and Bacon, 2009).

Similarly, as most of the developing nation's keepgrowing, their emissions of CO2 become one of the most important concerns in various agreements at international level especially concerning the ingress of Foreign Direct Investment (FDI) and the environmental quality. In handling the issue of CO2 emissions, the mottos of "green economy" and "low carbon city" are presently popular among the developing nations (Tang & Tan, 2014). Therefore, many developing nations are expected to control the growth of their CO2 emissions in the near future (Kojima & Bacon, 2009).

Many factors responsible for the growth of CO2 emissions worldwide include: population and economic growth, industrialization and FDI operations, and energy production and consumption (Black et al., 2015; Qader, 2009). The extent to which each of these factors contributes to CO2 emissions in the atmosphere varies from one region to another depending on the extent of the existence of these factors in a country. The process of understanding how these factors influence the concentration of CO2 emissions is vital for necessary environmental policy making.Though, many previous studies were conducted to examine the determinants of CO2 emissions in many countries, most of these studies (Danlami et al., 2017; Begum et al., 2015; Razak et al., 2013) concentrated mostly on the relationship between energy consumption, economic growth, population and CO2 emissions without considering the simultaneous impacts ofenergy production, capital formation and FDI on CO2 emissions.

Furthermore, Nigeria was once seen as one of the fast growing economies in the world and the largest economy in Africa (World Bank, 2015). This may have impact on the environmental quality. In addition the Nigerian Meteorological Agency (2012) data has shown that the average annual rainfall and temperature have been fluctuating and this cannot be unconnected to economic activities in the country.

Meanwhile, most of the studies on CO2 emissions concentrated mainly on one country as the focus of analysis. For instance, Tang and Tan (2014) focus only on Vietnam, Nnaji et al. (2013) on Nigeria, and Rui and Shuang (2011) on Shandong province. Therefore, base on the above argument, the contribution of this study is that it tries to assess the simultaneous impacts of factors, such as electricity production, GDP, and FDI on CO2 emissions in Nigeria. The findings of this study therefore, are expected to provide new avenues to policy makers in designing a comprehensive environmental policy in Nigeria. The paper will be presented as follows: Section 2 provides the review of related literature, method of analysis is contained in Section 3. Section 4 provides the estimated results. Finally, Section 5 provides the policy implications and concludes the study.

2. Review of Literature

The relationship among energy consumption, $C0_2$ emissions and economic growth can be categorized into three group of research in the literature. The first group of research paid attention to $C0_2$ emission-growth nexus which attempt to validating the EKC hypothesis, example of such studies are De Bruyn, Van Den Bergh, and Opschoor (1998), Halkos (2003), Jalil and Mahmud (2009), Fodha and Zaghdoud (2010), Narayan and Narayan (2010), Saboori, Sulaiman and Mohd (2012), Liu, Yan and Zhou (2016). The second group of research, for instance, Stern and Cleveland (2004), Soytas and Sari (2009), Ozturk (2010), Ouedraogo (2013), Danmaraya and Hassan (2016) and Solarin and Ozturk (2016) concentrate on energy-growth nexus where issues of energy consumption are related to economic growth. The third group of research such as: Soytas and Sari (2009), Al-mulali and Sab (2012), Govindaraju and Tang (2013), Salahuddin and Gow (2014) and Tang and Tan (2015) attempt at merging the $C0_2$ emissions-growth nexus with energy-growth nexus. In this case, the dynamic relationship among energy consumption, $C0_2$ emissions and economic growth are analyzed.

The relationship between environmental pollution and economic growth starts with the study of Grossman and Krueger(1991) for North America, which demonstrated that in the initial stage, environmental quality tend to deteriorate as per capital GDP increase, but later improve with further increase in GDP per capita. This brought about the EKC hypothesis, which suggests an inverted U-shaped relationship between environmental pollution and economic growth. Since then, many studies concentrate on the EKC hypothesis with diverse findings. For instance, Saboori, Sulaiman, and Mohd (2012) investigate the EKC hypothesis for Malaysia and found a U-shaped relationship between $C0_2$ emissions and economic growth, implying that $C0_2$ emissions fall with increase in income. Furthermore, an inverted U-shaped relationship among economic growth and $C0_2$ emissions was established in the studies of Halkos (2003) for OECD and non-OECD countries, Jalil and Mahmud (2009) for China, Pao and Tsai (2010) for BRIC countries, Heidari, Turan Katircioğlu, and Saeidpour(2015) for Association of South East Asian Nations,Tang and Tan (2015) for Vietnam, Bento and Moutinho (2016) for Italy, among others. Yet, some studies such as De Bruyn, Van Den Bergh, and Opschoor (1998) and Begum, Sohag, Abdullah and Jaafar (2015) asserted that the EKC hypothesis cannot hold and hence the EKC is invalid in explaining $C0_2$ emissions and economic growth.

