Impact Of Oil Price And Foreign Direct Investment On Carbon Emission In A Developing Country

Imaobong Judith Nnam[1], Chinwe R. Okoyeuzu[2], Wilfred I. Ukpere*[3]

[1]Department of Accountancy, University of Nigeria, Enugu Campus, Nigeria, ima.nnam@unn.edu.ng

[2]Department of Banking and Finance, University of Nigeria, Enugu Campus, Nigeria, chinwe.okoyeuzu@unn.edu.ng

[3]Department of Industrial Psychology and People Management, School of Management, College of Business and Economic, University of Johannesburg, South Africa, wiukpere@uj.ac.za

Abstract

Discussion on environmental health has taken center stage in recent times especially for an oil rich country that attracts a huge amount of Foreign Direct Investment (FDI) in that sector. This study therefore investigates the impact of these activities on the environment in order to provide evidence for policymakers. This study therefore analyzed how oil price and FDI impact carbon emission in a developing economy, using an ARDL estimation technique. It was established in this study that a positive relationship exists between oil price, FDI and carbon emission. Hence, a 1% increase in oil price will trigger a 5% increase in carbon emission and a 1% increase in FDI will trigger a 2% increase in carbon emission. The outcome of this study aligns with the EKC hypothesis which posits a positive relationship between the economic variables used and CO_2 emission. The study therefore recommends strong environmental protection policies, which will ensure that emissions are reduced whilst achieving continuous economic growth. Reducing carbon emissions in developing countries, especially Nigeria requires a comprehensive strategy that takes into consideration the role of foreign investment. Policymakers should, therefore, involve measures like carbon pricing and rules on industrial emissions that encourage the use of greener manufacturing techniques.

Key words: Foreign Direct Investments; Oil price; Carbon emission; ARDL; EKC hypothesis; Environmental protection.

JEL Classification: F21; F64

1. Introduction

Environmental health issues have been on the front burner of every country, both developed and developing ones. Greenhouse gas (GHG) in the atmosphere has been identified as a major cause of depletion to the environment, while carbon (CO_2) emissions account for over 60% of these GHG, among other gases (Malik, Latif, Khan, Butt, Hussain & Nadeem, 2020) Attention of various organizations has been directed towards finding means to mitigate these emissions. A key one is the Kyoto Protocol, of which Nigeria a part is, seeking to reduce the emission of gases that cause global warming. These CO_2 emissions arise mainly from the burning of fossil fuels and cement manufacturing and was responsible for about 78% of the increase in GHG during the period 1970-2010 (IPCC 2021; World bank Report 2010). Achieving a reduction in carbon emission may be perceived as an ethical dilemma, particularly for developing nations, as a successful mitigation plan would involve a separation between economic growth and carbon emission (Qiang, Wang & Zhang, 2020). This is quite challenging as most developing nations depend heavily on fossil fuel for energy and pursuing economic growth will lead to increased demand for energy supply. The quest for economic growth and human development in these nations have escalated their need and consumption of energy, which in turn has accelerated their carbon emissions. They pay little attention to sustainable development as national policies are not designed with adequate consideration for environmental health and carbon emission (Hanif, Raza, Pilar &Abbas, 2018, Shahbaz, Sharma, Sinha & Jiao, 2021).

As an oil rich country, Nigeria may not be affected by increases in oil prices. Studies such as that of Kassouri and Bilgili (2021) found that oil price shocks in oil-rich countries did not reduce CO_2 emissions. This means that there is increasing emission even during oil price shocks. Equally, with continuous FDl inflow in Nigeria,(being West Africa's largest FDl destination, (UNCTAD, World Bank Investment Report 2022)), productions which depend on fossil fuel, will continue. All these impact CO_2 emissions. FDI should use improved technology and should invest in greener energy. Being one of the top producers of oil in Africa and a huge recipient of FDl, Nigeria will expectedly continue to drive economic growth, which will significantly increase carbon emission in the country, as is the case with several other African countries that produce oil (Mensah et al., 2019).

Several studies considered macro-economic variables,

which drive CO_2 emission. For instance, Malik, Latif, Khan, Butt, Hussain and Wadeem (2020) considered the effects of oil prices, FDl and economic growth on CO_2 emission in Pakistan. Mensah et al. (2019) also tried to find the link between economic growth, non-renewable energy, energy consumption, CO_2 emission and oil prices in Africa. Gokmenoglu and Taspinar (2016) investigated the nexus between CO_2 emission, energy consumption, economic growth and FDl in Turkey. Turkey's economy is characterized by stability and high interest rates, which are associated with its rate of FDl inflow. The outcome of the study also revealed that although CO_2 emission increases with FDl influx, in the long-run, growth in the economy causes a decline in CO_2 emission. Their findings also confirm the EKC hypothesis. However, in Nigeria, FDl inflow continues to increase in spite of poor growth rates and low interest rates. What then is the attraction?

