SELECTED READINGS ON ENVIRONMENTAL ECONOMICS

Jarita Duasa

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Edited by
Jarita Duasa

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Introduction

Environmental economics is the subset of economics that is concerned with the efficient allocation of environmental resources. It is undeniable that the environment and economy are interdependent. The environment provides both a direct value as well as raw material intended for economic activity. Economic development could in turn provide better quality of environment. For that reason, the way in which the economy is managed has an impact on the environment which, in turn, affects both welfare and the performance of the economy.

Although the area of environmental economics has been introduced in many higher learning institutions particularly under the department or faculty of Economics worldwide, there is still limited number of published applied works in this area which could be referred by instructors and students. In other words, books on the application of theories in this area are limited in number as compare to the number of text books available in the market.

Due to this factor, an initiative is made in this edited book to provide several studies or researches on environmental economics which could expose the readers on research works which have been conducted by some researchers. The works or studies in this book are expected to be used as complementary readings for environmental courses taught either at undergraduate or postgraduate level.

Environmental economics takes into consideration on issues such as the conservation and valuation of natural resources, pollution control, waste management and recycling, and the efficient creation of emission standards. Economics provides important tool to make decisions about the use, conservation, and protection of natural resources because it provides

information about choices people make, the costs and benefits of various proposed measures and the likely outcome of environmental and other policies.

Since environment and economy are interdependent, there have been extensive studies conducted recently on the relationship between economic development and environmental quality. Chapter 1 of this book provides one study on a similar issue with the aim to test the well known Environmental Kuznets Curve (EKC) hypothesis on Nigeria, using Autoregressive Distributed Lag (ARDL) cointegration approach.

Using data from survey questionnaires, a study in Chapter 2 attempts to observe the households' attitudes and perception towards waste management system in a specific area in Malaysia, i.e. Gombak. In addition, a multiple regression using the Ordinary Least Square (OLS) method is conducted to determine socio-economic factors contribute to waste generation in the area.

On similar issue of economic development and environment quality as in Chapter 1, Chapter 3 attempts to test the relationship between economic development and environmental performance using cross-sectional data of countries in the world listed by the United Nation (UN). In specific, the study adopts Environmental Performance Index (EPI) as an indicator of the environmental performance of the country as well as its components, namely environmental health and ecosystem vitality. Several regression models base on the OLS method are developed including the regression with interaction variables to produce robust results.

Finally, Chapter 4 touches on the issue of 'sustainable development'. There have been debates and suggestions on

the definition of sustainable development over the past few decades. As a result, the concept of sustainable development has become broad and vague. However, the effort from the United Nation's World Commission on environment and development through the study known as the Brundland Commission defined sustainable development as "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" and this definition is accepted as a standard definition. Having said this, Chapter 4 has looked at this issue from both conventional and Islamic perspectives. The critics of conventional approach on this issue are debated and the Islamic perspective on the concept of sustainable development is discussed from environmental, socio-cultural and economic aspects.

CHAPTER 1

Re-investigating the Tenability of Environmental Kuznets Curve for Carbon Dioxide Emission: An ARDL Cointegration Approach for Nigeria.

Adam Shehu Usman, Rafia Afroz, Jarita Duasa, Turkhan Ali Manap

1.1 INTRODUCTION

The last two decades the world has witnessed unprecedented effects of global warming. The increasing CO2 in the atmosphere gave rise to warmer global temperature (IPCC. 1996). The main source of CO2 is fossil fuel, the main power source of automobile and industry that are directly linked with economic growth.The main source of CO2 is fossil fuel, the main power source of automobile and industry that are directly linked with economic growth and developments. The causal relationship between economic development and different indicators of environmental quality has been extensively explored in the recent years by the Environmental Kunzets Curve (EKC) models globally, regionally or country wise (Galeotti and Lanza 1999, Kumar and Aggarwal 2003,Martinez-Zarzoso and Bengochea-Morancho 2003, Hayward 2005). Grossman and Krueger (1991) first introduced Environmental Kuznets Curve (EKC) hypothesis for different environmental indicators such as CO2 emission. The EKC hypothesis stated an inverted *U*-shape relation between various indicators of environmental quality and per capita income. Under this hypothesis, CO2 emission was usually explained by linear, quadratic or cubic polynomial functions of income per capita. Using a variety of indicators of Environmental quality (EQ) or degradation, different studies have obtained

different results. Some studies found evidence for the inverted-U relationship between economic growth (using per capita income as a proxy) and EQ (measured by anthropogenic pollution). Others however, could not establish such relationship (Kahuthu, 2006; Deacon and Norman, 2006).

