Foreign Direct Investment, Energy Consumption and Greenhouse Gas Emissions in Nigeria

Oliseeloke Olise[1] DrLeera Kpagih[2] OgorchukwuAhiakwo[3]
DepartmentofEconomics, RiversStateUniversity, Port – Harcourt, RiversState[1]
DepartmentofEconomics, RiversStateUniversity, Port – Harcourt, RiversState[2]
DepartmentofEconomics, RiversStateUniversity, Port – Harcourt, RiversState[3]
Corresponding author: Kpagih.leera@ust.edu.ng, +234 8038803240
kpagih.leera@ust.edu.ng

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Abstract
This paper investigated the nature of the relationship that exists between foreign direct investment, energy consumption, and greenhouse gas emissions in Nigeria between 1990 and 2020. The investigation was done using the ARDL method of analysis. The bounds cointegration test found the existence of long run relationship among the variables. The long run estimation result showed that foreign direct investment in Nigeria has a negatively significant impact on greenhouse gas emission in the short run and long run. The result also shows that AGO consumption has a negatively insignificant impact on greenhouse gas emission in the short run and long run. While PMS consumption has a positively significant impact on greenhouse gas emission in the long run. The model goes on to propose the use of government policies that would promote FDI investment in Nigeria and a more business friendly environment.

Introduction

The Nigerian economy like most other African countries have witnessed an increase in the emission of greenhouse gases with increased economic activities (Olubusoye& Musa, 2020). Economic activities in Nigeria are driven by foreign investment into the oil sector, manufacturing sector, and service industry. Foreign companies consume a lot of energy in their industrial processes and emit a lot of greenhouse gases (GHGs) as waste. The continuous emission of GHGs which depletes the ozone layer and allow solar radiation into the Earth's is referred to as climate change (Akpodiogaga-a &Odjugo, 2010). This could lead to an alteration in rainfall pattern,it could cause drought, and severe and/or more frequent heat waves. (US EPA, 2022).

There is a general agreement that human activities are responsible for GHGs in the atmosphere (IPCC, 2018), of which carbon dioxide is a chief component. Carbon dioxide emissions in Africa are significantly low compared to other developing countries like China and India. However, the total emissions in Africa have significantly increased since the 1950s by more than twelvefold and are projected to increase further. (Olubusoye& Musa, 2020).

The United Nations Framework Convention on Climate Change (UNFCCC) was set up to stabilize the concentration of GHGs in the atmosphere. The parties which include countries in Africa reached a consensus to limit climate change to 1.5 degrees Celsius relative to the pre-industrial level. However, the body reports that the prevalent rate of emissions means that goal

may not be reached. (United Nations Department of Economic and Social Affairs, 2021).

In Nigeria, there is a lack of understanding of environmental sustainability. Industrial processes are extractive focused, and a lot of waste is produced. Nigeria's carbon dioxide emissions from the burning of fossil fuels and cement production have increased from 3.4 million tons in 1960 to 125.46 million tons in 2020 (Integrated Carbon Observation System, 2021). Nigeria has also experienced warming temperatures with 2021 being the warmest year on record since 1981 (Nigerian Meteorological Agency, 2022). The increase in GHG emissions in Nigeria has led to warming as in other parts of the world. It is therefore important to promote environmental sustainability in the country as that will go a long way to preserving the gains of economic development for a long time to come.

Given the importance of foreign investments, economic development, and energy consumption to sustainable development, it is vital for Nigeria to structure policies that ensure the development of a more environmentally friendly industry. Such policies will target the reduction of GHGs and extract a commitment from big multinational corporations in the conduct of their operations in Nigeria.

To do this, Nigeria needs to understand the current effect that foreign direct investment, economic development, and energy consumption have on GHG emissions in the country. This study intends to examine the nature of the relationship between foreign direct investment, energy consumption and GHGs in Nigeria.