Similar studies have also been conducted by Ghazouani (2021) to understand the impact of FDI influx, economic growth, crude oil price and international trade on carbon emission in Tunisia. Hanif, Raza, Pilar and Abbas (2018) conducted similar studies for Asian economies, while Shahbaz et al. (2021), Sreenu (2022) and Mujtaba and Jena (2021) conducted a similar study in India. A majority of these studies employed the ARDL and NARDL to determine the association between macro-economic variables and their impact on CO_2 emission. Similar studies have been conducted in Nigeria, using various combinations of macro-economic variables to see how these variables impact CO_2 emission. These have mostly considered population growth and economic growth (Sulaiman & Abdul-Rahim, 2018), financial development (Rafindadi, 2016; Ali, Law, Lin, Yusop, Chin, & Bare, 2019), energy consumption and GDP (Chindo, Abdulrahim, Waziri, Huong, & Ahmad, 2015), and FDI, GDP and gross domestic income (GDI) (Zubair, Samad & Dankumo, 2020). Most of the studies in Nigeria have attempted various macro-economic variables, but none tried to combine FDl and oil price, given their predominance in Nigeria's economy with other control variables. The present study covers this gap in literature, covering a wider period perspective, which ranges from 1972 to 2020. As it is an oil-rich country, which depends largely on fossil fuel as an energy source for developmental activities, whilst continually attracting FDl, Nigeria presents a good case study to investigate the impact of these variables on CO_2 emission to provide recommendations for policy makers to find ways to reduce or reverse the CO_2 emission footprint. The study, therefore, sets out to establish the impact of FDI influx and oil price on CO_2

emission, given the control variables. The study also tested to determine the presence of the Environmental Kuznets Curve. Hence, the study hypothesize that FDI influx and oil price positively impact CO_2 emission. The outcome of this study will contribute to the Body of Knowledge in several ways. There is no known study that has explored the effects of FDI and oil price on carbon emission in Nigeria. The ARDL utilized in this study is known for its robustness in analysis. The rest of the paper presents a literature review, the study's methodology and data, results, discussion and conclusion.

2. Literature

Discussion on environmental sustainability to mitigate the ill health of the environment has hovered around the improvement of dangerous effects of some of the macro-economic variables to provide the required push towards sustainability. Carbon emission has been identified as a major source of environmental pollution, whilst it has also gained a lot of attention concerning which macro-economic variables impact it. Several studies have considered various macro-economic variables such as economic growth, FDI, GDI, GDP, crude oil price, renewable energy, and so on and their effect on CO_2 emission. The EKC hypothesis, as well as the pollution haven hypothesis was used to explain the link between economic growth and FDI, respectively, as well as emission. The study has considered FDI and oil price and their impact on carbon emissions. The study also used certain control variables to establish their relationship with CO_2 emission.

Continuous economic growth as a macro-economic variable is greatly desired in any economy, while several scholars have reviewed its effects on environmental quality (Sreenu, 2022; Malik, Latif, Khan, Butt, Hussain & Nadeem, 2020; Mikagilov, Galeotti & Yasanov, 2018; Gokmenoglu & Taspinar, 2016), using the EKC hypothesis to explain the relationship. The EKC hypothesis advocates that in the initial stage of economic development, environmental quality is negatively affected. However, as economic development progresses, the effect on the environment eases and environmental quality begins to improve. These studies employed various macro-economic variables, including economic growth. Varying outcomes were found in these studies with some aligning with the EKC hypothesis, while others revealed contradicting outcomes. Sreenu (2022), in a study on the impact of FDI influx, oil price, and economic growth on carbon emission in India, found that a

