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Energy Consumption, Environmental Emissions and Economic Growth: An Empirical Analysis in Nigeria

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Abstract: This study examined the relations of energy consumption, emissionsand economic growth as an important yardstick determining the level of economic activities in Nigeria. Using ARDL method to cointegration. The empirical results shown that in long and short-run analysis, we found the amounts of energy used have a significant and positive relationship with economic growth, this result shows that an increase in energy used Nigeria is highly interconnected with the gross domestic product as an indicator of economic growth while foreign direct investment and fossil fuel are negatively related to gross domestic products. Thus, we recommended that wind or solar source of energy might be discovered plus measured as a substitute basis of energy meanwhile Nigeria is sound gifted with the wind and solar energy. This will support in decreasing CO_2 emissions in another hand to supporting growth in long run.

Keyword:CO_2 emissions, Economic growth, Energy consumption, ARDL

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I. INTRODUCTION

Recently, there has been emergent alarm about dilapidation and contamination of surroundings and climate change as the effect on prospect world development. In 2015, more than 190 countries representatives come across at Paris in France to deliberate the global conservational problems and their insinuations for prospect development of the both developing and developed nations (UNCED, 2015). The consultation noticeably signified out the relationships between natural environs and economic growth and placed accelerative the conception of "sustainable development" (DES, 2013). This has created bigger consciousness about ecological problems and eased the teamwork amongst the diverse nations to moderate our conservational dilapidation, mainly to moderate radiation of greenhouse gases such as CO_2 to avoid hostile environmental changes (Okubo & Levin, 2013), climate changes in forthcoming which if not stopped will have catastrophic costs for the health and growth of the human population globally (Nhamo, 2016).

The associations amid the growth and the environs are diverse, the surroundings make available resources to our economy, then turns as a bowl for radiation and waste (Singh, 2010). Therefore, natural resources are vital contributions to the process of making goods in the several parts of the economy, although manufacturing and ingesting too prime to contamination and added burdens on the environs (Tietenberg& Lewis, 2016). Deprived conservational excellence, in turn, distresses growth and health by depressing the amount and excellence of resources or due to wellbeing effects, etc. In this perspective, ecological rules can limit the adverse responses from the economic growth on the environs. Nevertheless, in what way operational they stand and whether they create a left use to society is the theme of ample discussion and be contingent on the method they are intended and applied (Bergstrom & Randall, 2016).

Thus, the encounter among environment and economic growth is severer nowadays than ever in the past, mainly in developing nations like Nigeria with fast-rising human population besides the mass poverty. Hence, the developing nations are making persistent struggles to set of scales on their want for speedy economic progression with the ecological concerns for protecting their natural base together (Omoju, 2014). In Nigeria, as in other developing nations, the embracing of growth plan centred mainly on economic growth, energy-intensive skills, and biochemical-based agrarian technology, disregarding indigenous growth model centred on locally self-reliant know how's, has run to ecological dilapidation (Onakoya, Salami, &Odedairo, 2013).

Nigeria's economy tussles to working leverage the country's very large wealth in oil and gas butstill country's poverty figure roughly.33% or more so, of its people (NBS, 2015). It has been argued that increases in

energy consumption have an adverse impact on environment, i.e. energy used have some impact on our environment fossil and liquid fuel consumption do substantially harm than more other of forms energy sources by most measures, comprising pollution i.e. airborne and rainwater, hurt to public health, flora and fauna and environment damage, and global heating (Elimelech& Phillip, 2011).

Nowadays, Nigeria is seen as one of the utmost emerging economy in Africa endowed with natural assets comprising prospective energy resources. Though, an increasing access to energy used in Nigeria it will stimulating the economic growth. Hence, being energy consumption as the wheels of growth in Nigeria, since energy consumption serveas an important feature of manufacturing goods and services. The result of confirm the interdependence between the economic growth and energy consumption with the higher coefficient (see, Jayathakumaran, et al., 2012; Ang, 2007; Foon, 2009 and Sari, et al., 2008).

Energy consumption is very vital in the Nigerian economy as it is an important input to producing virtually of the goods and services of the country's economy. It contributes to economic growth directly as it creates jobs opportunities in addition to value associated with extracting, transforming, besides distributing of energy. Hence, the energy consumption also strengthen the other sectors of the economy, as an input for nearly all production processes of goods or services. Energy consumption enhances economic growth enormously in Nigeria. In addition, steady and cheaper energy also aid to stimulate the economic growth. Thus, it enhanced turnover margins for the business firms as well as the higher disposable returns for the consumers provide incentives for speeded rates of economic growth (see, Gbadebo&Okonko, 2009; Aladejare, 2014 and Abosedra et al., 2015). In line with this, the coefficient of 6.4 and 7.8 in model 1 and 2 respectively, this indicate that an energy consumption serve as an important aspect of country's gross domestic product as well as economic growth. This study is consistent with neo-classical theories and environmental Kuznets curve hypothesis. Both theories agreed that energy consumption serve an immediate factor for economic growth.