As exhibited in Figure 1.1 below, Nigeria had, over the years, recorded quite moderately impressive growth in her Gross Domestic Product (GDP). It is in view of this, coupled with the absence of a standardized environmental policy framework[1], that this study seeks to investigate whether or not, the pattern of Nigeria's GDP is compatible with sustainable development (SD) in the context of environmental sustainability. The laxity in environmental regulation had accounted for enormous destruction of Nigeria's ecosystems. This is so much that, in 1999, the U.N. dubbed the Niger delta- where the oil deposits are found[2], the "most threatened" in the world. On the whole, at least, 119 species of her biodiversity are declared threatened[3]. Nigeria has a unique biodiversity including chimpanzees, gorillas, elephants and baboons, 290 species of mammals (4), 899 birds (4), 73 amphibians (2), 155 reptiles (7) and 4,715 species of higher plants (205)[4]. Her *Niger River Delta* is endowed with mangrove and coastal rainforests, naturally ornamented with rich oil deposits.

[1] Environmental policy in Nigeria is relatively, new, contained in section 20 of the 1999 constitution, (Makinde and Adeyoke, 2007).
[2] The oil from the region constitutes the major foreign exchange earner and contributes significantly to the growth of the nation.
[3] The figure for threatened species are those of 2004, retrieved on 16 May 2009 from http://rainforests.mongabay.com/deforestation/2000/Nigeria.htm.
[4] www.mongabay.com, retrieved on 16 May 2009

Nigeria has earned tremendously from oil revenue. The odd however, is that, the oil revenue which is approximately about $20 billion annually, is reported to have always accrued to the nation at a high cost in the form of environmental degradation, among others. Nigeria's oil production contributes to global warming and the danger of climate change through the flaring of natural gas[5] to the tune of 23 billion cubic meters yearly. This amounts to a

Figure 1.1: Annual Real GDP Growth Rate in Nigeria (1970-2005)



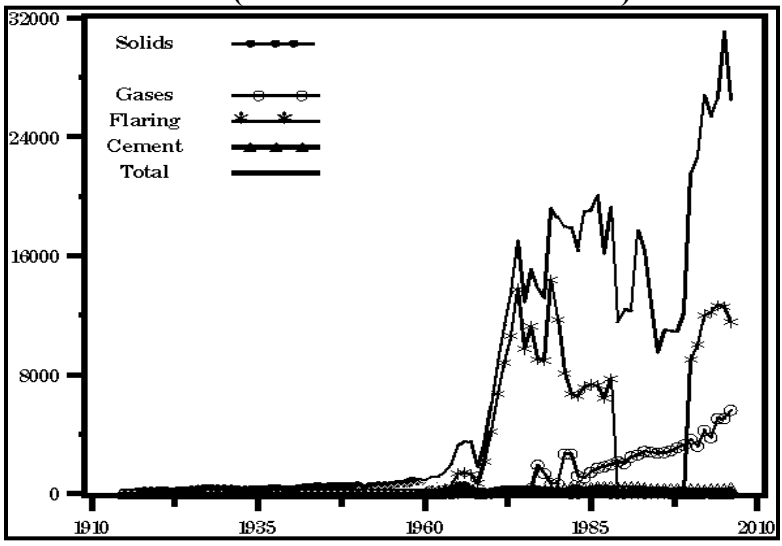
Source: Constructed by the researchers[6].

[5] The flaring of natural gas entails the burning of the associated gas that is originally extracted along with the crude oil to standardize the oil to exportable quality. Such ill practice however, leads to the waste of energy and over $2.5billion is lost annually in government revenue from so doing. Presently, there are all together, over 100 flare sites both Off-shore and in the Niger Delta.

[6] The relevant data set was taken from the United States Department of Agriculture, Economic Research Service, available at http://old.swivel.com/data_sets/show/1004019

yearly emission estimate of 400 million tons of carbon dioxide equivalents (Fact sheet, 2008, Environmental Rights Action/Friends of the Earth Nigeria). Figure 1.2 reveals that, of the total anthropogenic sources of CO2 pollution in Nigeria, gas flaring (in the production of crude oil) and liquid sources (e.g. the burning of petrol), are on the average, the major sources of anthropogenic emission of CO2 pollutant[7].