Taking the instance of Sohag, Abdullah and Jaafar (2015), their study investigates the dynamic impact of GDP growth, energy consumption and population growth on C02 emissions in Malaysia covering the period between 1970-2009 using the ARDL bound testing approach. Their study failed to validate the EKC hypothesis, meaning that the relationship between the variables did not justify the inverted U-shaped. Contrary to this finding, Sharif, Afshan, Chrea and Khan (2020) analyzed the EKC hypothesis in Malaysia using data covering 1995Q1 to 2018Q4 by employing the QARDL model and established the presence of the inverted U-Shaped curve in the Malaysian economy. Further, Saqib and Benhmad (2020) study the EKC hypothesis by investigating the relationship between ecological footprint, economic growth, energy consumption and growth for EU countroes covering the period of 1995 to 2015 and found that income growth support the validity of EKC hypothesis.

Similarly, the relationship connecting energy consumption with economic growth start with the study of Kraft and Kraft (1978) and since then, a lot of studies have attempt at investigating the energy-growth relationship with contradicting findings. While some studies, such as: Apergis and Payne (2010), Odhiambo (2014), Iyke (2015) and Tang, Tan and Ozturk (2016) argued in favor of unidirectional causality running from energy consumption to economic, other studies, for example, Ouedrago (2013), Stern and Enflo (2013) and Ahmed and Azam (2016) argued that economic growth granger causes energy consumption. Also, in the third category, bidirectional causality was found between energy consumption and economic growth. In this case, there is a feedback relationship between energy consumption and economic growth (see for example: Ziramba, 2009, Rahman et. al, 2015, & Solarin & Ozturk, 2016). The last categories are of the view that there is no causal relationship between energy consumption and economic growth. they are otherwise referred to as the neutrality hypothesis (see Oh & Lee, 2004 &, Alper & Oguz, 2016).

The impact of renewable energy consumption on economic growth in ASEAN countries using Generalized Method of Moment (GMM) has been found to be positive (Fadihah, Lestari, Sahdan & Ahmad, 2020). Also, Bouyghrissi, Berjaoui and Khanniba (2020) investigate the nexus between renewable energy consumption and economic growth in Moroco from 1990 to 2014 using the ARDL and Granger causality test. The empirical findings support positive causality running from renewable energy consumption to economic growth. In addition, Hassan, Danmaraya and Danlami 2018) examines the link connecting energy consumption with manufacturing performance by using panel data to sample low-income and averages income SSA countries during the period of 1995-2013 and establish that energy consumption lead to increase in manufacturing performance.

In conclusion, the literature has established conflicting evidences among $C0_2$ emissions-growth nexus and energy-growth nexus, which justifies this study in re-examining this relationship by merging the $C0_2$ emissions-growth nexus with energy-growth nexus in Nigeria for better policy recommendation.

3. Method of Analysis

Data and Description

This study used time series data for Nigeria from 1980 to 2015 onelectricity production,$C0_2$ emissions, FDI, and economic growth from the World BankWorld Development Indicators. $C0_2$ emissions are measured by $C0_2$ emissions in kilo terms (kt) as FDI is measured by foreign direct investment percentage of GDP. Economic growth is proxied by GDP growth as electricity production is measured by electricity production from oil, gas and coal source (% of total).

Empirical Model

The model for this study is given by:

$$CO_{2_t} = f(GDP_t + EP_t + FDI_t) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 1$$

Where $GDP_t$is the GDP growth, CO_2 indicates $C0_2$ emissions, EP stands for electricity production, and FDI represents foreign direct investment. Taking the natural logarithm of equation (1) lead to the specification of equation (2) as follows:

$$lnCO_{2_t} = \eta_0 + \eta_1 lnGDP_t + \eta_2 lnEP_t + \beta_3 lnFDI_t + \varepsilon_t \ldots\ldots\ldots\ldots\ldots\ldots.. 2$$

Where$\varepsilon_t$is the error term, *ln*represents natural logarithm, η_1, η_2, $\eta_5$are the parameters of $C0_2$ emissions with respect to the independent variables.