This study examines the association's midst the carbon dioxide emissions (CO_2), fossil fuel consumption, energy used, FDI's and openness in trade with GDP as an indicator of economic growth in Nigeria. This investigation employs the utmost suitable econometric tools: the Autoregressive distributive lag bounds testing method to co-integration and Granger causality tests.

II. LITERATURE REVIEW

Grossman and Krueger (1991) argue that there is positive association amongst ecological quality and growth. They suggested that increasing returns as of trade would prime to severer ecological control. Henceforth, trade openness would defend the surroundings. Beckerman (1992) examines the strong relationshipamongstthe incomes, besides the degree to which ecological protection measures are adopted shows the long-run, the surest way to improve the environment is to become rich".

Chindo et al (2015) examined the affiliation amongthe energy used, carbon dioxide emissions and GDP in Nigeria. The study employing ARDL method to co-integration, the outcomes showed there exists a long-run association energy used, carbon dioxide emissions in addition to GDP. Thus, both the short and long-run carbon dioxide emissions has been found to have a substantial and positive effect on gross domestic product, while energy used to reveal a significant and negative influence on GDP in short-run. Lin et al. (2015) examine the effect of industrialization on CO_2 emissions in Nigeria also, the outcomes show that growth has an inverse and significant affiliation with CO_2 emissions in Nigeria. Ali et al. (2016) examine the dynamic influence of urbanization, growth, energy consumption, plus trade openness on CO_2 emissions in Nigeria grounded on Autoregressive Distributed Lags Approach (ARDL) for the period of 1971-2011, the outcome reveals that urbanization does not have the significant effect on CO_2 emissions in Nigeria through growth, and energy used has a positive and significant to CO_2 emissions.

However, trade openness has the negative and significant effect on CO_2 emissions. Ejuvbekpokpo, (2014) the investigation results that reveal economic growth that have a pessimistic brunt on carbon emissions in Nigeria. The outcomes expose that economic growth has a negative impact on carbon dioxides in Nigeria.

Arouri et al. (2012) examine the association amongstcarbon dioxide emission, energy used in addition to real GDP for 12 North African and Middle East Nations between the periods of 1981–2005. Using latest bootstrap panel unit roots checks and co-integration methods, the study revealed that in long-run analysis energy used has an affirmative and significant effect on CO_2 emissions besides more remarkably real GDP shows a quadratic connection with CO_2 emissions for the states. Khan et al. (2013) examine the causative affiliation amid glasshouse emissions, economic growth and use of energy via co-integration and Granger causality check in Pakistan for the period of 1975–2011. The study outcomes disclose that energy used aids as an essential driver of carbon dioxide emissions then similarly showed unidirectional causality running from the use of energy to carbon dioxideemissions.

Alkhathlan et al (2013) investigate the affiliation among economic growth,CO_2 releases as well as energy use at the cumulative plus disaggregate stages in the kingdom of Saudi Arabia over the period of 1980-2011. Thus, the investigation outcomes are long run that income elasticity of CO_2 releases in three of four

investigation models is significant and positive as well as greater than expected short-run elasticity of income. Therefore, the study outcomes recommend that CO_2 releases upsurge by the escalation in income per head, which backings the certainty that there exists a monotonically growing affiliation among per capita CO_2 releases and income per head aimed at the collective models as well as intended for the fuel used in addition to electricity consumption models. Moreover, in short and long-run income elasticity of CO_2 releases are negatively used for the gas model.

Dantama et al., (2012) examines the effect of energy used on economic growth in Nigeria for the period between in 1980 to 2010, the study investigate energy consumption as an indicator of environmental degradation. Thus, the study employs ARDL approach. The outcomes showed a long run relationship between growth and energy used variables exist. FDI's and trade openness prime to dilapidation in ecological excellence. More so, there is a solid indication of a bidirectional causality amongstCO_2, FDI's and economic growth (Lau, Choong, and Eng, 2014). Additional researchers on this theme include; Daly, 1977; Meadows et al. 1972; Panayotou, 2003; Taylor and Copeland, 2004; Culas, 2007; DeFries et al. (2010); Rudel (2013); Shahbaz et al. (2013a,b,c); Ahmed et al (2014). Chiou-Wei et al., (2008); Khan et al., (2013); Mudakkar et al., (2013) and Zeb et al., (2014).

