Analysis of the nexus between Environmental quality and Economic growth

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ABSTRACT

This Paper inquiries into analysis of the nexus between environmental quality and economic growth for the period 1990-2018. In an attempt to realize the major objectives of the study various researcher's' works on relevant studies were exhaustively reviewed. The study utilizes annual time series data for its analysis and data on Carbon emissions metric tons per capita, GDP, Energy use and Access to electricity as a percentage of total population were collected for the period under review. Autoregressive distributed lag (ARDL) model approach was applied to estimate long run and short run relationship among the aforementioned variables. Both the short run and long run levels result fairly distinct with each other that GDP is positively and insignificantly related to carbon emissions both in the short run and long run which implies that Kuznet's Curve was not found in Nigeria, access to electricity was found to be negatively and significantly related to carbon emissions in the short run, reverse is the case in the long run, while energy use was found to be negatively and significantly related to carbon emissions in the long run it was directly opposite in the short run. The error correction model of the analysis is correctly sign and significant with 89% speed of adjustment per annum.

Keywords: Carbon Emissions, GDP, Environmental Kuznet Curve, IPAT, ARDL

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1.0 INTRODUCTION

Scientifically there exist a general consensus that human inclined economic activities of production and consumption poses a greater challenge and are capable of modifying the global environment to an unprecedented scale. Other activities which lead to pollution include thermal power stations, burning of fossil fuels, exhaust fumes. All these emit harmful pollutants like sulphur dioxide, carbon monoxide, etc, that cause acid rain, global warming, and the malfunctioning of human haemoglobin, etc. Ukpong (1994) .These activities have altered the chemical composition of the atmosphere through the emission of Green House Gases (GHG) (water vapor, carbon dioxide, methane, nitrous oxide) and ozone depleting substances force change on major biogeochemical cycles and greatly accelerated species extinction. The carbon dioxide(Co_2) remains the major component of GHG and considered a substantial cause of increasing global warming and climate change (IPCC,2014), by expectation it will be consistently rising as the main driving forces of environmental depletion. Statistics showed that Co_2 more than any other driver has contributed the most to climate change within 1750 to 2005 (UCS, 2017). Global CO_2 emissions increased from 22.3 billion metric tons in 1990 to 31.6 billion metric tons in 2008 and 35.6 billion metric tons in 2012. This represents a 41 per cent increase in CO_2 emissions since 1990.In 2012, the top-five emitters were China (share29 per cent), the USA (16 per cent), the European Union (EU27) (11 per cent), India (6 percent) and the Russian Federation (5percent), followed by Japan (4percent) (IEA, 2012).

Without GHG the average temperature of earth's surface would be about -18◦c (0◦F) rather than the present average 15◦c (59◦F) (Wikipedia, 2019). Economic activities after industrial revolution around have raised the greenhouse effect and caused earth's surface temperature to rise (EPA, 2017). Growing industrialization has worsened the ecological environment and also stimulated the global warming (Adom et al 2010). The vast majority of anthropogenic Co_2 emissions come from combustion of fossil fuels principally coal, oil and natural gas with additional contributions coming from agriculture, energy production and energy use. The highest share of Co_2 emission produced by middle income countries in Asia more specifically in India and china. In the existing literature that a consensus that economic growth enhancing polices results in consequent poor environmental quality. It's widely accepted that economic growth is linked to environmental degradation/ depletion through combustion of fossil fuels for both industrial and residential purposes. According to Kuznet model demand for environmental quality increases with income rises that a positive relationship exist between environmental degradation and income at lower levels while a negative relationship exist at higher income levels.

Relatively Nigeria an oil rich country is been challenged by poor environmental quality mainly resulting from oil exploration and production which has direct depletion /degradation impact on the soil for agricultural activities of (farming and fishing) and sea. Oil facilities and operations are located in key ecological areas, including important fishing grounds, mangroves and tropical rainforest. These areas are often heavily damaged by the oil leaks. Drinking water is polluted, people become ill and farmers lose their income because they can no longer cultivate the soil. The combustion coming from oil companies around the Niger Delta region is mainly pointed as the main cause for contamination of drinking water, posing of threat to health and livelihood of local farmers. Additional to this poor electricity supply in Nigeria is another round that adds to environmental degradation, the epileptic electricity has induced both residential and industrial sectors to seek for alternative energy sources which is mainly the use of gasoline generations to power up appliances which in turn emit Co2, noise and Air Pollution.

