FDI, Economic performance and CO_2 discharge in Nigeria

Ahmad Ahmad and Temitope J. Laniran
University of Bradford, United Kingdom

Abstract: **This study investigates the link among critical macroeconomic factors and CO_2 discharge in Nigeria from 1981 – 2017. In achieving this objective, the study adopted an emission model that incorporate FDI inflows, GDP per capita and trade for the period of study. Autoregressive distributive lag (ARDL) estimation technique was used for the model estimation. The result of the study shows that both FDI and economic performance have a positive on $CO_2$from industries and non-industries short-run analysis. However, the long run estimates reveals an inverse relationship among FDI, economic performance and CO_2 discharge from industries and non-industries. Hence, the study suggest that policymakers should upgrade polices that would continue enhancing environmental quality in the nation through facilitating the use of low emission energy and technology.**

Keywords: **CO_2 emission, FDI, Economic growth, ARDL, Nigeria**

I. INTRODUCTION

The main focus in determining the link among CO_2 discharge and macro-economic factors is to allow policymakers in judging the influence of economic activities on the environment. The condition of environmental settings in the presence of economic activities is highly essential in Morden economy for viable development, given the climate change challenges the world is faced with today. The great existential threat to is the increased damage to the environment because of the release and accumulation of dangerous pollutants such as CO_2 in the atmosphere from human economic activities among others. Economic variables such as FDI, trade and economic growth are often considered as major culprits leading to this result. For example, Abdouli, and Hammami, (2017) argued that FDI reduce the level of welfare when environment is deteriorated. This is done through the transmission of pollution from industrialized and developed economies to less developed nations where environmental laws are ineffective. However, Hassaballa (2013) argued that FDI increase the welfare as the environmental friendly technologies are used in both developed and emerging nations.

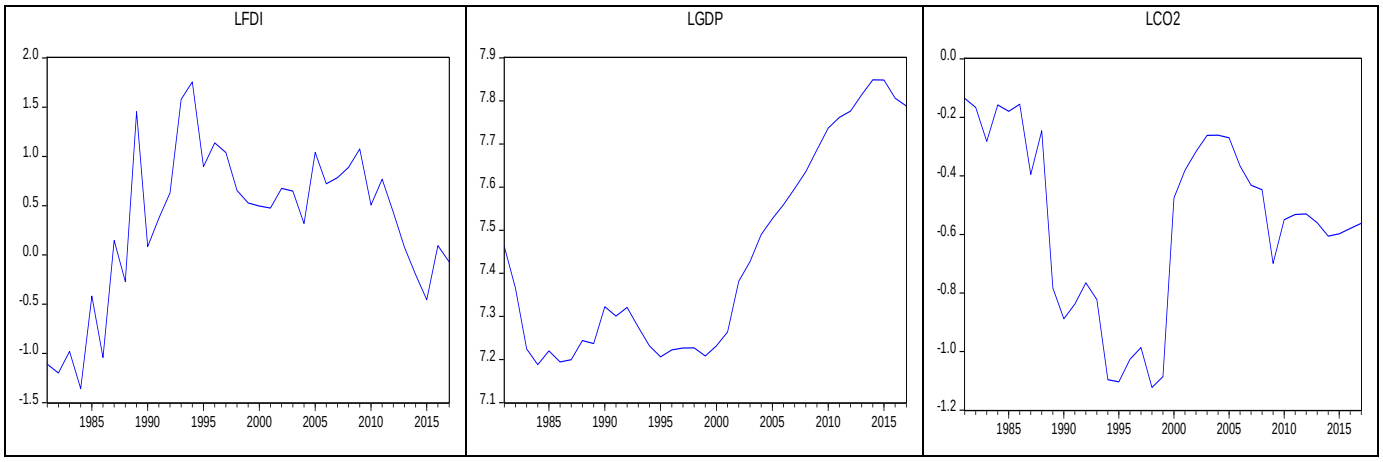
Similarly, the influence of trade on the environment, two strands of arguments have emerged in the literature. A malign strand that argues that increase in trade or trade liberalisation has adverse effects for the environment and causes increased emissions in developing countries (Dean, 2002; Hossain, 2011 and Ozturk and Acaravci 2013). They argue that due to the advantaged position of advanced countries they tend to export their eco-unfriendly products to developing countries such as used cars, which increases CO_2 emission in the developing countries. On the contrary, the benign strand argues that trade expansion through the importation of environmental friendly technology directly from industrialized nations enhance environmental condition (Frankel and Rose, 2005 and Jayantha Kumaran and Liu, 2012). Shahbaz et al. (2013) emphasize that trade promotes environmental quality as it's encourage research and development through FDI inflow.