Literature Review

Theoretical Framework

This study is anchored on the Environmental Kuznets Curve first developed by Gene Grossman and Alan Krueger in 1995. It proposes an inverted U-shaped relationship between different toxic wastes and per capita income. It states that a country's initial growth leads to progressive environmental degradation which improves after meeting a certain economic development milestone. The curve is represented graphically as follows:

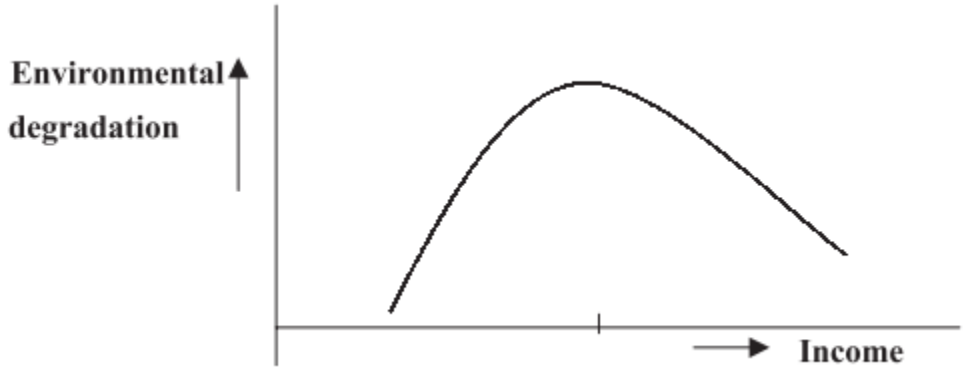

Figure 1: Environmental Kuznets Curve

The curve is used to explain the long-term relationship between environmental degradation and economic growth. As economic development intensifies with agriculture and other resource extraction, at the take-off stage, the rate of resource exhaustion starts to surpass its rate of

recovery, and waste produced increases in quantity and poisonous quality. At higher levels of development, structural changes occur towards more information-intensive businesses and administrations, coupled with expanded natural mindfulness, imposition of environmental regulations, improved innovation, and higher environmental spending, leading to leveling off and the gradual decline of environmental deterioration. As income moves past the EKC turning point, it is assumed that a move towards improving environmental quality begins. This describes the evolution of an economy from a clean agricultural economy to a polluting industrial economy and finally to a clean service economy. (Arrow et al., 1995).

Nigeria is a developing country with a high level of pollution. Considering the need to mitigate the adverse effects of climate change, the effects of foreign investment, economic development, and energy consumption on GHGs in Nigeria needs to be understood to reduce their impact.

Conceptual Clarification

Green House Gas Emissions

For this paper- greenhouse gas emissions will refer to carbon dioxide emissions in Nigeria. They include emissions following the burning of fossil fuels and the manufacture of cement.

Energy Consumption

Energy consumption can be basically defined as the use of energy for mechanical, technical, or domestic purposes. The energy consumption of interest to this paper is the type of energy consumed by industries. In Nigeria, industrial power consumption is done from either the national grid or a power generating set. Industrial power generation using industrial generator sets and other types of machinery like cranes, bulldozers, make use of AGO (Automotive Gas Fuel)/diesel as fuel. Offices and high-income earners in Nigeria also use AGO generator sets and PMS (Premium Motor Spirit) for transportation and other domestic purposes. In this paper, energy consumption will be disaggregated into AGO consumption and PMS consumption in Nigeria.

Empirical Literature

This part of the paper is going to review the literature on the relationship between foreign direct investment, economic development energy consumption, and greenhouse gas emissions in the global economy. All the literature in this line of research cannot be exhausted, but this would serve as a foundation to understand this paper.

Zubairet. al. (2020) inquired about the impact of gross domestic income, trade integration, foreign direct investment (FDI) inflows, gross domestic product (GDP), and capital on carbon emissions in Nigeria. An Autoregressive Distributed Lag (ARDL) bounds testing to cointegration and the improved Vector Autoregressive (VAR) approaches were employed for the analysis over the period 1980–2018. From the bounds testing to the cointegration result, they found the existence of a long-term relationship between carbon (CO2) emissions, income, trade integration, FDI inflows, GDP, and capital. They also discovered that an increase in FDI inflows, GDP, and capital reduced carbon dioxide emissions in Nigeria. The result of the Granger causality showed a two-way causality between CO2 emissions and FDI inflows, while a one-way causality occurred from the capital to CO2 emissions. Following empirical findings, they opined that the Government of Nigeria should continue to improve on providing incentives for