Unit Root Test

Identifying the point of integration on each variable is the initial conventional procedure in time series analysis. This is because non-stationary time series data can lead to spurious regression. For that reason, all the variables are subjected to non-stationarity test by using the Augmented Dickey-Fuller (1979) unit root test. Confirming the series to be stationary qualifies the study to test for the presence of long run cointegration among the variable.

Cointegration Test

In this study, the Autoregressive Distributed Lag (ARDL) method advanced by Pesaran, Shin and Smith (2001) is used to examine the long run cointegration among the variables. The ARDL method is superior to other techniques because the method can be used without regarding whether the variables are integrated of order zero I(0) or order one I(1) or the combination of both as against other techniques such as Johansen which require the variable to be integrated of the same order. Likewise, this method accommodates small sample size. These properties have made the ARDL test to be a well-known approach lately. The ARDL model used in this study is given by equation (3):

$$\Delta \ln CO_{2_t} = \vartheta_0 + \sum_{k=1}^{p} \vartheta_{1k} \Delta \ln CO_{2_{t-k}} + \sum_{k=1}^{q} \vartheta_{2k} \Delta \ln GDP_{t-k} + \sum_{k=1}^{q} \vartheta_{3k} \Delta \ln EP_{t-k} + \sum_{k=1}^{q} \vartheta_{4k} \Delta \ln FDI_{t-k} + \delta_{11} \ln CO_{2_{t-1}} + \delta_{12} \ln GDP_{t-1} + \delta_{13} \ln EP_{t-1} + \delta_{14} \ln FDI_{t-1} + \varepsilon_{1t}$$

$$\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots.. 3$$

Where ε_{1t} is the residuals which is assumed to be normally distributed, Δ represents the first difference operator, ϑ is the dynamics of error correction, δ represent long run relationships.

Using *F*-test, cointegration relationship is examined among the variables where the null hypothesis that $H_0: \delta_{11} = \delta_{12} = \delta_{13} = \delta_{14} = 0$ is tested against $H_1: \delta_{11} \neq \delta_{12} \neq \delta_{13} \neq \delta_{14} \neq 0$. In deciding cointegration among the variables, H_0 is rejected if the *F*-statistic is greater than the upper bound. On the contrary, if *F*-statistic is less than the lower bound, H_0 cannot be rejected, while the result becomes inconclusive if the *F*-statistic is between the upper and the lower bounds.

The Long run estimations

Following the cointegration test, next is to estimate the long run coefficients to determine the elasticities of the variable. Equation 4 presents the long run coefficients of the variable employed

$$lnCO_{2_t} = \eta_0 + \sum_{k=1}^{p} \eta_{1k}\, lnCO_{2_{t-k}} + \sum_{k=1}^{q_1} \eta_{2k} lnGDP_{t-k} + \sum_{k=1}^{q_2} \eta_{3k} lnEP_{t-k} + \sum_{k=1}^{q_3} \eta_{4k} lnFDI_{t-k} + ECM_{t-1} + \upsilon_{it} \quad \ldots\ldots 4$$

Where *ln* represents the natural log, η is the long run coefficients, and υ_{it} shows the white noise error term.

The Short run estimations

Having established the presence of cointegration and the long run estimates, we then estimate the short run coefficients and determine the ECM. Equation (5) presents the short run coefficients

$$\Delta lnCO_{2_t} = \lambda_0 + \sum_{k=1}^{p} \lambda_{1k}\, \Delta lnCO_{2_{t-k}} + \sum_{k=1}^{q_1} \lambda_{2k} \Delta lnGDP_{t-k} + \sum_{k=1}^{q_2} \lambda_{3k} \Delta lnEP_{t-k} + \sum_{k=1}^{q_3} \lambda_{4k} \Delta lnFDI_{t-k} + ECM_{t-1} + \upsilon_{it} \quad \ldots\ldots 5$$

Where λ represents the short run coefficients, υ_{it} is the white noise error term and ECM_{t-1} measured the speed of adjustment back to long run equilibrium. It is the adjustment mechanisms that stabilize the disequilibrium in the model.