Lastly, researchers on the effect of environment on growth exposed that result with some literature backup the fact that environment is hostile to economic growth while others were in the backing of the divergent view. It is significant to note that utmost of the empirical researches emphasized above, used traditional time series techniques. Therefore, the effect of economic growth on the environment can barely be recognized using ARDL model as embraced by the earlier researchers since conventional knowledge and recent studies in the field of economics and econometrics found most economic models to be vigorous in nature. This study will, however, fill the gap in the literature by provided that a simple method in explaining the influence of environmental emissions on economic growth in Nigeria via Autoregressive distribute lag method.

III. METHODOLOGY AND DATA

In spite of the fact that the inter-relationships between environmental degradation on economic growth variables are significant in the theories of growth (see Xepapadeas, 2005), there is little researches have examined the causal affiliation among environmental quality and growth, most prior researches engaged on Economic growth and environment using Environmental Kuznets curve as well as some used model of three or four variables but this study employed five controlled variables as an addition to examining their impact environment on economic growth see Chindo et al. (2015) and Rafindadi (2016). In this study, behind these authors, hence the study also employ Autoregressive distributive lags method to co-integration which was developed by Pesaran et al. (2001) to evaluate affiliation among the CO_2 releases, fossil fuel, energy used, trade openness and FDI using Nigeria as a study area for the periods of 1970–2014.

To begin with, the unit roots checks remain used to expose for the stationarity of data, which be able to normally denote as $-1 \leq \rho \geq 1$ or $\rho = 1$, $/\rho / < 1$. The unit root is studied trends plus first difference through an Augmented Dickey-Fuller (ADF) and a Philips–Perron unit roots checked. Consequently, a combined stochastic technique is employed somewhere the instruction of mixture is used (i.e. I(0) plus I(1)) per the unit roottest outcomes. The consequences of the unit root check technique are responsible for a unit root tests for cointegration, which is earlier tested from side to side the Engle-Granger or the Augmented Engle-Granger checks via an ARDL functions. This technique has been often called in contemporary literature and is preferred over the Johansen technique of cointegration subsequently it has the elasticity to an amendment interval lengths, escapes endogeneity then authenticate smooth in a little sample scopes to attain healthier outcomes. While the mathematical illustration ARDL techniques are used to check the presence of the connection amongst the environmental degradation and growth in Nigeria. Thus, we changed the study model to examining variables as stated below;

$$Y = f(EC, CO_2T, FF, TR, FDI) \quad (1)$$

Logging the variable produces:

$$\ln Y_t = \alpha_0 + \alpha_1 \ln EC_t + \alpha_2 \ln CO_{2_t} + \alpha_3 \ln FF_t + \alpha_4 \ln TR_t + \alpha_5 \ln FDI_t + \varepsilon_t \quad (2)$$

In Eq. (2), ***Y*** signifies gross domestic products (used as an endogenous variable as well as an indicator of economic growth), ***CO_2***symbolizes carbon dioxide emissions, ***EC*** denotes as an energy used, ***FF*** represents for the fossil fuel consumption, while *TR* expresses as a trade openness and ***FDI*** signifies foreign direct investment, next step of the co-integration check. Henceforth, there are different methods predominant such as: a lingering centred technique of Engle and Granger (1987), maximum-likelihood technique of Johansen and Juselius (1990) plus ARDL bound test which was developed by Pesaran et al., 2001. This present examination usages Autoregressive distributive lag bounds testing methods for the purpose to dodges the difficultly of

endogeneity and similarly to produces the larger outcomes for the smaller data arrays and assistances to assessment in the long-run investigation through the following equations:

$$\Delta \ln Y_t = \alpha_0 + \sum_{i=1}^{n} \chi_i \Delta \ln Y_{t-i} + \sum_{i-0}^{n} \gamma_i \Delta \ln EC_{t-i} + \sum_{i=0}^{n} \phi_i \Delta \ln FD_{t-i} + \sum_{i-0}^{n} \vartheta_i \Delta \ln TR_{t-i} +$$

$$\sum_{i-0}^{n} \psi_i \Delta \ln CO_{2t-i} + \sum_{i-0}^{n} \eta_i \Delta \ln FF_{t-i} + \tau_1 \ln Y_{t-1} + \tau_2 \ln EC_{t-1} + \tau_3 \ln FD_{t-1} + \tau_4 \ln TR_{t-1} + \quad (3)$$

$$\tau_5 \ln CO_{2t-1} + \tau_6 \ln FF_{t-1} + \varepsilon_t$$

Hence, derive the long-run coefficients as follows:

$$\alpha_0 = \frac{\tau_0}{1-\sum \tau_{1i}}, \chi_1 = \frac{\sum \tau_{1i}}{1-\sum \tau_{1i}}, \gamma_2 = \frac{\sum \tau_{2i}}{1-\sum \tau_{1i}}, \phi_3 = \frac{\sum \tau_{3i}}{1-\sum \tau_{1i}}, \vartheta_4 = \frac{\sum \tau_{4i}}{1-\sum \tau_{1i}}, \psi_5 = \frac{\sum \tau_{5i}}{1-\sum \tau_{1i}}, \text{ and } \eta_6 = \frac{\sum \tau_{6i}}{1-\sum \tau_{1i}} \quad (4)$$