economic agents, both local and foreign, under climate-friendly guidelines

Sarkodie&Strezov (2019) examined the effect of foreign direct investment inflows, economic development, and energy consumption on greenhouse gas emissions from 1982 to 2016 for the top five emitters of greenhouse gas emissions from fuel combustion in the developing countries: China, India, Iran, Indonesia, and South Africa. They employed a panel data regression with Driscoll-Kraay standard errors, a U test estimation approach, and panel quantile regression with non-additive fixed-effects. They found a strong positive effect of energy consumption on greenhouse gas emissions and confirmed the validity of the pollution haven hypothesis. The environmental Kuznets curve hypothesis is valid for China and Indonesia at a turning point of US$ 6014 and US$ 2999; second, a U-shape relationship is valid for India and South Africa at a turning point of US$ 1476 and US$ 7573. Foreign direct investment inflows with clean technological transfer and improvement in labor and environmental management practices will help developing countries achieve sustainable development goals. Mitigation of greenhouse gas emissions depends on enhanced energy efficiency, adoption of clean and modern energy technologies, such as renewable energy, and nuclear, and the utilization of carbon capture and storage for fossil fuel and biomass energy generation processes.

Balsalobre-Lorenteet. al. (2019) analyzed the relationship between economic growth and environmental degradation, and how innovation and energy use impact per capita greenhouse gas (GHG) emissions, in 17 selected OECD countries from 1990 to 2012. The empirical model is found in the empirical hypothesis of the environmental Kuznets curve (EKC) scheme. The econometric results reveal a complete significant relationship, where economic growth, renewable electricity use, and innovation correct environmental pollution, while biomass consumption and fossil electricity consumption affect negatively the environmental correction process. This study implements a novel methodology in the analysis of the relationship between per capita GHG emissions and selected auxiliary variables, through an interaction effect that moderates the relationship between energy variables and the economic cycle over per capita greenhouse gas (GHG) emissions. Hence, this study also incorporates De Leeuw's finite lags effect in auxiliary variables, to validate the long-run effect of these variables over per capita GHG emissions. Consequently, the results validate the positive role that regulatory energy policies, linked with energy innovation processes and the replacement of polluting sources, have on the environmental correction. The outcomes of this study demonstrate that in the long run, renewable electricity consumption and energy innovation measures delay technical obsolescence. These results enable certain strengthened conclusions that help to explain the interaction between energy regulation, economic growth, and per capita GHG emissions, and how they are necessary for the adoption of regulations that reduce energy dependency and mitigate the negative effect of dirty energy sources on per capita GHG emissions.

Demena&Afesorgbor (2019) in an attempt to further understand the FDI-environment nexus, conducted a meta-analysis of the effect of FDI on environmental emissions using 65 primary studies that produce 1006 elasticities. Their results show that the underlying effect of FDI on environmental emissions is close to zero, however, after accounting for heterogeneity in the studies, we find that FDI significantly reduces environmental emissions. Results remain robust after disaggregating the effect for countries at different levels of development as well as for different pollutants.

Esso &Keho (2016) examined the long-run and causal relationships among energy consumption, carbon dioxide (CO2) emissions, and economic growth for a sample of 12 selected-Saharanra African countries. It applied the bounds test to cointegration and the Granger causality test to annual data from 1971 to 2010. The empirical results are mixed across countries. In the long run, energy consumption and economic growth are associated with an increase in atmospheric pollution in most countries. Results from the Granger causality tests show evidence of economic growth causing CO2 emissions in the short-run in Benin, Democratic Republic of Congo, Ghana, Nigeria, and Senegal, implying that economic expansion cannot be achieved without affecting the environment. Evidence of reverse causality running from CO2 emissions to economic growth has been found in Gabon, Nigeria, and Togo, indicating that environmental policies aiming at reducing air pollution may have adverse effects on economic growth. Moreover, bidirectional causality between economic growth and CO2 emissions has been found in the short run for Nigeria and in the long run for Congo and Gabon. In the long-run, energy consumption and economic growth cause CO2 emissions in Benin, Cote d'Ivoire, Nigeria, Senegal, South Africa, and Togo.

