FINANCIAL FLOWS AND ENVIRONMENTAL SUSTAINABILITY IN NIGERIA: ENVIRONMENTAL KUZNETS HYPOTHESIS

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ABSTRACT

Introduction: This study examines the effect of financial flows (external and internal) on environmental sustainability in Nigeria, testing the environmental Kuznets hypothesis.

Methods: The study employed secondary data sourced from the Central Bank Statistical Bulletin and World Development indicator. The period of the inquiry was from 1991 to 2022, both years inclusive. The study employed the auto-regressive distributed lag to determine the short and long-run relationship between the outcome variables and explanatory variables.

Results: The findings revealed that external debt, net export and government expenditure on education has a positive significant effect on CO_2 emission. Foreign direct investment, foreign aid and tax revenue have a negative significant effect on CO_2 emission. It is therefore concluded that external debt and net export channeled through capital project and improvement in receipt from export would increase the units in per capital income of the populace, which in the short-run would increase the level of CO_2 emissions in Nigeria.

Conclusion and suggestion: It recommended that government should develop policies and incentives that would attract foreign direct investment in green industries and technologies, ensure foreign companies adhere to environmental regulations and standards in the recipient country.

INTRODUCTION

The environment is the balloon that accommodates both the social and economic activities of the people, firms and government. But for the attainment of sustainable development to be holistic and effective, the reduction of environmental degradation and

pollution must begin to find its impact on policies and fact books of international and national bodies (Zhao et al, 2017; Zubair et al, 2020). According to the indicators of the World Bank (2020) CO_2 emission intensity in Nigeria decreased from 0.6 metric ton per capita to 0.5 metric per capita from 2019 to 2020. In Nigeria, the negligence and understanding of environmental sustainability is still evident with the country's attention toward economic growth and other economic factors that will improve the specific development of this growth, neglecting the parameters of the sustainable development goals re-cast in 2015, that development is a three-fold perspective (Adediran, 2019; Ali et al., 2020; Sane et al., 2022).

The percentage of carbon footprints by household and organization differs from one country to another. Gershon and Patricia (2019) and Rahman et al. (2022) revealed that an average family of six in America emits 108 tons of CO_2 yearly, in Qatar an average family of six emits 300 tons of CO_2 yearly, 5.27 billion tons in Canada, 417.04 million tons in Australia, 387.39 million tons in United Kingdom, 571.14 million tons in China, 1.84 million tons in India and 122.78 million tons in Nigeria. This implies that annually an individual emits 4 tons of CO_2. However, the economic over-dependence on petroleum even without taking account of the manufacturing and industrial sector, makes examining carbon foot print relationship with economic activities essential. According to Ogbeide and Ugbogbo (2022), the replicative carbon footprint and emission in burning a gallon of petrol gives close to 19.64 pounds of carbon-dioxide (CO_2); the average combined fuel extinguished by trucks and cars is 23 miles per gallon, with vehicles travelling at about 8,000km on a yearly basis. It presupposes that close to two-hundred and seventeen gallons of fuel are used per vehicle per year by an individual in Nigeria.

Theoretically, the Environmental Kuznets Curve theory has been used in the works of Ayamba et al. (2020), Egbetokun et al. (2020), Sane et al. (2022) and Zafar et al. (2022) and implies that economic activities that would improve GDP per capita will have positive effect on environmental degradation, but when the income level reaches a particular threshold, socioeconomic activities will have negative effect on environmental degradation, believing that green appliances and technology would be embraced by populace.

Studies like those of Ridzuan et al. (2018), Egbetokun et al. (2020), Zubair et al, 2020) and Iheanachor and Ozegbe (2021) have been able to capture factors like trade openness, institutional quality, oil production and price, agricultural output and foreign direct investment effect on environmental sustainability. Continuously, in Nigeria, which is challenged with foreign-exchange gap and saving-investment gap, it depends on external financial flows to augment their developmental position. Foreign direct investment is a major external financial flow that has helped the developmental gauge of

the country push up from 2.3 billion during the COVID-19 period to 2.4 billion despite the economic disturbance of the pandemic. Being a major financial flow, Nigeria attracted 385million dollars foreign direct investment in the first quarter of 2020 and 407 million dollars in the second quarter of 2021 (CBN, 2021; Ofierohor et al., 2022). Ren et al (2014) and Bokpin (2017) reveal that foreign direct investment has a positive impact on the rapidly rising of CO_2 (carbon emission) while Shaari et al. (2014) and Hakimi and Hamdi (2016) reveal that green foreign direct investment in terms of technology and capital innovation would reduce CO_2 (carbon emission) in Tunisia and Morocco.

Inclusively, studies have not been able to investigate the impact of external and internal financial flows on environmental sustainability in Nigeria. Apart, from foreign direct investment, external flows like remittances, external debt, net export, and foreign aid all have their specific channel in improving the position of GDP per capita, which is the economic constructs captured in Environmental Kuznets Curve theory. Also, internal financial flows like government expenditure on health, government expenditure on education and tax revenue are fiscal policy measures that has the attributed to boost the attainment of GDPer capita. The internal component of financial flows along with the external components of financial flows impacts the achievement of environmental sustainability in Nigeria.