Figure 1.2: The Trend of CO2 Emission in Nigeria, 1910 – 2010 ('000' metric tons of Carbon).



Source: Carbon dioxide Information Analysis Center[8]

To attenuate the destruction to the ecosystem ensuing from anthropogenic pollution, among others, the World Commission on Environment and Development (WCED) had in 1987 recommended countries to follow the path of

[7] Note, CO2 emissions in the informal sectors such as the domestic burning of fuel wood are not captured by CDIAC.
[8] Retrieved on 10th November, 2009, from http://cdiac.ornl.gov/trends/emis/ngr.html

sustainable development (SD). This will not only ensure rapid economic growth but also the conservation of the environment within the context of a "growing economy". SD balances between the economy and the environment. It emphasizes balancing economic growth with the preservation of the ecosystems in order to check environmental degradation and its health risks to man and the biodiversity attributed to unregulated growth in economic activities. Unfortunately, this has been ignored by the major studies that have examined economic growth in Nigeria (Ayanwale,2007; Olomola and Saibu,2004; Akinlo, 2004). The study uses annual time-series data for the period 1970-2005 to investigate the long-run relationship between CO_2 pollution and GDP per capita in Nigeria.

1.2 METHOD

1.2.1 Data

This study uses total anthropogenic carbon dioxide emissions (through the use of gas fuel, liquid fuel, solid fuel, gas flaring and emission through the process of cement production) as a measure of environmental degradation. The choice of taking this indicator as a proxy for EQ is dictated by the availability of data and on account of the fact that, relative to other greenhouse gases (GHGs), it contributes 82 per cent to 'global warming' (Sadullah & Pinar, 2009; Eurostat, 2008). The annual time-series data used in this study covers the period 1970-2005. We obtain the CO2 data (measured in metric tons per capita) from World Bank, World Development Indicators (WDI) 2009 online database[9]. Moreover, annual series on constant GDP at 1990

[9] Although the time series for CO_2 emission is sourced from the World Bank, World Development Indicators (WDI) 2009 online database. Information on the breakdown of its constituent are sourced from the Carbon Dioxide Information Analysis Centre, where the former

price (National Currency) as well as, Population were obtained from United Nations Statistics Division online database.

1.2.2 Exploratory Data Analysis (EDA)

Since exploratory data analysis underscores the relevance of data in guiding analysis and hence, the choice of appropriate model, this study starts by exploring the properties of the data used. We begin examining the decadal trend of CO2 emission. We investigate the stationarity properties of each series. This is to ensure that the data used, satisfies the required conditions for ARDL approach which requires the dependent variable to be I(1), and that no independent variable should be I(2) or more. Following (Fosu and Magnus, 2006), we use ADF and PP unit-roots tests to investigate whether these two conditions are met. For diagnostic checking, we examine whether or not, estimated regression parameters are biased across the period considered. We evaluate their stability over the period, using both the cumulative sum (CUSUM) and cumulative sum of squares (CUSUMSQ) tests for structural stability due to Brown et al., (1975). Lastly, we examine the scatter plots to reveal the geometric relation between GDP and CO2 emission

1.2.3 Model Specification and Econometric Method

As evidenced in the EKC literature, most studies include both the 'linear' and 'squared' GDP per capita term as explanatory variables in the basic EKC model. The inclusion of the 'squared' term reflects changes in the sign of the

originally sourced the data set. This information is available at www. cdiac.ornl.gov.

income parameter. If such 'squared' term is significant, it implies that, pollution is not a monotonic function of income. In that case, there could be evidence for EKC consistent pattern provided the signs are as proposed under the EKC. Using CO_2 emission as our indicator of EQ, we specify the relevant models as thus;

$$CO_{2t} = \beta_0 + \beta_1 GDP_t + \beta_2 (GDP)^2_t + \varepsilon_t \quad (1)$$

$$LCO2_t = \beta_0 + \beta_1 (LGDP_t) + \beta_2 (LGDP)^2_t + \varepsilon_t \quad (2)$$

$$LCO2_t = \beta_0 + \beta_1 (GDP_t) + \beta_2 (GDP)^2_t + \varepsilon_t \quad (3)$$

where CO_{2t} (the measure of environmental degradation) represents carbon dioxide emission (metric ton per capita), ε_t represents white noise error term, GDP_t, represents gross domestic product per capita. We specify equation (1) with the 'level' quadratic form as model (1). Following Kahuthu (2006), we investigate double-log transformation (i.e, model (2)). Lastly, in accordance to the assertion by Richmond and Kaufmann (2006), who underscore the possibility of semi-log transformation to explain the nature of the relation, we also examine a log-linear specification for the relation (model (3)).