It's more evident that more countries in the lower-middle income strata are nonchalant about environmental quality than high income countries due to aspirations of achieving economic growth in order to curb ravaging poverty.

Most of developing countries are on the notion that 'grow the economy first' and then clean up any environment shortfall later.

Developing countries are mostly regarded as pollution heaven a setting whereby industrial firms from developed countries could easily relocate their operations without being compelled to comply with stringent environmental laws and regulations as obtain in their home countries. The pollution-heaven hypothesis as mentioned by Cole, 2004 is based on two hypothesis that (1) tough environmental standards and control measures in developed countries where such controls are either lax or nonexistent and (2) many developing countries desperately aspires to attract industries from developed countries have encouraged or even actively invited firms with agreement of minimal or outright waiver of environmental standards/laws.

2.1 Theoretical Framework

With regards to this paper two theories are uphold as the central premises to guide our analysis. The Stochastic Impacts by Regression on Population, Affluence and technology (STIRPAT) and the Environmental Kuznet Curve (EKC).

I. <u>STIRPAT</u>

Initially IPAT model by Ehrlich and Holdren (1970) and (Commoner, 1971).was initially widely used an analytical tool to model effects of human activities on the environment. It was brought about to analyze principle driving factors of anthropogenic impact on environment. IPAT assumes that environmental impact are the multiplicative product of three key driving forces “I” for Impact, “P” for population, “A” for affluence (Per capita consumption/production), “T” for technology (impact of consumption/production) $hence,\ I = PAT$

Mathematically affluence is seen as per capita GDP

$$PA = P(GDP/P) = GDP$$

$$T = I/PA = I \times (P/GDP \times P) = I\ /\ GDP$$

T = is the impact per unit of economic activity. Later on Waggoner and Ausubel (2002) reconceptualize IPAT and rename it IMPACT disaggregating T into consumption per unit of GDP (C) and impact per unit of consumption (T) so that I = PACT. IMPACT is aimed at identifications of factors that can be altered /modified to reduce impact and key factors that influence each factor. Both IPAT and IMPACT suffers a drawback such as that both model do not permit hypothesis testing also assumes proportionality in the functional between factors. To overcome this limitations (Dietz and Rosa, 1994) reformulated IPAT into a stochastic model and called it STIRPAT. Unlike the previous model STRIPAT is a stochastic model rather than accounting equation that can be used to empirically test hypothesis. Specification of STIRPAT model is given as

$$I = aP^bA^cT^de$$

Where a = scale of the model, P, A, T are the exponent of the model that must be estimated, e is the error term putting into logarithmic regression model it becomes

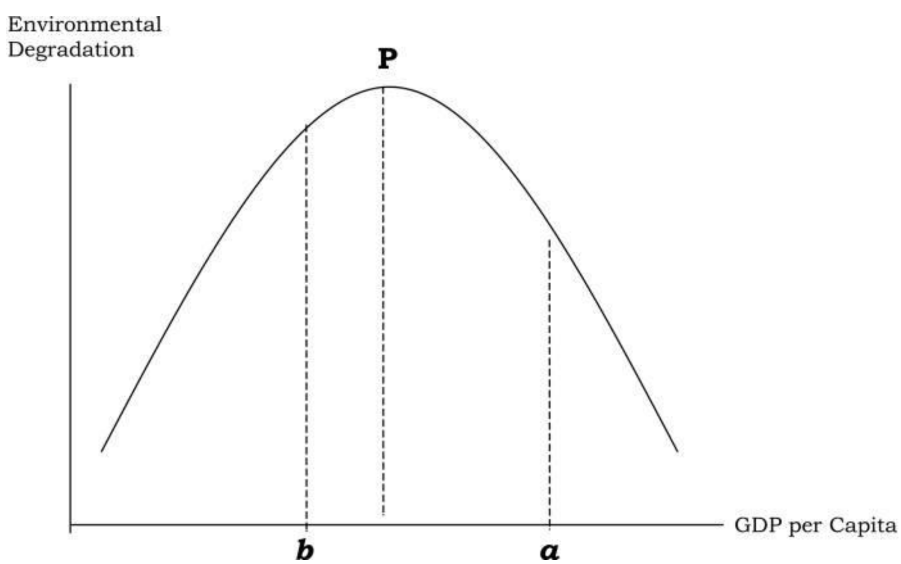
$$\log I = a + b(\log P) + c(logA) + e$$