LITERATURE REVIEW
Empirical Review
Zafar et al. (2022) examined the dynamic linkage between remittances, export diversification, education, renewable energy, consumption, economic growth and CO_2 emission in top-remittances receiving countries. The study subject matter was to examine if the visible component has a direct or inverse relationship with CO_2 emission, which is part of the sustainable development goal that is expected to be attained globally in year 2030. The study employs 25 receiving remittances of developed and developing countries in the world for the period 1986 -2017. The study employed the second generation unit-root technique, Westerlund and Edgerton co-integration approach and generalized quartile regression method. The outcome variable is CO_2 emission (metric tons), explanatory variables include education, remittances, export diversification, gross domestic product and renewable energy. The findings indicate that remittances help in reducing environmental degradation as they have a negative effect on emissions. Likewise, export diversification reduces CO_2 emissions, and renewable energy also contributes to decreasing CO_2 emissions. In contrast, economic growth is conducive to environmental degradation. The study is very unique because the study was able to cover the three segments of the SDGs (economic growth, social inclusion, and environment sustainability, picking one component from each of the strata. The study was unique in

measuring it on the CO2 emissions which have a dynamic and mixed relevance on the SDG's goal in a global view.

Sane et al. (2022) conducted a study to investigate the interconnectedness between electricity consumption, agriculture, GDP, oil production, and carbon dioxide (CO2) emissions in Nigeria using a decoupling approach. The findings revealed that agriculture, electricity, and GDP served as predictive variables for CO2 emissions based on Granger causality analysis. Particularly, the relationship between GDP and CO2 emissions suggested that CO2 emissions tend to increase alongside economic output and industrial expansion, highlighting GDP as a significant driver of CO2 emissions. The study underscored the dependence of modern agriculture on fossil fuels and fertilizers, leading to greenhouse gas emissions from both crop and livestock production. However, it also highlighted that increasing per capita real production could improve environmental quality and facilitate the adoption of renewable energy sources, thereby mitigating global warming effects. Policy implications of the study emphasized the need for agricultural sector policies to address CO2 emissions by tackling practices such as deforestation, land clearing, and the use of environmentally harmful fertilizers. Furthermore, the study recommended implementing financial market policies to regulate GDP in accordance with CO2 emission charges, thereby compensating for various sectors' contributions to emissions. These findings provide valuable insights for Nigerian policymakers in formulating effective CO2 emission mitigation strategies. Additionally, the study advocates for the adoption of alternative energy sources like biofuels, hydropower, and solar energy to reduce reliance on fossil fuels and promote sustainability in Nigeria.

Iheanachor and Ozegbe (2021) investigated the impact and relationship of foreign direct investment and sustainable development in Nigeria and Ghana. The purpose was to determine the influence of foreign direct investment inflow on the economic, social and environment pillars of sustainable development goals within the two countries. The study examined the influence on foreign direct on the three stratum's of sustainable development goals from the later end of the millennium development goals to the earlier stage of sustainable development goals. It explored how foreign direct investment and real gross domestic product influence the social and environmental component of sustainable development goals. The study was anchored on the two-gap theory of Harrod-Domar (1948, 1957). The variables include; real gross domestic product (Economic), expenditure on health and education (social), CO2 emission (Environmental) and gross capital formation. The findings revealed that foreign direct investment has a positive impact on economic sustainability in Nigeria and Ghana, but foreign direct investment has positive insignificant impact on social sustainability in Nigeria and Ghana. Foreign direct investment enhances environmental sustainability in both countries. The enquiry is

unique in capturing the level and stage of sustainable development goals, but the combination of health and education may not address goal 4 and goal 3, which are separate sustainable development goals.

Ayamba et al. (2020) investigated the impact of foreign direct investment on sustainable development in China. The aim was to determine the effect of foreign direct investment on economic development and spill-over effect on other social environmental development goals. The enquiry was to test if the attainment of economic goals will not jeopardize social and environmental attainment based on the Environmental Kuznets Curve theory. The secondary data were sourced from the China Statistical Year Book, from 1995 to 2016. The Johansen co-integration test, vector error correction model, impulse response and variance decomposition were employed in drawing out inferences. The variables include foreign direct investment, industrial solid waste, industrial sulphur dioxide and industrial smoke and dust, research and development and per capita output. The study did not address the social inclusiveness of poverty, health and education. The findings reveal that foreign direct investment has an insignificant influence on environmental quality in the long-run and helps financing of physical capital deficit. Based on the findings, the study was able to identify that there exists a negative relationship between attainment of economic growth and social/environmental quality.

Ali et al. (2020) investigated the relationship between trade openness and foreign direct investment, and institutional performance on environmental quality. The aim to validate or check the environmental performance from the ecological footprints, which is different from the usual CO2 and SQ2 which many studies have applied in their enquiry. The study applied the dynamic common correlated effects Western error correction model, panel co-integration test. The variables of this enquiry include: global footprints network, ecological footprints, trade openness, institutional performance, foreign direct investment, and urbanization. The findings reveal that explanatory variables (urbanization, trade openness and foreign direct investment) have positive significant effect on ecological footprints while institutional performance has negative effect on ecological footprint. The study only addressed the third pillar of the sustainable development goals. The study was able to identify the usage of a unique and global measurement of environmental sustainability. The double effects of pollution haven hypothesis and pollution halo hypothesis were synthesized.

Egbetokun et al (2020) examined the relationship between environmental pollution, economic growth and institutional quality in Nigeria. The study aimed to test the Environmental Kuznets Curve in validating with other environmental measures on some economic and institutional factors in Nigeria. The explanatory variables include population density, education expenditure and foreign direct investment and gross domestic investment as control variables while the outcome variables include the carbon

dioxide, nitrous oxide, suspended particulate matters, rainfall temperature, and total greenhouse emission. The study employed the auto-regressive distributed lag (ARDL) and revealed that there is presence of environmental pollution carbon emission and suspended particulate matters, implying that green growth objective can be pursued in Nigeria with a reserved effort. The study was unique in capturing a novel measure of environmental sustainability and pollution measures in Nigeria.