In the case of economic growth, the fact that the environment provides basic input for production (minerals and metals, soil, forest and water bodies among others) necessitates the depletion of the environment to get these inputs for production and ultimately economic growth. The waste generated from the production processing also return to the environment, it, therefore, becomes important to ensure that generation of factor inputs, processing as well as waste disposal are done in the most sustainable manner possible. In theorising this, economists have often argued along the line of the environmental Kuznets curve (EKC). The EKC illustrates a U-shaped relationship among pollutants and income. That is environmental pollution rises as the level of income increase, until a period of time then declines (Kuznets, 1955). It indicates how environmental quality measures changes as the fortunes of a country change (Dindah, 2004).

The Nigerian economy experienced significant growth in recent years with the growth rate averaging about 6% in the recent previous years. Nigeria being the most populous nation in Africa with population of over 160 million. The growth experienced automatically positions the country for the attention of investors. The inflow of FDI and economic growth however do come at a cost for countries usually the environment among others. On the average, not so much FDI has been attracted to the African continent on the aggregate, however, some African economies have attracted decent levels of FDI over the years, with Nigeria being a leader in this category. Even though Nigeria has been able to attract some levels of FDI, some studies have argued that Nigeria has not been able to optimally attract FDI levels commensurate to the market and resource capacities of the country (Laniran 2018). Figure 1 below shows the trend of GDP, FDI and carbon emissions in Nigeria over the period of study. This trend of FDI in Nigeria was at its lowest in the 1980s. According to Saibu, and Mesagan, (2016), this period coincides with the austerity period caused by the glut in the international crude oil market. For many years, policy makers

in the nation have adopted numerous policies to attract FDI. Government implemented the structural adjustment programme in mid 1986s. These programmes were implemented to enhance environment quality and increased FDI inflows into the economy. Since then through till 2010, FDI maintained a roughly increasing pattern although with dips occasionally. FDI from 2010 to Nigeria has however more or less witnessed a downward trend. In the case of GDP per capita, there was a downward trend from early 1980 through to the mid-1980s after which there was a relative stabilization at a low level through till 2000. This period coincides with military takeover of the government in the country. However, from early 2000s the economy grew at a relatively fast pace with a steady upward trend. For C02 emission there was a steady decline from the early 1980s through to the late 1990s. There was a spike in co2 emission around the year 2000, which coincides with the return of civilian government in the country as well as the sharp rise in GDP per capita. This however lasted only for a short period. From around mid-2000s whilst the economy was still growing the CO2 emission began a decline since then despite sustained growth in the economy.

Figure 1: Trend of FDI, GDP per Capita and Carbon emission in Nigeria (1980 – 2017)



Source: World Development Indicator 2019

The concerns of the impact of human economic activities have manifested itself at national and international levels. This has led to the need for global action that has culminated in various declarations from global conferences such as Rio de Janeiro in 1992, Johannesburg in 2002, Copenhagen in 2009, Durban in 2011, and more recently Paris in 2015.In view of the foregoing, this study, therefore, seeks to examine the link among FDI, trade, economic performance and CO_2 discharge. The paper is organized as follows: Section 2 illustrates some stylised facts about FDI, Economic performance and the CO_2 in Nigeria. Section 3 presents the literature and theoretical framework for the study. While, section 4 indicates the method, data and results of the study. Lastly, section 5 concludes the study.

