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Impact of Oil Exports on Carbon Dioxide Emission in Nigeria

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ABSTRACT: *The study empirically investigated the impact of oil exportation on carbon dioxide emission in Nigeria covering the period 1980 to 2020.The study employed preliminary test of Augmented Dickey Fuller and Dickey-Fuller GLS unit root testing procedure while the main estimation technique is the Autoregressive Distributed Lag (ARDL). Data for the study is sourced from the World Bank's development indicators and Central Bank of Nigeria statistical bulletin for various years. The dependent variable is carbon dioxide emission (CO2) while explanatory variables includes, oil export (X), gross domestic product (Y) for economic growth, total factor productivity (TFP) for technological progress and innovation, oil price (OP) and nominal exchange rate (EXR). Findings in the study show that the coefficient of oil export exhibit positive effect on carbon dioxide emission but only significant in the short run at 10percent level. The study concludes that the positive value of oil export poses serious environmental threat given the rise in carbon dioxide emission. The study therefore, recommends amongst others that the policymakers particularly the Nigerian government need to diversify the economy from oil-based to non-oil based, which will go a long way in reducing environmental challenge emanating from crude oil production for export. The government should also use the proceeds from oil export to put in place necessary infrastructural facilities that can facilitates production process for both government and private sector activities.*

KEYWORDS: Oil Exports, Carbon Dioxide Emission, ARDL, Nigeria.

INTRODUCTION

Indeed, there is no country either developed or developing that is self-sufficient in terms of goods and services needed to meet her daily needs of raw materials, semi-finished goods, and finished

goods. As a consequence, the involvement of countries in international trade as espoused by trade theories is inevitable. International trade can serve as a springboard to deliver economic prosperity to countries that are willing to open their economies to the rest of the world and its benefits range from contribution to poverty reduction, employment creation, per capita income expansion and achieving other macroeconomic goals. These benefits, among others, have led to arise in the number of countries moving towards globalization and liberalizing their economies. During the past few decades, many countries have experienced a considerable expansion in their international trade after adopting liberalization policies. A report by the World Trade Organization (WTO) showed that as of 2017, there were 247 free trade agreements, which were registered with the WTO and came into force (WTO, 2017). However, the success of any nation involving in trade often depend to a large extent on her ability to identify and exploit these opportunities, while formulating programmes and policies to stem and/or turn the challenges to opportunities.

Continually motivated by her quest for innovation policy since independence in 1960, Nigeria trade policy has witnessed tremendous swings from high protectionism within the first decade of independence to the current more liberal stance (Adenikinju, 2005). Trade policy in Nigeria is geared towards promoting manufactured exports and enhancing linkages in the economy. The aim is not only to increase export revenue and reduce the country's reliance on the oil sector (Olaniyi, 2005) but also to discourage dumping, support import substitution, stem adverse movements in the balance of payment, conserve foreign exchange and generate government revenue (Bankole & Bankole, 2004). In 1981, there was a policy shift towards export promotion and a move to intensify the use of local raw materials in industrial production thus tariffs on raw materials and intermediate capital goods were scaled down. In addition, with the adoption of the Structural Adjustment Programme (SAP) in 1986 there was a significant shift in trade policy towards trade liberalization. Since the inception of the World Trade Organization (WTO) in 1995, Nigeria has been negotiating a number of free trade agreements to attract foreign investment and to boost the national economy. As it were with other national economic policies, the motivation to embrace trade liberalization policy in Nigeria focused on the potential benefits associated with the openness of trade, such as to expand the domestic economy in a bid by the government to improve people's standard of living and job opportunities which would ultimately free its people from poverty and inequality.

In 1981, there was a policy shift towards export promotion and a move to intensify the use of local raw materials in industrial production thus tariffs on raw materials and intermediate capital goods were scaled down. In addition, with the adoption of the Structural Adjustment Programme (SAP) in 1986 there was a significant shift in trade policy towards trade liberalization. Since the inception of the World Trade Organization (WTO) in 1995, Nigeria has been negotiating a number of free trade agreements to attract foreign investment and to boost the national economy. As it were with other national economic policies, the motivation to embrace trade liberalization policy in Nigeria focused on the potential benefits associated with the openness of trade, such as to expand the domestic economy in a bid by the government to improve people's standard of living and job opportunities which would ultimately free its people from poverty and inequality.