T is disaggregated just like in the original IPAT equation, T is believed encompassed factors other than population and affluence that impact on environment and it’s now incorporated into e. Through STIRPAT model, Ecological Elasticity (EE) is developed to measure the degree of responsiveness or sensitivity of environmental impact to a change in any of the driving force either population, affluence or technology. This brings about (EEp) - population elasticity of impact while (EE_A) - Affluence elasticity of impact.

II Environmental Kuznets Curve (EKC)

The EKC was first proposed by Simon Kuznet in 1955. It's an inverted U-shape with income per capita on the horizontal X axis and environmental degradation on the vertical Y axis. Among the pioneer of researchers who applies in their empirical studies are Grossman and Krueger (1991) and later in 1992 World Bank report also adopted it. The EKC assumes that as an economy develops, market forces begins to increase and environmental quality decrease up to a turning point/maximal income level thereafter increase income growth along with increase in environmental quality. Basically environmental quality is a function of income growth at low income levels positive relationship exist between environmental degradation and income and conversely at high income levels a negative relationship exist in between. As the society moves into industrialization and agricultural mechanization the environmental continuous to be depleting until the income threshold is met then the society begins to be conscious about its environment and mark up being made on the process of growth is invested back to the environment and the ecosystem is restored.

Mathematically expressed as: $E = F(Y, Y^2, Z)$



2.2 EMPIRICAL LITERATURE

Maruotti (2011) found an inverted U-shaped relationship between urbanization and CO2 emissions as the effect is positive for low urbanization levels. When the countries were grouped based on threshold analysis the result showed that for the two groups a point is identified after which emission-urbanization elasticity become negative and increase in urbanization beyond such point do not increase emissions. For the other group, also it shows that urbanization does not contribute to more emissions rather than affluence and population.

Poumanyvong et al. (2012) applied Stochastic Impacts by Regression on Population, Affluence, and Technology (STIRPAT) technique and examined the impact of urbanization on national residential energy consumption and CO_2 emissions across 88 high, middle, and low income countries for the period of 1975–2005.The finding reveals that increase in the urban population decreases residential energy consumption in low income countries, whereas it increases the use of energy in high income countries. In the middle income countries the result indicated that household energy consumption initially falls and then rises with urbanization up to a given threshold at about 70 %. On the other hand, when the sample reduced to 80 countries the result shows that urbanization raises residential emissions in low and middle income countries. The residential emission of high income countries rises at the initial stage and consequently declined with urbanization up to66% turning point. Hossain (2011) investigated the dynamic causal relationship among CO_2 emissions, energy consumption, economic growth, trade openness, and urbanization across newly industrialized countries for the period of 1971−2007. The causality result reveals no element of long- run relationship, but unidirectional short-run connection exist that run from economic growth and trade openness to CO_2 emissions, from economic growth to energy consumption, from trade openness to economic growth, from urbanization to economic growth, and from trade openness to urbanization. It is also found that the elasticity of CO_2 emissions in relation to energy consumption is greater than the short-run elasticity, this means that with time when energy consumption increases in the countries under study, the level of emissions will also raises which brings about more environmental pollution. However, with regard to economic growth, trade openness, and urbanization the environmental quality is established to be normal good in the long-run.

