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ECONOMETRIC ANALYSIS OF THE POLLUTION HAVEN HYPOTHESIS AND THE ENVIRONMENTAL KUZNETS CURVE VIS-A-VIS CLIMATE CHANGE IN NIGERIA

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ABSTRACT

The subject of climate change has become a matter of serious concern in recent times given the stark reality of its grave consequences. This paper investigated climate change in Nigeria within the context of the Pollution Haven Hypothesis (PHH) and the Environmental Kuznets Curve (EKC) using the Vector Autoregressive (VAR) OLS estimate technique. Climate changed was proxied by Carbon dioxide emission, CO2 (CO) as dependent variable while Foreign Direct Investment (FDI), Barrels of Crude Oil Production (BCP), Per Capita Income (PCI) and Trade Openness (TO) were used to capture both the PHH and EKC as independent variables. The results revealed that there is no cointegrating relationship among the variables and no Granger Causality from independent variables to dependent variable. However, because of the unilateral Granger Causality from CO to FDI found in the results, it is adjudged that dirty FDI finds its way into the country. Thus there is the dire need for government to filter FDI that comes into the country through proper environmental laws and regulations.

KEY WORDS: Climate Change, Pollution Haven Hypothesis and Environmental Kuznets Curve

1. INTRODUCTION

The debate as to whether developing countries like Nigeria are robbing Peter to pay Paul in their quest for development through Foreign Direct Investment (FDI) and trade openness has taken heightened dimension in recent times given the stark realities these countries now face in terms of climate change. In Nigeria, extreme heat waves and flooding resulting in severe health consequences and even deaths are becoming more regular occurrences (Agada and Yakubu, 2022). The 2012, 2018 and 2022 devastating floods as well as the annual heat waves in recent years in Nigeria are clearly etched in the memories of even the most uninterested thus spurring huge interest in the subject of climate change, its causes and possible mitigating factors.

It is instructive however to note that the raging debate regarding the nexus between FDI and trade openness on the one hand and the environment in general and climate change in particular on the other hand is not entirely new. Concerns regarding this relationship have been raised long ago in economic literature in discourses regarding the Pollution Haven Hypothesis (PHH) and the Environmental Kuznets Curve (EKC). In a nutshell, the Pollution Haven Hypothesis promotes the notion that countries, especially developing countries, with weak environmental laws and regulations are attractive to corporations in advanced countries. In other words, large

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corporations in advanced countries of the world see developing countries with weak environmental laws and regulations as some sort of safe havens for their production or business activities that may not be very environmentally friendly (Nathan and Keyamo, 2021). To put it more succinctly, many obsolete technologies and production methods that have been jettisoned by developed countries often find their way with ease to developing countries.

The above is very evident in Nigeria and two quick examples will drive home the point. First is the Tokumbo (second hand or used) cars syndrome in Nigeria; a situation in which it is a norm to purchase cars that are no longer road worthy in developed countries into Nigeria as "new" cars. These Tokumbo cars might already have been used for upward of ten years in the advanced countries before getting into Nigeria and their use in the country will without a doubt increase CO_2 emission. This is in sharp contrast with what is the case in a country like Singapore where cars older than three years cannot be imported into the country and cars up to ten years in the country are deregistered (Singfat Chu, 2015). Second are the activities of oil multinationals in the Niger Delta region of Nigeria which clearly lead to myriads of environmental and health problems both seen and unseen (Abosede 2014). While environmental problems such as oil spillage, bush burning and deforestation are evident, there are many other problems that are less evident. For instance, it has been suggested in many quarters that there is a strong association between gas flaring and low sperm count in men as well as preterm births in women (Victoria et al, 2016). Thus, advocates of the Pollution Haven Hypothesis and environmentalists contend that all these possible negative externalities must be given due consideration to when contemplating FDI and trade openness in developing countries.

Basically, the Environmental Kuznets Curve (EKC) posits a bimodal relationship between income and the environment. It suggests that lower levels of per capita income are associated with environmental problems while such environmental problems essentially abate when per capita income increases to a very high level. Put differently, the environment tends to suffer during initial stages of growth but recovers at the later stages with sustained improvements in income per head. This recovery is predicated on the premise that with increased income, individuals and countries will be able to acquire much more environmentally friendly technology and even engage in environmental rehabilitation. As a result, the EKC wears an inverted U shape (Kasman and Duman, 2015).