4. Results

Unit Root Test

To find out the order of integration for each of the variable and detect the possibility of examining cointegration among the variables, this study used the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) unit root tests in testing the stationarity properties of the series. Table 1 presents the unit root test result.

Table 1: *Unit Root Test*

Series	ADF		PP	
	Levels	First Difference	Levels	First Difference
$C0_2$	0.921	-5.336*	0.511	-12.634*
	(0.491)	(0.000)	(0.768)	(0.000)
GDP	0.723	-5.953*	-5.483*	-9.549*
	(0.903)	(0.001)	(0.000)	(0.000)
EP	0.654	-8.883*	0.246	-7.909*
	(0.673)	(0.000)	(0.698)	(0.000)
FDI	-0.657	-5.161*	-0.769	-6.828*
	(0.543)	(0.003)	(0.822)	(0.000)

*Notes: * represents statistically significant at 5% level of significance. Figures in parenthesis represent probability.*
Source: Authors' Computation

Table 1 showed that all the variables are non-stationary at level using ADF and PP unit root test with the exception of GDP, which is found to be stationary in level under PP test. However, after taking the first difference, all the variables turn back to be stationary. This means that the variables are combination of 1(1) and one 1(0) variables. Hence, the study proceeds with the estimation of cointegration using the ARDL-Bound test.

Cointegration Test

In this sub-section, the ARDL model is employed to prove long run association between the variables. Table 2 presents the ARDL-Bound test to find out the long run connection among the variables.

Table 2: *ARDL Bounds Test Results*

				Critical values	
Variables	*F*-stat	Lag	Sig. Level	I(0)	I(1)
$F_{\ln C0_2}[\ln C0_2 / \ln GDP, \ln EP, lnFDI,$	6.343*	2	10%	2.26	3.35
			5%	2.62	3.79
			1%	3.41	5.62

*Note: * represents 5% level of significance*
Source: Authors' Computation

From Table 3, the result of the bound test pointed out that the estimated *F*-statistic of 6.343 is greater than the upper bound at 5% significance level. Therefore, we reject null hypothesis of no cointegration at 5% level of significance and conclude that long run relationship exist among the variables. Establishing long run relationship among the variables gives an opportunity to estimate the long run and short run coefficients.

Long Run Coefficient

Confirming the presence of cointegration among the variables qualifies this study to estimate the long run coefficients of the variables employed. Table 3 demonstrates the long run coefficient of the variable.

Table 3: *Long Run Coefficients. Dependent Variable:* $\Delta lC0_2$*Emissions*

Variable	Coefficient	Standard Error	t-Statistic	Prob.
ΔlnGDP	0.215	0.080	2.687*	0.000
ΔlnEP	0.492	0.134	3.671*	0.001
ΔlnFDI	0.136	0.027	5.037**	0.040
C	5.602	0.859	6.526**	0.000

*Note: * and ** represents 1% and 5% level of significance, respectively.*
Source: Authors' Computation

Table 3 demonstrates that economic growth has positive significant effect on $C0_2$ emissions in Nigeria. The coefficient of 0.21 indicates that 1 % increase in economic growth lead to 0.21% increase in $C0_2$ emissions in Nigeria. Similarly, electricity production has positive significant impact on emissions as 1% increase in electricity production would increase $C0_2$ emissions by 0.49%. The result of electricity production and economic growth followed the findings of Ali, Law and Zannah (2016) on Nigeria which revealed a positive impact of economic growth and electricity production on $C0_2$ emissions. Furthermore, the coefficient of $C0_2$ emissions with respect to FDI is 0.13 which signifies that the impact of FDI on $C0_2$ emissions in Nigeria is quite low. In this case, a 1% increase in FDI will translate to a 0.13% increase in emissions. This result replicates the studies of Acharyya (2009) for India which discovered a positive effect of FDI to $C0_2$ emissions. In general, both economic growths, FDI and electricity production increases environmental degradation in the long run.

Short Run Coefficient

Establishing the long run relationship and the coefficients of the long run allow the study to estimate the short run coefficients of the variables. Table 4 explain the short run ECM and coefficients of the variables.