Zhang and Lin (2012) applied STIRPAT model across national and regional levels in China and examined the interactions among urbanization, energy consumption, and CO_2 emissions for the period of 1995−2010. The outcome shows that urbanization increases energy use and CO_2 emissions at national level. At regional level, however, its effect on energy consumption and CO_2 emissions differ through regions as the impact of urbanization on CO_2 emissions in the central region is higher than that of the eastern region. However, the impact of urbanization on energy consumption is greater than that of CO_2 emissions in case of eastern region.(Hossain, 2012)Examined the causal relationshipamongCO_2 emissions, energy consumption, economic growth, foreign trade, and urbanization for the period of1960−2009 in Japan. The result shows that more consumption of energy increase environmental pollution, but economic growth, trade openness, and urbanization does not affect environmental quality in the long-run. Based on his study that examined the impact of income, urbanization, and industrialization on energy intensity across 76 developing countries.

Akpan and Akpan (2012) investigated the relationship between electricity consumption, carbon emissions and Economic growth in Nigeria for the period of 1970–2008 based on multivariate vector error correction model. The result reveals that in the long-run, increase in the overall economic performance increases emission of CO2 and more consumption of electricity could lead to more CO2 emission. The Granger causality result reveals unidirectional causality that run from economic growth to CO2 emissions.

Similarly (Hamisu et'al, 2016)in their study of Dynamic impact of urbanization, economic growth, energy consumption, and trade openness on CO2 emissions in Nigeria for the period of 1971-2011 based on Autoregressive distributed lag model (ARDL) The result exhibits that variables were cointegrated as null hypothesis was rejected at 1 % level of significance. The coefficients of long-run result reveal that urbanization does not have any significant impact on CO2 emissions in Nigeria, economic `growth, and energy consumption has a positive and significant impact on CO2 emissions. However, trade openness has negative and significant impact onCO2 emissions. Consumption of energy is among the main determinant of CO2 emissions which is directly linked to the level of income. Despite the high level of urbanization in the country, consumption of energy still remains low due to lower income and clear case of income inequality of the majority populace and this might be among the reasons why urbanization does not influence emissions of CO2 in the country.

Alam et al. (2012) investigated the possible existence of dynamic causality between energy consumption, electricity consumption, carbon emissions and economic growth in Bangladesh. The variables used are real GDP, per capita energy consumption, per capita electricity consumption and per capita CO2 emissions and employed Johansen co-integration, ARDL, granger causality and VECM econometrics techniques. The results indicate that unidirectional causality exists from energy consumption to economic growth both in the short and the long-run while bidirectional long run causality exists between electricity consumption and economic growth but no causal relationship exists in short run. The strong causality results indicate bidirectional causality for both the cases. A unidirectional causality runs from energy consumption to CO2 emission for the short run but feedback causality exists in the long run. CO2 Granger causes economic growth both in the short and in the long-run. An important policy implication from this result is that energy (electricity as well) can be considered as an important factor for the economic growth in Bangladesh. As higher energy consumption also means higher pollution in the long-run, as such policy makers should stimulate alternative energy sources for meeting up the increasing energy demand.

Saboori et'al (2012) established a long-run as well as causal relationship between economic growth and carbon dioxide (CO_2) emissions in Malaysia for the period 1980-2009. The variables used are per capita CO_2 emissions, and per capita real GDP with the use of ADF & PP unit root test, ARDL, VECM Granger Causality econometrics techniques. The Granger Causality test based on the Vector Error Correction Model (VECM) presents an absence of causality between CO_2 emissions and economic growth in the short run while demonstrating unidirectional causality from economic growth to CO_2 emissions in the long run. According to the findings, it implies that emission reduction policies and more investment in pollution abatement will not hurt economic growth and could be a feasible policy tool for Malaysia to achieve its sustainable development in the long run. Carbon capture and storage, carbon emissions tax and carbon trading scheme can be performed without much concern for long run income. Also suggest that, the policy tools should be accompanied by other possible strategies such as increasing plant efficiency, employing fuel balancing or fuel switching and making enhanced use of renew- able energy.