II. REVIEW OF LITERATURE

The link among macroeconomic factors and the environment has continued to gain the attention of researchers in recent times. Many studies have emphasized on the causal link among economic performance, FDI and CO_2 discharge. Nonetheless, the influence of GDP, FDI and CO_2 discharge is becoming a great issue in the literature (Abdouli, and Hammami, 2017). The subject of how macroeconomic variables affect the environment has been discussed through the EKC analysis.

EKC analysis was studied in many dimension. These studies have used dissimilar environmental deterioration variables, like carbon dioxide (CO_2) discharge (Shahbaz et al. (2013), sulphur dioxide (SO2) emission (Llorca and Meunié, 2009), nitrous oxide (N2O) emission, methane (CH4) emission and Total Suspended Particulate (TSP) (Cho et al., 2014), and water waste (Hai Sheng et al., 2005). This literature has two dimensions. The first dimension studied the pollution–economic growth nexus for single countries (Al-Mulali, et.al, 2015 and 2016). However, studies examine the pollution–economic performance nexus (Huang et.al 2008). While the objective of this study is not to limit itself to the EKC debate based on the theoretical limitations identified, the study, however, adopts and adapts the first strand as it provides a valid framework to build on since it focuses on Nigeria using time series data.Some of the empirical studies published from the sub-Saharan Africa region are presented in Table 1 below.

Table 1 Summary of selected literature from sub-Saharan Africa

Author	Period	Country	Method	Variables
Omisakin (2009)	1970-2005	Nigeria	OLS	CO_2 discharge, GDP, GDP square
Bello, A.K. and Abimbola, O.M., (2010)	1980-2008	Nigeria	OLS	CO_2, GDP, GDP square, foreign direct investment, the traded value of stock market energy

				consumption and manufacturing
Omojolaibi (2010)	1970-2006	West Africa	Pooled OLS and Fixed effect	CO_2emission, GDP, GDP square
Akpan and Akpan (2012)	1970-2008	Nigeria	VECM	CO_2emission, GDP, GDP square, electricity consumption
Alege and Ogundipe 2013	1970-2011	Nigeria	fractional co-integration analysis	CO_2 emission GDP, GDP square, foreign direct investment, trade openness, institutional quality and population density
Ali et.al (2016)	1971-2011	Nigeria	ARDL	CO_2emission, trade, income, energy consumption, and urbanization,

III. DATA AND METHOD

The time series data for the period 1981–2017 for the underlying study have been collected from mainly the World Development Indicator. The variable used in the study model include, economic performance (GDP current USD), capital (capital formation), FDI (FDI inflow), trade (export and import). Table 2 illustrates the summary statistics of all the variables used in the analysis.

Table 2: Nature of the statistical data

	CO_2	CAP	GDP	FDI	EXP	IMP
Mean	0.597537	37.10837	1740.526	1.794531	19.34768	12.89023
Median	0.587523	36.62556	1514.098	1.641739	20.97477	12.98578
Maximum	0.873822	89.38105	2563.092	5.790847	36.02327	22.81126
Minimum	0.325376	14.90391	1323.501	0.257422	5.249090	3.029761
Std. Dev.	0.170823	19.29095	432.7539	1.252732	8.292608	5.395536
Skewness	-0.041543	0.983760	0.739389	1.306944	-0.160902	0.022021
Kurtosis	1.863995	3.673443	1.986059	4.848466	2.095645	2.423852
Jarque-Bera	2.000174	6.667184	4.956247	15.80091	1.420516	0.514740
Probability	0.367847	0.035665	0.083901	0.000371	0.491517	0.773082
Sum	22.10886	1373.010	64399.47	66.39765	715.8640	476.9385
Sum Sq. Dev.	1.050502	13397.07	6741934.	56.49611	2475.625	1048.025
Observations	37	37	37	37	37	37

3.1 Model specification

Al-Mulali, et.al, (2016) adapted the technique introduced by Narayan and Narayan (2010) and tested it in Vietnam and Kenya respectively using the ARDL technique. In a similar manner, this study adapted the model as specified below from Narayan and Narayan (2010) and Al-Mulali, et.al, (2015 and 2016) and tested use ARDL technique for the model estimation.