Table 4: *Short Run Estimation*

Variable	Coefficient	Standard Error	t-Statistic	Prob.
ΔlnGDP	0.290	0.052	5.576	0.104
ΔlnEP	0.498	0.125	3.989*	0.001
ΔlnFDI	0.024	0.026	0.919	0.372
ΔlnFDI (-1)	-0.102	0.018	-5.534*	0.000
ECT(-1)	-0.695	0.130	-5.346*	0.000

*Notes: * represents statistically significant at 5% level of significance*
Source: Authors' Computation

Electricity production and FDI increases $C0_2$ emissions positively as in the long run, the coefficients of the short run shows that economic growth is not significant in explaining$C0_2$ emissions. The ECT measured the speed of convergence to the long run equilibrium, which is expected to be negative and less than one. The coefficient of 0.69 for the ECT reveals 69% speed of adjustment and converge to the long run equilibrium within one year.

Diagnostic Check

To ensure the consistency and efficiency of the estimated models, the study conducted diagnostic check on the models. Table 5 shows the result of serial correlation, normality and Heteroscedasticity test. From the table, the null hypothesis of no serial correlation, normality and Heteroscedasticity cannot be rejected. Hence, it can be concluded that the model has passed all of the diagnostic checks conducted.

Table 5: *Diagnostic Test of the ARDL Model*

Test Statistics	*F*-statistics	Prob.
Autocorrelation	0.631	0.314
Normality	0.210	0.735
Heteroskedasticity	0.734	0.458

Source: Authors' Computation

The stability of the model is proved by the cumulative sum of recursive residuals (CUSUM) and cumulative sum of recursive residuals square (CUSUMQ). Figure 1 and Figure 2 shows that the series are within the critical bound at 5% significance level which confirmed the model to be stable over time.

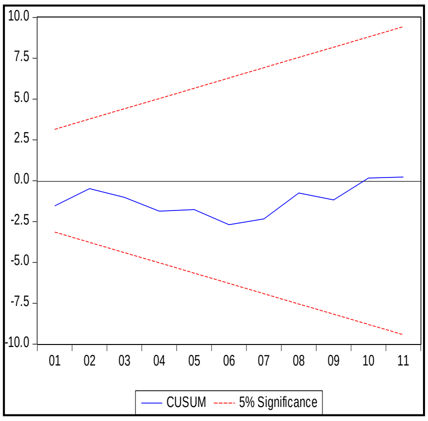

Figure 1: CUSUM

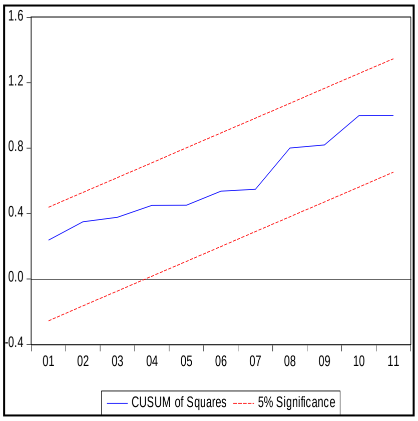

Figure 2: CUSUMQ

5. Policy Implication and Conclusion

From the policy point of view, policy makers should provide policies that will reduce environmental pollution with little or no harm to economic variables. Base on the findings of this study, policy makers should give more attention to economic growth, electricity production and FDI. This is owing to the fact that they contribute more to environmental pollution in Nigeria.

In conclusion, this study examined the effect of economic growth, FDI, and electricity production on $C0_2$ emissions in Ghana for the period of 1980-2015. The result of the cointegration test established the presence of a long run relationship among the variables. Furthermore, the coefficients of the long run reveal that economic growth, electricity production and FDI positively affect $C0_2$ emissions in Nigeria. Also, the short run ECM showed about 69% speed of adjustment back to the long run equilibrium.

Reference

Ahmed, M., & Azam, M. (2016). Causal nexus between energy consumption and economic growth for high, middle and low income countries using frequency domain analysis. *Renewable and Sustainable Energy Reviews*, *60*, 653-678.

Al-Mulali, U., & Sab, C. N. B. C. (2012). The impact of energy consumption and CO 2 emission on the economic growth and financial development in the Sub Saharan African countries. *Energy*, *39*(1), 180-186.