However, while acknowledging that international trade comes with a number of opportunities, it is instructive that the openness of trade is not without some challenges. There is particularly the growing consensus that the by-product of economic activity expansion triggered mainly from the emissions of production process could dampen the environment standards and ultimately cause a social economic burden to its people. Thus, beyond the benefits of international trade, academics and researchers have started to question the long-term effect of trade openness (trade liberalization) on the environment. To this end, the literature has continued to pay attention not only to the benefits of trade openness, but also the long-term effect of trade liberalization on the environment. Essentially, the potential environmental implications of international trade have been decomposed into scale, technique and composition effects (Antweiler & Taylor, 2001; Taylor, 2004). The scale effect on the one hand indicates the increase in pollution resulting from economic growth and growing market access, while the composition effect on the other hand captured by the change in the share of the dirty goods in GDP (Keho, 2016). With respect to the technique effect, it refers to import of cleaner technique of production that goes with trade liberalization.

LITERATURE REVIEW

Conceptual Clarifications

The Concept of International trade

The term international trade generally refers to the exchange of goods and services between countries. Saying it differently, it is a process of export and import of goods and services, where export means selling of goods and services of a country, while import means inflow of goods and services into a country. In a broader term, international trade has been described as process that allows countries to expand their markets and access goods and services that otherwise may not have been available domestically. Countries that engage in international trade usually operate under one umbrella or the other, such as, multilateral, bilateral, as well as regional agreement. However, the General Agreement on Trade and Tariffs (GATT) which was replaced by the World Trade Organization (WTO) in 1993 (Cooper 2012) is the organization that controls all registered international trade members' nations. According to Rutherford &Tarr (2002), international trade is an important engine of economic growth with potential of impacting the welfare of an economy significantly as well as the natural resources and the environment. In the word of Krugman & Obstfeld (1997), countries participate in international trade for two main reasons such as resource availability and production scale. Accordingly, countries differ from one another in terms of resource availability. Also, each country produces different products and gains from such differences. In addition, if a country specialized in a typical product then it would produce it more efficiently in large quantity compared to producing a wide range of products on a smaller scale. By and large, the resources, including natural and human resources in each country, play a very important role in trade relationships.

The Concept of oil exports

The export of oil refers to the shipment of crude oil and/or refined petroleum products from one country to another. Oil is a globally traded commodity, and countries that are major producers of oil often export significant amounts of it to other countries. Exporting oil can be a significant source of revenue for a country, but it also raises economic and political concerns, as countries often rely heavily on oil exports for their economic well-being and may be vulnerable to fluctuations in the global oil market.

Exporting countries typically sell oil to other countries through long-term contracts or spot market sales. Long-term contracts are agreements between a producer and a buyer to supply a certain amount of oil over a specified period of time, often at a fixed price. Spot market sales, on the other hand, are made on the spot market, where buyers and sellers negotiate the price and terms of a sale in real-time.

The Concept of carbon dioxide (CO_2) emissions

Greenhouse Gas (GHG) is any gaseous compound released in the atmosphere that can absorb infrared radiation, thereby trapping and holding heat in the atmosphere. It increases the temperature in the atmosphere and is responsible for the greenhouse gas effects, which ultimately lead to global warming**.** Carbon dioxide (CO_2) is the most common Greenhouse Gases (GHGs) emitted by human activities, in terms of the quantity released and the total impact on global warming. As a result, the term "CO_2" is sometimes used as a shorthand expression for all greenhouse gases. The CO_2 emissions are emissions mostly attributed to the burning of fossil fuels. For example, Carbon Dioxide Information Analysis Center report 2014 shows that oil producing African economies namely, Egypt, Algeria, Nigeria, Libya and Morocco combined contribute 46% of the continental total CO_2 emissions. Although, the South Africa was the continent highest emitter of CO_2 as at 2017 with a total of 421.7 $MtCO_2$, however, the second highest emitter was Egypt, followed by Algeria and Nigeria all of which are oil export dependent economies. Economic activities in these latter economies have closely tied to oil and gas exports with profits from petroleum exports currently account for more than 80% of total export revenue particularly in Nigeria.