Having stated the model, the next item of importance entails selecting a suitable econometric method for estimating the models. We employ the auto-regressive distributed lag (ARDL) approach to cointegration for estimating the long-run and short-run dynamics of the variables in the model. This is in view of the advantages of ARDL model among which is the fact that it is more appropriate for small sample, such as this study (Magnus and Fosu, 2006; Narayan, 2004).

Following Pesaran *et al*. (2001), the ARDL error correction representations for the models can be represented as:

$$\Delta CO2_t = \psi_{01} + \alpha_{11} CO2_{t-1} + \alpha_{21} GDP_{t-1} + \alpha_{31} (GDP)^2_{t-1} + \sum_{i=1}^{\rho} \phi_{11} \Delta CO2_{t-i} + \sum_{i=0}^{q} \phi_{21} \Delta GDP_{t-i} + \sum_{i=0}^{r} \phi_{31} \Delta (GDP)^2_{t-i} + \varepsilon_t \quad (4)$$

$$\Delta LCO2_t = \psi_{02} + \alpha_{12} LCO2_{t-1} + \alpha_{22} LGDP_{t-1} + \alpha_{32} (LGDP)^2_{t-1} + \sum_{i=1}^{\rho} \phi_{12} \Delta LCO2_{t-i} + \sum_{i=0}^{q} \phi_{22} \Delta LGDP_{t-i} + \sum_{i=0}^{r} \phi_{32} \Delta (LGDP)^2_{t-i} + \varepsilon_t \quad (5)$$

$$\Delta LCO2_t = \psi_{03} + \alpha_{13} CO2_{t-1} + \alpha_{23} GDP_{t-1} + \alpha_{33} (GDP)^2_{t-1} + \sum_{i=1}^{\rho} \phi_{13} \Delta CO2_{t-i} + \sum_{i=0}^{q} \phi_{23} \Delta GDP_{t-i} + \sum_{i=0}^{r} \phi_{33} \Delta (GDP)^2_{t-i} + \varepsilon_t \quad (6)$$

where Δ represent first difference operator, α_i are the long-run multipliers, ϕ_i are short-run dynamic coefficients, ε_t denotes white noise errors and Ψ_i represent the drift terms. Under this procedure, the null hypothesis of no long-run relationship defined by H_N: $\alpha_1 = \alpha_2 = \alpha_3 = 0$ is tested against the alternative of H_A: $\alpha_1 \neq \alpha_2 \neq \alpha_3 \neq 0$. The relevant F-test as approximated by Pesaran and Pesaran (1997) and Pesaran et al.(2001) for large sample-sized observations, has a non-standard distribution, contingent on (i) whether variables in the ARDL model are I(1) or I(0), (ii) the number of regressors, (iii) whether the ARDL model contains an intercept and or a trend (Narayan, 2004). In such circumstance, a lower value assumes the regressors are I(0) and an upper value assumes the regressors are purely I(1). A long-run relationship, which entails selecting a model of the

order ARDL(p, q, r) is said to exist if the calculated F-statistic is higher than the upper bound critical value. Since this study is based on small sample of observations, we use the reformulation of the critical value compatible with small samples by Narayan, (2004).

1.3 RESULTS

1.3.1 The Trend of Total Anthropogenic CO2 Emission

A quick flip at the decadal trend of total CO2 anthropogenic emission shows that, the emission pattern does not trend with time. Rather, the mean value increased between the first and second decades and decreased between the second and third decades (Figure 1.3). This assessment of emission pattern is very important as it provides a guide on whether or not, our model should contain a trend term. Also, regarding diagnostic checking, high values abruptly fluctuating from the majority were not observed. To further ascertain whether we do not need a trend term, as suggested by the box plot, we examine the plots of per capita income and emission, both in log and first difference. This is shown in Figure 1.4 below.