Zhu, Duan, Guo, & Yu (2016) investigated the impact of foreign direct investment (FDI), economic growth, and energy consumption on carbon emissions in five selected member countries in the Association oSsoutheastsian Nations (ASEAN-5), including Indonesia, Malaysia, the Philippines, Singapore, and Thailand. They employed a panel quantile regression model that takes unobserved individual heterogeneity and distributional heterogeneity into consideration. Moreover, to avoid an omitted variable bias, certain related control variables were included in the model. Empirical results show that the effect of the independent variables on carbon emissions is heterogeneous across quantiles. Specifically, the effect of FDI on carbon emissions is negative, except at the 5th quantile, and becomes significant at higher quantiles. Energy consumption increases carbon emissions, with the strongest effects occurring at higher quantiles. Among the high-emissions countries, greater economic growth and population size appear to reduce emissions. The results of the study also support the validity of the halo effect hypothesis in higher-emissions countries. However, little evidence was found in support of an inverted U-shaped curve in the ASEAN-5 countries. In addition, a higher level of trade openness can mitigate the increase in carbon emissions, especially in low- and high-emissions nations.

Alshehry&Belloumi (2015) investigated the dynamic causal relationships between energy consumption, energy price, and economic activity in Saudi Arabia based on a demand-side approach. They used a Johansen multivariate cointegration approach and incorporated CO2 emissions as a control variable. The results indicate the existence of at least a long-run relationship between energy consumption, energy price, carbon dioxide emissions, and economic growth. Furthermore, a long-run unidirectional causality stands from energy consumption to economic growth and CO2 emissions, bidirectional causality between carbon dioxide emissions and economic growth, and a long-run unidirectional causality runs from energy price to economic growth and CO2 emissions. In the short-run, there is a unidirectional causality running from CO2 emissions to energy consumption and economic output and from energy price to CO2 emissions. Even though the energy-led growth hypothesis is valid, the share of energy consumption in explaining economic growth is minimal. Energy price is the most important factor in explaining economic growth. Hence, policies aimed at reducing energy consumption and controlling CO2 emissions may not reduce significantly Saudi's economic growth. Investing

in the use of renewable energy sources like solar and wind power is an urgent necessity to control fossil fuel consumption and CO2 emissions.

Keho (2015) analyzed the relationship between foreign direct investment, exports, and economic growth in 12 selected sub-Saharan African countries from 1970 to 2013. The study used the Johansen multivariate co-integration approach for analysis. Results showed that all three variables are co-integrated in ten of the selected countries. Economic growth has a positive long-run effect on FDI in five countries and exports are positively related to FDI in four countries. The results of Granger causality tests are also mixed across countries. The results reveal a short-run bidirectional causality between FDI and GDP and unidirectional causality running from GDP to exports in Ghana. Bidirectional causality exists between FDI and exports in Benin. GDP causes exports in Benin, Congo Democratic, and Gabon. FDI causes exports in Cote d'Ivoire and Kenya. In the long run, both GDP and exports cause FDI in Benin, Burkina Faso, Gabon, and Senegal. Bidirectional causality exists between FDI and GDP in Cameroon, Cote d'Ivoire, and South Africa, and between FDI, GDP, and exports in Congo Democratic. There is bidirectional causality between GDP and exports in Ghana, and between FDI and exports in Kenya. Overall, the results provide an empirical basis for FDI and export-promoting policies.

Lin, Omoju, &Okonkwo (2015) investigated the impact of industrial value-added on CO2 emissions in Nigeria using the Kaya Identity framework and Augmented Dickey-Fuller (ADF), Johansen's cointegration technique, and vector error correction model (VECM). The data spans from 1980 to 2011. The result of the ADF test indicates that continual long-term policies that exert permanent shocks on the variables are required to achieve economic development, industrialization, and CO2 reduction. The result of the analysis shows that industrial value-added has an inverse and significant relationship with CO2 emissions, which suggests that there is no evidence that industrialization increases carbon emissions in Nigeria. GDP per capita and population have positive and significant impacts on CO2 emission. Energy intensity and carbon intensity have a positive but very weak significant impact (at a 10% level) on CO2 emission. They recommended that policymakers in Nigeria should pursue pragmatic industrialization policies coupled with modest decarbonization and energy-efficiency measures to ensure long-term industrial, economic, and sustainable development.