Essentially, oil producing economies such as Nigeria has continued to be linked to steep societal inequalities and environmental disasters. For example, the value for CO_2 emissions from gaseous fuel consumption (kt) in Nigeria increased from 212.69 in 1970 to 7,484.35 in 1990 and peaked at 33,131.34 in 2014 (WDI, 2018). As a percentage of total emission, CO2 emissions from gaseous fuel consumption increased from 0.99% in 197to 19.09% in 199and peaked at 34.41% in 2014 (WDI, 2018).Also, the value for CO2 emissions from liquid fuel consumption (kt) in Nigeria increased from 641in 197to 29,802 and 32,38in 2014. It peaked at 39,776 in 2005 (WDI, 2018). In terms of solid fuel consumption (kt), the value for CO2 emissions in Nigeria increased from 58 in 196to 121.01 in 2014 (WDI, 2018)

Theoretical Framework

Environmental Kuznets Curve (EKC) theory

The well-known inverse U-shape relationship of income and inequality in the income distribution shown by Simon Kuznets (1955) has been extended to describe the relationship between per capita income and pollution. If one assumes that the environment quality is a normal good then one can expect that demand for environmental standards will increase with income. The pioneering work on EKC started by Grossman & Krueger (1995) who finding show that at lower levels of per capita income, environmental quality would fall with economic growth. However, at a higher level of per capita income, environmental standards rise as the economy expands. Put simply, as per capita income increases along with trade liberalization, the effect on the environment would take the inverse U-shaped relationship. Hence, the connection of pollution and trade-led economic growth is hypothesized to be both positive and negative, depending on the level of per capita income and the stage of growth that the economy is going through.

However, one weakness to this model is that at which level of income per capita the relationship of trade and environment standards would switch from positive to negative. One can also question the suitability of this model across different countries, rather than for one country over time. In contrast, Beckermen (1992), writes that, in the end the best and probably the only way to attain a decent environment is to become rich. Thus, to some, GDP is both the cause and the cure of the environmental deterioration. Some suggest that when a study is done on a cross-country basis involving developed and developing countries, it is expected that developed countries (high income) possess a low pollution level and developing countries (low income) possess a high pollution level, so the finding that postulates the Inverse-U of EKC is just juxtaposition. The other theory used in explaining the Inverted-U curve is based on the normal or natural process that takes place in economic progress.

Gains-from-trade Hypothesis

Frankel & Rose (2005) suggest that there is the possibility of an effect in the opposite direction. Termed as the Gains-from-trade Hypothesis the authors urge that it is not unrealistic to expect that trade liberalization could bring a positive effect on the environmental quality even for a given level of GDP per capita. They support their argument by explaining that it is likely that trade liberalization is able to spearhead good managerial and technological innovation that benefits the economy and the environment. This can happen especially through the role of multinational corporations. Trade liberalization enables the corporations to bring clean state-of-the-art production techniques from higher standard source countries of origin to host countries. Along with the openness, the heightened public awareness of environmental standards will push for stringent laws at an international level. The authors also emphasize that whether the race-to-the-bottom effect in practice dominates the gains from trade effect is an empirical question. On an optimistic note they suggest that even for a given level of GDP per capita, the environmental gains from trade will be apparent because the GDP measurement does not adequately capture the

increase in welfare arising from enhanced variety of consumption.

Empirical Review

Jayadevappa and Chhatre (2000) examine the links between international trade and environmental quality by performing a comprehensive literature review. The study revealed some linkages between trade and environment through conventional trade theory. However, interactions between international trade and types of pollution, their Link and assimilative capacity need to be analyzed using a general equilibrium approach. Antweiler et al (2001) extend their study on 43 countries, for the period 1971–1996 and use SO2 as a proxy for environmental degradation. They find that the trade openness increases emissions through the indirect influence of economic growth expansion. Ghirmay et al. (2001) investigated the impact of exports on economic growth in 19 developing countries using a vector error correction model (VECM).They obtain a long-term relationship between trade openness and economic growth in twelve of the developing countries investigated. They note that East Asia and Southeast Asia have not the same growth process.