Zubair et al. (2020) investigated the relationship between gross domestic income, trade integration, FDI inflows and capital reduced CO_2 emissions. In empirical evidence from Nigeria, the aim of the inquiry was to examine if foreign direct investment along with other economic and trade factors increase the carbon emission in the country or if foreign direct investment of green solutions aids in the reduction of carbon emissions in the country. The study employed the auto-regressive distributed lag, vector auto-regressive approaches from the period of 1980 to 2018. The study revealed that there is long-run relationship between carbon emission, income, trade integration, FDI inflows, gross domestic product and capital while the Granger causality shows a two-way impact between CO_2 emission and foreign direct investment in Nigeria.

Yusof et al. (2019) investigated the effect of foreign direct investment on sustainable development in ASEAN 3 and 5 countries. The study analyzed conceptually the relationship between foreign direct investment economic growth, environmental quality and income inequality. The study looked at how the comprehensive effect of the three pillars of the sustainable development goals cannot be captured by doing a qualitative content analysis. Also, income inequality is not the only social pillar in the sustainable development goal, poverty, health and education are also excluded in this particular enquiry.

Adediran (2019) examined influence of foreign direct investment on sustainable development in Nigeria. The enquiry was theoretical and empirical. The study subject matter was to show explanatorily the influence of foreign direct investment in the aviation industry and its impact in the maintaining and attainment of the sustainable development goals in Nigeria. The nature of the policies and laws that ensure foreign direct investment stock and flows are employed toward attainment of the three pillars of the sustainable development goals. The findings reveal that foreign investment is germane for the development of the aviation industry. The empirical enquiry only addressed the social and environmental impact but neglected the economic pillar which can be explained better by examining a linear regression. The study also lacked a theoretical framework.

Ridzuan et al. (2018) investigated the combined flow impact of foreign direct investment and trade openness on attainment of sustainable development in Malaysia. The subject matter was to determine the percentage and coefficient value of foreign direct

investment and trade openness on the influence of economic growth, income distribution and environmental quality. The secondary data were from 1970 to 2013, the influence of the enquiry was analyzed with auto-regressive distributed lag, error correction model and Toda-Yamamoto and non-causality test. The variables include total labor force, domestic investment, foreign direct investment, human capital, trade openness, financial development (M2), Gini-coefficient, and CO2 emission; per capital energy consumption was used in the development of the three models that addressed the three pillars of the sustainable development goals. The findings reveal that foreign direct investment has improved growth, income distribution and lowers pollution levels in Malaysia, but in the results of trade openness enhances growth and income distribution there was a negative effect on environmental quality, The study is quite unique in concept and model but the income distribution used does not answer the holistic component of the social pillars of the sustainable development goals.

Ridzuan et al. (2017) examined if foreign direct investment is a successful flow into Singapore. The theme was to test the effectiveness of foreign direct investment with some other macro-economic and trade measures on the three levels of sustainable development goals in an economy. The model was developed into three models, the endogenous growth model anchored for economic and social perspective while the Environmental Kuznets Curve theory was adopted for the environmental perspective. The Toda-Yamamoto Granger causality, auto-regressive distributed lag, and unconditional error correction model were employed to determine the inference for the enquiry. The data employed were for 44 years from 1970-2013. The variables included; Gross domestic product, Gini coefficient, CO2 emission, labor force, gross fixed capital formation, foreign direct investment, human capital, trade openness, financial development (M2), and domestic investment. The findings reveal that foreign direct investment has significant positive impact on economic growth but no significant effect on environmental quality, but will improve income inequality.

Bokpin (2017) investigated the relationship between foreign direct investment and environmental sustainability capturing the institution and governance advantage policy of the economy. The secondary data were sourced from 1990-2013 with African countries. The panel data used regression analysis. The variables include natural resources depletion, forest reserve depletion, foreign direct investment, institutional quality and governance quality, economic growth, level of urbanization and level of domestic investment. The theoretical framework includes the Environmental Kuznets Curve and pollution haven hypothesis. The findings reveal that foreign direct investment has sustainability based on the good governance and institutional quality. The study is unique in the determination of the relationship of foreign direct investment and environmental sustainability (from the aspect of natural resources depletion) based on the fact that the

environmental sustainability is not reliant on the CO2 emission (pollution haven hypothesis) alone. The institution and governance are included and also address the macro-economic monetary and fiscal policies in the economy.

Voica et al. (2015) examined the effect of foreign direct investment on sustainable development. The subject matter of the enquiry was to determine the extent and value impact of foreign direct investment on the three pillars of sustainable development goals (economic, social, and environmental). The study was able to develop three models with distinctive classifications having the following independent variables; Economic variables include real GDP per capita, primary energy consumption and energy consumption in transport relative to GDP. Environmental variables included green gas emission and share of renewable energy in gross final energy consumption and electricity generated from renewable source (EL-RENEW) and share of environmental and labor taxes in total tax revenue from taxes. Social variables included health life years and life expectancy at birth (LIFE), poverty or social exclusion (poverty) and employment rate of older workers (EMPL). The study employed the correlation analysis and least squares data regression to determine the relationship and impact between the variables. The findings reveal that the biggest developmental impacts on foreign direct investment in the country are the environmental effects, economic effects and social effects. The study was able to conceptualize foreign direct investment flow and stocks. Also, the study was able to find out that the most important influence of foreign direct investment is first on the environmental pillar followed by the social and economic pillar (beta coefficient ranking).

