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Does the Level of Economic Growth Influence Environmental Quality in Nigeria: A Test of Environmental Kuznets Curve (EKC) Hypothesis?

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Abstract: This study presents evidence that carbon emission in Nigeria is not driven by economic growth; rather, it is influenced by financial developments. We find a statistically significant negative impact of FDI stock on per capita CO_2 in Nigeria during 1980-2008. The other financial developments indicator, the stock value traded, has a significant and positive impact on carbon emissions. In addition, the results show the non-existence of the inverted-U Environmental Kuznets Curve in Nigeria, judging by the signs and significance of the coefficients of per capita growth and its square.

Key words: Environmental kuznets curves, economic growth, carbon emissions, financial development, enviromental quality, hypothesis

INTRODUCTION

There is a clear evidence that although economic growth usually leads to environmental deterioration in the early stages of the process, in the end the best and probably the only way to attain a decent environment in most countries is to become rich (Beckerman, 1992).

The raging and contentious issue in the environmental economics literature that has generated a vast amount of empirical research and debate centres on causal relationship between growth and environment. While the debate appears to be fairly settled and extensively researched in the context of the developed economies, the same issue has just stimulated renew interests in the developing countries most especially sub-Saharan Africa. Central to the heart of the debate is the proof of existence and applicability of Environmental Kuznets Curve (EKC hereafter) to most anthropogenic activity-related Greenhouse Gases (GHGs) which are by products of the process of development. EKC hypothesizes that at low level of income, an increase in national income corresponds to an increased environmental pressure, in later stages of development the de-linking between economic growth and environmental degradation leads to a better environmental quality.

The inverted-U shaped resulting from this relationship is usually known as Environmental Kuznets Curve (EKC). The ultimate goal of any economy regardless of its political system inclinations and arrangement is to achieve a desirable and sustainable level of economic growth and development. For this goal to be achieved there is need to allow for mutual interactions among the various component parts making the system. The outgrowth of this complex interdependent relationship which engendered growth trajectory has a direct bearing on the environment. The quality of this environment therefore is often believed to vary with the different stages, pattern and structure of development. For example, World Development Report published in 1992 stated that some indicators of environmental deterioration such as carbon dioxide emissions and generation of urban waste, still increasingly worsen with the progress of economic development. However, some environmental indicators such as a lack of safe drinking water and urban sanitary conditions will improve through economic growth. This suggests by implication that economic growth may also promote environmental quality.

Even for some social and physical scientists, growing economic activity (production and consumption) requires larger inputs of energy and material and generates larger quantities of waste by-products. Increased extraction of natural restheces, accumulation of waste and concentration of pollutants will therefore overwhelm the carrying capacity of the biosphere and result in the degradation of environmental quality and a decline in human welfare, despite rising incomes. Furthermore, it is argued that degradation of the resthece base will eventually put economic activity itself at risk. To save the environment and even economic activity from itself, economic growth must cease and the world must make a transition to a steady-state economy. At the other extreme are those who argue that the fastest road to

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Table 1: Trend of Carbon emission and some selected variables

Years	Per capita CO_2	FDI stock (US$ million)	GDP per cap (NGN)	Manu /GDP	Energy consumption per capita	Traded stock value	GDP	Stock traded/GDP
1980-1989	0.837	4425.887	1440.788	8.186	786.746	422.04	187403.5	0.003
1990-1999	0.452	15526.920	1533.667	5.012	779.810	4954.15	280082.7	0.016
2000-2008	0.412	41023.390	1666.230	4.104	770.308	442201.60	510153.2	0.722

World Bank, 2007 CD-ROM

environmental improvement is along the path of economic growth; with higher incomes comes increased demand for goods and services that are less material intensive, as well as demand for improved environmental quality that leads to the adoption of environmental protection measures.

These divergent opinions were trailed by series of empirical verifications which consequently generated a huge body of studies. It is interesting to note that the majority of studies thus far conducted were based on cross-country studies, there were relatively few studies on a single country. Most studies on the EKC relationship in single countries were conducted after 1997 by researchers such as Alcantara and Roca (1995), Sun (1999) and Friedl and Getzner (2003). Interestingly, different results are often noted to emanate from both cross-country and single study analysis. Despite this avalanche of studies, fewer studies are still credited to the developing economies in general, with a few and scanty studies for the sub-Saharan Africa in particular of which Nigeria typically exemplifies.

In Nigeria, with the current interest and debates about sustainable development the issue has been consistently brought to the fore. Within such debates, there has been persistent interest in exploring the Environmental Kuznets Curve (EKC) which poses an inverted U-relationship between some of environmental quality degradation and some measure of economic growth. Also in Nigeria the need to develop and strengthen the frontier of development actually informed government various decisive steps towards adopting reforms programmes which include among others: financial sector reforms and consequent liberalization, significant trade liberalization, willingness to allow for unfettered market system the freedom to work, improvements to supervisory and regulatory systems and policies more conducive to inflows of foreign direct investment. All these gave a boost to impressive economic growth but all these are not without some costs.