decrease in economic growth will increase CO_2 emission. Mujtaba and Kuma (2021), in their study to examine the uneven impact of economic growth on price and FDI inflow on CO_2, found that an increase in economic growth will cause a decrease in CO_2 emission. Gokmenoglu and Taspinar (2016) found no causal relation between GDP and CO_2 emission, supporting the EKC hypothesis. Shahbaz (2021), in a study to find the impact of economic growth and its drivers on CO_2 emission in India from 1980 to 2019, found that GDP has a direct impact on CO_2 emission and in the long run, the decrease in per capita GDP does not impact or reduce CO_2 emission. This outcome contradicts the EKC hypothesis. Ostic et al. (2021), in their study to assess the impact of petroleum, FDI and economic growth on CO_2 emission in OPEC countries, found a positive and notable relationship between economic growth and CO_2 emission. Chisti, Ahmed Murshed, Namkambe and Ulucak (2021), in a similar study to determine the connection between FDI, terrorism, CO_2 effusion and economic growth, found that economic growth induces CO_2 effusion in all the selected countries. Malik et al. (2020), in a study to find the effects of oil price, FDI and economic growth on CO_2 emission in Pakistan, found that economic growth hikes CO_2 discharges in the short- and long-run, while these outcomes support the EKC hypothesis. Jebli (2019), in a study to analyse how the consumption of renewable energy affected economic growth and carbon emission in 12 MENA countries, also found that economic growth led to environmental degradation.

Studies in Nigeria have found varying outcomes. Suleiman and Abdul-Rahim (2018), in their study, found that both in the long and short term, economic growth significantly affected CO_2 emission. Rafindadi (2016) discovered that economic growth lowers energy requirements, causing a hike in CO_2. In a study on macro-economic determinants of carbon dioxide emission in Nigeria, Nwedeh (2019) revealed an N-shaped association between tested macro-economic variables and CO_2 discharge. These findings contradict the EKC hypothesis. Ali Law, Lin, Yusop, Chin and Bare (2018) examined the connection between economic development and carbon dioxide discharge in Nigeria and found a positive and notable impact of economic growth, economic development, energy consumption and CO_2 discharge in the long run. Contrarily, Zubair, Samad and Dankumo' s (2020) study, which was carried out to find the effect of GDP, GDI,

FDI inflow and capital on CO_2 emission in Nigeria, established that continuously pursuing economic growth, which they proxied with GDP, does not significantly impact CO_2 emission's intensity. This outcome may be explained as a repercussion for underutilization of energy in Nigeria as the nation has not yet been transformed into a fully industrialized nation.

Discussions on FDI and environmental impact have been ongoing, and researchers have adopted the pollution haven hypothesis, as well as the pollution halo hypothesis to explain FDI inflow in countries. FDI has been a major source of cheap finance for development in many countries and some of these countries attract FDI by providing necessary infrastructures (Malik, Latif, Khan, Butt, Hussain, & Nadeem, 2020). FDI has been revered as a means of protecting the environment by improving productivity through the use of improved technology (Gokmenoglu & Taspinar, 2016). However, some of the developing countries have not established environmental standards to check hazardous practices accompanying the FDI (Malik et al., 2020). In their study on the effects of FDI influx, economic development and oil prices on CO_2 discharge in Pakistan, Malik et al. (2020) found that FDI significantly and positively affected CO_2 emission both in the long and short term. Gokmenoglu and Taspinar (2016), in their study to establish the link between CO_2 discharge, energy consumption, economic development and FDI influx in Turkey, also realised that FDI had an inelastic positive and notable impact on CO_2 discharge in the long term. This can be explained by the increased energy usage following economic activities occasioned by the inflow of FDI. Even though this is later countered by increased economic growth. Contrarily, in another study by Ghazouani (2021), which investigated the impact of FDI inflow on CO_2 discharge in Tunisia with a view to avoiding inappropriate policy recommendations, observed that FDI inflow occurs with uneven environmental consequences. The study established the presence of the pollution halo hypothesis. FDI inflow attracted green technology and did not impact CO_2 emission. The uneven environmental consequences may be owing to the aftermath of economic boom, thereby still keeping their energy consumption high. However, the immediate effect of FDI inflow does not increase CO_2 emission. Such a country should adopt and strictly maintain the introduced green technology to ensure that the pollution halo state is maintained. There is a need for

continuous investment to adopt green technology. However, this may be obtainable in a more developed nation, which has existing environmental standards. However, in developing nations sustainability is neglected in the quest for growth and development, as they face dire economic challenges. As production is increasing owing to the massive FDI inflow, unrenewable energy sources depend hugely on power. For instance, the study by Hanif, Raza, Pilar and Abbas (2018) investigated the impact of FDI on carbon discharge and tested the presence of the pollution haven theory in Asia's developing countries. The study established that FDI inflow is a significant source of carbon emission. This finding is synonymous with the pollution haven hypothesis. They also observed that the use of fossil fuel increases carbon emission, which can be explained as an outcome of increased economic activity owing to a massive inflow of FDI, enabled by lenient environmental regulations.