$$\ln(CO_2)_t = \propto_0 + \propto_1 \ln GDP_t + \propto_2 lnCAP_t + \propto_3 lnFDI_t + \propto_4 lnEXP_t + \propto_5 lnIMP_t + \varepsilon_t \quad (1)$$

In equation 1: $\ln(CO_2)$ is the carbon dioxide dischargefrom industries and non-industries, $\ln$ GDP illustrates GDP per capita, lnCAP is the gross capital formation, lnFDI indicate the foreign direct investment, $\ln$ EXP shows the level of export,lnIMP is the import. All the variables are changed to log.

IV. RESULT

These sections discuss the outcome of the study model. Table 3 illustrates that stationary level of the variables were found in mixed nature, that is some variables are in I(0) while others are in I(1).

Table 3: Stationarity test result

Variable	PP LEVEL		PP First diff	
LINF	-2.0193*	(0.2776)	-5.8141*	(0.0000)
LMS	-0.1931	(0.9304)	-3.7667	(0.0071)
LFD	-2.6656	(0.0899)	-10.255	(0.000)
LGDP	-1.3737	(0.5841)	-6.2153	(0.000)
LTO	-2.0650	(0.2593)	-8.0385	(0.000)
IMP	-1.7082	(0.4187)	-6.8555	(0.000)

Table 4 illustrates the occurrence of long run link among the variables of the model as shown by the F-value and the critical bound values.

Table 4: ARDL Bounds Test for the $C0_2$ emission model

F-statistics	1% I(0)	I(1)	5% I(0)	I(1)
12.78	3.5	4.63	2.81	3.76

The results show that GDP has a negative coefficient. Both short and long-run estimate illustrate that GDP have positive influence on $CO_2$from industries and non-industries. There is a possibility of an inverted U-shaped association among GDP and CO_2 discharge in Nigeria. It is important to note that evidence or not of EKC in an economy, particularly developing ones varies with time. Similar to that of GDP per capita and FDI reduce CO_2 discharge in the long run, however, in the short run, it was positive.

In the case of domestic investment, a positive association between capital and CO_2 discharge was found in long run, although in the short run it was insignificantly negative. This implies that investment accelerates pollution, as reported by Ghali and El–Sakka (2004). Furthermore, exports have a significant short-run negative relationship with CO_2 emission but positive in the long run. Most of Nigeria's export is

accounted for by the Petroleum sector and highly polluted products. However, imports have a significantly negative effect on $CO_2$from industries and non-industries in both the long and short run which illustrates that imports in Nigeria have not gotten to the level where it increases pollution. Perhaps it is safe to say the dumping argument does not yet hold in Nigeria (see Prusa, 2005).

