Does Institutional Quality Moderate the Impact of Trade and Foreign Direct Investment (FDI) on Climate Change in Sub-Saharan Africa (SSA): Greening the African Economies Oddity?

Afamefuna Angus **EZE***; Emeka ThankGod **EKENE***; Emmanuel Chikeluba **OSILO***; Henry T. **ASOGWA****; Boniface Denis **UMOH****; Amos Iloabuchi **UGWUOTI*****; Romanus O. **UGWUANYI**** and Ezebuilo Romanus **UKWUEZE***

*Department of Economics, University of Nigeria, Nsukka, Enugu, Nigeria
**Institute for Development Studies, University of Nigeria, Enugu Campus, Enugu, Nigeria
***Department of Geoinformatics and Surveying, University of Nigeria Enugu Campus, Enugu, Nigeria

Abstract Globalization has increased connections between countries mainly through trade and foreign direct investment (FDI). This study explores how trade and FDI affect environmental outcomes, with a focus on the role of institutional quality. Using data from 47 sub-Saharan African countries collected between 2005 and 2022, and applying advanced statistical methods, the study finds that FDI has a mixed but important impact on pollution. In contrast, more open trade tends to lessen environmental pressures. Strong institutions characterised by good governance, the rule of law, and low corruption increase the likelihood that trade and FDI can support sustainable development. Therefore, the study recommends that sub-Saharan African governments strengthen institutional reforms and support investments and trade policies that are environmentally responsible.

Keywords: Institutional quality, greenhouse gas, trade openness, pollution, and investment.

I. INTRODUCTION

Foreign direct investment (FDI) is widely recognized as a key driver of economic growth in many countries. Economists such as De Mello (1997), Falki (2009), and Agosin and Machado (2005) have outlined two main ways FDI promotes growth. First, it encourages the adoption of new technologies in production through capital spillovers. Second, it facilitates knowledge transfer by providing labor training, skill development (Cerulli and Poti, 2009; Lundvall, 1988), and introducing improved management practices and organizational methods (Mansfield and Romeo, 1980). Additionally, increased competition from foreign investment pushes inefficient businesses out and reallocates resources to more productive firms, raising overall economic productivity (Acharya and Keller, 2008; Pavcnik, 2002). Open and functional international economic systems rely heavily on FDI as a catalyst for development.

Countries engage in competitive trade because no nation can produce everything it needs or consume all it produces. Trade accelerates economic growth by fostering competition across sectors like industry, finance, tourism, manufacturing, and agriculture. Lewis (1980) emphasized that international trade is a primary engine of long-term growth, driving healthy competition domestically and internationally, while also giving developing countries access to modern technology and managerial expertise.

Industrialization, a crucial growth driver, typically outperforms agriculture in global markets, generating more foreign exchange. However, industrial growth is not without environmental costs. Manufacturing industries contribute to pollution of air, land, and water, and pose hazards to workers and urban populations. Industrialization also increases greenhouse gas emissions, a critical contributor to climate change, which remains one of the world's most urgent challenges (Blanco et al., 2014). The trade effects of scale, technique, and composition, identified by Grossman and Krueger (1991), describe the complex relationship between trade and greenhouse gas emissions. Key immediate drivers include GHG

intensity, energy consumption, population growth, and GDP per capita.

The environmental impact of industrial growth includes pollution and industrial risks. Trade's GHG intensity is influenced by specialization in production and the energy intensity of manufacturing processes. Trade can promote efficiency improvements (technique effect), lowering emissions where energy use is high. However, increased trade may also raise GHG emissions when production relies on energy sources with high emissions, especially when inefficient production methods are involved.

Developing countries gain from both trade and FDI inflows, but sometimes import pollution along with foreign machinery needed for industrialization. Agrawal (2015) notes that FDI promotes trade, technology transfer, capital flows, and regional integration. Studies by Tiwari and Mutascu (2011), Bouchoucha and Ali (2019), and Azam and Haseeb (2021) highlight FDI's positive effects on output, income, employment, and overall well-being. Evidence shows significant positive links between FDI, trade openness, and long-term economic growth (Nair-Reichert and Weinhold, 2001; Khamphengvong and Srithilat, 2017; Sakyi et al., 2015).

Nevertheless, FDI also entails environmental costs. It may increase harmful emissions like CO2, N2O, and methane, which threaten human health and ecosystems. In BRICS countries, FDI inflows contribute to environmental hazards, potentially curbing expected growth (Acharyya, 2009; Moosa, 2019; Antweiler et al., 2001). The scale effect refers to pollution and resource depletion linked to economic expansion, while the composition effect reflects shifts towards polluting industries (Acharyya, 2009). Technological advances and industrial patterns influence pollution intensity (Moosa, 2019). Multiple studies identify FDI as a significant source of CO2 and greenhouse gas emissions globally (Mahmood et al., 2020; Mukhtarov et al., 2020; Essandoh et al., 2020; Nguyen et al., 2020; Do and Dinh, 2020; Jiang et al., 2020).

The neo-technological hypothesis suggests FDI may have positive environmental impacts by transferring environmentally friendly technologies to host countries (Hassaballa, 2014). This relationship modeled through composition, scale, and technique effects linking FDI inflows and environmental pollution (Frankel, 2009).

The role of institutional quality in economic outcomes has been highlighted since Douglas North's work (North, 1990). Institutional quality influences investment and economic activity. Thus, institutional factors frequently affect the nature, quality, and regulation of both FDI and trade flows (Bailey, 2018; Bénassy-Quéré et al., 2007; Daude and Stein, 2007; Gastanaga et al., 1998; Globerman and Shapiro, 2002; Sabir et al., 2019; Wei, 2000).

Studies on institutions and FDI show mixed results. Using the ARDL approach, Shah et al. (2015) and Ahmad et al. (2018) found that institutional quality has minimal effects on FDI in the primary sector but encourages it in manufacturing and services in Pakistan. Saikia (2021) found that countries with stronger institutions attract more FDI in these sectors. This study examined the growing oddity of how institutional quality moderates the effects of trade and FDI on climate change in sub-Saharan Africa.

II. STUDY EVIDENCE

The Pollution Haven Hypothesis (PHH) offers a key theoretical explanation of how foreign direct investment (FDI), trade, and environmental outcomes intersect, particularly in sub-Saharan Africa. According to this view, stricter environmental regulations in developed economies raise the cost of operating polluting industries, encouraging multinational firms to relocate such activities to countries with weaker standards. Developing economies, with less stringent enforcement, therefore become attractive destinations for pollution-intensive investment (Aliyu and Ismail, 2015).

However, many low- and middle-income countries have not fully realize the potential benefits of trade and investment because their institutional frameworks remain weak. Governance systems often lack the capacity to enforce environmental laws effectively, limiting the extent to which regulations shape business behaviour. This makes institutional quality a central factor in understanding how trade and FDI affect environmental sustainability in sub-Saharan Africa.