Despite the grave environmental concerns embodied in both the Pollution Haven Hypothesis and the first segment of the Environmental Kuznets Curve, trade economists have continued to advocate for liberalization and greater trade volume. They opine that environmental improvements can be achieved by making efficient use of the proceeds from trade (Kurniawan and Managi, 2018). Further, it is their considered view that by promoting allocation efficiency and correcting market failures, the environment will gain much from trade liberalization. However, many scholars (Managi *et al*., 2009; Cole, 2004; Cole and Elliott, 2003) have put forth the argument that the gains of trade liberalization on the environment are limited to developed countries that have sound environmental laws and regulations. On this basis, there have been heightened calls on developing countries to strengthen their environmental regulations if they must stand the chance to gain from trade. However, there is still much to be desired in this regard as weak environmental laws under various guises are still pervasive in many developing countries.

In Nigeria, CO_2 emission probably because of its pervasiveness has continued to dominate discussions on the environment, pollution and climate change. Several laws, regulations and agencies have been put in place over the years to tackle CO_2 emissions and all other environmental challenges. While some level of progress may have been made, it is obvious that there is urgent need for more action particularly in making the laws more effective and efficient as it has been observed that problems such as insufficient or inadequate punitive measures, noncompliance, poor compensation for injured parties, administrative bottlenecks and even government complicity still negate against the workability of environmental laws in Nigeria (Stephen, 2023). Against this backdrop, it is important to investigate climate change in Nigeria within the context of the pollution haven hypothesis and the Environmental Kuznets Curve. Using CO_2 as a proxy for climate change, this study not only provides insight into factors that cause climate change but by using proxies embedded in the Pollution Haven Hypothesis(PHH) and the Environmental Kuznets Curve(EKC) as independent variables, it also provides evidence of the existence or otherwise of the PHH and EKC in Nigeria. Specifically, FDI, real per capita income, the ratio of exports plus imports to GDP (trade openness) and annual barrels of crude oil production are used to proxy the PHH and EKC. The introduction of annual barrels of crude oil production in this work as one of the proxies for the PHH which is novel is predicated on the fact that crude oil production is perhaps the biggest source of fossil fuel in Nigeria.

2. LITERATURE REVIEW

2.1 Theoretical Literature

There are two dominant theories in economic literature regarding the dynamics between the environment on one side and economic variables such as income, FDI and trade on the other side. These are the Pollution Haven Hypothesis (PHH) and the Environmental Kuznets Curve (EKC) theory and they both form the theoretical pillar of this work.

Mutascua (2018) emphasizes that the Pollution Haven Hypothesis suggests that developing countries sadly holds a comparative advantage for pollution-intensive goods in the sense that because of weak environmental laws and regulations, foreign corporations find these developing countries as a ground with the ease of doing business. Thus production activities that these corporations in advanced countries would not be able to execute in their countries, they would easily execute in developing countries because these developing countries constitute a safe haven for them. It is therefore the position of the Pollution Haven Hypothesis that trade benefits the environment of advanced countries while it is harmful to the environment of developing countries. Millimet (2016) buttresses the Pollution Haven Hypothesis by establishing that there is a strong negative relationship between environmental laws and foreign direct investment inflows in developing countries.

The Environmental Kuznets Curve espouses the notion that as economic growth processes, the environment will initially suffer degradation until a particularly income level is achieved where things will turn around positively for the environment. The fundamental argument is that as income increases, the country will be able to invest into the environment and improve it. While many studies have supported this position, Huang and Zhao (2018) argued that increased income does not necessarily translate to an improved environment as they found out that the reverse might even be the case.

2.2 Empirical Literature

Amaefule and Ebelebe (2022) investigated the nexus between

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Foreign Direct Investment (FDI) movement into Sierra Leone and Nigeria and climate change scare (CCS). Their goal was to establish the presence or otherwise of the Pollution Haven Hypothesis in both countries. Using the quasi-experimental research design as well as the non-linear autoregressive distributed lag (NARDL) technique alongside data from the World Development Indicator, the study established that the movement of FDI into Sierra Leone has a positive impact on CO_2 emission while it has a mixed impact on CO_2 emission in Nigeria. Thus, while the result for Sierra Leone implied the existence of the Pollution Haven Hypothesis in the country, the result for Nigeria implied the existence of the Pollution-halo Haven issue. The study concluded by recommending the influx of environmentally friendly FDI into both countries to foster economic growth amidst a clean environment.