Table 5: Model estimated outcome

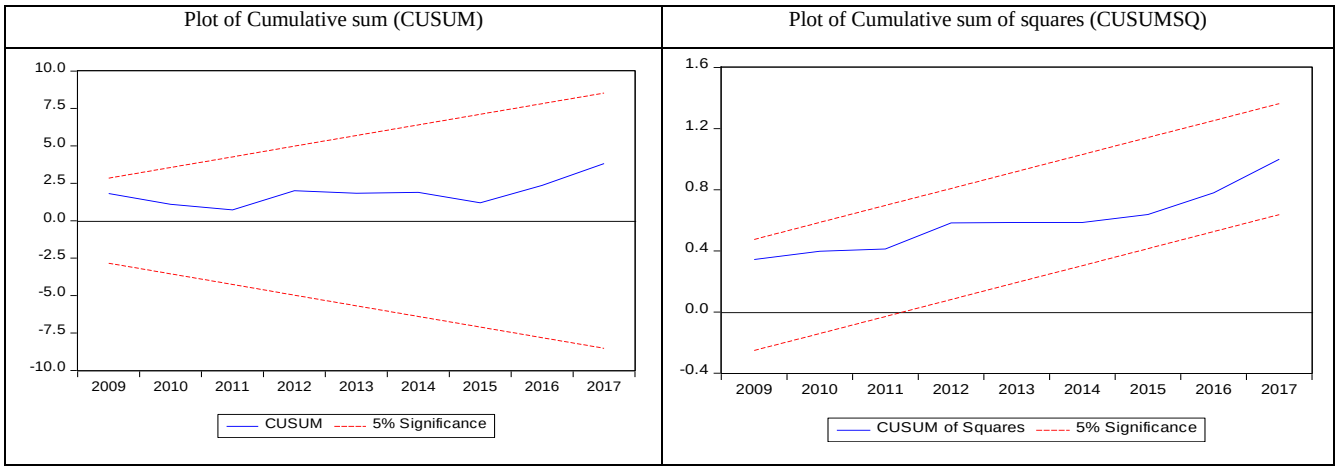
Variables	Long Run		Short Run
GDP	-0.9881** (0.4079)	ΔGDP	0.9719** (0.3195)
FDI	-0.3433*** (0.0910)	ΔFDI	0.1614*** (0.0269)
CAP	0.7438 (0.4487)	ΔCAP	-0.8038 (0.1367)
EXP	0.3306* (0.1821)	ΔEXP	-0.1165* (0.0368)
IMP	- 0.4881** (0.1540)	ΔIMP	-0.1320** (0.0444)
C	-2.7717 (4.3820)	ECMt−1	-0.9175*** (0.0751)

***, **, * illustrate significance at 1%, 5% and 10%

Post estimation validation

The post validation test of the model was checked by stability test. The outcome indicated that the model is stable as line does not pass the critical lines at 5% shown in fig 1

Fig1: Stability test



V. CONCLUSION

The study examines the link among critical macroeconomic factors and CO_2 discharge in Nigeria. The study utilized the Bounds test/ARDL approach. The estimates outcome reveals that a macro-economic factor accelerates CO_2 discharge from industries and non-industries in the long-run. The outcome reveals that both FDI and GDP per capita have a positive short-run relationship with CO_2 emission from industries and non-industries; however, it becomes an inverse relationship in the long run. The outcome also found that for export and domestic investment, there is an inverse short-run relationship with CO_2 emission; however, it becomes a positive relationship in the long run. However, import decrease the capacity of CO_2 discharge for short and long run estimate. From the outcome of this research, since FDI and GDP increase CO_2 discharge in the short run and export and domestic investment increases CO_2 discharge in the long run, it is essential to promote the attraction of non-fossil export as well as non-resource driven FDI.

REFERENCES

[1] Abdouli, M. and Hammami, S., (2017). Economic growth, FDI inflows and their impact on the environment: an empirical study for the MENA countries. *Quality & Quantity*, *51*(1), pp.121-146.

[2] Akpan, G.E. and Akpan, U.F., (2012). Electricity consumption, carbon emissions and economic growth in Nigeria. *International Journal of Energy Economics and Policy*, *2*(4), pp.292-306.

[3] Alege, P.O. and Ogundipe, A.A., (2015). Environmental quality and economic growth in Nigeria: A fractional cointegration analysis. *International Journal of Development and Sustainability*, *2*(2).

[4] Ali, H.S., Law, S.H. and Zannah, T.I., (2016). Dynamic impact of urbanization, economic growth, energy consumption, and trade openness on CO 2 emissions in Nigeria. *Environmental Science and Pollution Research*, *23*(12), pp.12435-12443.

[5] Al-Mulali, U., Saboori, B. and Ozturk, I., (2015). Investigating the environmental Kuznets curve hypothesis in Vietnam. *Energy Policy*, *76*, pp.123-131.

[6] Al-Mulali, U., Solarin, S.A. and Ozturk, I., (2016). Investigating the presence of the environmental Kuznets curve (EKC) hypothesis in Kenya: an autoregressive distributed lag (ARDL) approach. *Natural Hazards*, *80*(3), pp.1729-1747.