Empirical studies exploring the interplay among FDI, trade, institutions, and environmental outcomes present mixed evidence. Some researchers find that FDI and institutional quality are positively and significantly related, suggesting that better governance attracts more sustainable investment flows (Nnyanzi and Bbale, 2016; Adegboye et al., 2020; Mohamed et al., 2022; Valery, 2021; Osabohien et al., 2020;

Zorodzai, 2021; Dossou et al., 2023; Acheampong et al., 2020; Bouchoucha and Benammou, 2018). Others, such as Nondo, Kahsai, and Hailu (2016), report no statistically significant link between institutional quality and FDI inflows in Africa.

The environmental effects of trade and FDI are also debated. Some studies (Asongu and Odhiambo, 2020; Ali et al., 2019; Wang et al., 2022) suggest that trade raises CO_2 emissions, while FDI follows a U-shaped pattern—initially reducing environmental harm but contributing to higher emissions at later stages of development. Similarly, Duodo et al. (2021) find that FDI may improve outcomes in the short term but becomes detrimental over time, while trade consistently worsens environmental quality. Other evidence (Appiah et al., 2022; Bambi et al., 2024) reinforces the possibility of a non-linear relationship, showing a U-shaped effect of FDI on emissions.

The moderating role of institutions has been particularly emphasized. Several studies (Jahanger et al., 2022; Ali et al., 2019; Acheampong and Dzator, 2020; Wang, 2024; Adedoyin et al., 2022) highlight that stronger institutions help mitigate CO_2 emissions, underscoring governance as a critical factor for sustainability. Nonetheless, some findings complicate this picture, showing that institutions have limited direct influence on FDI inflows even though they strongly shape trade patterns (Adedoyin et al., 2022; Asamoah et al., 2019). For instance, Asamoah, Adjasi, and Alhassan (2016) argue that good governance dampens the negative effects of economic volatility on FDI, thereby indirectly encouraging investment.

Taken together, existing literature does not provide a unified conclusion. While there is general agreement that institutional quality matters, its precise role in moderating the environmental impacts of FDI and trade in sub-Saharan Africa remains contested. This study seeks to contribute to this debate by empirically testing whether better governance frameworks reduce the environmental costs of globalization in the region.

III. METHODOLOGY

This study explores how institutional quality influences the relationship between foreign direct investment (FDI), trade openness, and climate change in 47 sub-Saharan African (SSA) countries between 2005 and 2022. The choice of countries and period reflects data availability and the need for consistency across variables. The key dependent variable is climate change, measured primarily through CO_2 emissions, while the main explanatory variables are FDI, trade openness, and institutional quality. To avoid bias and improve reliability, additional control variables are included, following economic theory and prior empirical studies.

Descriptive statistics (Table 2) highlight significant disparities in emissions across countries. The mean CO_2 value is about 23,589.31, with some countries recording levels as high as 448,000, reflecting differences in fossil fuel reliance, industrial activity, and deforestation rates. Other variables also show wide variation, reinforcing the heterogeneity of the SSA region. The correlation matrix (Table 3) suggests strong associations among governance indicators, raising concerns of multicollinearity. In line with Gujarati and Porter (2003), highly correlated variables (above ±0.80) are included in separate regressions, a practice also adopted in recent works (Ekeocha et al., 2023; Ogbonna et al., 2022). This approach ensures that the results remain robust and unbiased.

Table 1: Variables of the study and their measurements

Variables	Measurement	Motivating studies	Source
Climate change	CO2 emissions (kt)	Lee, et al (2023), Setzer, andHigham, (2023)	World Bank, (2024a)
Foreign direct investment	Foreign direct investment, net inflows (% of GDP)	Ogbuabor, et al (2024a, 2024b, 2023b)	World Bank, (2024a)
Trade openness	Trade (% of GDP)	Ogbuabor, et al (2024a, 2024b, 2023b)	World Bank, (2024a)
Industrialization	Industry (including construction), value added (constant 2015 US$)	Emeka, et al (2024), Quito, et al (2023)	World Bank, (2024a)
Financial Development	Domestic credit to private sector (% of GDP)	Ekeocha, et al (2023)	World Bank, (2024a)
Renewable Energy	Renewable energy consumption (% of total final energy consumption)	Yolcan, (2023), Wu, et al (2023)	World Bank, (2024a)
Government Effectiveness	Estimate		
Rule of law	Estimate		
Regulatory Quality	Estimate	Vu, (2022), Ogbonna, et al (2021), (2022)	World Bank, (2024b)
Control for corruption	Estimate		
Voice and accountability	Estimate		
Political stability/absence of violence	Estimate		
Governance Quality	Authors computation with principal component analysis		

Source: Authors computations 2024

Table 2: Descriptive statistics

Variables	Observations	Mean	Std.dev	Minimum	Maximum
Climate change	846	23589.31	68739.64	111.8	448298.1
Foreign direct investment	846	3.620869	5.050482	-17.29212	38.94286
Trade openness	846	73.59271	45.48389	2.698834	347.9965
Industrialization	846	1.15e+10	2.21e+10	7.62e+07	1.49e+11
Financial Development	846	23.2172	24.04548	0.003393	142.422
Renewable Energy	846	57.23865	30.12302	0.111	97.411
Government Effectiveness	846	-0.7729641	0.6111312	-2.439963	1.150494
Rule of law	846	-0.6919175	0.6071224	-2.070811	1.023956
Regulatory Quality	846	-0.6910798	0.6062198	-2.30232	1.196947
Control for corruption	846	-0.6576894	0.6112868	-1.936706	1.160793
Voice and accountability	846	-0.640002	0.7148866	-1.99927	0.9750996
Political stability/absence of violence	846	-0.595634	0.8506423	-2.699193	1.201015
Governance Quality (PCA)	846	0.08089	2.086723	-4.94085	5.662782

Source: Authors computations 2024

Table 3: Correlation Matrix of the Variables

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
(1) Climate Change	1.0000												
(2) Foreign Direct Investment	-0.0943	1.0000											
(3) Trade Openness	-0.1127	0.2818	1.0000										
(4) Industrialization	0.8353	-0.1240	-0.1351	1.0000									
(5) Financial Development	0.5814	-0.0365	0.1097	0.3462	1.0000								
(6) Renewable Energy	-0.4557	0.0359	-0.3339	-0.4914	-0.5364	1.0000							
(7) Government Effectiveness	0.2604	0.0490	0.1014	0.1820	0.6693	-0.4010	1.0000						
(8) Rule of Law	0.1761	0.0617	0.0976	0.1016	0.6147	-0.3712	0.9218	1.0000					
(9) Regulatory Quality	0.1847	0.0523	0.0883	0.0677	0.6263	-0.2313	0.8929	0.8957	1.0000				
(10) Control for Corruption	0.1336	0.0634	0.1644	0.0261	0.5350	-0.3317	0.8524	0.8973	0.8184	1.0000			
(11) Voice and Accountability	0.1405	0.0653	-0.0086	-0.0533	0.5243	-0.1805	0.6750	0.7546	0.7269	0.7215	1.0000		
(12) Political Stability	-0.0153	0.1421	0.2934	-0.1028	0.3521	-0.2935	0.6340	0.7093	0.6354	0.6568	0.5905	1.0000	
(13) Governance Quality	0.1681	0.0787	0.1342	0.0472	0.6229	-0.3390	0.9323	0.9683	0.9295	0.9249	0.8289	0.7784	1.0000