The associated costs are mostly in form severe environmental degradation. The rapid growth in population both in the rate and level further exacerbate the problem. Most empirical studies on the EKC hypothesis use cross-sectional data consisting of several countries for their empirical estimations. In this study we have taken a single country approach. This study examines the relationship between economic growth and co_2 per capita. The main objective of the study is to investigate whether an EKC path exists for Nigeria as the per capita incomes grow.

Stylised facts on EKC in Nigeria: Table 1 shows anecdotal evidence on the growth-environment nexus in Nigeria. It is evidently clear that average annual growth of per capita CO_2 fell precipitously from 0.84 tons capita^{-1} 1980-1989 period to 0.41 tons capita^{-1} in 2000-2008. This result is not unexpected given the rate of decline in the ratio of share of the manufacturing sector to total GDP which took downward trend from 8.186 in 1980-1989 period to 4.104 in 2000-2008. In terms of the relationship between per capita CO_2 emissions and GDP per capita, an inverse relationship was observed which suggests that as GDP per capita is increasing; per capita emission is falling over the set of periods. The financial development variables like the ratio of traded stock to GDP and FDI increased substantially over the same period. For instance, the value of FDI that stood at US$4,426 million in 1980-1989 grew by 827% to reach its value in 2000-2008. Similar pattern of movement was observed in the case of traded stock value which increased consistently over the same period. Interesting to note is that of energy consumption per capita which does not show any significant changes as can be shown from the Table 1.

MATERIALS AND METHODS

The study aims to investigate the influence of economic growth on the environmental quality in Nigeria. Thus, in order to study whether the EKC hypothesis does apply, this study employs the standard EKC specification. Though, three types of empirical methods are typically used in the analysis of the EKC hypothesis (Selden and Song, 1994; Grossman and Krueger, 1995; Holtz-Eakin and Selden, 1995; Friedl and Getzner, 2003) and they are in log-linear, quadratic and cubic forms. The study intend to adapt the work of Baek and Koo (2008) and Tamazian *et al.* (2009) in which EKC is specified as follows to reflect the influence of economic growth together with some financial development indicators on per capita CO_2 emission:

$$CO_2 = f(FDI, GDP, GDP^2, MANF, ENERGY, STOCK) \quad (1)$$

For estimation purpose, we re-specify the model as follows:

$$\ln CO_2 = \alpha_0 + \alpha_1 \ln fdi + \alpha_2 gdp + \alpha_3 manf + \alpha_4 \ln energy + \alpha_5 stock + \varepsilon \quad (2)$$

To examine the curvilinear nature of the relationship between per capita CO_2 emissions and economic growth we rely on the specification in the literature as also used by Tamazian *et al.* (2009), by including the square of the GDP into the model, hence the Eq. 3:

$$\ln CO_2 = \beta_0 + \beta_1 \ln fdi + \beta_2 gdp + \beta_3 gdp^2 + \beta_4 manf + \beta_5 \ln energy + \beta_6 stock + v \quad (3)$$

$$\alpha_1>0;\ \alpha_2>0;\ \alpha_3<0;\ \alpha_4>0 \text{ and } \alpha_5>0$$
$$\beta_1>0;\ \beta_2>0;\ \beta_3<0;\ \beta_4>0;\ \beta_5>0;\ \text{and } \beta_6>0$$

Where $\ln CO_2$ indicates the log of per capita CO_2 emission, the economic development is measured by gdp, which is the per capitagrowth rate of GDP while gdp^2 is its squared. The share of manufacturing in the GDP is represented by manf. The financial development indicators used are the log of Foreign direct investments, lnfdi and the ratio of traded value of stock market to the GDP, represented by stock. A control variable capturing the influence of energy consumption, lnenrg is also included. This also follows from the specification of Tamazian *et al.* (2009). The analysis involves testing for the order of integration of variables. The idea is to ensure that inferences drawn from estimated relationships are non-spurious. It thereafter estimated models 2 and 3.

RESULTS AND DISCUSSION

Unit roots test: There are concerns about parametric inferences and spurious regression on the possibility of unit roots when using time series data (Wooldridge, 2000). The presence of non-stationary series provides invalid interpretations of the standard statistics such as t-statistics, F-statistics and confidence intervals. To avoid this problem, non-stationary variables should be differenced to make them stationary. Table 2 shows the results of the unit root tests. The tests are carried using Augmented Dickey Fuller (ADF) and Phillip-Peron (PP) to determine the time series properties of the data set. ADF shows that 43% of the variables are stationary at first difference while PP indicates that 71% of the variables are stationary at first difference.

Empirical results: The empirical results and estimates for equation on per capita CO_2 emission for Nigeria are presented in this subsection. The extent of the influence of economic, financial development and other control variables such as energy consumption on per capita CO_2 emission are discussed in the model 1 (Table 3). Subsequently is the discussion on EKC or curvilinear relationship between economic growth and CO_2 emission in Nigeria (Table 3; Fig. 1).