[7] Apergis, N. and Ozturk, I., (2015). Testing environmental Kuznets curve hypothesis in Asian countries. *Ecological Indicators*, *52*, pp.16-22.

[8] Apergis, N. and Payne, J.E., (2009). CO2 emissions, energy usage, and output in Central America. *Energy Policy*, *37*(8), pp.3282-3286.

[9] Apergis, N. and Payne, J.E., (2009b). Energy consumption and economic growth in Central America: evidence from a panel cointegration and error correction model. *Energy Economics*, *31*(2), pp.211-216.

[10] Banerjee, A., Dolado, J.&Mestre, R., (1998). Error-correction mechanism tests for cointegration in a single-equation framework. *Journal of time series analysis*, *19*(3),

[11] Bello, A.K. and Abimbola, O.M., (2010). Does the level of economic growth influence environmental quality in Nigeria: a test of environmental Kuznets curve (EKC) hypothesis *Pakistan Journal of Social Sciences*, *7*(4), pp.325-329.

[12] Cho, C.H., Chu, Y.P. and Yang, H.Y., (2014). An environment Kuznets curve for GHG emissions: a panel cointegration analysis. *Energy Sources, Part B: Economics, Planning, and Policy*, *9*(2), pp.120-129.

[13] Davis, S.J. and Caldeira, K., (2010). Consumption-based accounting of CO2 emissions. *Proceedings of the National Academy of Sciences*, *107*(12), pp.5687-5692

[14] Dean, J.M., (2002). Does trade liberalization harm the environment? A new test. *Canadian Journal of Economics/Revue canadienned'économique*, *35*(4), pp.819-842.

[15] Dinda, S., (2004). Environmental Kuznets curve hypothesis: a survey. *Ecological economics*, *49*(4), pp.431-455.

[16] Engle, R.F. and Granger, C.W., (1987). Co-integration and error correction: representation, estimation, and testing. *Econometrica: Journal of the Econometric Society*, pp.251-276.

[17] Farhani, S., Mrizak, S., Chaibi, A. and Rault, C., (2014). The environmental Kuznets curve and sustainability: A panel data analysis. *Energy Policy*, *71*, pp.189-198.

[18] Frankel, J.A. and Rose, A.K., (2005). Is trade good or bad for the environment? Sorting out the causality. *Review of economics and statistics*, *87*(1), pp.85-91.

[19] Ghali, K.H. and El-Sakka, M.I., (2004). Energy use and output growth in Canada: a multivariate cointegration analysis. *Energy economics*, *26*(2), pp.225-238.

[20] Haisheng, Y., Jia, J., Yongzhang, Z. and Shugong, W., (2005). The impact on environmental Kuznets curve by trade and foreign direct investment in China. *Chinese Journal of Population Resources and Environment*, *3*(2), pp.14-19.

[21] Hamilton, J.D., (1994). *Time Series Analysis*. Princeton, NJ: Princeton University Press.

[22] Hassaballa, H., (2013). Environment and foreign direct investment: policy implications for developing countries. *Journal of Emerging Issues in Economics, Finance and Banking*, *1*(2), pp.75-106.

[23] Hossain, M.S., (2011). Panel estimation for CO2 emissions, energy consumption, economic growth, trade openness and urbanization of newly industrialized countries. *Energy Policy*, *39*(11), pp.6991-6999.

[24] Huang, B.N., Hwang, M.J. and Yang, C.W., (2008). Causal relationship between energy consumption and GDP growth revisited: a dynamic panel data approach. *Ecological economics*, *67*(1), pp.41-54.

[25] Jawaid, S.T. and Saleem, S.M., (2017). Foreign capital inflows and economic growth of Pakistan. *Journal of Transnational Management*, *22*(2), pp.121-149.

[26] Jayanthakumaran, K. and Liu, Y., (2012). Openness and the environmental Kuznets curve: evidence from China. *Economic Modelling*, *29*(3), pp.566-576.

[27] Johansen, S. and Juselius, K., (1990). Maximum likelihood estimation and inference on cointegration—with applications to the demand for money. *Oxford Bulletin of Economics and statistics*, *52*(2), pp.169-210.