Source: Authors computations 2024

Fixed effect regression

To address unobservable heterogeneity, this study employs the Fixed Effects model to control for time-invariant characteristics in the underlying model[1]. A simple Fixed Effects model is presented here:

$$CO2_{i,t} = \alpha_i + \delta_1 FDI_{i,t} + \delta_2 TOP_{i,t} + \delta_3 INDUS_{i,t} + \delta_4 FDEV_{i,t} + \delta_5 RE_{i,t} + \delta_5 INSTQ_{i,t} + \delta_6 INSTQ * FDI_{i,t} + \delta_6 INSTQ * TOP_{i,t} + v_i + \pi_{i,t} \quad (1)$$

Where: the variables are as defined in section 3.1; $\pi_{i,t} = \mu_i + \varepsilon_{i,t}$, where μ_i is the country-specific effect. In Equation (3), v_i denotes the country fixed effect, capturing unobservable heterogeneities. The indices (i) (t) refer to the cross-sectional and time dimensions, respectively.

Dynamic system GMM estimation

The choice of the dynamic system Generalized Method of Moments (GMM) approach is particularly suitable for panel data where feedback effects and reverse causality are likely. For example, while FDI may influence emissions, the state of the environment may also shape investment flows. By treating all independent variables as endogenous and using lagged values as instruments, the model minimizes bias and improves precision (Kamguia et al., 2022; Ogbuabor et al., 2023a).

System GMM is preferred over difference GMM, as recommended by Bond (2002), because it produces more efficient estimates when dealing with persistent variables. To control for cross-sectional dependence (Pesaran, 2021), the regressions include time-fixed effects. The specification is consistent with recent applications in African development studies (Asongu and Nting, 2021; Ekeocha et al., 2021, 2022; Ogbuabor et al., 2023a, 2023b):

$$CO2_{i,t} = \alpha_i + \psi CO2_{i,t-1} + \delta_1 FDI_{i,t} + \delta_2 TOP_{i,t} + \delta_3 INDUS_{i,t} + \delta_4 FDEV_{i,t} + \delta_5 RE_{i,t} + \delta_5 INSTQ_{i,t} + \delta_6 INSTQ * FDI_{i,t} + \delta_6 INSTQ * TOP_{i,t} + \pi_{i,t} \quad (2)$$

where: **INSTQ**, represents the individual institutional quality indicators, every other variables are as earlier defined in Section 3.1; $\pi_{i,t} = \mu_i + \varepsilon_{i,t}$, where μ_i is the country-specific effect; and the error term, $\varepsilon_{i,t} \sim iidN(0, \sigma_\varepsilon^2)$, shows no serial correlation, $E[\varepsilon'_{i,t}, \varepsilon_{i,s}] = 0$. The countries are the cross-sectional units, so that $i = 1, 2, \ldots, 47$, while the time, $t = 1, 2, \ldots, 18$.

System GMM is preferred over difference GMM, as recommended by Bond (2002), because it produces more efficient estimates when dealing with persistent variables. To control for cross-sectional dependence (Pesaran, 2021), the regressions include time-fixed effects. The specification is consistent with recent applications in African development studies (Asongu and Nting, 2021; Ekeocha et al., 2021, 2022; Ogbuabor et al., 2023a, 2023b).

The robustness of the model is validated through several diagnostic checks, including the Arellano-Bond second-order autocorrelation test [AR(2)], the Hansen test for instrument validity, and the Wald test for overall model significance. Collectively, these measures strengthen the reliability of the

[1]The choice of the Fixed effects over Pooled OLS, and Random effect technique was based on the Breuch Pagan test, where the Fixed effects becomes more preferred if the P-value of the Breuch Pagan test is < 0.05 and the Pooled OLS and Random effect becomes preferable if otherwise.

results and ensure that the study's conclusions rest on sound econometric foundations.

IV. RESULTS

The moderating influence of institutional quality on the relationship between trade openness and foreign direct investment, and climate change in sub-Saharan Africa was examined in this study. For estimation, we used the dynamic panel system GMM regression technique, as shown in Table 4. Six global governance metrics are accommodated in each table's seven panels, together with an aggregate indicator derived from principal component analysis to reduce collinearity. In accordance with Pesaran (2021), we conducted a cross-sectional dependence test prior to estimating the system GMM models in order to guarantee the accuracy of our estimations. According to Ogbuabor et al. (2022), this test is especially important when the number of entities (N) exceeds the temporal dimension (T). The test results showed no evidence of cross-sectional dependence in our panel data. The table containing the specific test results is available upon request but has not been provided here for the sake of conciseness. At a 1% significance level, the results shown for each panel in Table 4 show a significant and favourable influence of the beginning level of climate change (i.e., the response variable's lag) on the current level for all panels. This finding implies that historical climate events have a significant impact on Africa's contemporary climate. This outcome is consistent with Beka et al.'s (2024) findings, which came to a similar conclusion. Panels 1–7 cover both the individual institutional quality indicator variable index and the composite index (PCA), which are: rule of law, voice and accountability, regulatory quality, political stability, government effectiveness, control of corruption, and the aggregate index. According to the findings, foreign direct investment has a negative and significant influence on climate change as measured by CO2 emissions in SSA nations in panels 5 and 6, but not in panel 3. This conclusion supports the pollution halo hypothesis (PHH), which is supported by the work of Limazie and Woni (2024), Pradhan et al. (2021), and Dhrifi et al. (2019). In contrast, panels 2, 4, and 7 show that foreign direct investment has a favourable and large impact on climate change in SSA nations. This outcome is consistent with the findings of studies such as Li et al. (2019), Gong et al. (2021), Abdo et al. (2020), Wang et al. (2020), and Raihan (2023) and supports the pollution haven hypothesis (PHH). Across all panels, trade openness results show a negative and significant influence on climate change in SSA nations. This result supports the findings of Udeagha and Ngepah (2021), Khan et al. (2021), and Khan et al. (2021).