Eq (3), assessments the long-run affiliation amongst the study variables via the ARDL bound test techniques. Hence, the null hypothesis is verified by $H_0 : \tau_1 = \tau_2 = \tau_3 = \tau_4 = \tau_5 = \tau_6 = 0$ and $H_1 : \tau_1 = \tau_2 = \tau_3 = \tau_4 = \tau_5 = \tau_6 = 0$ to choose whether co-integrationin the long run association occured. So, the F-statistics with lower and upper bounds, I(0) and I(1), consistently, prime to the rejection of the null hypothesis. If the values surpass the upper bound boundary, the conclusion of the study may be prime to throwaway the null hypothesis by co-integration too, in this regard there is no need to check the expected values at the order of integration. However, in situation whreby the F-statistics values are drops within the upper or lower bound borders, thus the assessment cannot be through deprived of meaningful the instruction of co integration for repressors, hence there is needs for the unit roots check (see, Pesaran and Pesaran,1997; Pesaran et al., 2001; Narayan, 2004; Narayan, 2005). Then the study model is also needs to check for Schawrtz-Byesian Criteria (SBC) and Akaike's Information criteria (AIC), Error Correction Model (ECM) is appraised Equation (5) underneath:

$$\Delta \ln Y_t = \alpha_0 + \sum_{i=1}^{n} \chi_i \Delta \ln Y_{t-i} + \sum_{i=0}^{n} \gamma_i \Delta \ln EC_{t-i} + \sum_{i-0}^{n} \phi_i \Delta \ln FD_{t-i} + \sum_{i-0}^{n} \vartheta_i \Delta \ln TR_{t-i} +$$

$$\sum_{i-0}^{n} \psi_i \Delta \ln CO_{2t-i} + \sum_{i=0}^{n} \eta_i \Delta \ln FF_{t-i} + \varphi ECT_{t-i} + \varepsilon_t \quad (5)$$

Where error-correction term ect_{t-1} can be expressed as:

$$ect_{t-1} = \tau_{t-1} = Y_{t-1} - (\alpha_0 + \chi_1 \ln Y_{t-1} + \gamma_2 \ln EC_{t-1} + \phi_3 \ln TR_{t-1} + \vartheta_4 \ln FDI_{t-1} + \psi_5 CO_{2t-1} + \eta_6 \ln FF_{t-1}) \quad (6)$$

Where, Δ is the first difference operator, and τ is the coefficient of error-correction term that measures the speediness of adjustment to long-run equilibrium. If τ is negative and significant, then cointegration exist. In order to test for cointegration, we first estimate the F-Statistics then compare with the upper bound critical values in the Narayan (2005) table. Cointegration exist when F-Statistics stands greater than the upper bounds and; it does not exist when the F-Statistics remains lower than the lower bounds critical values of Narayan. Meanwhile, the resultremains inconclusive when the F-Statistics falls within the upper and lower bounds. To test for cointegration, the null hypothesis is set as H_0: $\tau_1 = \tau_2 = \tau_3 = \tau_4 = \tau_5 = \tau_6 = 0$while the alternative hypothesis is given as H_1:$\tau_1 \neq \tau_2 \neq \tau_3 \neq \tau_4 \neq \tau_5 \neq \tau_6 \neq 0$. Whereas, ECT_{t-1} remains the error correction models. The important of error correction model is indicative of long-run association amongst the dependent and independent variables. Thus, values of the error correction model are calculated from the approximation for the long term coefficient. This study covered the periods of 1970–2014. World development indicators website were used to retrieved data on gross domestic product (% annual growth) alternative to growth, carbon dioxide emissions (total), energy used per capita (kt of oil equivalent), Fossil fuel (% of total energy consumption) and per capita trade openness (exports plus imports) and foreign direct investment (FDI). Henceforth, the expected signs of the variables are explained below in table 1.