Ibrahim (2016) analyzed the dynamics of energy consumption, economic growth and population growth on carbon dioxide emissions using panel data over the period 1990 to 2011 for 9 leading African economics namely, Nigeria, South Africa, Egypt, Algeria, Angola, Morocco, Sudan, Kenya, and Ethiopia. The variables used are real gross domestic product, energy consumption, CO_2 emissions and population growth and employed panel data estimation techniques such as Im, Pesaran and Shin (1997) panel unit root test, Pedroni (1997, 1999, and 2000) panel co-integration test, Kao and Chian (2000) panel dynamic least squares (DOLS) model, and Dumitrescu-Hurlin (2012) panel causality test. The results indicated that energy consumption is the most important factor contributing to environmental pollutions and that the economies of the panel are very much unlikely to attain environmental Kuznets curve (EKC) turning point in the long run. As such based on the empirical findings, the study recommends that Africa's energy policy (specifically the panel's energy policy) should be geared towards improving energy consumption efficiency rather than reducing energy consumption so as not to adversely affect development.

Arouri et'al (2012) investigated the relationship between carbon dioxide emissions, energy consumption, and real GDP for 12 Middle East and North African Countries (MENA) countries over the period 1981–2005. The variables used in the study includes CO_2 emissions, Energy consumption, and Per capita real GDP and employed Bootstrap panel unit root tests and co-integration, and panel error correction model (ECM) technique. The findings show that in the long run energy consumption has a positive significant impact on CO_2 emissions. More interestingly, they show that real GDP exhibits a quadratic relationship with CO_2 emissions for the region as a whole. However, although the estimated long run coefficients of income and its square satisfy the EKC hypothesis in most studied countries, the turning points are very low in some cases and very high in other cases, hence providing poor evidence in support of the EKC hypothesis. CO_2 emission reductions per capita have been achieved in the MENA region, even while the region exhibited economic growth over the period 1981–2005. The econometric relationships derived in this study suggest that future reductions in CO_2 emissions per capita might be achieved at the same time as GDP per capita in the MENA region continues to grow.

Ozturk and Acaravci (2012) in their study "The long run and causal analysis of energy, growth, openness and financial development on carbon emissions in Turkey" for the 1960 to 2007 periods. Their empirical results support the validity of EKC hypothesis in the Turkish economy. It means that the level of CO_2 emissions initially increases with income, until it reaches its stabilization point, then it declines in Turkey.

Shahbaz et'al (2012) probe the dynamic relationship between economic growth, energy consumption and CO_2 emissions in Romania for period of 1980–2010. The variables used are energy emissions per capita, real GDP per capita, energy consumption, per capita and applied ADF unit root test, and ARDL. The results confirm long run relationship between economic growth, energy consumption and energy pollutants. The empirical evidence reveals that Environmental Kuznets curve (EKC) is found both in long and short runs in Romania. Further, energy consumption is major contributor to energy pollutants. However, the study suggest that democratic regime significantly contribute to decline CO_2 emissions through effective implementation of economic policies and financial development improves environment i.e., reduces CO_2 emissions by redirecting the resources to environment friendly projects. Their Granger causality test based on the Vector Error Correction Model (VECM) presents an absence of causality between CO_2 emissions and economic growth in the short-run while demonstrating unidirectional causality from economic growth to CO_2 emissions in the long-run. Corroborating with their findings therefore, it implies that emission reduction policies and more investment in pollution abatement will not hurt economic growth and could be a feasible policy tool for Malaysia to achieve its sustainable development in the long-run. Carbon capture and storage, carbon emissions tax and carbon-trading scheme can be performed without much concern for long run income. Of course, these policy tools should be accompanied by other possible strategies such as increasing plant efficiency, employing fuel balancing or fuel switching and making enhanced use of renewable energy.

3.0 The Data

Data for this study was obtained from World Development Indicators (WDI, 2018), World Bank for the period of 1990–2018. CO2 emissions is measured by the in kilo terms (kt), economic growth (Y) is proxied by real GDP, energy consumption is representation of fossil fuel consumption which comprised of coal, oil, petroleum, and natural gas products, while access to electricity is the proportion of household with access to electricity as percentage of total population.