Theoretical Framework
Environmental Kuznets Curve theory

The theory explains the inverted U-shaped linkage between environmental quality and GDP per capital income (Grossman & Krueger, 1995). The Environmental Kuznets Curve theory explains the relationship between the income level of individuals or household which leads to economic activities that can affect the quality of the environment. It further explains that higher capital income can increase household consumption of pollution-related products. Once their income level has improved in the form of better amenities and living standards, their consumptions pattern should tend toward green products which would require the products pattern of most multi-national companies to change their production activities to match up with the customer demands. This in respect implies that a higher income level from the household agents causes environmental depletion (Hitman & Barman, 2012). The theory posits that economic sustainability has a positive significant effect on environmental quality. The theory illustrates this position through the Kuznets U theory. In the short-run, income is impactful

on the environment, but in the long-run it has a negative impact on the environmental quality. The capturing of the external and internal financial flows on environmental sustainability in Nigeria shows that external flows coming into the economic boundary through various channels would improve the per capita income of the populace and also the internal flows in the country are expended to improve the per capita income of the populace which could have a short-run and long-run effect on environmental degradation.
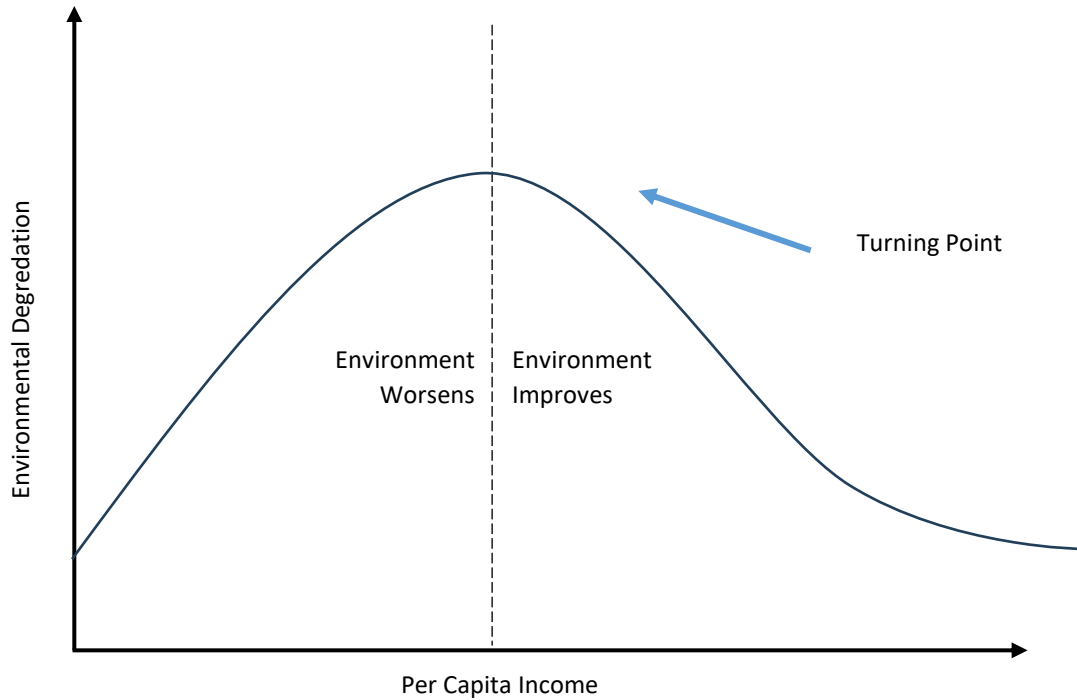
Figure 1. Environmental Kuznets Curve

Methodological Framework

In capturing the relational impact of external flows and internal flows in form of external debt, foreign direct investment, foreign aid, net export, remittances, government expenditure of education and health and tax revenue on CO2 emission the following equation is used:

$$E_t = (\beta_0 + + \beta_1 * Y + \beta_2 * Y^2 + \mu_t) \tag{1}$$

where;

E   = the environmental degradation or pollution level

Y   = the income per capita

β0 β1 and β2 are the coefficients to be estimated

μ = the error term

This is to test the Environmental Kuznets Curve theory asking whether internal (government expenditure on health and education and tax revenue) and external flows

(external debt, foreign direct investment, foreign aid, net export and remittances) components, when transformed to the firm, government and household, increase the level of environmental degradation.

$$E(C_{02})_t = (\beta_0 + \beta_1 * Y_{EF*IF} + \beta_3 * Y_{EF*IF}^2 + \mu_t) \qquad 2)$$

E   = the environmental degradation (C_{02} emission)

Y   = the income per capita

Y_{EF} = linear impact of external flows on per capita income

Y_{IF} = linear impact of internal flows on per capita income

Y^2 = quadratic effect of per capita income (responsible for the inverted U-shaped in EKC)

Y_{EF}^2 = quadratic effect of external flow on per capita income

Y_{IF}^2 = quadratic effect of internal flow on per capita income

β_0 β_1 and β_2 are the coefficients to be estimated

μ   = the error term

RESEARCH METHODS

The secondary data were sourced from the World Development Index and Central Bank statistical bulletin of 2022. The environmental sustainability was measured with CO2 emission. The financial flows were captured from external flows of foreign direct investment, remittances, foreign aids, external debt and net export and the internal flows were captured from the government expenditure on health, education and tax revenue. The auto-regressive distributed lag (ARDL) model was used to draw inference after the stationary test gave validity not to violate Engel Granger (1949).