Table 1: Expected signs

Variables	**Signs**
Carbon dioxide emissions (CO_2)	Cause Of glasshouse smokes, which added to global warming, bullying human and natural surroundings. Fossil fuel consumptionand

	industrialprocess, CO_2 may have effect to growth and then we expected $\alpha 1<0$
Energy used (***EC***)	We presume that $\alpha\ 2 > 0$ if oil and gases is used as a sources of energy to meet as a daily energy consumption positively to growth, then we expected $\alpha\ 2< 0$.
Fossil fuel consumption (***FF***)	If the industries and other commercial activities are used oil and gas as a major sources of energy positively to the growth and then we expected $\alpha 3>0$
Foreign direct investment (***FDI***)	FDI may have impact positively to Economic growth. We expected that $\alpha 4>0$
Trade (***TR***)	Trade also have positive impact to growth and then we expected $\alpha 5>0$

IV. RESULTS AND DISCUSSIONS

As usual in the first stage, the study employed unit roots test that is Augment Dickey Fuller (ADF) in addition to Phillips-Perron (PP) to test the order of stationarity amongst the study variables of interest. The outcomes are presented intable 2 below. Therefore, the numerical valuespropose throughout the study variables have a unit root difficult at level with intercept and trends as well as a non-stationarity. Subsequently at the first differenceboth intercept and trends all variables remain initiate to be a stationary at *I*(1). Thus, this perception promote that the counts of all-time series data remain integrated at *I*(1), this kind of difficult ascends in unit root check in line for the structural breaks and promote or tips to a feeble forecasting power and ambiguous outcomes. Refer to table 2 for the results of the unit root test.

Table 2: Results of the Unit Root Test

Level	**ADF**		**PP**	
Variables	**Intercept**	**Trend with Intercept**	**Intercept**	**Trend with Intercept**
Y	0.327	-0.018	-0.193	-0.234
CO_2T	-2.198	-2.989	-2.381	-2.957
CO_2M	-2.386	-3.946**	-2.148	-3.882**
EC	-1.873	-3.068	-2.091	-2.175
FF	-3.127**	-2.906	-2.568	-2.084
FD	-3.777***	-4.076**	-3.717***	-4.042**
TR	-2.662*	-2.404	-2.519	-2.187
First Difference				
Y	-5.796***	-6.489***	-5.932***	-6.487***
CO_2	-6.601***	-6.659***	-7.216***	-8.463***
CO_2M	-7.357***	-7.369***	-13.876***	-15.221***
EC	-5.412***	-5.478***	-5.290***	-5.567***
FF	-5.261***	-5.476***	-5.261***	-5.472***
		-6.231***		

FD	-9.2636***		-19.845***	-18.978***
TR	-8.93959***	-9.18959***	-8.89432***	-9.31889***

Note: *, **, *** show significance level at 10%, 5% and 1% respectively. Values in parenthesis are probability values.

Subsequently, to achieve the objective of this paper, we examined variables similarities began with an introductory examination of the dataset with the demonstration of the descriptive statistics which show the data spread. Moreover, correlation matrix was as well presented here to show the possible relations among environmental and the growth of the economy in Nigeria. Table 3 provides evidence on the minimum as well as the maximum values, means, standard deviations and skewness. The circumstance that the entire experimental variables shows significant variation, it is a justification that panel autoregressive distributed lag estimation technique could be applied for the objective of the study. The correlation coefficients indicated that a correlation existed among the dependent and independent variables, the variables carbon dioxide emissions from manufacturing, carbon dioxide emissions from the transport, energy consumption, foreign direct investment, fossil fuel, trade openness and real GDP per capita were; -0.04, 0.21, 0.01, 0.03,-0.25, and -0.01 respectively. The coefficients were within a reasonable range hence is considered plausible. The ranges fall within -0.25 to 0.21.Refer to the table 3 for the summary of descriptive statistics and correlation matrix.

Table 3: Summary of Descriptive Statistics and Correlation Matrix

	CO2Mt	CO2Tt	ECt	FDIt	FFt	TRt	Yt
Mean	11.359	48.116	688.915	2.815	17.810	48.275	4.445
Median	11.347	47.811	691.087	2.534	18.986	48.293	4.887
Std. Dev	3.412	4.772	54.864	2.0935	4.476	16.130	7.994
Min	4.249	39.311	573.545	0.1508	5.968	19.620	-13.127
Max	18.430	56.305	796.632	10.832	22.845	81.813	33.736
Skewness	-0.115	-0.152	-0.361	1.8730	-1.449	0.029	0.957
CO_2T	1.000						
CO_2M	0.163	1.000					
EC_t	-0.681	-0.365	1.000				
FDIt	-0.348	-0.301	0.247	1.000			
FF_t	-0.525	-0.339	0.790	0.162	1.000		
TR_t	-0.587	0.214	0.471	0.333	0.399	1.000	
Y_t	-0.039	0.207	0.005	0.032	-0.250	-0.006	1.000

Source: Authors computation based on data from World Development Indicators (WDI)

The subsequent stage, is an ARDL bounds analysis outcomes are presented in Table 4. Henceforth, the F-statistics of all highlighted variables (i.e., gross domestic product as a dependent as well as an indicator of growth and other controlled variables. Consequently the calculated F-statistics drop outside of the critical bounds at the *I* and *I(0)*. This outcome reveals the study have two cointegration vectors and confirms. Therefore, the existence of a long-run association among the variables over the periods of 1970–2014. Refer to the table 4 for the ARDL bounds test for co-integration.