3.1 Specification of the Model

Following Hossain (2011) and Farhani etal. (2013), access to electricity is added into the emission regression as opined that CO2 emissions will be determined by, income and energy consumption, the base line model is therefore specified below;

$$Co2 = A\ \alpha_1 GDP\ \alpha_2 EC\ \alpha_3 EG \text{-- (1)}$$

The method of analysis/estimation that will be used in this paper is the Autoregressive Distributed Lagged Model (ARDL) due it's to flexibility, dynamism and its capability to accommodate variables of different order of integration.

$$\boldsymbol{Co2_t = \alpha_0 + \partial_1\ Co2_{t-1} + \partial_2\ GDP_{t-1} + \partial_3\ EG_{t-1} + \partial_4\ EC_{t-1} + \sum_i^n = 0\ \beta_1\ \Delta Co2_{t-1} + \sum_i^n = 0\ \beta_2 \Delta GDP_{t-1} + \sum_i^n = 0\ \beta_3\ \Delta EG_{t-1} + \sum_i^n = 0\ \beta_4\ \Delta EC_{t-1} + e_t} \text{----------- (2)}$$

Where

$CO2_t$= carbon emission **$CO2_{t-1}$=** lag of carbon emission

GDP_t = Gross Domestic Product **GDP_{t-1}=** lag of GDP

EG_t = Energy Use **EG_{t-1} =** lag of energy use

EC_t= Access to electricity **EC_{t-1}=** lag of Access to electricity

The Expressions with the summation sign (∂1-∂4) represent the long-run relationship. The remaining expressions (β1-β4) correspond to the short-run dynamics of the model.

After formulating ARDL model which describe the relationship between the variables, then the long-run relationship model for exchange rate and its determinants can be estimated as in equation (3)

$$Co2_t = \alpha_0 + \partial_1 \; Co2_{t-1} + \partial_2 \; GDP_{t-1} + \partial_3 \; EG_{t-1} \; + \partial_4 \; EC_{t-1} \quad \text{---------} \; (3)$$

In order to estimate the short-run dynamics, the error correction model (ECM) was expressed in equation (4)

$$\Delta Co2_t = \textstyle\sum_i^n = 0 \; \beta_1 \; \Delta Co2_{t-1} + \sum_i^n = 0 \; \beta_2 \Delta GDP_{t-1} + + \sum_i^n = 0 \; \beta_3 \; \Delta EG_{t-1} + \sum_i^n = 0 \; \beta_4 \; \Delta EC_{t-1} + \lambda ECM_{t-1} \; \text{---} \; (4)$$

Where: ECM_{t-1}: The lagged error-correction term, λ: Parameter indicating the speed of adjustment back to long run equilibrium after short run shock, λ was expected to have negative sign and significant for the long run equilibrium. The larger the error correction coefficient indicates faster adjustment back to long run equilibrium after short run shock.

Table 1 – UNIT ROOT TEST

VARIABLES	ADF	PP	Order of Integration
Co2	4.4658***	4.4670***	I (1)
GDP	8.6363***	8.6266	I (1)

Energy Use	5.O352 ***	5.2255***	**I(1)**
Access to electricity	21.1681 ***	5.1288***	**I(1)**

* * *, ** *, indicate rejection of null hypothesis at 1%, 5%, 10% level of significance respectively.

Table 2- ARDL Bounds test (co-integration test)

Critical values	**I(0) Bound**	**I(1) Bound**	F Statistic
1 %	4.29	5.65	**5.24**
5%	3.23	4.35	
10 %	2.72	3.77	