Chang (2010) used multivariate co-integration Granger causality tests to investigate the correlations between carbon dioxide emissions, energy consumption, and economic growth in China. The results of the study demonstrate bi-directional causality running from (1) GDP to CO2 emissions and the consumption of crude oil and coal; and (2) electricity consumption to GDP. Furthermore, increased GDP growth or energy consumption will stimulate CO2 emissions. Electricity consumption likewise is positively correlated with GDP growth, and coal consumption and CO2 emissions manifested bi-directional causality with a feedback effect. This study thus concludes that these variables attained Granger causality and a closed relationship. Economic growth induces a higher level of energy consumption and CO2 emissions. These facts make it difficult for the Chinese government to pursue a mutually exclusive policy, given that economic growth increases energy consumption and CO2 emissions, whilst the adoption of an energy conservation policy would have adverse effects on economic prosperity.

The literature reviewed above shows a lack of consensus on the impact FDI, economic development, and energy consumption have on GHG emissions in developing countries in

general and Nigeria in particular. This provides a good reason for this analysis to be done in Nigeria to see its independent results and to determine the exact impact of FDI and energy consumption on GHGs in Nigeria. This information will enable the Nigerian government structure policies to enable economic development while mitigating carbon dioxide emission.

Methodology

This part of the paper will present the data and the model that would be used to analyze the impact of foreign direct investment, energy consumption, and economic development on carbon dioxide emissions in Nigeria between the period of 1990 and 2020. The subsequent part of this paper will present the results of the analysis and conclude the paper.

Model Specification

The environmental Kuznets curve hypothesis serves as the analytical framework for this analysis. The theory suggests that energy growth and economic development are initially accompanied by high levels of carbon dioxide emission. Continuous energy consumption and economic growth would lead to a reduction in emission levels in society as the government becomes more conscious of the implications of environmental degradation on society. Implicit to the theory is the idea that energy consumption should drive economic growth. The theory informs the specification of the model below:

CO2=f (Foreign direct investment, Energy consumption, Gross domestic product) (3.1)

The left side of equation 3.1 shows the dependent variable, CO2. The right side of the equation contains the independent variables which are foreign direct investment, energy consumption, and gross domestic product. The equation simply states that carbon dioxide emission in Nigeria is a function of foreign direct investment, energy consumption, and economic growth. Energy consumption will be disaggregated into diesel/ago consumption and PMS consumption. This disaggregation informs the transformation of equation 3.1 into the econometric form below:

$$CO2_i = \alpha_0 + \alpha_1 FDI_i + \alpha_2 AGO_i + \alpha_3 PMS_i + \alpha_4 GDP_i + \mu_i \quad (3.2)$$

Equation 3.2 above is shown in the log-linear form in equation 3.3 below:

$$CO2_i = log\alpha_0 + \alpha_1 logFDI_i + \alpha_2 logAGO_i + \alpha_3 logPMS_i + \alpha_4 logGDP_i + \mu_i \quad (3.3)$$

α_1>0;α_2>0;α_3>0;α_4>0

Where:

CO2 is carbon dioxide emission, FDI is foreign direct investment, AGO is automotive gas fuel/ diesel, PMS is premium motor spirit, GDP is gross domestic product, μ_i is the white noise error term, α_0 is the constant of the equation and $\alpha_1, \alpha_2, \alpha_3 and\ \alpha_4$ are parameter estimators for FDI, AGO, PMS and GDP respectively.

The nature and sources of the variables in the model are explained in the table below:

Table 3.1: Description of variables

VARIABLES	MEASUREMENTS	SOURCE OF DATA
Carbon dioxide (CO2)	This is the amount of carbon emitted from liquid fuel consumption into the Nigerian atmosphere as a percentage of total fuel combustion.	World Bank development indicators 2021.
Foreign Direct Investment (FDI)	This is the amount of foreign exchange that is brought into Nigeria for investment. It is usually measured in American dollars.	World bank development indicators 2021.
Automotive Gas Fuel (AGO)	This is the amount of ado (Diesel) used to fuel generators, cars, and machinery. It is measured in metric tons.	NNPC statistical bulletin 2000 to 2021.
Premium Motor Spirit (PMS)	This is the quantity of premium motor spirit that is used by Nigerians to fuel generators and different machineries. It is presented in metric tons.	NNPC statistical bulletin 2000 to 2021.
Gross Domestic Product growth rate (GDP)	This is the annual growth rate of the gross domestic product in Nigeria. It is measured in percentage.	World Bank development indicators 2021.