In Nigeria and in most developing nations endowed with oil, revenue from oil forms the main source of revenue for government spending. Apart from being the leading source of revenue, oil has been found to be the main source of energy, even globally, and contributes heavily to environmental pollution (Ostic, et al., 2021). Globally, oil prices have been characterized by shocks, volatility, and decline. The US Energy Information Administration (2020) reports that the decline has equally reduced emission rates in the US. Despite the scarcity of literary works on the effects of oil prices on CO_2 emission, there are diverse beliefs about the influence of oil prices on CO_2 emission. One believes that increases in oil prices, caused by supply shocks, will impact income adversely, causing a decrease in the demand for fossil fuel and, by extension, a decrease in CO_2 emission. The carbon curse hypothesis is hereby used to explain this phenomenon. The carbon curse hypothesis assumes that economies rich in coal and petroleum emit more carbon to produce the same amount of output as economies that lack fossil fuels.

However, some findings contradict this belief. For instance, Kassouri, Biligil and Akaskaye (2021), in a study to evaluate oil shocks occasioned by movement in oil prices related to CO_2 emission to determine the role of emission drivers and to determine if oil shocks can forecast the trend of CO_2 emission in the US, found that surges in oil prices owing to oil supply disruptions do not lead to a reduction in CO_2 emission in the US. Ghazouani (2021) tried to establish

the effects of crude oil prices and other variables on CO_2 discharge in Tunisia. The study concluded that crude oil prices positively affected CO_2 emission in the long term. This means that a rise in crude oil prices escalates CO_2 discharge in Tunisia. Contrarily, Shahbaz et al. (2021) tried to investigate the impact of economic growth drivers on CO_2 emission. They found that increasing oil prices positively affected CO_2 emissions by reducing it. They explain this outcome as the effect of over-dependence on oil as an energy source. A high price will affect general manufacturing activities, as well as power generation. They also believe that this outcome explains the unsteady pattern of economic growth in India. Similarly, Sreenu (2022) engaged in a comprehensive study on the impacts of FDI influx and oil price on CO_2 discharge in India. The study observed that increases in oil prices cause a reduction in CO_2 emissions. Apergis and Gangopadhyah (2020) conducted a study to establish if policy makers are biased in their choice of energy, given the consequences of environmental health and to determine the effects of movement in energy prices on pollution in Vietnam. The study found that oil price has a negative effect on pollution in the short term. In the long term, an asymmetric effect of oil prices on pollution was detected. These controversial outcomes provide an impetus to embark on this study, which will help to provide a guide for policymakers to develop a masterplan geared towards engendering environmental sustainability. The study therefore hypothesize that oil price does not positively impact on CO_2 emission; there is no positive relationship between FDI inflow and CO_2 emission; and there is no positive relationship between economic development and CO_2 emission in Nigeria.

3. Methodology and Data

Model

This study focused on the effect of oil price and FDI influx on carbon emission in Nigeria

$$CO_{2t=}\beta_o + \beta_1 Y_t + \beta_2 Y2_t + \varepsilon_t$$

Equation 1

CO_2 refers to carbon emission. The Y and Y2 introduced the dependent variables and certain control variables. The t represents the year. The variables were natural logarithm

to help to eliminate heteroscedasticity. The model for the study is presented as follows:

$$-\mathrm{l_n}CO_{2t} = \beta_0 + \beta_1 \mathrm{l_n oil_t} + \beta_2 \mathrm{lnNatr_t} + \beta_3 \mathrm{lnGDPC_t} + \beta_4 \mathrm{FDI_t} + \beta_5 \mathrm{EXP_t} + \beta_6 \mathrm{DCPS_t} + \beta_7 \mathrm{INF_t} + \beta_8 \mathrm{UP_t} + \varepsilon_t$$

$$\Delta \mathrm{lnCO2_t} = \delta_0 + \delta_1 \mathrm{lnCO2_{t-1}} + \delta_2 \mathrm{lnoil_{t-1}} + \delta_3 \mathrm{lnNatr_{t-1}} + \delta_4 \mathrm{lnGDPC_{t-1}} + \delta_5 \mathrm{lnFDI_{t-1}} + \delta_6 \mathrm{lnEXP_{t-1}} + \delta_7 \mathrm{lnDCPS_{t-1}} + \delta_8 \mathrm{INF_{t-1}} + \sum_{j=1}^{i} \tau ij\, \Delta \mathrm{lnco2_{t-j}} + \sum_{j=0}^{m} \tau 2j \Delta \mathrm{lnoil_{t-1}} + \sum_{j=0}^{n} \tau 3j \Delta \mathrm{lnNatr_{t-1}} + \sum_{j=0}^{m} \tau 4j \Delta \mathrm{lnGDPC_{t-1}} + \sum_{j=0}^{o} \tau 5j \Delta \mathrm{lnFDI_{t-1}} \sum_{j=0}^{p} \tau 6j \Delta \mathrm{ln}\Delta \mathrm{EXP_{t-1}} + \sum_{j=0}^{q} \tau 7j \Delta \mathrm{lnDCPS_{t-1}} \sum_{j=0}^{r} \tau 8j \Delta \mathrm{lnINF_{t-1}} + \epsilon t$$

To establish the optimal lag in the above equation, the authors adopted the schwarz information criteria (SIC). Further, they conducted a test to establish a long run relationship, which will be revealed by the F-statistics value.