Source: Author calculation using e-views

Table 3 ESTIMATED LONG RUN COEFFICIENTS

Variable	***Coefficient***	***St. error***	***t-statistic***	***P-value***

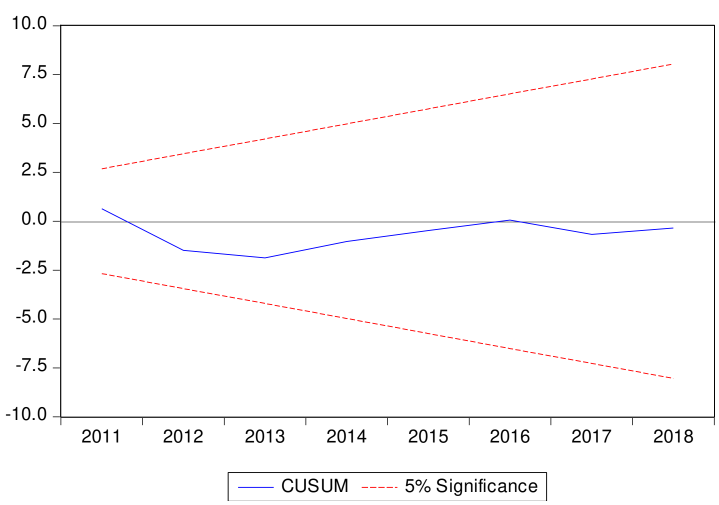
GDP	**0.035997**	**0.006433**	**5.595304**	**0.0005**
Energy Use	**-0.000697**	**0.001835**	**-0.379817**	**0.7140**
Access to Electricity	**0.009443**	**0.007700**	**1.226459**	**0.2549**

Source: Author calculation using e-views 9

Table 4- Estimated error correction representation

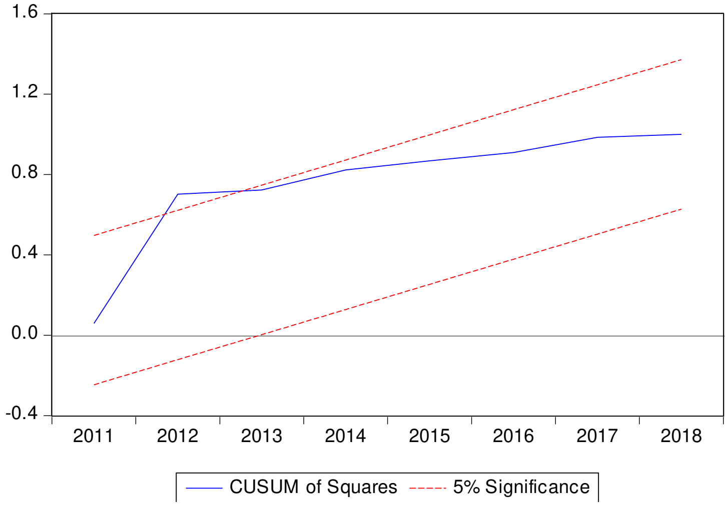
Variable	*Coefficient*	*Standard error*	*t-statistic*	*P-value*
D(Co2(-1))	**0.680294**	**0.230927**	**2.945928**	**0.0185**
D(GDP)	**0.002509**	**0.006878**	**0.364768**	**0.7247**
D(Energy Use)	**0.000617**	**0.001167**	**0.529089**	**0.6111**
DLOG(Access to electricity)	**-0.013199**	**0.005799**	**-2.275881**	**0.0524**
ECM(-1)	**-0.895280**	**0.243821**	**-3.671875**	**0.0063**

Figure 1- CUSUM TEST



Source: Author calculation using e-views 9

FIGURE 2- (CUSUMSQ)



Source: Author calculation using e-views 9

2.0 EMPIRICAL RESULTS AND DISCUSSION

This section will be devoted to present and discuss the results of empirical analysis of the nexus between environmental quality and economic growth in Nigeria. The analysis proceeds via testing the properties of time series using unit roots test and co-integration tests. First, the integration of all variables will be identified, using ADF and PP tests. Even though, ARDL approach does not need a unit root test, but in the case of variables that integrated of order two I(2) the computed F-statistics provided by Pesaran et al. (2001) will be not valid, because the bounds test is designed on the assumption that the variables are I(0) or I(1). Therefore, the researcher implemented the unit root test in the ARDL context to ensure that none of the variables are integrated of order more than I (1). The results of unit root test constant are reported in Table 1.