Using the generalized method of moments (GMM) as well as the system-generalized methods of moments (Sys-GMM) across a sample of some twenty-one developing and developed countries, Monica and Neha (2021) sought to understand the interconnection between FDI, financial development, sustainability and institutional factors vis-à-vis the pollution Haven Hypothesis. Using data gleaned from the World Development Indicators over the period of 1990 to 2016, the results revealed that FDI significantly provoked environmental degradation thereby confirming the Pollution Haven hypothesis particularly in developing countries. The study recommended full disclosure of environmental policies for all companies operating in developing countries especially at the commencement of their operations.

Ajayi and Ogunrinola (2020) examined environmental degradation in Nigeria within the context of the Environmental Kuznets Curve and the Pollution Haven Hypothesis. Working with data from 1960 to 2017 and employing the Autoregressive Distributed Lag (ARDL) technique, the study identified the presence of the Environmental Kuznets Curve in Nigeria particularly in the long-run. In addition, the study validated the Pollution Haven Hypothesis in Nigeria via its finding that trade openness and population growth stimulate environmental degradation in the country. It was also observed that financial development abates environmental degradation in both the short-run and the long-run. It was recommended that Nigeria should pursue policies that will bring renewable energy onboard.

Nasir, Nick and Shehu (2023) used panel data to determine whether or not the Environmental Kuznets Curve theory and the Pollution Haven Hypothesis hold in Sub-Saharan. Analyzing data from thirteen countries within the sub-region using the Ordinary Least Squares technique, the study discovered the reversed U-sharp Environmental Kuznets Curve and the Pollution Haven Hypothesis in the sub-region. The study also found a positive relationship between fossil fuel consumption and CO_2 emission while also highlighting same linkage between economic activity, financial sector and CO_2 emission in the long-run. Regulatory incentives to encourage financial intermediation for environmentally friendly energy sources were recommended to bridge the gap between the quest for growth and the environment.

Temurshoev (2006) investigated the presence of the Pollution Haven Hypothesis in China specifically with respect to the country's trade volume with the United States. The study specifically tried to find out by how much more will pollutants such as CO_2, NO_2 and SO_2 increase in both countries if trade volume that is exports and imports increase by same proportion. From the results, the study could not establish the existence of the Pollution Haven Hypothesis in China as a result of her trade with the United States. Thus, the United States is not considered to gain in terms of her environment in her trade with China.

Folorunso, Sunday, Isaac and Robert (2019) used the Autoregressive Distributed Lag technique to carry out an inquest as to the existence of the Pollution Haven Hypothesis in Nigeria. Making use of relevant data covering the period of 1970 to 2017, the study employed FDI as a proxy for economic activity while using CO_2 emission to measure the state of the environment. The study established that previous lags of FDI have a positive significant impact on its present value implying that FDI in Nigeria attracts more FDI into the country. In addition, trade openness was discovered as a major prompter of environmental degradation thus confirming the Pollution Haven Hypothesis in Nigeria. The study cautions that government must weigh the benefits of more FDI inflows against its cost in terms of the environment.

Using cointegration and the error correction method, Riti and Kamah (2015) examined the linkage between trade openness and FDI inflows in Nigeria on economic progress in Nigeria as well as the impact of globalization on the environment in the country. The study covered the period of 1981 to 2013 and used CO_2 emission to measure environmental degradation. While the study found out that trade openness and FDI inflow positively impacts economic progress, at the same time, FDI inflow has a detrimental effect on the environment. On this basis, the study called on the government to adopt necessary policies that will reduce the negative effect of globalization on the environment.

Lundh (2017) sought to find out empirically whether differences in environmental policy stringency has an impact on FDI within the period of 2003 to 2012 in BRIICS and OECD countries. The study which employed the use of the fixed effect model identified the presence of a weak Pollution Haven Hypothesis particularly when the environmental policy stringency variable has a lag of one year.

Levinson and Taylor (2008) made use of pollution abatement cost as measure for environmental stringency in examining the effect of environmental regulations on trade inflows in a sample of 130 companies in Mexico, Canada and the United States from 1977 to 1986. Employing the use of the multi sector equilibrium model, the results revealed a strong connection between industry pollution abatement cost and net imports from Canada and Mexico into the United States.

On their part, Kozluk and Timilotis (2016) concluded from their study findings that there is no strong connection between a country's environmental policies and her trade inflows. Taking a sample from BRIICS and OECD countries in the period of 1990 to 2000 and using a gravity model of bilateral trade in manufacturing industries, the study could not find strong evidence buttressing the Pollution Haven Hypothesis.