Linear Representation:

$$Co_{2t} = (\beta_0 + \beta_1 FDI_t + \beta_2 FA + \beta_3 Rem_t + \beta_4 NetE + \beta_5 ExtD_t + \beta_6 GEE + \beta_7 GEH_t + \beta_8 TAXR_t + \varepsilon_t) \qquad (3)$$

The auto-regressive distributed lag (ARDL) approach by Pesaran et al. (2001) is used for testing the existence of co-integration relationship and error-correction estimation. The ARDL approach is applied to the exogenous and endogenous variables of a different order of co-integration (Pesaran & Pesaran, 1997). This approach allows the estimation of short and long-run parameters concurrently. The short-run (error-correction model) model and the long-run model (co-integration model) of the ARDL model equation can be specified below as:

$$\Delta LCo_{2_t} = \rho\varrho_{t-1} + \sum_{i=1}^{q} \alpha_{1i}\Delta LCo_{2_{t-i}} + \sum_{i=0}^{q} \alpha_{2i}\Delta LFDI_{t-i} + \sum_{i=0}^{q} \alpha_{3i}\Delta LFA_{t-i}$$
$$+ \sum_{i=0}^{q} \alpha_{4i}\Delta LRem_{t-i} + \sum_{i=0}^{q} \alpha_{5i}\Delta LNetE_{t-i} + \sum_{i=0}^{q} \alpha_{6i}\Delta LExtD_{t-i}$$
$$+ \sum_{i=0}^{q} \alpha_{7i}\Delta LGEE_{t-i} + \sum_{i=0}^{q} \alpha_{8i}\Delta LGEH_{t-i} + \sum_{i=0}^{q} \alpha_{9i}\Delta LTAXR_{t-i}$$
$$+ \beta_1 LFDI_{t-1} + \beta_2 LFA_{t-1} + \beta_3 LRem_{t-1} + \beta_4 LNetE_{t-1}$$
$$+ \beta_5 LExtD_{t-1} + \beta_6 LGEE_{t-1} + \beta_7 LGEH_{t-1} + \beta_8 LTAXR_{t-1} + \varepsilon_t$$

$$(4)$$

The short-run model (error-correction model):

$$\Delta LCo_{2_t} = \rho\varrho_{t-1} + \sum_{i=1}^{q} \alpha_{1i}\Delta LCo_{2_{t-i}} + \sum_{i=0}^{q} \alpha_{2i}\Delta LFDI_{t-i} + \sum_{i=0}^{q} \alpha_{3i}\Delta LFA_{t-i}$$
$$+ \sum_{i=0}^{q} \alpha_{4i}\Delta LRem_{t-i} + \sum_{i=0}^{q} \alpha_{5i}\Delta LNetE_{t-i} + \sum_{i=0}^{q} \alpha_{6i}\Delta LExtD_{t-i}$$
$$+ \sum_{i=0}^{q} \alpha_{7i}\Delta LGEE_{t-i} + \sum_{i=0}^{q} \alpha_{8i}\Delta LGEH_{t-i} + \sum_{i=0}^{q} \alpha_{9i}\Delta LTAXR_{t-i} + \varepsilon_t$$

$$(5)$$

Where:

CO₂ represents CO_2 emission; FDI refers to foreign direct investment; FA denotes foreign aid; Rem constitute remittances; NetE signifies net export; ExtD corresponds to external debt; GEE pertains to government expenditure on education; GEH relates to government expenditure on health; TAXR indicates tax revenue; $⟦\rho\varrho⟧\_{(t-1)}$ is the lagged error correction term for equation 1.1-1.2 α1- α8 are the short-run coefficients β1-β7 is the long-run parameter for the explanatory variables; t is the period in the inquiry, ε_t is the error term.

Table 1. Description of Variables

S/N	Description	Unit	Source
1	Foreign Direct Investment (FDI)	₦' Billion	CBN Statistical Bulletin (2022)
2	Foreign Aid (FA)	US Dollars	World Development Indicators (2022)
3	Remittances (Rem)	US Dollars	World Development Indicators (2022)

4	External Debt (ExtD)	US Dollars	World Development Indicators (2022)
5	Net Export (NetE)	US Dollars	World Development Indicators (2022)
6	Government Expenditure on Health	₦' Billion	CBN Statistical Bulletin (2022)
7	Government Expenditure on Education	₦' Billion	CBN Statistical Bulletin
8	Tax Revenue	₦' Billion	CBN Statistical Bulletin
9	Carbon Emission	Metric tons per capita	World Development Indicators (2022)

Source: Author's Compilation (2023)

RESULT AND ANALYSIS

Table 2. Descriptive Analysis

	C02_EMI	EXT_DEBT	FDI	FOR_AID	GEE	GEH	NET_EXPT	REMIT	TAXR
Mean	0.687608	3.281089	3.483937	8.994511	2.160876	1.957320	6.628978	3.661185	2.912723
Median	0.702691	3.212587	3.546409	9.257645	2.137101	2.010938	6.919588	3.998536	3.101953
Maximum	0.916428	4.534918	4.593828	10.05812	2.596487	2.507382	7.299083	8.333830	3.824655
Minimum	0.491388	2.642356	2.155943	8.181815	1.600755	1.350319	5.313048	0.118105	1.620328
Std. Dev.	0.120860	0.530335	0.657173	0.577609	0.342817	0.387844	0.616041	2.252081	0.645785
Skewness	0.260684	0.630027	-0.405812	-0.126114	0.072610	-0.211088	-0.853167	0.063689	-0.560416
Kurtosis	1.836589	2.447183	2.371540	1.540015	1.342765	1.519025	2.563353	1.885666	2.128239
Jarque-Bera	2.099409	2.445565	1.361025	2.835434	3.574708	3.063212	4.007054	1.624871	2.604297
Probability	0.350041	0.294410	0.506357	0.242266	0.167403	0.216188	0.134859	0.443776	0.271947
Sum	21.31586	101.7138	108.0021	278.8298	66.98715	60.67692	205.4983	113.4967	90.29442
Sum Sq. Dev.	0.438215	8.437666	12.95629	10.00897	3.525710	4.512684	11.38519	152.1560	12.51115
Observations					31				

Note: C02 (Carbon emission), FDI (Foreign direct investment), FA (Foreign aid), EXTD (External debt), REM (Remittances), NetE (Net export), GEE (Government expenditure on education), GEH (Government expenditure on health) and TAXR (Tax revenue).