The principal component analysis (PCA) results of the interaction between foreign direct investment and the individual institutional quality index and the composite/aggregate index, the effects of foreign direct investment on climate change in SSA countries are significantly moderated by individual institutional quality, such as rule of law, government effectiveness, and corruption control in panels 1, 5, and 6, respectively. The results shown in Table 5 further reinforce this conclusion by showing that the effect of foreign direct investment on climate change is moderated by institutional quality. However, the remaining panels, such as panel 7's composite index (PCA), demonstrated a negligible but adverse moderating influence on the relationship between foreign direct investment and climate change in SSA. These results suggest that enhancing institutional quality will lessen the negative environmental effects of foreign direct investment. As institutional quality rises, government policies and regulations aimed at luring FDI

inflows tighten to favour high-quality FDI inflows with contemporary production and management technologies, as well as more suitable and effective post-production waste treatment technologies. These results are consistent with those of other research, such as that conducted by Wang et al. (2022), Nguyen et al. (2023), Ha and Nguyen (2021), Bouchoucha (2024), Mehmood (2022), Limazie and Woni (2024), and Bissoon (2012).

While the fixed effects analysis indicates that institutional quality does not moderate the relationship between trade and climate change, the most robust analysis, conducted using system GMM, reveals that voice and accountability, as well as political stability in panels 2 and 4, positively and significantly moderate the trade openness-climate change nexus in Sub-Saharan Africa. This finding aligns with previous studies like Hakimi and Hnadi (2019) and Wenlong et al. (2022). Whereas the control of corruption and the composite index results in panels 6 and 7 showed a positive but insignificant moderating role on the TOP-climate change nexus in SSA. However, other interactive results with individual institutional quality variables like rule of law, regulatory quality, and government effectiveness showed a negative and insignificant moderating effect on the TOP-climate change nexus in SSA. The findings imply that strengthening institutional quality will positively attract environment friendly trades among SSA countries and the rest of their trading partners. The findings of the individual institutional quality indicator variables reveal that the rule of law, regulatory quality, government effectiveness, and control of corruption in panels 1, 3, 5, and 6, respectively, positively and significantly impact climate change in SSA. This agrees with findings of Hakimi and Handi (2019), Nguyen et al. (2023), Ha and Nguyen (2021), Bouchoucha (2024) and Wang et al. (2021). Whereas the composite index in panel 7 positively but insignificantly affects climate change in SSA. This finding suggests that institutional quality is an essential element/catalyst in reducing CO2 emissions and greening the economies of SSA countries.

Other control variables like industrialization and financial development conform to a priori expectations of positive and significant effects on CO2 emissions across all the panels in SSA. This is true because the higher the industrial and financial activities in a country, the higher the CO2 emissions and vice versa. This means that industrialization and financial development deteriorate environmental quality in SSA countries. This corroborates the arguments of Usman et al. (2021) and Alola et al. (2019) that financial development increases the consumption of environmentally degrading goods. However, renewable energy consumption reveals a negative and significant effect across all panels except in panel 2, which suggests that if SSA countries begin to consume energy that is environmentally friendly, it will go a long way in reducing CO2 emissions.

Table 4: System GMM result for the moderating role of institutional quality on the effects of foreign direct investment and trade openness on climate change in sub-Saharan Africa

Variables	Rule of Law	Regulatory Quality	Voice and Accountability	Government Effectiveness	Political Stability	Control for Corruption	Governance Quality
One lag period of climate change	.929*** (0.000)	.928*** (0.000)	.919*** (0.000)	.940*** (0.000)	.944*** (0.000)	.917*** (0.000)	.931*** (0.000)
Foreign direct investment	-.007** (0.048)	.003*** (0.016)	-.002 (0.546)	0.004*** (0.003)	-.010*** (0.004)	-.011*** (0.000)	.004*** (0.001)
Trade openness	-.001*** (0.002)	-.0003* (0.079)	-.001*** (0.003)	-.001*** (0.000)	-.001*** (0.002)	-.001*** (0.002)	-.001*** (0.000)
Industrialization	2.88*** (0.000)	3.35*** (0.000)	3.56*** (0.000)	2.36*** (0.009)	2.12*** (0.000)	3.68*** (0.000)	3.01*** (0.000)
Financial Development	0.001** (0.020)	.001*** (0.027)	.0005 (0.234)	.0005* (0.090)	.0004 (0.170)	.001*** (0.008)	.001* (0.064)
Renewable Energy	-.001*** (0.003)	-.0003 (0.164)	-.001* (0.080)	-.001** (0.056)	-.0003*** (0.019)	-.001*** (0.021)	-.0004*** (0.020)
Governance institutions	.070** (0.027)	-.017 (0.433)	.080** (0.030)	-.027** (0.040)	.080*** (0.001)	.052* (0.084)	.013 (0.128)
Governance Institution * Foreign direct investment	-.015*** (0.000)	-.002 (0.411)	-.001 (0.115)	-.004 (0.201)	-.017*** (0.000)	-.022*** (0.000)	-.004 (0.617)
Governance Institution * Trade Openness	-.0001 (0.666)	.0003* (0.088)	-.0005 (0.261)	0.0004*** (0.012)	-.0001 (0.838)	.0001 (0.706)	.00005 (0.617)
Constant	.702*** (0.000)	.610*** (0.000)	.790*** (0.000)	.549*** (0.000)	.585*** (0.000)	.767*** (0.000)	.625*** (0.000)
Diagnostic Checks							
Time effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Instruments	42	42	42	42	42	42	42
No of Groups	47	47	47	47	47	47	47
F-statistics	0.000	0.000	0.000	0.000	0.000	0.000	0.000
AR1	-4.82(0.000)	-4.76(0.000)	-4.81 (0.000)	-4.57 (0.000)	-4.80 (0.000)	-4.86 (0.000)	-4.80 (0.000)
AR2	-0.97 (0.333)	-0.82 (0.410)	-0.80 (0.424	-0.65 (0.518)	-0.86 (0.392)	-1.16 (0.246)	-0.91 (0.362)
Sargan	68.04 (0.000)	67.78 (0.000)	67.59 (0.000)	57.21 (0.003)	64.53 (0.001)	56.51 (0.005)	65.36 (0.000)
Hansen	40.32 (0.148)	41.35 (0.125	40.65 (0.140)	40.41 (0.146)	41.01 (0.132)	40.60 (0.141)	40.90 (0.135)

Source: Authors 2024. **Note:** *, **, and *** denote significant at 10%, 5% and 1% levels, respectively. In all cases, p-values are in parentheses. PCA is the aggregate governance institutions indicator obtained from principal component analysis. Notice that the governance institution indicator variables are included in separate regressions to avoid the problem of collinearity.