Source: Authors Compilation

Method of Data Analysis

The first analysis done was the descriptive statistics of the variables in the model will help u understand the nature of the different variables within the timeframe of the study.

The next analysis involved a unit-root test to determine if the variables are stationary. This will be the Augmented Dickey-Fuller unit root test which was developed in 1987 (Dickey &Pantula 1987). This unit root test method is multidimensional in its approach as it controls for the presence of serial correlation in a model and is asymptotical in its performance. The unit root test is important because regression analysis done without a unit root test could lead to spurious results (Granger &Newbold, 1974).

The result of the unit root test informed the researcher to engage the Auto-Regressive Distributed Lag (ARDL) regression technique to analyze the model. Prior to the ARDL estimation, a cointegration test using the bounds approach technique developed by Pesaran et al (2001) was carried out to test for the existence of long run relationship among the variables.

The ARDL long run and short run estimation followed the co-integration test conducted. The integrity of the estimation was tested using four different estimation methods. These are the residual normality test, the autocorrelation test and the heteroskedasticity test.

Result and Discussion

The result of the different empirical tests carried out will be presented and interpreted in this part of the paper.

Table 4.1 below displays the results of theunit root test to determine the level of stationarity of the different variables.

Table 4.1: Augmented Dickey-Fuller Unit Root Test

Series	ADF Test Statistics @ level	5% critical values @ level	ADF Test Statistics @ 1st difference	5% critical value @ 1st difference	Order
CO2	-2.177217	-3.568379	-5.651477	-3.574244	I(1)
FDI	-1.203582	-3.568379	-6.343044	-3.574244	I(1)
AGO	-4.326975	-3.568379	-	-	I(0)
PMS	-0.179390	-3.568379	-4.313362	-3.574244	I(1)
GDP	-3.675717	-3.568379	-	-	I(0)

Source: E-views Output

Table 4.2 contains the result of the augmented dickey fuller test conducted. CO2, FDI and PMS are stationary at first differencing while GDP and AGO is stationary at level. When variables are integrated at different orders, the Autoregressive Distributed Lag (ARDL) regression is used to analyze the model (Shrestha and Bhatta 2018). The first step of the ARDL analysis is the bounds cointegration test which is used to test for the existence of long run relationship among the variables in the model. The bounds test results are presented in table 4.3 below:

Table 4.3: ARDL Bounds Test

K	F-Statistic	Significant	Lower Bound I(0)	Upper Bound I(1)
4	4.787867	10%	2.752	3.994
		5%	3.354	4.774
		1%	4.768	6.67

Source: E-views output

The result of the bounds test is presented in table 4.3 above. The calculated F-statistics of 4.787867 is greater than the upper bound at 10%. Therefore, this paper will proceed to estimate the long run and short run models to adequately understand the impact of foreign direct investment and energy consumption on carbon dioxide emission in Nigeria. Table 4.4 below presents the long run estimates:

Table 4.4: Long run estimation result

Variable	Coefficient	Std. Error	T-statistic	P-Value
FDI	-2.57E-09	1.19E-09	-2.156122	0.0434
AGO	-0.006015	0.004762	-1.263164	0.2211
PMS	0.001971	0.000687	2.870367	0.0095
GDP	0.470915	0.613855	0.767144	0.4520

Source: E-views Output

Table 4.4 presents the long run results of the model used to determine the impact of foreign direct investment and energy consumption on carbon dioxide emission in Nigeria. The result shows that FDI has a positively significant relationship with carbon dioxide emission in Nigeria in the long run. The nature of this relationship however implies that an increase in FDI into

Nigeria by 1%, carbon dioxide emission will increase by 2.57E-09% in the long run.

The result also shows that AGO consumption has a negatively insignificant relationship with carbon dioxide emissions in Nigeria in the long run. PMS on the other hand has a positively significant relationship with carbon dioxide emission in Nigeria in the long run. A 1% increase in PMS consumption would lead to a 0.001971% increase in carbon dioxide emission in Nigeria in the long run.