Source: Author's Compilation (2023)

The above table depicts the descriptive statistics used in the study. CO2 (Carbon_emission) has a mean value of 68.7%, a median value of 70.2%, and standard deviation has a variation of 12.0. FDI (Foreign direct investment) has a mean value of 3.48%, a median value of 3.54%, and standard deviation has a variation of 0.65. FA (Foreign aid) has a mean value of 8.99%, a median value of 9.25%, and standard deviation has a variation of 0.57. REM (Remittances) has a mean value of 3.66%, a median value of

2.99%, and standard deviation a variation of 2.25. Ext D (External debt) has a mean value of 3.28%, a median value of 3.21%, and a standard deviation variation of 0.53. NetE (Net export) has a mean value of 6.62%, a median value of 6.91%, and standard deviation of a variation of 0.61. GEH (Government expenditure on health) has a mean value of 1.95%, a median value of 2.01%, and a standard deviation variation of 0.42. GEE (Government expenditure on education) has a mean value of 2.05%, a median value of 0.38%, and a standard deviation has a variation of 0.34. TAXR (Tax revenue) has a mean value of 2.91%, a median value of 3.10%, and a standard deviation variation of 0.64.

The skewness in the variable includes; CO_2 (Carbon_emission) indicates a long-tailed (positive skewness) at 0.26. FDI (Foreign direct investment) indicates a short-tailed (negative skewness) at -0.40. FA (Foreign aid) indicates a short-tailed (negative skewness) at -0.12. REM (Remittances) indicates a long-tailed (positive skewness) at 0.06. ExtD (External debt) indicates a long-tailed (positive skewness) at 0.63. NetE (Net export) indicates a short-tailed (positive skewness) at -0.85. GEH (Government expenditure on health) indicates a short-tailed (negative skewness) at -0.21. GEE (Government expenditure on education) indicates a positive-tailed (positive skewness) at 0.07.

The kurtosis in the variable includes: CO_2 (Carbon_emission) is leptokurtic at 1.83, since (1.83<3), FDI (Foreign direct investment) is leptokurtic at 2.37, since (2.37<3), FA (Foreign aid) is leptokurtic at 1.54, since (1.54<3), REM (Remittances) is leptokurtic at 1.88, since (1.88<3), ExtD (External debt) is leptokurtic at 2.44, since (2.44<3), NetE (Net export) is leptokurtic at 2.56, since (2.56<3), GEE (Government expenditure on health) is leptokurtic at 1.51, since (1.51<3), GEE (Government expenditure on education) is leptpkurtic at 1.34, since (1.34<3), and TAXR (Tax revenue) is leptokurtic at 2.12, since (2.12<3).

Table 3. Correlation Matrix

	CO_2 EMI	NET_EXP	GEH	GEE	FOR_AID	FDI	EX_DEBT	REMI	TAXR
CO$_2$ EMISSION	1.000000								
NET_EXPORT	-0.311139	1.000000							
GEH	-0.316415	0.668813	1.000000						
GEE	-0.219439	0.670670	0.616078	1.000000					
FOREIGN_AID	-0.226270	0.638019	0.688810	0.652149	1.000000				
FDI	-0.288411	0.683226	0.670475	0.685242	0.618368	1.000000			
EXTERNAL_DEBT	-0.054966	0.724541	0.603118	0.646547	0.541298	0.642482	1.000000		
REMITTANCES	-0.289423	0.601788	0.601117	0.715019	0.602570	0.769184	0.440442	1.000000	
TAXR	-0.22752	0.652798	0.689127	0.799851	0.633372	0.981283	0.889142	0.783942	1.00000

Source: Author's Compilation (2023)

The table above shows the correlation matrix t that helps to test for multicollinearity among the outcome and explanatory variables. The multicollinearity of 0.90 shows to be very high and would generate spurious results if used for any ordinary

least squares estimation. The above shows that the relationship between the variables is below the threshold of 0.90. The explanatory variables of net export, foreign aid, foreign direct investment, external debt, remittances (external flows) and government expenditure on health, government on education and tax revenue (internal flows have negative relationship with CO_2 (Carbon emission) in Nigeria.

Table 4. Unit Root Analysis

Variable	Level T-Stat	Critical Value @ 5%	First Difference T-stat	Critical Value @ 5%	Prob	Order of Integration
CO_2	-3.0426	-3.56837	-5.42045	-3.57424	0.0007	I(I)
FDI	-1.8819	-3.56837	----------	---------	0.0013	I(0)
FA	-2.34611	-3.5875	-5.3015	-3.5806	0.0010	I(1)
REM	-2.6000	-3.5683	---------	---------	0.0000	I(0)
EXTD	-1.50601	-3.5742	-3.7468	-3.5742	0.0349	I(I)
NEtE	-1.7390	-3.5683	-5.5735	-3.5742	0.0005	I(I)
GEE	-2.6623	-3.5683	-5.8412	-3.5742	0.0002	I(I)
GEH	-1.9051	-3.5683	-6.4024	-3.5742	0.0001	I(I)
TAXR	-2.6193	-3.5683	-3.0369	-4.4407	0.0451	I(I)

Source: Author's Compilation (2023)

The Augmented Dickey-Fuller unit root results, which are a pre-estimation test, help to give direction on the actual econometrics analysis that would be suitable for drawing inferences for the outcome and explanatory variables in the model specification. The FDI (Foreign direct investment) and the REM (Remittances) are both stationary at level I(0). CO2 (Carbon emission), FA (Foreign aid), ExtD (External debt), NetE (Net export), GEE (Government expenditure on education), GEH (Government expenditure on health) and TAXR (Tax revenue) are stationary at the first difference I(I). Based on the order of integration of the variables, the ARDL (auto-regressive distributed lag) technique was used to investigate both short and long-run relationships. This has to be followed, so as not to validate the position of Granger 1957, in drawing inference from faulty unit root expressions.