Table 5: Fixed Effect result for the moderating role of institutional quality on the effects of foreign direct investment and trade openness on climate change in sub-Saharan Africa

Variables	Rule of Law	Regulatory Quality	Voice and Accountability	Government Effectiveness	Political Stability	Control for Corruption	Governance Quality
Foreign Direct	-0.001	0.001	0.000	0.002	-0.000	-0.003**	-0.000
Investment	(0.003)	(0.003)	(0.003)	(0.003)	(0.002)	(0.002)	(0.001)
Trade Openness	0.006***	0.004***	0.006***	0.005***	0.004***	0.004***	0.004***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)
Industrialization	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Financial	0.005***	0.005***	0.006***	0.005***	0.005***	0.005***	0.005***
Development	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Renewable Energy	-0.025***	-0.025***	-0.025***	-0.025***	-0.024***	-0.025***	-0.025***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Governance Quality	-0.248***	-0.116**	-0.211***	-0.228***	-0.204***	-0.179***	-0.084***
	(0.051)	(0.049)	(0.055)	(0.045)	(0.041)	(0.023)	(0.017)
Institutional	-0.001***	0.001***	-0.001***	0.002***	-0.001***	-0.008***	-0.001***
Quality * Foreign	(0.003)	(0.003)	(0.003)	(0.003)	(0.002)	(0.002)	(0.001)
Direct Investment							
Institutional	0.003***	0.001**	0.003***	0.003***	0.001	0.002***	0.001***
Quality * Trade	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.000)
Openness							
Constant	9.239***	9.336***	9.215***	9.288***	9.277***	9.394***	9.358***
	(0.111)	(0.112)	(0.117)	(0.109)	(0.111)	(0.103)	(0.107)
Observations	846	846	846	846	846	846	846
R-squared	0.739	0.732	0.736	0.740	0.744	0.755	0.738
Number of code	47	47	47	47	47	47	47
Year FE	YES	YES	YES	YES	YES	YES	YES
country FE	YES	yes	yes	yes	Yes	yes	yes
R-squared	0.7395	0.7316	0.7361	0.7400	0.7443	0.7554	0.7385
F-statistics	87.88	84.38	86.34	88.10	90.13	95.59	87.41
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)

Source: Authors. **Note:** *, **, and *** denote significant at 10%, 5% and 1% levels, respectively. In all cases, p-values are in parentheses. PCA is the aggregate governance institutions indicator obtained from principal component analysis. Notice that the governance institution indicator variables are included in separate regressions to avoid the problem of collinearity.

VI. CONCLUSION

Environmental pollution is a current issue that concerns nations globally, including developing regions like the SSA Countries. Empirical discovery examines the role That Trade openness and attracting foreign direct investment play in a country's development. Unfortunately, despite the impact of trade activity on the environment, policy engagement on the outcomes, and the progress framework remain poor. Using annual data from 47 SSA nations from 2005 to 2022 and applying the Two-Step System GMM technique reveals that trade openness has a negative impact on climate change in SSA countries, whereas foreign direct investment has a mixed and considerable impact on environmental pollution levels. However, in a setting with high-quality institutions, this power level will increase. This fundamentally aligns with the theoretical provision earlier demonstrated by the Pollution Haven Hypothesis (PHH) that foreign direct investment (FDI), trade, and environmental outcomes intersect, particularly in the context of the sub-Saharan Africa environment, especially as connected with households and firms' energy emission in recent Eco activities. Sadly, legislation is poor at regulating actors' activities as the rising climate change outcome is gradually rising across urban settings in Africa, as demonstrated by Aliyu and Ismail (2015).

However, many low- and middle-income countries have not been able to fully realize the potential benefits of trade and investment because their institutional frameworks remain weak. Governance systems often lack the capacity to enforce environmental laws effectively, limiting the extent to which regulations shape business behaviour. This makes institutional quality a central factor in understanding how trade and FDI affect environmental sustainability in sub-Saharan Africa.

With the obtained results, the study recommends that Governments in SSA should focus on enhancing the quality of institutions, specifically targeting improvements in the rule of law, government effectiveness, and control of corruption. By fostering transparent and accountable governance, countries can better regulate FDI to ensure it aligns with Sustainable Development Objective 16.

Governments should encourage policies that attract high-quality FDI with sustainable practices. This includes implementing stricter environmental regulations and incentivizing investments that incorporate modern, efficient production and waste treatment technologies. Such measures can ensure economic growth is coupled with environmental stewardship. This aligns with SDG goals 8 and 9.

Finally, governments in SSA should integrate climate considerations into trade and investment policies. Strengthening institutional quality can facilitate the adoption of eco-friendly practices in trade. By enhancing voice and accountability, countries can ensure that environmental impacts are considered in the trade-openness policies. This aligns with SDG 13.

ACKNOWLEDGMENTS

We sincerely appreciate the World Bank Development Indicators for providing us with all the data used in this study. In addition, we acknowledge the University of Nigeria, Nsukka, for providing us with the platform.

REFERENCES

[1] Abdo, A.B., Li, B., Zhang, X., Lu, J., and Rasheed, A. (2020), Influence of FDI on Environmental Pollution in Selected Arab countries: A spatial