Figure 1.3: Box Plot of Decadal Trend of CO2 Emission

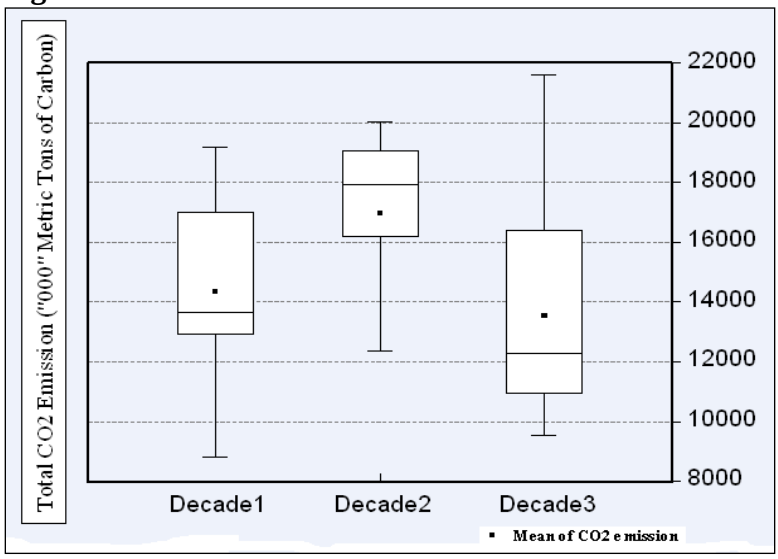
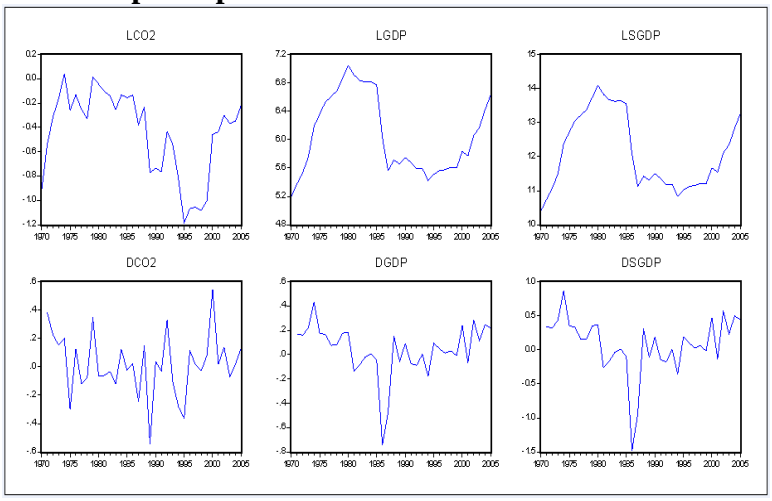


Figure 1.4: Plots of log and first-differenced values of per capita income and CO2 emission.



The plot shows that, the values of per capita income and most especially, per capita CO2 emission does not trend with time. This suggests that we may not bother our model by including the trend term as explanatory variable as far CO2 emission in Nigeria is concerned.

1.3.2 Unit Root Test

Although ARDL method is credited for not requiring the unit root pre-test analysis. This is because, it provides a bound covering all possible classifications of the variables into I(0) and I(1) or even when they are functionally integrated (Bahmani-Oskooee, 2001). Notwithstanding, we do conduct the test to ascertain that the dependent variable is I(1) and none of the variables are I(2). This is because, ARDL approach requires these two conditions to be met (Fosu and Magnus, 2006). Table 1 shows the unit root test for the variables.

Table 1.1: Unit Root Test

	LEVEL		FIRST DIFFERENCE	
	Without Trend	**With Trend**	**Without Trend**	**With Trend**
Augmented Dickey Fuller				
CO2	-2.209575	-2.773542	-6.826402***	-6.694059***
GDP	-1.447094	-0.258257	-4.150455***	-4.323627***
$(GDP)^2$	-1.455988	-0.539112	-4.180880***	-4.288448***
LCO2	-2.092495	-2.584499	-6.127396***	-5.996883***
LGDP	-1.446611	-0.066821	-4.179047***	-4.403695***
$(LGDP)^2$	-1.446611	-0.066821	-4.179047***	-4.403695***
Phillips-Perron				
CO2	-2.278868	-2.831398	-6.930881***	-6.784070***
GDP	-1.296523	-1.018413	-4.106678***	-4.293461***
$(GDP)^2$	-1.368382	-1.414467	-4.176574***	-4.227235**
LCO2	-2.135235	-2.627891	-6.213277***	-6.074838***
LGDP	-1.188704	-0.751142	-4.171765***	-4.403695***
$(LGDP)^2$	-1.188704	-0.751142	-4.171765***	-4.403695***

Note: *** and ** denote significance at the 1% and 5% levels, respectively.