The paper will proceed to present the short run result.

Table 4.5: Short run estimation result

Variable	Coefficient	Std. Error	T-statistic	P-Value
D(FDI)	-2.89E-09	8.94E-10	-3.230543	0.0042
D(FDI(-1))	-3.46E-09	8.74E-10	-3.958474	0.0008
D(AGO)	0.001408	0.001910	0.737185	0.4696
CointEq(-1)*	-0.566966	0.138626	-4.089890	0.0006
R-Squared	0.616624			
Adjusted R-squared	0.552729			
Durbin-Watson stat	2.251423			

Source: E-views output

The result of the short run estimation of the relationship between foreign direct investment, energy consumption and carbon dioxide emissions in Nigeria is presented in table 4.5 above. The result shows that FDI has a negatively significant impact on carbon dioxide emission in Nigeria in the short run. This nature of relationship is also true after one year lag of FDI flow into Nigeria in the short run. AGO consumption on the other hand has a positively insignificant relationship with carbon dioxide emissions in Nigeria in the short run.

The error correction mechanism is correctly signed and significant. This implies that the speed of transformation from the short run to the long run is approximately 57 percent. The r-squared of approximately 61 percent implies that foreign direct investment and energy consumption explain 61 percent of the fluctuation in carbon dioxide emissions in Nigeria.

Post Estimation Test

The table below contains the result of the different post estimation tests carried out in this paper are presented in table 4.6 below

Table 4.6: - Post Estimation Test

Test	**Techniques**	**Statistic**	**P-Value**	**Remarks**
Residual Normality	Jacque-Bera	Jacque-Bera	0.796411	Accepted
Serial Correlation	Breusch-Godfrey	X^2	0.1849	Accepted
Heteroskedasticity	Breusch- Pagan- Godfrey	X^2	0.8333	Accepted

Source: E-views output

The result of the post estimation test carried out are presented in the table 4.6 above. The Jacque-Bera test result shows that the model is normally distributed. The serial correlation test and

heteroskedasticity test also shows that the error terms are free from serial correlation and heteroskedasticity.

Implications of Results

The estimation result shows a consistent relationship between FDI and carbon dioxide emissions in Nigeria in both the short run and long run. FDI has a negative relationship with carbon dioxide emissions in Nigeria in both periods. Therefore, FDI would be encouraged in Nigeria as it is not dangerous to the environment and has the potential to provide positive dividends to the economy. Regarding, energy consumption, PMS consumption has no impact on carbon dioxide emissions in the short run. However, in the long run there is a positively significant impact of PMS consumption on carbon dioxide emissions in Nigeria. AGO consumption on the other hand has a positive but insignificant impact on carbon dioxide emissions in the short run, while the nature of the relationship becomes negatively insignificant in the long run. In summary AGO consumption does not significantly lead to carbon dioxide emissions in Nigeria in both the short run and long run, unlike PMS consumption that significantly impacts on carbon dioxide emissions in the long run.

Conclusion and Recommendations

The general objective of this paper was to analyze the nature of the relationship between foreign direct investment, energy consumption and carbon dioxide emissions in Nigeria. The specific objective was to determine the nature of the long run impact of foreign direct investment, AGO consumption and PMS consumption on carbon dioxide emissions in Nigeria between 1990 and 2020.

Data from the world bank and the NNPC statistical bulletin were used to carry out the analysis. The unit root test result informed the paper to use the ARDL method of analysis to estimate the model. The bounds cointegration test conducted showed the presence of cointegration among the variables. The result of the estimation shows that FDI and AGO consumption does not significantly contribute to carbon dioxide emissions in Nigeria while, PMS consumption significantly impacts on carbon dioxide emissions in Nigeria in the long run.

Given the result of the analysis, the paper proses that the Nigerian government should encourage policies that would enable FDI's into the country. Policies that would also encourage a business-friendly environment would be important for the FDI's to invest in Nigeria. The result also shows that the Nigerian government policies in the energy sector should encourage more AGO consumption as it has no significant impact on carbon dioxide emissions in Nigeria. PMS consumption should not be encouraged as it is significantly harmful to the environment.

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