Econometric analysis Perspective. *Environmental Science Pollution Research*, 27, 28222-28246.
[2] Acemoglu, D. (2015). Why Nations Fail? *Pakistan Development Review*, 54, 301–312.
[3] Acharya, R. C. and Keller, W. (2008). Estimating the Productivity Selection and Technology Spillover Effects of imports. *National Bureau of Economic Research, Working Paper* 14079, http://www.nber.org/papers/w14079
[4] Acharyya, Joysri (2009). FDI, Growth and The Environment: Evidence from India on CO2 emission during the last two decades. *Journal of Economic Development*, 34(1), 43 - 58.
[5] Acheampong, A. O., and Dzator, J. (2020). Managing Environmental Quality in Sub-Saharan Africa: Does Institutional Quality Matter? In C. M. Hussain (Ed.), Handbook of Environmental Materials Management Springer. Advance online publication. https://doi.org/10.1007/978-3-319-58538-3_215-1
[6] Adedoyin, F.F., Bekun, F.V., Eluwole, K.K., and Adams, S. (2022). Modelling the Nexus between Financial Development, FDI, and CO2 Emission: Does Institutional Quality Matter? *Energies*,15(7464). https://doi.org/10.3390/en15207464
[7] Adegboye, F. B., Osabohien, R., Olokoyo, F. O., Matthew, O., and Adediran, O. (2020). Institutional quality, Foreign Direct Investment, and Economic Development in sub-Saharan Africa. *Humanities and Social Sciences Communications*, 7(38) https://doi.org/10.1057/S41599-020-0529.
[8] Agosin, M. R., and Machado, R. (2005). Foreign Investment in Developing countries: Does it crowd in Domestic Investment? *Oxford Development Studies*, 33(2), 149–162. doi:10.1080/13600810500137749
[9] Ikechukwu, M., and Agu, C. (2024). Moderating Effect of Institutional Quality on the Population Growth-Environmental Sustainability Nexus in Sub-Saharan Africa. *Applied Journal of Economics, Management and Social Sciences*, 5(1), 51–65. https://doi.org/10.53790/ajmss.v5i1.89
[10] Ahmad, M. H., Ahmed, Q. M. and Atiq, Z. (2018). The Impact of Quality of Institutions on Sectoral FDI: Evidence from Pakistan. *Foreign Trade Review*, 53(3), 174–88. doi.org/10.1177/0015732517734757
[11] Ali, H. S., Zeqiraj, V., Lin, W. L., Law, S. H., Yusop, Z., Bare, U. A. A., and Chin, L. (2019). Does quality institutions promote environmental quality? *Environmental Science and Pollution Research*, 26(2), 10446–10456, https://doi.org/10.1007/s11356-019-04670-9
[12] Ali, S., Yusop, Z., Kaliappan, S. R., and Chin, L. (2020). Dynamic common correlated effects of Trade openness, FDI, and Institutional performance on Environmental quality: Evidence from OIC countries. *Environmental Science and Pollution Research*, 27(11), 11671-11682.
[13] Aliyu, A. J. and Ismail, N. W. (2015). Foreign Direct Investment and Pollution Haven: Does Energy Consumption Matter in African Countries? *International Journal of Economics and Management (IJEM)*, 9 (5), 21–39. http://www.econ.upm.edu.my/ijem.
[14] Alola, A. A., Bekun, F. V., and Sarkodie, S. A. (2019). Dynamic impact of Trade Policy, Economic Growth, Fertility rate, Renewable and non-renewable Energy Consumption on Ecological footprint in Europe. *Science of the Total Environment*, 685, 702-709.
[15] Antweiler, W., Copeland, B. R., and Taylor, M.S. (2001). Is Free Trade Good for the Environment? *The American Economic Review*, 91(4), 877-908.
[16] Appiah, M., Li, M., Onifade, S. T., and Gyamfi, B. A. (2022) Investigating Institutional Quality and carbon mitigation drive in sub-Saharan Africa: Are growth levels, energy use, population, and industrialization consequential factors? *Energy and Environment*, 1-27. https://doi.org/110.1177/0958305X221147602.
[17] Arellano, M., and Bond, S. (1991). Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations. *The Review of Economic studies*, 58(2), 277-297.
[18] Asamoah, M. E., Adjasi, C. K. D., and Alhassan, A. L. (2016) Macroeconomic uncertainty, Foreign Direct Investment and Institutional Quality: Evidence from sub-Saharan Africa: *Economic Systems,* 579. http://dx.doi.org/doi:10.1016/j.ecosys.2016.02.010
[19] Asamoaha, L. A., Mensaha, E. K., and Bondzieb, E. A.(2019). Trade openness, FDI and Economic Growth in sub-Saharan Africa: Do Institutions Matter? *Transnational Corporations Review*,11(1), 65–79, https://doi.org/10.1080/19186444.2019.1578156
[20] Asongu, S. A., and Nicholas M. Odhiambo, N. M. (2020). Trade and FDI Thresholds of CO2 emissions for a Green Economy in sub-Saharan Africa. *African Governance and Development Institute*, 20(72). https://mpra.ub.uni-muenchen.de/107494/
[21] Azam, Muhammad and Haseeb, Muhammad (2021). Determinants of foreign direct investment in BRICS- Does renewable and non-renewable Energy Matter? *Energy Strategy Reviews*, 35 100638https://doi.org/10.1016/j.esr.2021.100638
[22] Bailey, N. (2018). Exploring the relationship between institutional factors and FDI attractiveness: A meta-analytic review. *International Business Review*, 27(1), 139–48. doi.org/10.1016/j.ibusrev.2017.05.012

[23] Bambi, P. D. R., Batatana, M. L. D., Appiah, M., and Tetteh, D. (2024). Governance, institutions, and climate change resilience in Sub-Saharan Africa: assessing the threshold effects. *Frontiers in Environmental Science*, 12. https://doi.org/10.3389/fenvs.2024.1352344

[24] Bénassy-Quéré, A., Coupet, M. and Mayer, T. (2007). Institutional Determinants of Foreign Direct Investment. World Economy, 30(5), 764–82. doi.org/10.1111/J.1467-9701.2007.01022.X.

[25] Bissoon, O. (2012), Can better Institutions attract more Foreign Direct Investment (FDI)? Evidence from Developing countries. *International Research Journal of Finance and Economics*, 82, 142-158.

[26] Blanco, G., Gerlagh, R., Suh, S. et al. (2014). *Drivers, trends and mitigation in Climate change 2014: Mitigation of climate change.* Contribution of Working Group III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, Assessment Report. Cambridge and New York: Cambridge University Press.

[27] Blundell, R., and Bond, S. (1998). Initial conditions and moment restrictions in Dynamic Panel Data models. *Journal of Econometrics*, 87, 115-143.

[28] Bouchoucha, N. (2024). Does Institutional Quality Mitigate the Effect of Foreign Direct Investment on Environnemental Quality: Evidence of MENA Countries. *Journal of the Knowledge Economy*, 1-19. https://doi.org/10.1007/s13132-023-01606-0

[29] Bouchoucha, N. and Ali, W. (2019), "The impact of FDI on economic growth in Tunisia: an estimate by the ARDL approach", *Munich Personal RePEc Archive*, (1),1-23.

[30] Bouchoucha, N., and Benammou, S. (2018). Does Institutional Quality Matter Foreign Direct

[31] Cerulli G, Poti B (2009) Measuring Inter-sectoral knowledge spillovers: An application of sensitivity analysis to Italy. *Econ Syst Res,* 21(4), 409–436

[32] Chang, S. C. (2015). The Effects of Trade Liberalization on Environmental Degradation. *Quality and Quantity*, 49(1), 235-253. DOI 10.1007/s11135-013-9984-4

[33] Daude, C. and Stein, E. (2007). The Quality of Institutions and Foreign Direct Investment. *Economics and Politics*, 19(3), 317–44. doi.org/10.1111/J.1468-0343.2007.00318.X.

[34] De Mello, L.R. (1997). Foreign Direct Investment in Developing Countries and Growth: A Selective Survey, *Journal of Development Studies*, 34(1), 1-34.

[35] Denis, U.B., Emeka, E.T., Ogbuabor, J.E. et al.(2025). Economic Complexity and Health Outcomes in Africa: Empirical Insights from Panel Data Analysis. *J Knowl Econ*. https://doi.org/10.1007/s13132-024-02295-z.

[36] Dhrifi, A., Jaziri, R., andAlnahdi, S. (2020). Does Foreign Direct Investment and Environmental Degradation matter for Poverty? Evidence from Developing countries. *Structural Change and Economic Dynamics*, 52, 13-21.

[37] Do, T., and Dinh, H. (2020). Short-and Long-term Effects of GDP, Energy Consumption, FDI, and Trade Openness on CO2 emissions. *Accounting,* 6(3), 365-372.