The result in table 2 indicated that all variables are not stationary at level but rather at first difference using ADF and PP test. Across all test statistics all variables are found at 1% critical values.For testing the existence of long run relationship between the dependent and explanatory variables in equation (3), The null hypothesis defined as H0: $\partial 1 = \partial 2 = \partial 3 = \partial 4 = 0$ meaning that there is no co-integration (no existence of long-run relationship) among the variables under consideration whereas the alternative hypothesis is defined as H1: $\partial 1 \neq \partial 2 \neq \partial 3 \neq \partial 4 \neq \partial 5 \neq 0$ which signify the existence of co-integration presence or evidence of long-run relationship (Pesaran et al., 2001). The bounds test (F-statistic) was computed to differentiate the long-run relationship between the concerned variables. The computed F-statistic value was evaluated with the critical `values tabulated in of Pesaran et al. (2001). The null hypothesis of no co-integration against alternative hypothesis of co-integration was tested and results represented Table 2-ARDL Bounds Test. Since the computed F-statistic (5.24) greater than upper bound test value at 5% (4.35) therefore, the null hypothesis of no long-run relationship between C02 and independent variables (GDP, EC, and EG) is rejected. The results indicated that there are evidence of co-integrating (the existence of a long- run relationship) between the Co2 and the other explanatory variables.

In Table 3, the long-run ARDL model is estimated. The appropriate number of lags for each variable in the model is detected automatically by the program procedure using the Akaike information criterion (AIC). The result in table 4 indicated that only GDP was found to be positive and significantly related to Co2 meaning that higher income growth adds to environmental degradation vis-a-vis low environmental quality while energy use was found to be negative and statistically insignificantly related to Co2, access to electricity was found to be positively (negatively) and statistically insignificantly related to Co2 emissions (environmental quality). In a more detailed description, 1% change in growth rate of Nigerian economy will leads to increase of Co2 emissions by almost 4% while a unit change in energy use will leads to a decline/reduction of Co2 emissions by 0.0697% and a percentage change in access to electricity will lead to increase of Co2 emissions by 0.0944%. This implies that in the long run as the economy grows further income of the populace increases thereby people shift to a more environmental friendly energy sources ie renewable energy

Regarding the short run analysis, Table 4 shows the results of error correction model using ARDL framework. The appropriate number of lags Selected based on Akaike information criterion. Contrary to the long run model, the short run model here indicated both GDP and Energy use to be positively and statistically insignificantly related to Co2 emissions while Access to electricity was found to be negatively (positively) and significantly related to Co2 emissions (Environmental quality), this can be fathom as more people and business enterprises get more access to electricity supply from the national grid their efforts to obtain alternative gasoline power sources drops which in turn reduce the aggregate carbon emissions in the society.

ECM result reveals that exchange rate (EXR) relatively strong adjustment to equilibrium with a speed of adjustment of 89.5% whenever there is a shock in long run equilibrium. The error correction term is correctly signed (negative) and statistically significant at 1%, this implies that, if there is any shock to the economy, the speed of Environmental quality adjustment is very fast that converges back to the equilibrium. With all these, the findings of the ECM model reveal that a robust and reliable result for the investigation so far. Reference to these findings it was found that EKC hypothesis is not found in the Nigerian environmental setting.

Finally, the stability of ARDL long run model parameters were examined using the cumulative sum of the recursive residuals (CUSUM) and the cumulative sum of the squares of recursive residuals (CUSUMSQ) tests proposed by Brown et al. (1975), the graphical results presented in Figures 1 and 2 respectively illustrate that, residuals were within the critical bounds at 5% level of significance. This signifies that the ARDL estimates are dynamically and structurally stable, consistent and reliable.

Based on the findings, this study will like to recommend the federal government to prioritize energy sector in its appropriation bill and also make a stringent inquiry on how, why and where funds meant for revitalization of the energy sector are diverted to? Through which the condition remained unchanged regarding the generation and distribution of electricity in the country over the years. It has been found that access to electricity improves the environmental quality as it obliterate the motive to source for alternative unfriendly gasoline energy platform which emits additional carbon emissions and exhaust smoke which pollutes the air and depletes the ozone layer.

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