The unit root test shows that the dependent variable is I(1) and none of the variables is I(2). This implies that, the

requirements for conducting the ARDL test are met. Thus, we can proceed to conducting the test.

1.3.3 ARDL Cointegration Test

For all models (4, 5 & 6) specified above, we choose appropriate lag lengths on the highest F-statistic value as proposed by Bahmani-Oskooee & Ng (2002). Based on the appropriate lags as shown in Table 1.2, we investigated the existence of cointegration among the variables in each model.

Table 1.2: Bounds Test Result for equations (4, 5 & 6).

ARDL-OLS Reg. Model	Lag	No. of Obs.	Computed F-Statistic	Prob.	Critical-F Values I(0)	Critical-F Values I(1)	Bounds Test Outcome
Level**	1	34	5.3552	0.005	3.160	4.218	cointegrated
Log-Linear**	1	34	4.8715	0.008	3.160	4.218	cointegrated
Log-log*	5	30	3.6400	0.057	2.676	3.586	cointegrated

Notes: Asymptotic critical value bounds are obtained from appendix A2 & A3 Case II: restricted intercept and no trend for k=3 (Narayan 2004, p.26-28).**(*) denote significance levels at 5%(10%), respectively.

In order to investigate whether there is cointegration, we estimated the long-run relationship and the short-run dynamics using the Akaike Information Criterion (AIC). The results are as depicted on Table 1.3 below. The diagnostic tests for the long-run result presented in Table 1.3, shows that with the exception of the log-log specification, other models (i.e., level and log-linear specification) are correctly specified. A quite important point to note here is that, none of the variables in the log-log specification is found to be significant below or at 10% level.

Therefore, we disregard the log-log specification since even the lagged error term, the significance of which is a relatively more efficient way of establishing long-run relation (Bahmani-Oskooee, 2001; Kremers et al., 1992), is insignificant.

Hence, we examined only the results from the 'level' and 'log-linear' specifications. A quick glance at the 'level' specification shows that the model explains 71% of the variations in CO2 emission. Moreover, the value of Durbin-Watson statistic, the non-significance of the Jaque-Bera statistic, heteroskedasticity and serial correlation chi-square statistics give credence to the correctness of the model. Given the large calculated F-statistic value of 25.2655, we rejected the null hypothesis that the model has no explanatory power. The significance of GDP and the non-significance of squared-GDP term in the model shows that, only GDP per capita explains CO2 emission. As a whole, the insignificance of the RESET test for functional form misspecification suggests that, the model has not been wrongly specified.

D-W represents the Durbin-Watson test; Auto is the Breusch-Godfrey LM test for autocorrelation; Norm is the Jarque-Bera normality test; Hetero is the White test for heteroskedasticity; RESET is the Ramsey test for functional form. Meanwhile, in the 'log-linear' specification, the model explains 73% of the variations in the growth of CO2 emission. Again, as shown in Table 1.3, this model yields satisfactory results for all diagnostics. The insignificance of the RESET test for functional form misspecification points that, the model is correctly specified.

In addition, to ascertain that the estimated regression parameters are not biased across the period considered, we evaluated their stability over the period using both the