[38] Dossou, M. A. T., Kambaye, E. N., Asongu, S. A., Alinsato, A. S., Berhe, M. W., and Dossou, K. P. (2023). Foreign Direct Investment and Renewable energy Development in sub-Saharan Africa: Does governance quality matter? *African Governance and Development Institute Working Paper* No. 061, Yaoundé

[39] Duodu, E., Kwarteng, E., Oteng-Abayie, E. F., and Frimpong, P.B. (2021). Foreign Direct Investments and Environmental Quality in sub-Sahara Africa: The Merits of Policy and Institutions for Environmental Sustainability. *Environmental Science and Pollution Research*. https://doi.org/10.1007/s11356-021-15288-1.

[40] Essandoh, O. K., Islam, M., and Kakinaka, M. (2020). Linking International Trade and Foreign Direct Investment to CO2 emissions: Any differences between developed and developing countries? Science of the Total Environment, 712, 136437.

[41] Falki, N. (2009). Impact of Foreign Direct Investment on Economic Growth in Pakistan. *International Review of Business Research Papers*, 5(5), 110-120.

[42] Gastanaga, V. M., Nugent, J. B. and Pashamova, B. (1998). Host country reforms and FDI inflows: How much difference do they make? *World Development*, 26(7), 1299–1314. doi.org/10.1016/S0305-750X(98)00049-7.

[43] Globerman, S. and Shapiro, D. (2002). Global Foreign Direct Investment Flows: The Role of Governance Infrastructure. *World Development*, 30(11), 1899–1919. doi.org/10.1016/S0305-750X(02)00110-9.

[44] Gong, M., Zhen, S., Liu, H. (2021), Research on the nonlinear Dynamic relationship between FDI and CO2 emissions in the "One Belt, One Road" countries. *Environmental Science Pollution Research*, 28, 27942-27953.

[45] Grossman, G. M., and Krueger, A. B. (1991). Environmental Impacts of the North American Free Trade Agreement. *NBER Working Paper* No. 3914.

[46] HA, T. C., and NGUYEN, H. N. (2021). The role of Institutions on FDI and Environmental pollution nexus: evidence from developing countries. *The Journal of Asian Finance, Economics and Business*, 8(6), 609-620.

[48] Hakimi, A., andHamdi, H. (2020). Environmental effects of trade openness: what role do institutions have?. *Journal of Environmental Economics and Policy*, 9(1), 36-56.
[49] Hassaballa, H. (2014). The effect of lax Environmental laws on Foreign Direct investment inflows in Developing countries. *Journal of Emerging Trends in Economics and Management Sciences*, 5(3), 305-315.
[50] Jahanger, A., Usman, M., Balsalobre-Lorente, D. (2022). Linking Institutional quality to Environmental Sustainability. *Sustainable Development*, 30(5), 1749–1765. https://doi.org/10.1002/sd.2345.
[51] Jiang, Z., Lyu, P., Ye, L., and Zhou, Y. w. (2020). Green Innovation Transformation, Economic Sustainability and Energy Consumption during China's New normal Stage. *Journal of cleaner production*, 273, 123044. doi:10.1016/j.jclepro.2020.123044
[52] Khamphengvong, V. and Srithilat, K. (2017), "The relationship among FDI, Trade Openness and Economic Growth: Empirical evidence from Lao PDR", 4th International Conference on Industrial Economics System and Industrial Security Engineering (IEIS), July, 1-6, doi: 10.1109/IEIS.2017. 8078623.
[53] Khan, H., Weili, L., and Khan, I. (2022). Environmental Innovation, Trade Openness and Quality Institutions: An integrated Investigation about Environmental Sustainability. Environment, Development and Sustainability, 1-31.
[54] Khan, H., Weili, L., and Khan, I. (2022). Environmental Innovation, Trade Openness and Quality Institutions: An integrated investigation about Environmental Sustainability. Environment, Development and Sustainability, 1-31.
[55] Khan, H., Weili, L., Khan, I., and Khamphengxay, S. (2021). Renewable energy Consumption, Trade Openness, and Environmental Degradation: A Panel Data Analysis of Developing and Developed countries. Mathematical Problems in Engineering, 2021(1), 6691046.
[56] Lewis, W. Arthur (1980). The slowing down of the engine of Growth. *American Economic Review,* 70(4): 555-64.
[57] Li, Z., Dong, H., Huang, Z., Failler, P. (2019), Impact of Foreign Direct Investment on Environmental Performance. *Sustainability*, 11(13), 3538.
[58] Limazie, M. S., and Woni, S. (2024). Foreign Direct Investment and Carbon Emissions in ECOWAS: Does good Governance matter? *Journal of Economics and Development*, 26(2), 139-153.
[59] Lundvall, B.A. (1988). Innovation as an interactive Process: from User-producer interaction to the National System of innovation. In: Dosi, G., Freeman, C., Nel- son, R., Silverberg, G., Soete, L. (Eds.), Technical change and Economic Theory. Pinter, London .
[60] Mahmood, H., Alkhateeb, T. T. Y., and Furqan, M. (2020). Exports, Imports, Foreign Direct Investment and CO2 Emissions in North Africa: Spatial analysis. *Energy Reports*, 6, 2403-2409.
[61] Mansfield, E., Romeo, A., 1980. Technology Transfer to overseas Subsidiaries by U. S.-based firms. *Q. J. Econ*. 95 (4), 737–750. doi: 10.2307/1885489
[62] Mehmood, K. A. (2023). FDI and poverty in-line with quality of Governance and Voice and Accountability: Follow-ups based on linear and non-linear ARDL. *Pakistan Journal of Commerce and Social Sciences (PJCSS*), 17(2), 394-423.
[63] Mohamed, A., Moshi, J., and Mwoya, B. (2022). Does Institutional Development attract Foreign Direct Investments in Sub-Saharan Africa? A Dynamic Panel Analysis. *African Journal of Economic Review*, 10(1).
[64] Moosa, Imad A. (2019). The environmental effects of FDI: EVIDENCE from MENA countries, The Economic Research Forum (ERF), *Working Paper* No. 1321, 1–20.
[65] Mukhtarov, S., Aliyev, S., Mikayilov, J. I., Ismayilov, A., andRzayev, A. (2020). The FDI-CO2 nexus from the Sustainable Development perspective: The case of Azerbaijan. *International Journal of Sustainable Development and World Ecology*, 1-9.
[66] Nair-Reichert, U. and Weinhold, D. (2001), "Causality tests for Cross-Country Panels: A new look at FDI and Economic growth in Developing countries. *Oxford Bulletin of Economics and Statistics*, 63(2), 153-171. doi: 10.1111/1468-0084.00214.
[67] Nguyen, Y., Le, S., Ngo, N., and Nguyen, H. (2023). Impacts of FDI and Environmental Pollution in ASEAN Countries: The Role of Institutions. *International Journal of Energy Economics and Policy*, 13(5), 242-250.
[68] Nondo, C., Kahsai, M. S., and Hailu, Y. G. (2016). Does institutional quality matter in Foreign Direct Investment?: Evidence from Sub-Saharan African countries. *African Journal of Economic and Sustainable Development*, 5(1), 12 – 30.
[69] North, D. C. (1990). Institutions, Institutional Change, and Economic Performance. Cambridge: Cambridge University Press. https://doi.org/10.1017/CBO9780511808678
[70] Ntow-Gyamfi, M., Bokpina, G. A., Aboagyea, A. Q. Q., and Ackah, C. G. (2020). Environmental Sustainability and Financial Development in Africa; Does Institutional Quality play any role? *Development Studies Research*, 7(1), 93–118, https://doi.org/10.1080/21665095.2020.1798261.