Jia et al. (2018), this study analyzed the relationship between global oil trade and carbon dioxide emissions using data from 1990 to 2014. The researchers found that oil exports are associated with higher carbon dioxide emissions, while oil imports are associated with lower emissions. Muhammad & Arshad (2018), the study investigates the relationship between oil exports and carbon dioxide emissions in a panel of developing countries using data from 1980 to 2014. The study finds that oil exports have a positive and statistically significant relationship with carbon dioxide emissions in developing countries. Ahmed et al (2018), the study examines the relationship between oil exports and carbon dioxide emissions in developing countries using panel data from 1980 to 2014. The study finds that oil exports have a positive and statistically significant relationship with carbon dioxide emissions in developing countries.

Ahmed et al (2019), the study investigates the relationship between oil exports and carbon dioxide emissions in developing countries using panel data from 1980 to 2014. The study finds that oil exports have a positive and statistically significant relationship with carbon dioxide emissions in developing countries. Chen et al. (2019) , the study used a life-cycle assessment approach to estimate the carbon footprint of global oil trade. The researchers found that the carbon footprint of oil exports is generally higher than that of oil imports, due to differences in the production and transportation processes.

Wang et al. (2020) has found that the net CO2 emissions transfer to China has resulted from its trading activities with Western Europe, North America, and other developed countries whereas its emissions outflow embedded in trade are transfer to Sub-Saharan Africa, America, and South Asia. Using computable general equilibrium (Zhang, 2020) reports that advanced countries tend to shift their pollution to developing countries.

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METHODOLOGY

Model Design

The ex post facto research design was used to ascertain how oil exportation affected carbon dioxide emission (CO2) in Nigeria. The study sourced data from the World Bank's Development Indicators, International Monetary Fund database, and Central Bank of Nigeria Statistical Bulletin, Organization of Petroleum Exporting Countries (OPEC) which have relevant statistical information on oil exportation and carbon dioxide emission in Nigeria.

Model Specification

$$EM = f(FDI, ENERGY, GDP, TD) \quad (3.1)$$

Where:
EM = Total Carbon Dioxide emission;
FDI = Foreign Direct Investment;
ENERGY = Primary Energy Consumption;
GDP = Gross Domestic Product and

X = Oil Export;

Expressing the above functional representation in a polynomial form would provide us with a modified variant of the model as shown below.

$$CO = \beta_0 X_t^{\beta_1} FDI_t^{\beta_2} Y_t^{\beta_3} TFP_t^{\beta_4} OP_t^{\beta_5} EXR_t^{\beta_6} \varepsilon^{\mu_t} \quad (3.2)$$

Where:

CO = Carbon dixoide emission ;
X = Oil Export;

FDI = Foreign Direct Investment;
Y = Gross Domestic Product;
TFP = Total Factor Productivity;
OP = Oil Price; and
EXR = Exchange rate

The econometric and estimable variant of the model in equation (3.2) is as given below.

$$CO_t = \beta_0 + \beta_1 X_t + +\beta_2 FDI_t + \beta_3 Y_t + \beta_4 TFP_t + \beta_5 OP_t + \beta_6 lnEXR_t + \mu_t \quad (3.3)$$

In Equation (3.3) all the variables are as earlier defined while $\beta_i$ate parametric constants. A priori, $\beta_1, \beta_2 > 0$.

EMPIRICAL RESULTS AND DISCUSSIONS

Table 1: Unit Root Test Results

Variable	ADF test			ADF-GLS test		
	Level	First Difference	I(d)	Level	First Difference	I(d)
CO2	-1.521	-8.237***	I(1)	-2.665	-11.046***	I(1)
FDI	-8.135***	N/A	I(0)	-8.240***	N/A	I(0)
X	-6.102***	N/A	I(0)	-4.837***	N/A	I(0)
Y	-3.778***	N/A	I(0)	-1.912	-3.270***	I(1)
TFP	-3.859***	N/A	I(0)	-2.617***	N/A	I(0)
OP	-4.537***	N/A	I(0)	-2.593**	N/A	I(0)
EXR	-7.344***	N/A	I(0)	-7.445***	N/A	I(0)

Source: *Extract from Eview 10 Output*

Table 1, shows the result of unit root test conducted with Augmented Dicky Fuller Test (ADF). To get a robust result for this empirical study, we adopted the outcome of ADF statistics due to the robustness of its result in point of structural breaks. In line with the prepositions of Jenkins and Box (1970). Variable that are not stationary at levels would be made stationary after first difference. The following variables in the model were made stationary after first difference, CO2, GDP while FDI, X, TFP, OP and EXR are stationary at level.