Data

Annualized data was used for the analysis. The authors extracted data from world development indicators for the period 1972 to 2020 and were guided by data availability. The variables of interest are:

CO_2- carbon emission

Oil- Brent oil price

Natr- natural resources

GDPC- Gross domestic product per capita

FDI- Foreign direct investment per capita

Exp- export of goods and services

DCPS- domestic credit to private sector

INF- inflation, GDP deflator annual%

The authors used controlled variables in the study to establish their effect on carbon discharge in the country. Oil price is the main independent variable because a developing country with high dependence on oil as an energy source will exert impact on the environment with an increase in oil prices. An increase may initiate lower consumption and a reduction in emission. Similarly, a rise in price may introduce alternative sources that may produce heavier emissions, which can also impact the nation's inflation. Hence, it was necessary to establish controls for inflation. There are issues of uncertainty associated with high inflation, as it impacts carbon emission through reductions in savings, investment, and energy consumption.

Foreign direct investment inflow was used because it has an environmental impact on the economy owing to climate change. Similarly, the effect of economic activities on carbon emission is key for policy makers. While paying attention to addressing climate change, care must be taken that economic growth is not affected negatively.

The relationship that exists between exports and carbon emission is essentially through a high increase in exports that will promote high energy use, which will impact emission. Natural resources are influenced when there are increased exports. Exports stimulate the use of technology to meet demand. Improved technology lowers emission naturally.

Domestic credit to the private sector has a direct link with carbon discharge. The availability of finance raises standards of living in an economy, as well as their ability to demand energy. Financial development can equally promote advanced technology that will emit lower carbons.

4. Result

The results of the descriptive statistics are presented in Table 1 below.

	Mean	Median	Maximum	Minimum	Std. Dev.
CO_2	10.09091	11.08306	18.43044	0.583028	4.781722
DCPS	9.091788	8.168808	19.6256	4.699551	3.385303
EXPT	19.21748	20.06654	36.02327	5.24909	7.780408
FDI	1.426823	1.093559	5.790847	-1.15086	1.219196
GDPC	0.522881	1.472851	12.45747	-15.4504	5.330813
INF	20.52082	11.48876	219.0028	0.686099	32.13185
NATR	0.011901	0.003901	0.11136	7.35E-06	0.024148
OIL	35.71143	26.99	102.58	3.22	26.722

The descriptive results show that the oil price was high in 2011 (102.58). The average closing price was as high as $94.88. The high price was associated with OPEC's decision at the time, caused by unusual tensions, with the cartel refusing to agree to increase production. The mean value of oil for the period assessed was slightly twice the average value of CO_2.

Carbon emission's maximum emission in 1973 (18.43) indicates that emissions from manufacturing industries and construction was high in that year, while minimal value was captured in 2016 (0.58).

The value of exports as of 2000 was high (36.02), while it was low in 1986 at 5.25. With more production from the productive sectors, exports were improved in 2000.

Unit Root Test

The series that was investigated was the time series, which is ordinarily prone to shocks. Due to associated fluctuations embedded in the time series, it is subjected to unit root tests. There are multiple tests towards stationarity. Here the study adopted the Augmented Dickey- Fuller (ADF) and Phillips -Perron (PP) tests. The study established that some of the variables were stationary at levels while others were stationary at first difference. The choice for adopting the ARDL estimation technique was, therefore, justified.