[71] Ogbuabor, J. E., Emeka, E. T., Orji, A.(2025). Effect of Resource Rent on Infrastructural Development in Africa: Moderating Role of Governance Institutions. *Politická Ekonomie*, 73(1),31–57, https://doi.org/10.18267/j.polek.1450.
[72] Pavcnik, N. (2002). Trade Liberalization, exit, and Productivity improvements: Evidence from Chilean plants. *Rev. Econ. Stud*, 69 (1), 245–276.
[73] Pradhan, A. K., Sachan, A., Sahu, U. K., and Mohindra, V. (2022). Do Foreign Direct Investment Inflows affect Environmental Degradation in BRICS Nations? *Environmental Science and Pollution Research*, 29, 690-701.
[74] Qamruzzaman, M. (2021). Nexus between Environmental Quality, Institutional Quality and Trade Openness through the channel of FDI: An application of common correlated effects estimation (CCEE), NARDL, and Asymmetry causality. *Environmental Science and Pollution Research*, 28(37), 52475-52498.
[75] Raihan, A. (2023), Exploring Environmental Kuznets curve and Pollution Haven Hypothesis in Bangladesh: The impact of Foreign Direct Investment. *Journal of Environmental Science Economics*, 2(1), 25-36.
[76] Sabir, S., Rafique, A. and Abbas, K. (2019). Institutions and FDI: Evidence from Developed and Developing countries. *Financial Innovation*, 5(1), 1–20. doi.org/10.1186/S40854-019-0123-7.
[77] Saikia, M. (2021). Foreign Direct Investment And Institutions: A case of Indian firms. *The Journal of International Trade and Economic Development*, 30(5), 725–38. doi.org/10.1080/09638199.2021.1894217.
[78] Sakyiet, D., Commodore, R. and Opoku, E.E.O. (2015). Foreign Direct Investment, Trade Openness and Economic Growth in Ghana: an Empirical Investigation. *Journal of African Business*, 16,1-15, doi: 10.1080/15228916.2015.1061283
[79] Shah, S. H., Ahmad, M. H. and Ahmed, Q. M. (2015). The nexus between Sectoral FDI and Institutional Quality: Empirical Evidence from Pakistan. doi.org/10.1080/00036846.2015.1103039.
[80] Tiwari, A.K. and Mutascu, M. (2011). Economic growth and FDI in Asia: A panel-data Approach", Economic Analysis and Policy, 41(2), 173-187. doi: 10.1016/S0313-5926(11)50018-9.
[81] Udeagha, M. C., and Ngepah, N. (2022). Does Trade Openness Mitigate the Environmental Degradation in South Africa?. *Environmental Science and Pollution Research*, 29(13), 19352-19377.
[82] Usman, M., Kousar, R., Makhdum, M. S. A., Yaseen, M. R., andNadeem, A. M. (2022). Do financial Development, Economic Growth, Energy Consumption, and Trade Openness Contribute to increase carbon emission in Pakistan? An insight based on ARDL bound testing approach. *Environment Development and Sustainability*, 1-30.
[83] Valery, D. N. (2021). Institutional Quality and its Impact on Inward Foreign Direct Investment in Sub-Saharan Africa, 2006-2018: A Dynamic Panel Data Analysis (Master's Thesis), Seoul National University, Seoul, Republic of Korea.
[84] Wang, M. L., Ntim, V. S., Yang, J., Zheng, Q., and Geng, L. (2022). Effect of Institutional Quality and Foreign Direct Investment on Economic Growth and Environmental Quality: evidence from African countries. *Economic Research-Ekonomska Istraživanja*, 35(1), 4065-4091. https://doi.org/10.1080/1331677X.2021.2010112
[85] Wang, M., SarkodieNtim, V., Yang, J., Zheng, Q., Geng, L. (2022), Effect of Institutional Quality and Foreign Direct Investment on Economic Growth and Environmental Quality: Evidence from African countries. *Economic Research-EkonomskaIstraživanja*, 35(1), 4065-4091.
[86] Wenlong, Z., Tien, N. H., Sibghatullah, A., Asih, D., Soelton, M., and Ramli, Y. (2023). Impact of Energy Efficiency, Technology Innovation, Institutional Quality, and Trade Openness on Greenhouse gas Emissions in Ten Asian Economies. *Environmental Science and Pollution Research*, 30(15), 43024-43039.
[87] Zorodzai (2021). The Relationship between FDI, Political and Institutional risk in Sub-Saharan Africa (Master's Thesis), University of Cape Town, Cape Town, South Africa

AUTHORS

First Author –Afamefuna Angus EZE*, Department of Economics, University of Nigeria, Nsukka. Nigeria angus.eze@unn.edu.ng
Second Author – Emeka ThankGod EKENE, Department of Economics, University of Nigeria, Nsukka. Nigeria ekene.emeka.pg80103@unn.edu.ng
Third Author – Emmanuel Chikeluba OSILO, Department of Economics, University of Nigeria, Nsukka. Nigeria chikeluba.osilo.pg00013@unn.edu.ng
Fourth Author – Henry T. ASOGWA, PhD, Institute for Development Studies, University of Nigeria, Enugu Campus, Nigeria. Henry.asogwa@unn.edu.ng
Fifth Author – Umoh, D. Boniface, PhD, Institute for Development Studies, University of Nigeria, Enugu Campus, Enugu, Nigeria. boniface.umoh@unn.edu.ng
Sixth Author– Amos Iloabuchi UGWUOTI, PhD, Department of Geoinformatics and Surveying, University of Nigeria Enugu Campus, Enugu, Nigeria. Iloabuchi.ugwuoti@unn.edu.ng

Seventh Author – Ugwuanyi, O. Romanus. Institute for Development Studies, University of Nigeria, Enugu Campus, Enugu, Nigeria. romanus.ugwuanyi@unn.edu.ng
Eight Author– Ezebuilo Romanus UKWUEZE, PhD, Department of Economics, University of Nigeria, Nsukka. Nigeria. ezebuilo.ukwueze@unn.edu.ng

Correspondence Author – Asogwa, T. Henry, Institute for Development Studies, University of Nigeria, Enugu Campus, Enugu, Nigeria, henry.asogwa@unn.edu.ng +2348060230891