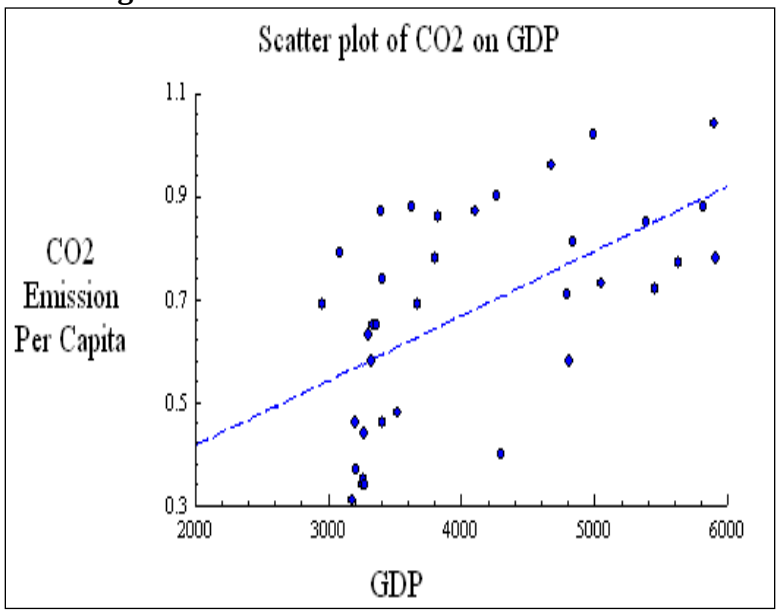
cumulative sum (CUSUM) and cumulative sum of squares (CUSUMSQ) tests for structural stability using the model developed by Brown et al., (1975). We conducted these tests for both the 'level' and 'log-linear' models. We found that, the regression equation is stable since neither the CUSUM nor CUSUMSQ test statistics exceed the bounds at the 5% level of significance. Figures 1.5 and 1.6 below show the Plots of the CUSUM and CUSUMSQ. The plots are contained in the appendix.

Table 1.3: Estimated long run relationship between GDP and CO_2

	CO_2		
	Level	Log-Linear	Log-Log
Intercept	-2.4680	-6.2748**	-17.36
GDP	0.0013598*	0.0025570*	
GDP^2	0.0000014	0.000002591*	
LGDP			-198.9782
$(LGDP)^2$			100.51
ECT(-1)	-0.38863***	-0.35424***	-0.20509
Turning Point	-	4,934.4	-
R2	0.70973	0.73103	0.90918
Adj. R2	0.68164	0.70500	0.80538
D-W	2.3105	2.0522	2.1596
F-Statistic	25.2655***	28.0854***	8.7590***
χ2 Auto	1.3806	0.038869	0.79082
χ2 Norm	0.61061	0.12334	2.4530
χ2 Hetero	0.054194	2.2835	0.15652
χ2 RESET	2.7805*	1.7829	7.0025***

Notes: ***,** and * denote significance levels at 1%, 5% and 10% , respectively.

Figure 1.5: CO2 as alinear function of GDP

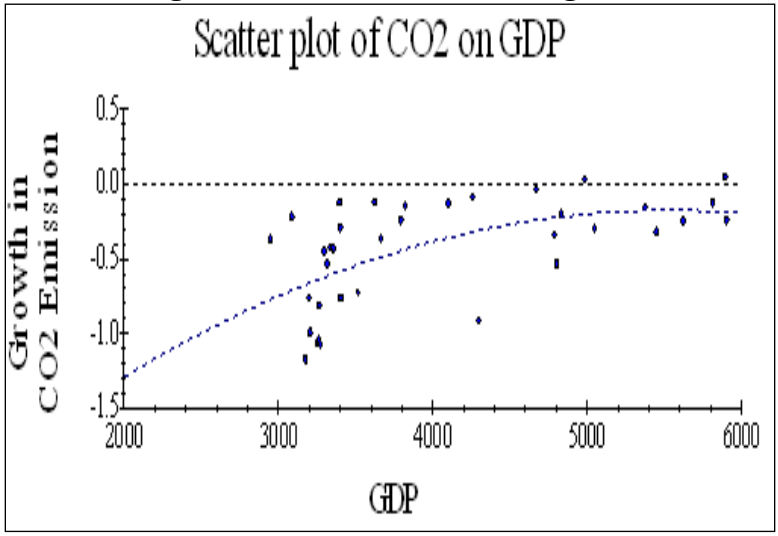


On the other hand, the 'log-linear' model establishes evidence for the EKC assertion through the relationship between GDP per capita and growth in CO2 emission. In the 'log-linear' model, both the linear and quadratic income terms were found to be significant and they both have expected signs as proposed under the EKC. The relationship thus, suggests a turning point as shown in the scatter plot below.

A turning point for growth in CO2 occurs at GDP per capita income of about N 4,934 (Nigeria Naira). To sum, although both 'level' and 'log-linear' specifications provided different results, that does not denote inconclusiveness (A. Kahuthu, 2006). Rather, the results collectively proffer a more comprehensible explanation to EKC for CO2 in Nigeria. The 'level' form shows that Nigeria's economy is still at its growing phase, yet to attain a state of high industrialization characterized by high environmental

awareness of the consumers (green consumers) and access to more expensive clean technology. This conforms to the World Bank classification of Nigeria among the low income countries (Todaro and Smith, 2006), basically unindustrialized. On the other hand, the relationship between GDP per capita and growth in CO2 emission under 'log-linear' specifications provide evidence in respect of EKC for the 'growth' in CO2 emission. This is an uncommonly tested hypothesis. This suggests that even where EKC for CO2 does not exist, such could be true for the 'growth' in CO2 which is less apparently observed.