Table 4: ARDL Bounds Test for Co-integration

Co-integration tests Bound testing for co-integration			Diagnostic tests	
Models	F Statistics	Lag	R^2	DW test
$Y = f(CO_2T, EC, FDI, FF, TR,)$	5.053**	1,1,0,0,0,0	0.947	2.110
$Y = f(CO_2M, EC, FDI, FF, TR,)$	5.097**	1,0,0,0,0,0	0.756	2.287
	Critical value			
Significance level	Lower bounds (0)		Upper bounds (I)	
1% level	4.030		5.598	
5% level	2.922		4.268	
10% level	2.458		3.647	

The critical values according to Narayan (2005) (Case III: Unrestricted intercept and on trends) No trend, K = 5, *(***), (**), (*) denotes Significant at 1%, 5% and 10% respectively.*

The critical value ranges ofF-statistic are 5.0529 and 5.09716 at 5% significance level respectively. Thus, the first long-run relationship denotes the situationwhere lnY_t is the dependent variable and carbon dioxide emissions from transport as a principal variable in the main model in this study. However, to examine the robustness of autoregressive distributive lags bounds check method for long run association, the study also used theJohansen and Juselius test since the Johansen and Juselius multivariate co-integration methodology is well recognized. However, after conclude the co-integration amongst the variables of the study, the short and long-run investigation was showed in Table 5.

Table 5: Short run and Long run Results

$Y = f(CO_2T, EC, FDI, FF, TR,)$	Coefficient		T-Ratio (p value)	
Variable	Short run	Long run	Short run	Long run
CO_2t	-.1141*	-.0194	-1.9325[.061]	-.094506[.925]
EC	1.346***	6.430***	3.8461[.000]	3.7543[.001]
FF	-.3406***	-1.626***	-3.8441[.000]	-3.7419[.001]
TR	.0079	.0376	.23684[.814]	.23002[.819]
FDI	-.0458**	-.2188***	-2.3407[.025]	-3.0808[.004]
R^2	0.947			
DW test	2.110			
F-statistics	5.053**			

Table 5 above illustrates the long-run result reveal that, it was found that the coefficient of Energy consumption (*ECt*) in the model has a significant and positive association with economic growth. This result shows an increase in energy consumption in Nigeria is highly interconnected with the economic growth in Nigeria. For instance, a 1% increase in energy consumption leads to increases in economic growth by 6.43%. This study is consistent with the EKC's theory and neo-classical economic theories which considered that an energy consumption as an intermediate factor for the economic growth, also the study consistent with the empirical literature such as Soytas& Sari, (2009); Apergis& Payne, (2009). On the other hand, fossil fuel *($lnFF_t$)* and foreign direct investment net inflows *($lnFD_t$)* has a negative impact on growth (lnY_t) in Nigeria and these relationships are statistically significant at 1% significant level. Thus, a 1% increase in fossil fuel consumption and foreign direct investment will lead to the decrease in economic growth by -1.6% and -0.21% respectively. These results are in conformity with that of Smarzynska, (2004); Alfaro et al., (2004) and Searchinger, (2008). The negative sign for the coefficient of the foreign direct investment is in accordance with the economic theory, where an increase in the price of borrowing will affect investment and further reduce the gross domestic product. The other variables on the model are not important in influencing the economy of Nigeria in the long-run.

Meanwhile, in the short-run relationship amongst environmental emissions and economic growth, thus, the short-run outcomes reveal that economic growth (lnY_t) is still significant and positively linked to the energy consumption ($lnEC_t$) at 1% significant level with the coefficient value of 1.346 which means that a 1% increase in energy consumption will lead to 1.34% increase in economic growth (lnY_t).This results are consistent with the empirical findings of the following: Shahbaz& Lean, (2012) and Lise& Van Montfort, (2007).Although FDI's is negatively related to economic growth(lnY_t) at 5% level of significance with the coefficient of 0.045 means that 5% increase in FDI's will lead to decrease to - 0.04% in economic growth in case of Nigeria and some others developing countries.Henceforth, this might happen from profit repatriation by multinational companies to their respective countries for re-investing and others forms of market power See, Stanisic (2008); Fedderke, &Romm, (2006) and Belloumi, (2014). Fossil fuel ($lnFF_t$) is negatively related to economic growth at 1% significant level with coefficient of -0. 340. Although a1% increase in fossil fuelwill have the effect of economic growth by -0.34% decrease in growth also in the case Nigeria. This results are consistent with; Shafiee& Topal, (2008) and Ocal&Aslan, (2013).