Unit root **Table 2**

	At Levels			
Methodology	PP		ADF	
variables	t-stat.	Pvalue	t-stat.	Pvalue

$LNCO_2$	-2.3776	0.3861	-2.3349	0.4078
LNDCPS	-2.9299	0.1626	-2.9179	0.1664
LNEXP	-2.3617	0.3942	-2.1506	0.5053
LNFDI	-3.5427	0.046	-2.3593	0.3952
LNGDPC	-1.9297	0.6237	-1.9297	0.6237
LNINF	-5.5453	0.0002	-5.5981	0.0002
LNNATR	-3.113	0.115	-2.9164	0.1667
LNOIL	-2.8089	0.2013	-2.7334	0.2285
	At First Difference			
Variables	t-stat.	Pvalue	t-stat.	Pvalue
$d(LNCO_2)$	-8.1133	0	-7.2864	0
d(LNDCPS)	-8.8004	0	-8.2858	0
d(LNEXP)	-7.2679	0	-7.3327	0
d(LNFDI)	-11.205	0	-11.2978	0
d(LNGDPC)	-6.9695	0	-6.869	0
d(LNINF)	-28.6777	0	-22.9461	0
d(LNNATR)	-8.6729	0	-8.8363	0
d(LNOIL)	-5.9686	0	-5.7352	0

Some of the variables were stationary at levels 1(0), while others were stationary at first difference1 (1).

Table 3 Lag Selection

Lag	0	1	2	3
LogL	-2386.33	-2158.917	-2085.682	-1993.481
LR	NA	355.9536*	85.97145	72.15728
FPE	1.37E+34	2.51e+31*	5.30E+31	1.19E+32
AIC	104.1449	97.779	98.11661	97.62961*
SC	104.5026	101.3568*	104.9144	107.6474
HQ	104.2789	99.11925*	100.6631	101.3823

*Specifies lag order selected criterion. The authors adopted the Schwarz information Criterion SC for their analysis.

ARDL

Regression analysis with CO_2 **Dependent variables long-run estimates**	
Constant	177.8442
	(0.209)
@TREND	-7.34886
	(0.0011)**
LNoil(-1)*	0.592
	(0.025)**

LNNATR**	-0.03923
	(0.2985)
LNINF**	-0.05831
	(0.5181)
LNGDPC**	0.00253
	(0.2921)
LNFDI**	0.266053
	(0.026)**
LNEXP**	-0.03725
	(0.7035)
LNDCPS**	-0.51973
	(0.1173)

Co-integration Test

This study used the co-integration test, as prescribed by Pesaran and Shin (2001). Accordingly, the calculated F-statistics should be higher than the critical values for co-integration to exist. The calculated F-statistics presented lower values than the critical values of the upper bounds, hence the study did not progress to perform the error correction terms.

Table 4

	Bound test estimates		
F-Bound Test Statistics	Significance	1(0)	1(1)
3.179543	10%	2.59	3.789
	5%	3.039	4.339
	1%	4.055	5.64
	Robustness Test		
R-squared	0.88414		
Adjusted R-squared	0.83984		
F-statistic	19.9583		
Prob Value	0		
Breusch-Godfrey Serial Correlation LM Test:	0.2897	3.5762	0.1673
Heteroskedasticity Test:	0.3645	0.3368	0.2411

From our empirical investigations, there is carbon emission, which may result from rising oil costs. Similar to our research, Davis and Socolow (2014) discovered that a $10 increase in oil prices can result in an increase of 0.4% in

carbon dioxide emissions. This is due to the fact that rising oil costs encourage people to produce energy and heat using more carbon-intensive fuels. Carbon emissions are low when oil prices are very low because overall economic activity is low. However, as consumers move to more carbon-intensive fuels as oil prices rise, emissions also rise. When oil prices are extremely high, emissions again decline as a result of energy conservation and a shift to greener energy sources.

5. Discussion

The estimation results indicate a positive relationship between the dependent variable (CO_2) and the oil price. A 1% increase in oil price will trigger a 5% increase in carbon emission. This outcome corroborates with Kassouri et al (2021) and Ghazouani (2021). They found that increase in oil price due to oil supply disruptions does not lead to a reduction in CO_2 emission in the US. This finding also contradicts the finding of Sreenu, (2022) and Apergis and Gangopadhyah (2020). The carbon curse hypothesis can be used to explain this outcome. The carbon curse hypothesis assumes that countries rich in coal, oil and gas, emit more CO_2 to generate the same amount of economic output as countries lacking in fossil fuels. This also can be explained as the effect of over dependence on oil for energy source.

The study further establishes a positive relationship between CO_2 and foreign direct investment. A 1% increase in FDI will promote a 2% significant change in carbon emission. This leads the study to reject the null hypothesis which states that there is no positive relationship between the FDI inflow and CO_2 emission. This finding also corroborates the findings of Malik et al, (2020). In their study on the effect of FDI, economic growth and oil prices on CO_2 emission in Pakistan found that FDI significantly and positively affected CO_2 emission both in the long and short run. Gokmenoglu and Taspinar, (2016), in their study found that FDI in the long run has an inelastic positive and statistically significant impact of CO_2 emissions in Turkey. This outcome can be explained by the increased energy consumption following economic activities occasioned by the inflow of FDI and given that some of the developing countries do not have environmental standards in place to check hazardous practices accompanying the FDI. Even though FDI have been looked up to as a means of protecting the environment through improving productivity and use of improved technology.