[28] Kuznets, S., (1955). Economic growth and income inequality. *The American economic review*, 45(1) pp.1-28.

[29] Laniran, T.J., (2018). Capital Flows and Economic Growth: Does the Role of State Fragility Really Matter for Sustainability? In *Financing Sustainable Development in Africa* (pp. 145-173). Palgrave Macmillan, Cham.

[30] Llorca, M. and Meunié, A., (2009). SO2 emissions and the environmental Kuznets curve: the case of Chinese provinces. *Journal of Chinese Economic and Business Studies*, *7*(1), pp.1-16.

[31] Narayan, P.K. and Narayan, S., (2010). Carbon dioxide emissions and economic growth: Panel data evidence from developing countries. *Energy policy*, *38*(1), pp.661-666.

[32] Omisakin, D. and Olusegun, A., (2009). Economic growth and environmental quality in Nigeria: does environmental Kuznets curve hypothesis hold? *Environmental Research Journal*, *3*(1), pp.14-18.

[33] Omojolaibi, J.A., (2010). Environmental quality and economic growth in some selected West African Countries: a panel data assessment of the environmental Kuznets curve. *Journal of Sustainable Development in Africa*, *12*(8), pp.35-48

[34] Onafowora, O.A. and Owoye, O., (2014). Bounds testing approach to analysis of the environment Kuznets curve hypothesis. *Energy Economics*, *44*, pp.47-62.

[35] Onafowora, O.A. and Owoye, O., (2014). Bounds testing approach to analysis of the environment Kuznets curve hypothesis. *Energy Economics*, *44*, pp.47-62.

[36] Ouattara, B., (2004). *Foreign aid and fiscal policy in Senegal* (pp. 262-267). Manchester: Mimeo University of Manchester.

[37] Ozturk, I. and Acaravci, A., (2013). The long-run and causal analysis of energy, growth, openness and financial development on carbon emissions in Turkey. *Energy Economics*, *36*, pp.262-267.

[38] Pesaran, M.H., Shin, Y. and Smith, R.J., (2001). Bounds testing approaches to the analysis of level relationships. *Journal of applied econometrics*, *16*(3), pp.289-326.

[39] Phillips, P.C. and Perron, P., (1988). Testing for a unit root in time series regression. *Biometrika*, *75*(2), pp.335-346.

[40] Prusa, T.J., (2005). Antidumping: a growing problem in international trade. *World Economy*, *28*(5), pp.683-700.

[41] Rafindadi, A.A., (2016). Does the need for economic growth influence energy consumption and CO2 emissions in Nigeria? Evidence from the innovation accounting test. *Renewable and Sustainable Energy Reviews*, *62*, pp.1209-1225.

[42] Saibu, O.M. and Mesagan, E.P., (2016). Environmental Quality and Growth Effects of Foreign Direct Investment in Nigeria. *Iran Economic Review* 20(2) pp. 125-140

[43] Seker, F., Ertugrul, H.M. and Cetin, M., (2015). The impact of foreign direct investment on environmental quality: a bounds testing and causality analysis for Turkey. *Renewable and Sustainable Energy Reviews*, *52*, pp.347-356.

[44] Shahbaz, M., Hye, Q.M.A., Tiwari, A.K. and Leitão, N.C., (2013). Economic growth, energy consumption, financial development, international trade and CO2 emissions in Indonesia. *Renewable and Sustainable Energy Reviews*, *25*, pp.109-121.

[45] Shahbaz, M., Khraief, N., Uddin, G.S. and Ozturk, I., (2014). Environmental Kuznets curve in an open economy: a bounds testing and causality analysis for Tunisia. *Renewable and Sustainable Energy Reviews*, *34*, pp.325-336.

[46] Zambrano-Monserrate, M.A. and Fernandez, M.A., (2017). An environmental Kuznets curve for N2O emissions in Germany: an ARDL approach. In *Natural Resources Forum* 41(2), pp. 119-127