Table 2: Bound Test
Bound Cointegration Results

Level of Significance	**F-Statistics**	**I(0)**	**I(1)**	
10%	7.444405***	2.75	3.79	
5%		3.12	4.25	
1%		3.93	5.23	

Note: *** implies significance at 1% and by implication the rejection of the null hypothesis of no cointegration

The result presented in table 2, shows that the calculated F-statistics of 7.444405 is higher than the upper bound critical value of 4.25 at 5% significant level. Based on this result, it is concluded that a long run relationship exists among the variables in the model. So, there is a long run co-integration amongst the variables in the model.

Explanation of the Estimated Long-run and short run for the Model

Table 3. Empirical results on oil exportation and carbon dioxide emission

Panel A: Long Run Equation	**Dependent variable: Carbon Dioxide Emission (CO2)**			
	Coefficient	**Standard Error**	**T-statistic**	**P-value**
X	0.055423	0.033727	1.643264	0.1108
Y	-1.547285	0.546498	-2.831275	0.0082
TFP	2.011798	0.737519	2.727789	0.0106
OP	-0.008343	0.051374	-0.162404	0.8721
EXR	0.001216	0.000806	1.507368	0.1422
Panel B: Short Run Equation				
Constant	8.296629	2.087946	3.973585	0.0004
$\Delta CO2_{t-1}$	-0.819588	0.157126	-5.216130	0.0000
ΔX_{t-1}	0.045424	0.024397	1.861864	0.0724
ΔY_{t-1}	-1.268137	0.355247	-3.569728	0.0012
ΔTFP_{t-1}	1.648846	0.477825	3.450732	0.0017
ΔOP_{t-1}	-0.006838	0.042597	-0.160533	0.8735
ΔEXR_{t-1}	0.000996	0.000585	1.702225	0.0991
ECT_{t-1}	-0.819588	0.113536	-7.218783	0.0000

Source: *Extract from Eview 10 output*

Note: The value in parenthesis represent the probability values for the various post estimation tests performed, while *** denote 1% level of significance.

The coefficient of GDP proxied for national income exhibited negative effect and statistically significant at 1 per cent in both long run and short run, which is contrary to the study's a priori expectation. This outcome reveals that a unit change in gross domestic product (Y), will lead to -1.547 and -1.268 units decrease in carbon dioxide emission in both long run and short run. However, at early stage of growth in the developing countries according to Kuznets hypothesis, it is expected that it will experience reasonable level of environmental challenges; this outcome contradicts this scholarly position.

The value of total factor productivity (TFP) holds positive sign and significant at 1 per cent level in both long run and short run and contrary to study's a priori expectation. This is evidenced at a unit change in total factor productivity will lead to 2.012 and 1.649 units increase in carbon dioxide emission. This finding justifies the position of Kuznets hypothesis of environmental contest at early stages of development, in term of the mode of production process with less concern about carbon dioxide emission. Importantly, because of Nigeria's level of development, the current technological usage will continue to pose serious environmental challenges. This is evidenced in gas flaring and oil spillage seen in Niger Delta region with attendance consequence on aquatic

animals and inability of host community to carried out their economic activities in area of agricultural production and fishing. This also has implication on human health because of the kind of foods and water consumed in the host community.