Other variables like inflation, local credit to private sector, exchange rate and natural rent all related negatively to carbon emission. As the economy makes effort to industrialize, there should be a balance between both environmental sustainability and economic growth. Such observation has earlier been made by (Oluremi et al., 2021)

This outcome aligns with the findings of Sreenu, (2022), Mujtaba & Kuma (2021), Ostic et al (2021) and Zubair et al (2020). These studies found a negative relationship between economic growth and CO_2 emission. This outcome may be explained as a consequence of underdevelopment as Nigeria is yet to be transformed into an industrialized Nation.

6. Conclusion and policy implications of research findings

This study endeavored to find the impact of oil price and FDI on carbon emission in Nigeria as an oil-dependent economy with heavy inflow of FDI in that sector. The association between carbon emission and oil price has attracted attention from scholars and policymakers as oil price plays a significant role in oil-dependent economies. The findings reveal that the high rise in oil price has the potential to drive carbon discharge. This finding is in tandem with the outcome of studies by Ghazouani (2021). Basically, a scarcity of oil may cause a shift towards other sources that are likely to worsen emission. Hence, it is natural to expect a positive association between oil price and carbon emission. The study also establishes a positive relationship between CO_2 and foreign direct investment.

Financial development was proxied in the study, considering credit to the private sector, inflation, exchange rate and natural rent and all related negatively to carbon emission. Overall, this study aligns with the EKC hypothesis which believes that the relationship between economic variables and CO_2 emission is positive. In other words, the pollution level will continue to increase as oil price and FDI increases until a point where the pollution level will begin to decrease as economic growth continues to rise. FDl inflow and increasing oil prices are expected to drive the economic growth, while causing increasing pollution. However, it is expected that with time pollution will begin to reduce if the appropriate environmental regulations are put in place.

In other words, Nigeria should manage to draw in environmentally friendly policy towards FDI. Flexible

environmental regulations is necessary. Therefore, it is crucial to adopt policies that establish and strengthen environmental protection laws. especially as many investors in Nigeria are basically targeting natural resources, which may have negative implications on economic development and growth. Nonetheless, it is challenging for a developing country to attain economic growth without being exposed to high climate risks. Measures like carbon pricing, limitations on emissions from the use of fossil fuels, and incentives for the development of renewable energy sources should be encouraged by policy makers.

3. References

Ali, H. S., Law, S. H., Lin, W. L., Yusop, Z., Chin, L., & Bare, U. A. A. (2019). Financial development and carbon dioxide emissions in Nigeria: evidence from the ARDL bounds approach. Geo Journal, 84(3), 641-655.

Apergis, N., & Gangopadhyay, P. (2020). The asymmetric relationships between pollution, energy use and oil prices in Vietnam: Some behavioural implications for energy policy-making. Energy Policy, 140, 111430.

Chindo, S., Abdulrahim, A., Waziri, S. I., Huong, W. M., & Ahmad, A. A. (2015). Energy consumption, CO_2 emissions and GDP in Nigeria. Geo Journal, 80(3), 315-322.

Chishti, M. Z., Ahmed, Z., Murshed, M., Namkambe, H. H., & Ulucak, R. (2021). The asymmetric associations between foreign direct investment inflows, terrorism, CO_2 emissions, and economic growth: a tale of two shocks. Environmental Science and Pollution Research, 28(48), 69253-69271.

Davis, S. J., & Socolow, R. H. (2014). Commitment Accounting of CO2 emissions. Environmental Science & Technology, 48(23), 13656-13663. doi: 10.1021/es502942e.

Ghazouani, T. (2021). Impact of FDI inflow, crude oil prices, and economic growth on CO_2 emission in Tunisia: Symmetric and asymmetric analysis through ARDL and NARDL approach. Environmental Economics, 12(1), 1.

Gökmenoğlu, K., & Taspinar, N. (2016). The relationship between CO_2 emissions, energy consumption, economic growth and FDI: the case of Turkey. The Journal of International Trade & Economic Development, 25(5), 706-723.

Hanif, I., Raza, S. M. F., Gago-de-Santos, P., & Abbas, Q. (2019). Fossil fuels, foreign direct investment, and economic growth have triggered CO_2 emissions in emerging Asian

economies: some empirical evidence. Energy, 171, 493-501.