The estimated ARDL error correction model, in the short-run, energy consumption will be adjusted to the deviation from the long-run. The result indicates that a positive and significant affiliation exists in the short-run between energy consumption ($\Delta lnEC_t$) on the one hand and economic growth on the other hand. It means that energy consumption has a positive influence on the economic growth. Henceforth, this study does observe that there is a positive and significant affiliationamongst economic growth outlays while, energy consumption on the other hand which a positive associationamongst economic growth in addition to trade openness, but this relation is statistically insignificant. In other words, this finding agrees with the Neo-Classicalist which considered energy consumption as an intermediate factor for economic growth and also, states that an increased in energy consumption stimulates growth but in other hand aids to emit more carbon dioxide emissions. The

study outcomes consistent with Environmental Kuznets curve theory is expanded by adding energy consumption, financial developmentplus trade openness.

However, two variables will be adjusted to the deviation from the long run, they are carbon dioxide emissions, fossil fuel and FDI. These outcomes indicate that a negative and significant relationship exists in the short-run between carbon dioxide emissions ($\Delta lnCO2_t$), fossil fuel ($\Delta lnFF_t$) and FDI ($\Delta lnFDI_t$) on the one hand and economic growth on the one hand too. It means that carbon dioxide emissions, fossil fuel and FDI have a negative influence on the economic growth. Thus, the study outcomes do observe that a negative and significant relationship between growth outlays on the one hand and carbon dioxide emissions, fossil fuel and FDI on the other hand. The interpretation of these study results is that there is evidence to suggest that the energy consumption is vital for economic growth in Nigeria while, carbon dioxide emissions, fossil fuel and FDI are not statistically significant to the growth. This finding may sound counter-intuitive but, it is still in line with some past literature reported for Nigeria (Wolde-Rufael 2006; chindo et al., 2015). The *ECM* coefficient of -0.20 and significant at 1%, this result displays that the speediness of adjustment from the long-run in around 20%. Therefore, it shows the speed of adjustment of series towards long-run equilibrium to be 20% in the first year. Thus, this study found in short and long-run association amongst the variables with a positive and a statistically significant affiliation amongst the carbon dioxideemissions and growth. Additionally, applying a revised version of the Granger causality test.The study also found a unidirectional causality running from emissions to growth; from energy consumption to growth and from energy consumption to carbon dioxide emissions all without a response. Moreover, the coefficient is negative less than 1 percent and significant which confirmed the ARDL approach.

Towards check the efficacy as well as consistency of the study model have shown diagnostics checks which are stated in Table 6. Therefore, the serial correlation test is the foremost in the time series difficulties. The outcomes disclose that the study model has conceded serial correlation check and normality check, functional form is stable as well as heteroskedasticity check as the study might not throwaway their null hypotheses. Then the overall note that, the research model can produce well-organized as well as consistent appraisal having conceded the foremost diagnostics check. Refer to the table 6 for the Diagnostics test.

Table 6: Diagnostics Test

	LM Version	F Version
Serial Correlation	CHSQ(1)= .22081[.638]	F(1, 34)= .17550[.678]
Functional Form	CHSQ(1)= .87857[.349]	F(1, 34)= .70918[.406]
Normality	CHSQ(2)= 2.7624[.251]	Not applicable
Heteroscedasticity	CHSQ(1)= .17408[.677]	F(1, 41)= .16666[.685]

Thus, the two separate diagrams that is Cusums checks in (Figure 1 & 2) aimed at constancy of the research model for periods show significance level at 5 % as the blue line is inside the critical bounds. Hence, the study model is steady for the studied periods. The result is as a graphical presentation of these two tests is provided in Figures below:

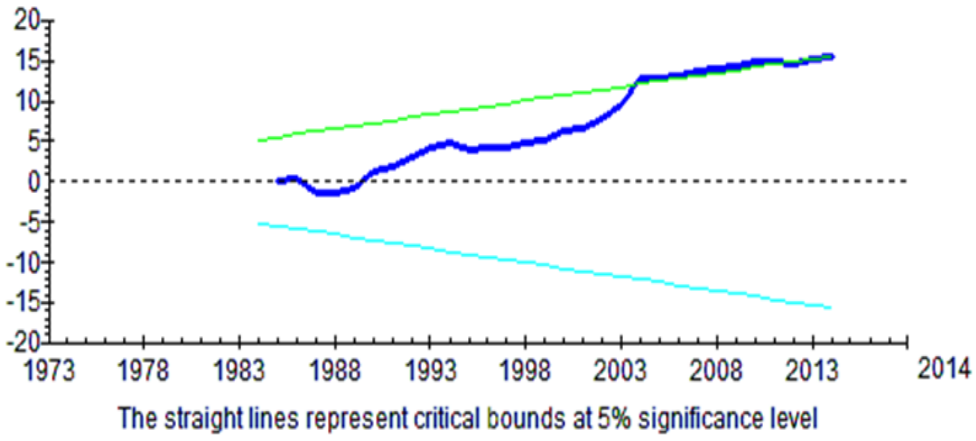

Figure 1 Cumulative Sum of Squares of Recursive Residuals

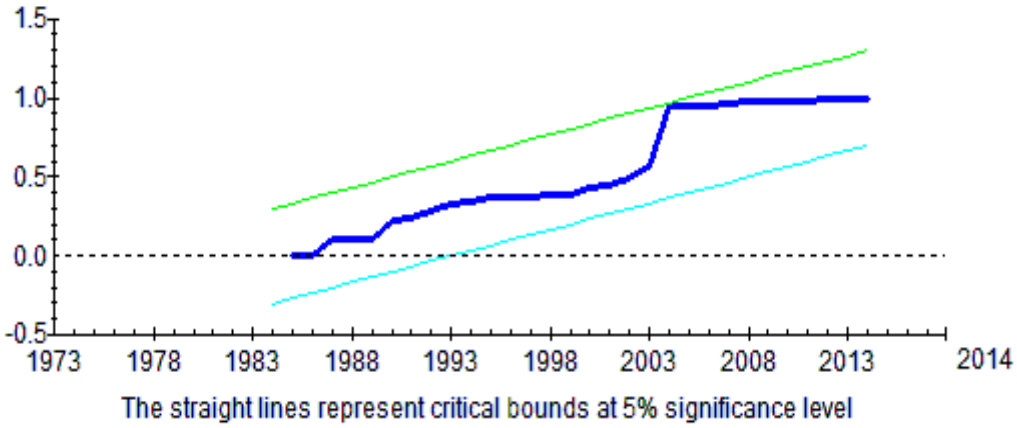

Figure 2 Cumulative Sum of Squares of Recursive Residuals

V. CONCLUSIONS AND POLICY RECOMMENDATION

This paper studied the co-integration relation between energy use and economic growth in Nigeria for the periods of 1970 to 2014, using ARDL method to co-integration developed by Pesaran et al. (2001). The observed outcomes shown in long-run analysis we found the coefficients of Energy consumption have a significant and positive relationship with growth, this result shows that an increased in energy consumption in. Nigeria is highly interconnected with the gross domestic product as an indicator for growth. For instance, a 1% increase in energy consumption increasegrowth by 6% while fossil fuel and foreign direct investment, net inflows have a negative influence on GDP in Nigeria then these relationships are statistically significant at 1% respectively. However, in short run analysis reveals that growth is still positively related to energy consumption at 1% significant level and the coefficient is 1.347 which means that a 1% increase in energy consumption will prime to 1.347% increase in growth. While, .FDI is negatively related to GDP at 5% level of significant and the coefficient 0.045% means that 5% increase in GDP will lead to decrease to - 0.045% in FDI, and fossil fuel is negatively related to growth at 1% significant level and coefficient -0. 340. 1% increase in growth will have effect of decrease -0.340% of fossil fuel consumption. Like other studies, `this study conform to most of the literature whose focus were on single or group of countries (see Halicioglu, 2009; Soytas and Sari, 2009; Lise and Van Montfort, 2007; Al-Iriani, 2006; Huang et al., 2008).

This current study studied the impact of energy consumption on economic growth, the main outcome of the study showed that the industrialization process is the principal cause of high level of gross domestic products in Nigeria through this it will generate more carbon dioxides emission as well as it is harmful to the environment. Henceforth, this outcome ought to be an overlay to the means for guiding principle option to curtail the prevalence of carbon dioxides emission by improving the industrial and production process, as a factor which is measured vigorous to protect the physical environment in Nigeria which are on the pathway of economic transformation. In view of that the following recommendations are made with regards to environment and economic growth in Nigeria.

Policy designed at the protect our environment through reducing pollution as well as deforestation in course of industrialization and production or mining process in Nigeria ought to expand the economic activities, take crucial steps to afford healthy environment and establish movement to enlightened community on the significance of healthy eco system. Government of Nigeria should undoubtedly spell out the penalties for polluters and others emitters who's refused to reduce the allowed abatement to firms or individuals.

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