3. DATA, ESTIMATION TECHNIQUE AND MODEL SPECIFICATION

The data on the variables (carbon dioxide emission CO2, Foreign Direct Investment FDI, Trade Openness TO, Barrels of Crude Production BCP and Per Capita Income PCI) used in this study were drawn from the World Development Indicators. Unit Root Tests were conducted using the Augmented Dickey Fuller Statistics to determine stationarity. As will be seen, based on the Unit Root Test and the Johansen cointegration test, the Vector Autoregressive (VAR) model was adopted to estimate the coefficients of the variables. It should be noted that all variables are considered endogenous in a VAR model.

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The VAR models for the variables are specified as follows:

$$InCO_{2t} = \alpha_1 + \Sigma^{k}_{i=1}ß_i InCO_{t-1} + \Sigma^{k}_{j=1}ð_j InFDI_{t-j} + \Sigma^{k}_{m=1}ŋ_m InPCI_{t-m} + \Sigma^{k}_{p=1}đ_p InBCP_{t-p} + \Sigma^{k}_{q=1}ϕ_q InTO_{t-q} + u_{1t} \quad (1)$$

$$InFDI_t = \alpha_2 + \Sigma^{k}_{i=1}ß_i InCO_{t-1} + \Sigma^{k}_{j=1}ð_j InFDI_{t-j} + \Sigma^{k}_{m=1}ŋ_m InPCI_{t-m} + \Sigma^{k}_{p=1}đ_p InBCP_{t-p} + \Sigma^{k}_{q=1}ϕ_q InTO_{t-q} + u_{2t} \quad (2)$$

$$InPCI_t = \alpha_3 + \Sigma^{k}_{i=1}ß_i InCO_{t-1} + \Sigma^{k}_{j=1}ð_j InFDI_{t-j} + \Sigma^{k}_{m=1}ŋ_m InPCI_{t-m} + \Sigma^{k}_{p=1}đ_p InBCP_{t-p} + \Sigma^{k}_{q=1}ϕ_q InTO_{t-q} + u_{3t} \quad (3)$$

$$InBCP_t = \alpha_4 + \Sigma^{k}_{i=1}ß_i InCO_{t-1} + \Sigma^{k}_{j=1}ð_j InFDI_{t-j} + \Sigma^{k}_{m=1}ŋ_m InPCI_{t-m} + \Sigma^{k}_{p=1}đ_p InBCP_{t-p} + \Sigma^{k}_{q=1}ϕ_q InTO_{t-q} + u_{4t} \quad (4)$$

$$InTO_t = \alpha_5 + \Sigma^{k}_{i=1}ß_i InCO_{t-1} + \Sigma^{k}_{j=1}ð_j InFDI_{t-j} + \Sigma^{k}_{m=1}ŋ_m InPCI_{t-m} + \Sigma^{k}_{p=1}đ_p InBCP_{t-p} + \Sigma^{k}_{q=1}ϕ_q InTO_{t-q} + u_{5t} \quad (5)$$

Equations 1 to 5 above consists of the short-run relationships because the Johansen cointegration test revealed that there is no cointegrating equation as we shall see shortly. $InCO_2$, InFDI, InPCI, InBCP and InTO are the respective logs of CO_2, FDI, PCI, BCP and TO while u_{1t} to u_{5t} are the respective stochastic terms or white noise. The a priori expectation is that all the variables except PCI will have a positive relationship with CO_2. The a priori expectation for PCI is ±.

4. DATA ANALYSIS AND RESULTS

4.1 Unit Root Test

The Augmented Dickey-Fuller (ADF) stationarity test is presented in Table 1.

Table 1: ADF Unit Root Test

Variables	Levels	First Difference	Remark
CO_2	-2.724484	-6.769595	1(1)
FDI	-1.077225	-6.772077	1(1)
PCI	-2.510603	-4.870527	1(1)
BCP	2.004544	-4.354134	1(1)
TO	-1.446092	-3.78334	1(1)

Source: Author's computation Eviews

From Table 1, it is clear that all the variables are stationary at first difference. This forms the basis for the use of the VAR estimation technique.

4.2 Johansen Cointegration Test

Presented in Table 2 is the Johansen Cointegration Test to determine whether the variables have a long-run relationship.

It is very clear from Table 2 that at both Trace and Maximum Eigenvalue, there are no cointegrating equations among the variables hence we accept the null hypothesis in the Table.