Iorember, P. T., Goshit, G. G., & Dabwor, D. T. (2020). Testing the nexus between renewable energy consumption and environmental quality in Nigeria: The role of broad-based financial development. African Development Review, 32(2), 163-175.

Kahia, M., Ben Jebli, M., & Belloumi, M. (2019). Analysis of the impact of renewable energy consumption and economic growth on carbon dioxide emissions in 12 MENA countries. Clean Technologies and Environmental Policy, 21(4), 871-885.

Kassouri, Y., Bilgili, F., & Kuşkaya, S. (2022). A wavelet-based model of world oil shocks interaction with CO_2 emissions in the US. Environmental Science & Policy, 127, 280-292.

Lin, B., & Xu, B. (2020). How does fossil energy abundance affect China's economic growth and CO_2 emissions? Science of the Total Environment, 719, 137503.

Malik, M. Y., Latif, K., Khan, Z., Butt, H. D., Hussain, M., & Nadeem, M. A. (2020). Symmetric and asymmetric impact of oil price, FDI and economic growth on carbon emission in Pakistan: Evidence from ARDL and non-linear ARDL approach. Science of the Total Environment, 726, 138421.

Mensah, I. A., Sun, M., Gao, C., Omari-Sasu, A. Y., Zhu, D., Ampimah, B. C., & Quarcoo, A. (2019). Analysis on the nexus of economic growth, fossil fuel energy consumption, CO_2 emissions and oil price in Africa based on a PMG panel ARDL approach. Journal of Cleaner Production, 228, 161-174.

Mikayilov, J. I., Galeotti, M., & Hasanov, F. J. (2018). The impact of economic growth on CO_2 emissions in Azerbaijan. Journal of Cleaner Production, 197, 1558-1572.

Mohammed, S. D. (2019). Clean development mechanism and carbon emissions in Nigeria. Sustainability Accounting, Management and Policy Journal, 11(3):523-551.

Mujtaba, A., & Jena, P. K. (2021). Analyzing asymmetric impact of economic growth, energy use, FDI inflows, and oil prices on CO_2 emissions through NARDL approach. Environmental Science and Pollution Research, 28(24), 30873-30886.

Oluremi, O. R., Adeoye, I. B., & Afolabi, A. F. (2021). Examining the relationship between inflation and carbon dioxide emissions in Nigeria: A quantile regression approach. Journal of Cleaner Production, 315, 128187. doi: 10.1016/j.jclepro.2021.128187

Ostic, D., Twum, A. K., Agyemang, A. O., & Boahen, H. A. (2022).

Assessing the impact of oil and gas trading, foreign direct investment inflows, and economic growth on carbon emission for OPEC member countries. Environmental Science and Pollution Research, 29(28), 43089-43101.

Rafindadi, A. A. (2016). Does the need for economic growth influence energy consumption and CO_2 emissions in Nigeria? Evidence from the innovation accounting test. Renewable and Sustainable Energy Reviews, 62, 1209-1225.

Shahbaz, M., Sharma, R., Sinha, A., & Jiao, Z. (2021). Analyzing nonlinear impact of economic growth drivers on CO_2 emissions: Designing an SDG framework for India. Energy Policy, 148, 111965.

Sreenu, N. (2022). Impact of FDI, crude oil price and economic growth on CO_2 emission in India:-symmetric and asymmetric analysis through ARDL and non-linear ARDL approach. Environmental Science and Pollution Research, 1-14.

Sulaiman, C., & Abdul-Rahim, A. S. (2018). Population growth and CO_2 emission in Nigeria: a recursive ARDL approach. Sage Open, 8(2), 2158244018765916.

UNCTAD (2022). World Investment Report. [Online] Available: https://unctad.org/topic/investment/world-investment-report [23 January 2023].

Wang, Q., & Zhang, F. (2021). The effects of trade openness on decoupling carbon emissions from economic growth–evidence from 182 countries. Journal of Cleaner Production, 279, 123838.

World Bank Group. (2019). Nigeria Economic Update: Jumpstarting Inclusive Growth - Unlocking the Productive Potential of Nigeria's People and Resource Endowments. Washington, DC: World Bank. © World Bank. [Online] Available: https://openknowledge.worldbank.org/handle/10986/32795 [16 April 2021].

World Bank (2020). World Development Indicator. [Online] Available: http://www.worldbank.org/en/publication/wdr2019 [18 May 2021].

Zubair, A. O., Samad, A. R. A., & Dankumo, A. M. (2020). Does gross domestic income, trade integration, FDI inflows, GDP, and capital reduce CO_2 emissions? Empirical evidence from Nigeria. Current Research in Environmental Sustainability, 2020, 2, 100009.