Figure 1.6: EKC for CO2 in Nigeria



1.4 CONCLUSION AND POLICY IMPLICATION

This paper investigated the trends of CO2 emission per capita and the existence of EKC for CO2 emissions per

capita in Nigeria using annual secondary time series data. The study showed that CO2 emission does not trend with time. Its mean value increases between the first and second decades and decreased between the second and third decades mimicking some sort of convergence. However, conclusion based on such a small sample is difficult, most especially, as the plot for per capita emission of CO2 shows an upward trend beyond 2000 (after the third decade).

The ARDL-cointegration test for different specifications yield quite interesting results which give new insights to the EKC proposition. While we found that for the case of Nigeria, the double-log specification does not give an accurate representation of the relation between GDP and CO2 emission, the 'level' specification shows that, CO2 emission is a linear function of GDP, instead of a polynomial specification suggested by the EKC. This is evidenced by the none significance of the quadratic income term in the model for 'level' specification. This result conforms to the findings of Azomahou et al., (2006) and Grubb et al., (2006). The model shows that, on average, a naira increase in GDP per capita brings about approximately, 0.0014 increase in the intensity of CO2 emission per metric ton. This result does not conform to the findings of Olusegun (2009) who found a U-shaped relationship between income and CO2 in Nigeria, for a 'level' specification.

However, for the purpose of policy consideration, we rely on the 'level' specification. Here, the government could help initiate an inverted-U shaped relationship by embarking on policies that will not only bring about spectacular economic growth, but those that could bring about a cleaner environment. This will help in achieving a long-run decoupling link between economic growth and pollution in Nigeria. The achievement of such decoupling link could also be accelerated if the government introduces and monitors the

implementation of more efficient use of energy in the country. This is a more feasible solution since the reduction in CO2 emission while the country is still at its growing phase is perilous in the context of reducing the country's momentum for growth and increasing poverty (Murthy et al. 2006).

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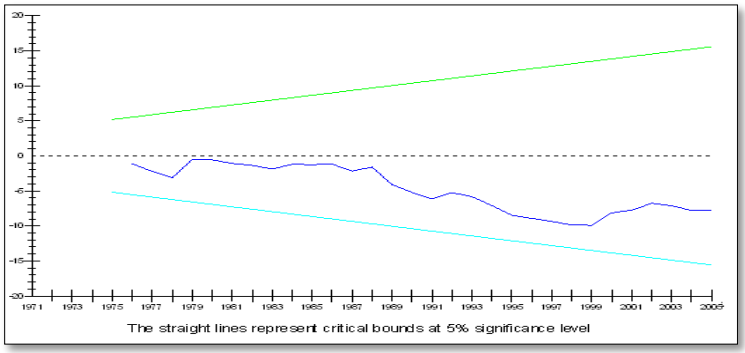
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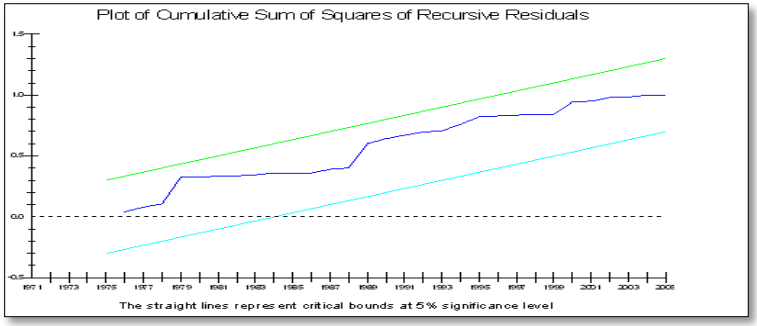
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APPENDIX

1. Cumulative sum (CUSUM) and cumulative sum of squares (CUSUMSQ) tests for the 'level' model.





2. Cumulative sum (CUSUM) and cumulative sum of squares (CUSUMSQ) tests for the ‘log-linear’ model.