The study revealed that oil prices is negatively signed and statistically insignificant in both long run and short run, though the sign conform to the study's a priori expectation. The value shows that a unit change in oil price, will lead to -0.008 and -0.007 units decrease in carbon dioxide emission in both long run and short run. This implies that changes in crude oil price influenced negatively on carbon dioxide emission. This is because fall in oil price precipitate into less oil export commodity consequently limiting crude oil production, and further pose little or no challenge to environmental quality. Essentially, since Nigeria is oil exporting country and large proportion of foreign exchange earnings come from oil, changes (decrease/increase) might not really exert decrease in carbon dioxide emission. Earlier report on environmental sustainability index describes the healthiness of the environment at a low level of 55.89 in 2019 (World Economic Forum, 2020), thus, signaling that the country is still facing substantial environmental problems (World Economic Forum, 2001).

Lastly, nominal exchange rate shows positive effect on carbon dioxide emission and statistically significant at 10 per cent only in the short run. This finding contradicts theoretical expectation. Statistically, a unit change in the value of exchange rate will lead to 0.001 and 0.001 units increase in carbon dioxide emission in both long run and short run. Consistent fall in the value of Naira to US$ pose serious concern to rising cost of basic products with implication on real income of citizens. In other to cushion the effect of rising cost of goods, citizens is left with no other choice resulting to use of traditional energy with severe consequence on environmental quality.

Oil Exportation and Carbon dioxide Emissions

The a priori expectation is that oil export coefficient supposed to exert positive and significant relationship with carbon dioxide emission in Nigeria, according to Kuznets hypothesis that natural resource rich countries experience environmental degradation during exploration at early stage of growth, which conform to the finding of Hu, et al (2020) conducting in both developed and developing economies. This finding conforms to Zhu et al. (2018). The finding shows that oil export exhibit positive relationship with carbon dioxide emission, this led to the rejection of null hypothesis and accept alternative hypothesis. The policy implication is that oil export from exploration leads to environmental pollution particularly gas flaring with attendant effect on carbon dioxide emission.

Table 4. Diagnostic and post estimation test for oil exportation and carbon dioxide emission

Diagnostic and Post-Estimation Results	
Adjusted R2:	0.573017
F-statistics:	14.08463 (0.000001)
Serial Correlation LM Test (Breusch-Godfrey	2.312824 (0.1176)
Heteroscedasticity test (ARCH LM)	0.023140 (0.8799)
Ramsey RESET Test	0.000211 (0.9998)

Source: *Extract from Eview 10 output*

Note: The value in parenthesis represent the probability values for the various post estimation tests performed.

The adjusted R-squared of the result reveals that the model for this study explained about 57% of total variation in the carbon dioxide emission. The Linearity RESET test confirms that the model is free from misspecification. The F-values and probability value associated with the ARDL model are insignificant, thus, the null hypothesis of linearity is retained and the model is correctly specified. The F-statistics for serial correlation result of are not significant as the probability is above 5 per cent level of significance, indicating acceptance of the null hypothesis of no serial correlation. Also, the test for heteroscedasticity shows that in the model, there is constant spread of the residual because the test does not reject the null hypothesis of heteroscedasticity presence. This is arrived at when the probability of F-statistic for the model is greater than 0.05 per cent level of significance. To this end, the study then proceeds to analyze and discuss the elasticities of the coefficients with focal point on whether oil importation contributes to carbon dioxide emission.

CONCLUSION/RECOMMENDATIONS

Given the period under consideration coupled with the above empirical findings, it is only rationale therefore, to infer as follows: deduction from the empirical estimates on the impact of oil exportation on carbon dioxide emission is more pronounced in the long run just as seen with the outcome of oil import. Essentially, the positive signs are an indication of long-term reliance on oil exportation at the detriment of economic diversification that can boost non-oil trade. For Nigeria government to reduce the level of carbon dioxide emission in the oil-producing, more effort should be put in place to reduce petroleum importation. In other words, clean and renewable sources like hydropower, wind, solar and nuclear power, etc. should be encouraged in the various socio-economic activities. Secondly, the burden lies on the policymakers particularly the Nigeria's executive arm to diversify the economy from oil-based to non-oil based, which will go a long way in reducing environmental challenge emanating from crude oil production for export. This can be achieved by using the proceed from oil export to put in place necessary infrastructural facilities that can facilitates production process for both government and private sector activities. In addition, this drive is fundamental but the government need to embark on institutional reforms across various sectors of the economy to encourage private sector participation in the non-oil sector.

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