The results show that economic development captured by GDP growth rate and manufacturing share has no significant impact on per capita CO_2 emissions. Energy consumption is also found to have similar results. However, the FDI stock and stock value traded have significant impact on per capita CO_2 emissions. The FDI stock has 1% significant but negative effect on per capita CO_2 emissions suggesting that increasing FDI leads to low per capita CO_2 emission. For every 1% increase in FDI stock the per capita CO_2 emissions are decreasing by 0.39%. This result is controversial because it is contrary to the visualized expectations in Nigeria where the bulk of FDI inflows are mostly in the oil sector that evidently increases CO_2 emissions through the gas flaring activities.

The findings are however in line with Soysa and Neumayer (2004), Liang (2006) and Tamazian *et al.* (2009) who show that increase in FDI leads to decline in per capita CO_2 emissions. On the other hand, it find that the value of stock traded may increase per capita CO_2 emissions. For every 1% increase in value of stock traded per capita CO_2 emissions increases by 0.24%.

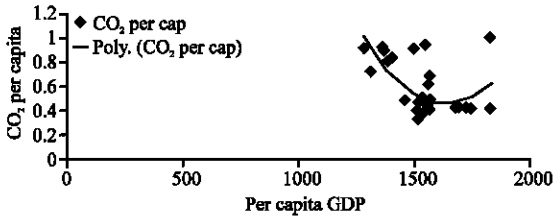

Fig. 1: EKC in Nigeria, researchers' illustration based on data obtained from WDI 2007

Table 2: Unit root test

	ADF				PP			
	Without trend		With trend		Without trend		With trend	
Variables	Level	First difference	Level	First difference	Level	First difference	Level	First difference
$lnco_2$	-1.732	-4.770*	-2.101	-4.960*	-1.838	-6.035*	-2.030	-6.060*
gdp	-5.444*	-	-5.343*	-	-5.720*	-	-5.475*	-
gdp2	-10.545*	-	-10.211*	-	-9.377*	-	-8.936*	-
lnenrg	-2.453	-	-3.833**	-	-2.526	-7.496*	-3.224	-7.174*
lnfdi	1.161	-	-4.097**	-	0.580	-3.001**	-1.504	-3.078
manf	-1.395	-5.605*	-2.407	-5.959*	-1.207	-8.050*	-2.531	-16.699*
stock	-1.414	-5.795*	-2.694	-5.935*	-1.193	-9.468*	-2.745	-15.341*

*, **, ***indicate significance at 1, 5 and 10%, respectively

Table 3: Per capita CO_2 emission equation

	Coefficients	
Variables	Model-1	Model-2
Log (FDI Stock)	-0.38806* (0.135544)	-0.38799** (0.138822)
Economic growth rate	-0.00119 (0.007224)	-0.00115 (0.007462)
Economics growth rate squared	-	3.91E-05 (0.001028)
Manufacturing share of GDP	0.00952 (0.042455)	0.009695 (0.043666)
Log (Energy consumption)	1.371413 (2.255507)	1.369178 (2.319635)
Stock value traded	0.2367** (0.1149)	0.2372*** (0.118124)
Constant	-6.19795 (15.75939)	-6.1854 (16.20361)
AR (1)	0.402152*** (0.21207)	0.399541*** (0.22046)
R^2	0.864418	0.864427
Adjusted R^2	0.82568	0.816977
SE of regression	0.148198	0.151853
Sum squared resid	0.461215	0.461184
Log likelihood	17.75507	17.75601
Durbin-Watson stat	1.924004	1.923201
F-statistic	22.31464	18.21744
Prob (F-statistic)	0.0000	0.0000

(i) *, **, ***, represents 1, 5 and 10% level of significance, respectively, (ii) Figures in parenthesis are standard errors

The results for curvilinear effect between GDP growth rate and per capita CO_2 emissions show that despite controlling for other factors, economic growth rate and its squared remain insignificant and there signs are converse of the expected. These results tend to portray a view that economic development has no influence on the CO_2 emissions in Nigeria. This result is different from that of Omisakin (2009) who show that economic growth, captured by per capita GDP is significant and that EKC hypothesis does not hold in Nigeria. Perhaps, the inclusion of other determinants of per capita CO_2 emission such as the financial development and control variables in the model and the representation of economic growth by the growth rate of per capita GDP seem to have brought out the real underlying relationship between economic growth and CO_2 emissions.

Figure 1 shows the plot of regression between per capitaCO_2 and per capita GDP from 1980-2008. The polynomial trendline depicts a nearly U-shape curve. The take from the figure is that with increasing per capita GDP, per capita CO_2 emission decreases up to a certain point after which the increasing per capita GDP leads to a rising per capita CO_2 emission. Although this figure supports that of Omisakin (2009), we however, differ in the significance of per capita GDP in explainning per capita CO_2 emission.

CONCLUSION

In this study, the relationship between economic growth and environmental quality is examined in Nigeria using a model that recognises the influence of financial developments and the level of energy consumption during the period 1980-2008. The results show that growth rate of per capita GDP plays no significant role in the dynamics of per capita CO_2. Financial developments indicators are found to be central to carbon emissions in Nigeria.

Finally, the results also show the non-existence of the inverted-U EKC curve in Nigeria, judging by the signs and significance of the coefficients of per capita growth and its square.

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