Ali, H. S., Law, S. H., & Zannah, T. I. (2016). Dynamic impact of urbanization, economic growth, energy consumption, and trade openness on CO 2 emissions in Nigeria. *Environmental Science and Pollution Research*, 1-9.

Alper, A., & Oguz, O. (2016). The role of renewable energy consumption in economic growth: Evidence from asymmetric causality. *Renewable and Sustainable Energy Reviews*, *60*, 953-959.

Apergis, N., & Payne, J. E. (2010). Energy consumption and growth in South America: Evidence from a panel error correction model. *Energy Economics*, *32*(6), 1421-1426.

Begum, R. A., Sohag, K., Abdullah, S. M. S., & Jaafar, M. (2015). CO 2 emissions, energy consumption, economic and population growth in Malaysia. *Renewable and Sustainable Energy Reviews*, *41*, 594-601.

Bento, J. P. C., & Moutinho, V. (2016). CO 2 emissions, non-renewable and renewable electricity production, economic growth, and international trade in Italy. *Renewable and Sustainable Energy Reviews*, *55*, 142-155.

Black, G., Black, M.A., Solan, D. & Shropshire, D. (2015). Carbon free energy development and the role of small modular reactors: a review and decision framework for deployment in developing countries. *Renewable and Sustainable Energy Reviews*, (43) 2015, 83-94.

Danlami, A.H., Applanaidu, S. D. & Islam, R. (2017). Movement towards a low carbon emitted environment: a test of some factors in Malaysia. *Environment, Development and Sustainability*, (2) 1085-1102.

Danmaraya, I. A., & Hassan, S. (2016). Electricity consumption and manufacturing sector productivity in Nigeria: An ARDL-Bounds testing approach. *International Journal of Energy Economics and Policy*, *6*(2), 1-7.

De Bruyn, S. M., van den Bergh, J. C., & Opschoor, J. B. (1998). Economic growth and emissions: Reconsidering the empirical basis of environmental Kuznets curves. *Ecological Economics*, *25*(2), 161-175.

Dickey, D. A., & Fuller, W. A. (1979). Distribution of the estimators for autoregressive time series with a unit root. *Journal of the American statistical association*, *74*(366a), 427-431.

Fodha, M., & Zaghdoud, O. (2010). Economic growth and pollutant emissions in Tunisia: An empirical analysis of the environmental Kuznets curve. *Energy Policy*, *38*(2), 1150-1156.

Govindaraju, V. C., & Tang, C. F. (2013). The dynamic links between CO 2 emissions, economic growth and coal consumption in China and India. *Applied Energy*, *104*, 310-318.

Grossman, G. M., & Krueger, A. B. (1991). *Environmental impacts of a North American free trade agreement* (No. w3914). National Bureau of Economic Research.

Grossman, G. M., & Krueger, A. B. (1994). *Economic growth and the environment* (No. w4634). National Bureau of Economic Research.

Halkos, G. E. (2003). Environmental Kuznets Curve for sulfur: Evidence using GMM estimation and random coefficient panel data models. *Environment and Development Economics*, *8*(04), 581-601.

Heidari, H., Katircioğlu, S. T., & Saeidpour, L. (2015). Economic growth, CO 2 emissions, and energy consumption in the five ASEAN countries. *International Journal of Electrical Power & Energy Systems*, *64*, 785-791.

Iyke, B. N. (2015). Electricity consumption and economic growth in Nigeria: A revisit of the energy-growth debate. *Energy Economics*, *51*, 166-176.

Jalil, A., & Mahmud, S. F. (2009). Environment Kuznets curve for CO 2 emissions: A cointegration analysis for China. *Energy Policy*, *37*(12), 5167-5172.

Kojima, M. & Bacon, R. (2009). Changes in CO2 emissions from energy use. working paper, World Bank/Oil, Gas, and Mining Policy Division, Washington, DC.

Kraft, J., & Kraft, A. (1978). Relationship between energy and GNP. *Journal of Energy Development;(United States)*, *3*(2).

Liu, Y., Yan, B., & Zhou, Y. (2016). Urbanization, economic growth, and carbon dioxide emissions in China: A panel cointegration and causality analysis. *Journal of Geographical Sciences*, *26*(2), 131-152.