Table 5. Lag Length Selection Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	27.75330	NA	2.22e-12	-1.293331	-0.868998	-1.160435
1	206.7110	234.4963	3.37e-15	-8.049036	-3.805705	-6.720078
2	476.8509	186.3034*	5.71e-20*	-21.09317*	-13.03084*	-18.56815*

Source: Author's Compilation (2023)

The Akaike information criterion depicting the lag order length of (II) for the model is selected. After establishing the lag order length, the ARDL, short and long-run equation results were estimated and explained.

Table 6. ARDL Bound Test

t-statistics	Value	K	I(0)	I(I)
F-statistics	8.345921	8	2.22	3.39

Source: Author's Compilation (2023)

The ARDL Bound test helps to ascertain whether there is a long-run co-integration relationship between the dependent variable of POVR and explanatory variable FDI, FA, ExtD, NetE, REM, GEE, and GEH. The result of the F-statistics value is 8.345921 higher than the I(I) and I(0) result which is 2.22 and 3.39 at a 5% level of significance. The calculated F-value is higher than the upper bound critical value; this implies that there is a long-run co-integration relationship between the outcome and explanatory variables.

ARDL Co-integration and Long-run Run Result

Table 7. Co-integration Form

Variable	Coefficient	Std-Error	t-Statistic	Prob
D(EXTERNAL_DEBT)	-0.261601	0.058875	-4.443329	0.0022
D(EXTERNAL_DEBT(-1))	-0.128963	0.042832	-3.010908	0.0168
D(FDI)	-0.121024	0.033005	-3.666825	0.0063
D(FDI(-1))	0.292101	0.063927	4.569265	0.0018
D(FOREIGN_AID)	-0.311945	0.052272	-5.967682	0.0003
D(GEE)	0.099152	0.059572	1.664410	0.1346
D(GEH)	-0.093360	0.028423	-3.284604	0.0111
D(NET_EXPORT)	0.228912	0.048680	4.702401	0.0015
D(NET_EXPORT(-1))	-0.595093	0.068225	-8.722534	0.0000
D(REMITTANCES)	0.036553	0.006692	5.462319	0.0006
D(REMITTANCES(-1))	0.016392	0.004673	3.507699	0.0080
D(TAXR)	-0.166588	0.032801	-5.078764	0.0010
ECM(-1)	-1.022132	0.081682	-12.513542	0.0000

Source: Author's Compilation (2023)

The table above shows the short-run relationship between financial flows and environmental sustainability in Nigeria. The result shows that the speed of adjustment from an earlier disturbance away from the long run represented by the cointeg (-1) is negative and significant with an associated coefficient estimate of -1.022132. The value of the error correction term is 1.022132 and depicts that a variation from the long-run

equilibrium in one year is corrected by 2%. The model further shows the presence of a long-run relationship among the variables in all models. At a speed of adjustment of 2%, there exists a short-run association between all the explanatory variables and the outcome variable.

Table 8. Long-run Coefficients

Variable	Coefficient	Std-Error	t-Statistic	Prob
EXTERNAL_DEBT	0.131067	0.018434	7.110213	0.0001
FDI	-0.256632	0.084618	-3.032822	0.0162
FOREIGN_AID	-0.265008	0.075189	-3.524554	0.0078
GEE	0.248305	0.070789	3.507654	0.0080
GEH	-0.012850	0.032676	-0.393240	0.7044
NET_EXPORT	0.304934	0.074254	4.106604	0.0034
REMITTANCES	0.000162	0.007549	0.021519	0.9834
TAXR	-0.162981	0.032425	-5.026366	0.0010
C	1.525201	0.527902	2.889173	0.0202

Source: Author's Compilation (2023)

The long-run coefficient further showed the following for the external flows that ExtD (External debt) has a positive significant effect on CO_2 (Carbon_emission) which implies that a percentage increase in ExtD (External debt) will lead to a 0.13 unit increase in CO_2 (Carbon_emission). FDI (Foreign direct investment) has a negative significant effect on CO_2 (Carbon_emission) which implies that a percentage increase in FDI (Foreign direct investment) will lead to a -0.25 unit decrease in CO_2 (Carbon_emission). FA (Foreign aid) has a negative significant effect on CO_2 (Carbon_emission) which implies that a percentage increase in FA (Foreign aid) will lead to a -0.26 unit decrease in CO_2 (Carbon_emission). NetE (Net export) has a positive significant effect on CO_2 (Carbon_emission) which implies that a percentage increase in NetE (Net export) will lead to a 0.30 unit increase in CO_2 (Carbon_emission). REM (Remittances) has a positive insignificant effect on CO_2 (Carbon_emission) which implies that a percentage increase in REM (Remittances) will lead to a 0.00 unit increase in CO_2 (Carbon_emission). The internal flows revealed that GEE (Government expenditure on education) has a positive significant effect on CO_2 (Carbon_emission) which implies that a percentage increase in GEE (Government expenditure on education) will lead to a 0.24 unit increase in CO_2 (Carbon_emission). GEH (Government expenditure on health) has a negative insignificant effect on CO_2 (Carbon_emission) which implies that a percentage increase in GEH (Government expenditure on health) will lead to a 0.01 unit decrease in CO_2

(Carbon_emission). TAXR (Tax revenue) has a negative significant effect on CO_2 (Carbon_emission) which implies that a percentage increase in TAXR (Tax revenue) will lead to a -0.16 unit decrease in CO_2 (Carbon_emission).