Table 2: Johansen Cointegration Test

Trend assumption: Linear deterministic trend

Series: CO BCP FDI PCI TO

Lags interval (in first differences): 1 to 1

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None	0.449512	63.65273	69.81889	0.1406
At most 1	0.409249	42.75948	47.85613	0.1385
At most 2	0.353122	24.33687	29.79707	0.1866
At most 3	0.212361	9.090952	15.49471	0.3570
At most 4	0.020807	0.735928	3.841466	0.3910

Trace test indicates no cointegration at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None	0.449512	20.89324	33.87687	0.6921
At most 1	0.409249	18.42262	27.58434	0.4603
At most 2	0.353122	15.24592	21.13162	0.2720
At most 3	0.212361	8.355024	14.26460	0.3438
At most 4	0.020807	0.735928	3.841466	0.3910

Max-eigenvalue test indicates no cointegration at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

4.3 VAR Granger Causality Test

Contained in Table 3 are the VAR Granger Causality Tests for the variables. This test is designed to provide insight into the direction of causality among the variables haven established that there is no cointegration among the variables.

Table 3: VAR Granger Causality Test

VAR Granger Causality/Block Exogeneity Wald Tests

Sample: 1 37

Included observations: 36

Dependent variable: CO

Excluded	Chi-sq	df	Prob.
FDI	0.080893	1	0.7761
PCI	0.880838	1	0.3480
BCP	0.209676	1	0.6470
TO	0.004381	1	0.9472
All	1.820343	4	0.7688

Dependent variable: FDI

Excluded	Chi-sq	df	Prob.

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CO	3.636731	1	0.0565
PCI	0.494806	1	0.4818
BCP	8.948862	1	0.0028
TO	1.207526	1	0.2718
All	11.56499	4	0.0209

Dependent variable: PCI

Excluded	Chi-sq	df	Prob.
CO	1.832781	1	0.1758
FDI	7.857680	1	0.0051
BCP	0.071024	1	0.7899
TO	0.011896	1	0.9131
All	9.307310	4	0.0539

Dependent variable: BCP

Excluded	Chi-sq	df	Prob.
CO	0.137209	1	0.7111
FDI	0.231475	1	0.6304
PCI	0.274284	1	0.6005
TO	2.034058	1	0.1538
All	4.320703	4	0.3643

Dependent variable: TO

Excluded	Chi-sq	df	Prob.
CO	0.474968	1	0.4907
FDI	0.201900	1	0.6532
PCI	0.967106	1	0.3254
BCP	0.744752	1	0.3881
All	4.730207	4	0.3161

Source: Author's computation, Eviews

Of particular interest in Table 3 is the Granger Causality from the independent variables to CO. This however is not to relegate the importance of the other Granger Causalities among the variables to the background as they can also provide vital details for policy. It is clear from Table 3 that there is no unilateral or joint causality from the independent variables to the dependent variables thus making it difficult to identify the Environmental Kuznets Curve (EKC) or the Pollution Haven Hypothesis in Nigeria. It is nonetheless interesting to note that there is unilateral Granger Causality from CO, that is, Carbon dioxide emission CO_2, to FDI which raises the fundamental concern as to the possibility that dirty environment or weak environmental regulations in Nigeria attract dirty FDI since carbon dioxide emission is often a proxy for dirty environment or weak environmental regulations. This might just explain why despite cries of environmental degradation in some parts of Nigeria such as the Niger Delta amidst seeming government concerns and action, multinational oil companies still find the Niger delta as a bastion for their activities. On the basis of this finding, the Pollution Haven Hypothesis cannot be completely dismissed in Nigeria. There is therefore the need for government to filter the kind of FDI that has access to the country.

5. CONCLUSION

This study basically set out to empirically identify the Pollution Haven Hypothesis (PHH) and the Environmental Kuznets (EKC) Curve in Nigeria. While the findings revealed that there is no cointegration between the variables and no Granger Causality from any of the PHH or EKC variables to Carbon dioxide emission (CO), the Granger causality from CO to FDI is certainly worrisome and calls for strong government action to screen and rescreen the kind of FDI that comes into the country. Government should not only ensure that production activities of foreign companies operating in Nigeria meet international best practices but also take decarbonization and environmental cleanup much more seriously. Reneging on crucial environmental cleanups such as the Ogoni cleanup sends a wrong signal to foreign companies and might further attract dirty FDI to the country.

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