Narayan, P. K., & Narayan, S. (2010). Carbon dioxide emissions and economic growth: Panel data evidence from developing countries. *Energy Policy*, *38*(1), 661-666.

Nnaji, C.E., Chukwu, J.O. & Moses, N. (2013). Electricity supply, fossil fuel consumption, CO2 emissions and economic growth: implications and policy options for sustainable development in Nigeria. *International Journal of Energy Economics and Policy*, 3 (3) 262-271.

Odhiambo, N. M. (2014). Energy dependence in developing countries: Does the level of income matter?. *Atlantic Economic Journal*, *42*(1), 65-77.

Oh, W., & Lee, K. (2004). Energy consumption and economic growth in Korea: Testing the causality relation. *Journal of Policy Modeling*, *26*(8), 973-981.

Ouedraogo, N. S. (2013). Energy consumption and economic growth: Evidence from the economic community of West African States (ECOWAS). *Energy Economics*, *36*, 637-647.

Ozturk, I. (2010). A literature survey on energy–growth nexus. *Energy policy*, *38*(1), 340-349.

Pao, H. T., & Tsai, C. M. (2010). CO 2 emissions, energy consumption and economic growth in BRIC countries. *Energy Policy*, *38*(12), 7850-7860.

Pesaran, M. H., Shin, Y., & Smith, R. J. (2001). Bounds testing approaches to the analysis of level relationships. *Journal of Applied Econometrics*, *16*(3), 289-326.

Phillips, P. C., & Perron, P. (1988). Testing for a unit root in time series regression. *Biometrika*, *75*(2), 335-346.

Qader, M.R. (2009). Electricity consumption and GHG emissions in GCC countries. *Energies*, (2) 1201-1213.

Rahman, M. S., Junsheng, H., Shahari, F., Aslam, M., Masud, M. M., Banna, H., & Liya, M. (2015). Long-run relationship between sectoral productivity and energy consumption in Malaysia: An aggregated and disaggregated viewpoint. *Energy*, *86*, 436-445.

Razak, M.I., Ahmad, I., Bujang, I., Talib, A.H. & Ibrahim, Z. (2013). IPAT- fuzzy model in measuring air pollution: evidence from Malaysia. *American International Journal of Contemporary Research*, (6) 62-69.

Rui, Z. & Shuang, L. (2011). A study on the development of low-carbon economy in Shandong province-based on empirical analysis on the influence factor of carbon emissions. *Energy Procedia*, (5) 2152-2159.

Saboori, B., Sulaiman, J., & Mohd, S. (2012). Economic growth and CO 2 emissions in Malaysia: A cointegration analysis of the environmental Kuznets curve. *Energy Policy*, *51*, 184-191.

Salahuddin, M., & Gow, J. (2014). Economic growth, energy consumption and CO 2 emissions in Gulf Cooperation Council countries. *Energy*, *73*, 44-58.

Solarin, S. A., & Ozturk, I. (2016). The relationship between natural gas consumption and economic growth in OPEC members. *Renewable and Sustainable Energy Reviews*, *58*, 1348-1356.

Soytas, U., & Sari, R. (2009). Energy consumption, economic growth, and carbon emissions: Challenges faced by an EU candidate member. *Ecological Economics*, *68*(6), 1667-1675.

Stern, D. I., & Cleveland, C. J. (2004). Energy and economic growth. *Encyclopedia of Energy*, *2*, 35-51.

Stern, D. I., & Enflo, K. (2013). Causality between energy and output in the long-run. *Energy Economics*, *39*, 135-146.

Tang, C. F., & Tan, B. W. (2015). The impact of energy consumption, income and foreign direct investment on carbon dioxide emissions in Vietnam. *Energy*, *79*, 447-454.

Tang, C. F., Tan, B. W., & Ozturk, I. (2016). Energy consumption and economic growth in Vietnam. *Renewable and Sustainable Energy Reviews*, *54*, 1506-1514.

Tiwari, A.K. (2011). A structural VAR analysis of renewable energy consumption, real GDP and CO2 emissions: evidence from India. *Economics Bulletin*, 31 (2) 1793-1806.

Ziramba, E. (2009). Disaggregate energy consumption and industrial production in South Africa. *Energy Policy*, *37*(6), 2214-2220.