Diagnostic Tests of Financial Flows and Sustainable Development in Nigeria

Table 9. Ramsey Reset Test and CUSUM Test

	Value	Probability
F-statistics	0.366678	0.6975
Likelihood	0.98964	0.7639

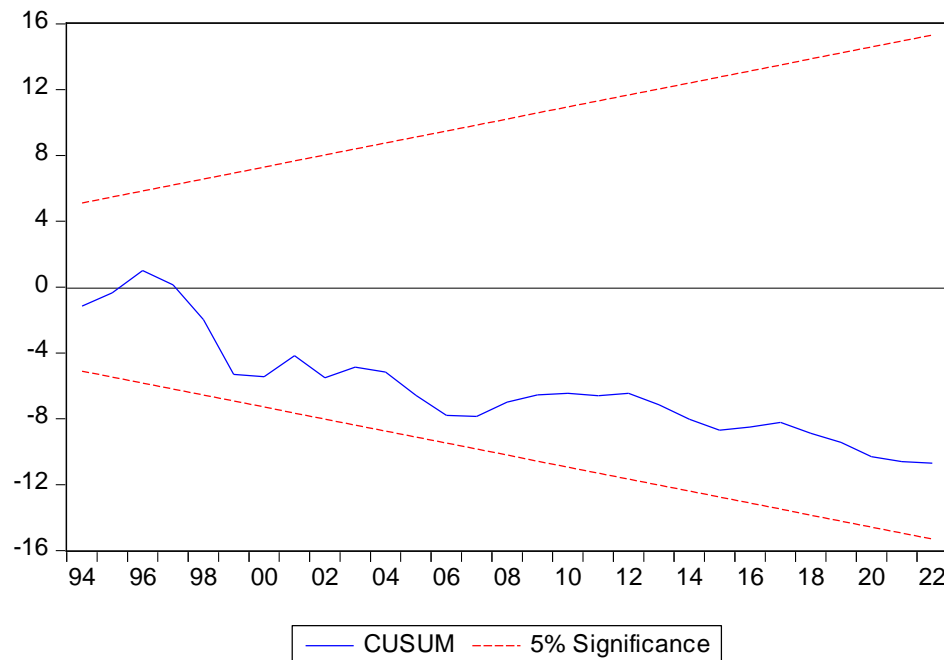Source: Author's Compilation (2023)

Figure 2. CUSUM Test

The diagram above depicts that the model and internal parameters falls within the 5% level of significance critical bounds. This reveals that the model estimated is stable dynamically which makes the model valid for policy recommendations.

CONCLUSION

The findings revealed that external debt, net export, government expenditure on education have positive significant effect on CO_2 emission. Foreign direct investment, foreign aid, tax revenue have negative significant effect on CO_2 emission.

It implies that the external debt component that the government is exposed toward increases the level of CO_2 emission in the country. This means that government usage of external debt is toward the improvement of amenities or infrastructure, which would help to improve the gross domestic per capita of the citizens. It is recommended that government

should ignore the reliance on external debt, since government lacks the impetus and financial discipline to use this external financial channel to benefit the populace, which would reduce external degradation of the populace, if the financial flow is used accurately. Inclusively, net export implies an increase in receipt from international trade would increase the level of level of CO_2 emission in the country. This means that the overall increase in net exports which are benefits from manufactured goods, agricultural products, natural resources and services, increase the level of CO_2 emissions in the country. It implies that the country's trade activities, particularly exports, are contributing to higher carbon emissions. This could be due to the production process involved in manufacturing export goods being energy-intensive and reliant on fossils fuels or the transportation of goods leading to increase emissions. It is therefore recommended that government should encourage industries to switch from fossil fuels to renewable energy sources like solar and wind. To increase that switch, government can give tax incentives and subsidies to companies using such form of energy. The positive significant relationship between government expenditure in education and level of CO_2 emission implies that education would improve the human capital of the citizen, which would enable them to be employable and give them the ability to attract good employment, meaning machinery and appliances would contribute to increase levels of CO_2 emissions. But, based on the relevance of education in improving gross domestic income and also reducing level of CO_2 emission, it is recommended that government should incorporate sustainability into the education curricula, redirect government expenditure toward green infrastructure projects and implement training programs for government officials and employees on sustainability and green practices.

However, it implies that foreign direct investment is contributing to the reduction in emission in the country. It implies that the country is particularly pursuing the transfer of cleaner technologies, better environmental practices and investments in greener industries. It is recommended that the government should develop policies and incentives that attract foreign direct investment in green industries and technologies, and ensure foreign companies adhere to environmental regulations and standards. It also implies that aid is effectively utilized toward environmental benefits and projects in the economy. It implies the funding of renewable energy projects and reforestation. It is recommended that policies and standards are aligned to reinforce each other in the economy. Theoretically and empirically, it is assumed from the long-run findings that foreign direct investment, foreign aid and tax revenue are macro per capita income constructs that would reduce the level of CO_2 emissions in the country while external debt, net export, government expenditure on education are long-run macro per capita income constructs that would increase the level of CO_2 emissions in the country.

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