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Foreign Direct Investment, Institutional Quality, and Environmental Pollution in Selected African Countries

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ABSTRACT

African countries increasingly attract foreign direct investment as they strive for economic growth and development. However, there have been concerns over the rising effects of FDI on pollution. These concerns are rooted in the potential for industrial activities associated with FDI to have adverse environmental impacts. Hence, the needs to tackle the problem of pollution cannot be overemphasized. One way to do this is by strengthening the quality of African institutions. This study was conducted to examine the effects of institutional quality and FDI on environmental pollution in selected African countries. Environmental pollution was measured using CO_2 emission.The result of the PCSE estimator showed that institutional quality had negative effects on environmental pollution, but the effect of FDI was positive and insignificant. Also, the effect of moderating effect showed that institutional quality has the potential to reduce the positive effect of FDI on environmental pollution. It was recommended that African governments should strengthen the quality of their institutions by strengthening environmental governance frameworks.

INTRODUCTION

Foreign Direct Investment (FDI) is vital to a country's economic growth. This is especially true in less developed countries. It is an important tool for employment creation, poverty reduction and economic growth (Crescenzi *et al*., 2022). However, while FDI can provide significant benefits to an economy, it is not without possible drawbacks. One of these is environmental pollution. FDI can sometimes result in environmental harm, especially if the host country's environmental rules are weak.This may allow multinational corporations (MNCs) to engage in environmentally detrimental practices than they might have done in countries with stronger environmental laws (Chirilus & Costea, 2023). This is referred to as the pollution haven hypothesis (Raihan, 2023).

It implies that multinational corporations, particularly those in pollution-intensive industries, may invest in or relocate production to nations with less stringent environmental regulations to avoid the higher costs of compliance in their home countries. This frequently results in developing countries with weak environmental enforcement attracting global corporations eager to cut regulatory costs, potentially leading to increasing pollution and environmental deterioration in such areas (Bashir, 2022; Raihan, 2023).

In recent times, Foreign direct investment is becoming more and more popular in African nations as they work to build their economies (Adegboye & Okorie, 2023). From $2,845 million in 1990, FDI inflows to Africa increased to $82,196 million in 2021 (United Nations Conference on Trade and Development (UNCTAD), 2023). However, the growing impact of foreign direct investment on pollution has raised worries. These worries stem from the possibility that industrial operations linked to foreign direct investment could negatively affect the environment.

Many African countries have less stringent or poorly enforced environmental regulations (Baajike *et al*., 2022). This creates a situation where foreign investors are not held to high environmental standards, leading to pollution concerns. Also, there are concerns that FDI are attracted into resource extraction industries, such as mining and oil exploration, and these pose environmental challenges (Kimiagari *et al*., 2023). According to Adegboye and Okorie (2023), the African region had the highest return on investment, at almost 11%, compared to Asia's 9.1%, Latin America and the Caribbean's 8.9%, and the global average of 7.1%. One of the reasons for this is because most of the FDI flows to Africa are attracted to the resource sector with the intention of exploiting Africa's resources to their advantage (Geda & Yimer, 2023). This is more so because of the weak regulation and compliance in African countries.

Ironically, as FDI inflows in Africa continue to rise, CO_2 emissions are also on the increase. For instance, Carbon dioxide (CO_2) emissions from industrial processes in Sub-Saharan Africa increased from 23.6232 metric tons (MT) in 71.6857 metric tons (MT) in 2022. Similarly, Carbon dioxide (CO_2) emissions from Industrial combustion in Sub-Saharan Africa increased from 58.9712 metric tons (MT) in 91.7708 metric tons (MT) in 2022 (World Bank, 2023). Air pollution is one of today's most serious environmental issues, posing a risk to human health. Every year, air pollution claims the lives of approximately 1.1 million people throughout Africa (Capitanio *et al*., 2024). Similarly, many African countries have annual mean pollution concentrations exceeding the World Health Organization guideline (Fisher *et al*., 2021). Fisher *et al*. (2021) also argued that in 2019, air pollution-related illness and mortality cost Ethiopia $3.02 billion,

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Ghana $1.63 billion,and Rwanda $349 million. Hence, the needs to tackle the problem of pollution cannot be overemphasized. One way to do this is by strengthening the quality of African institutions. Stronger institutions may create, implement, and enforce more stringent environmental legislation to reduce emissions and pollutants. They can move the focus from pollution-intensive sectors to those that support long-term growth by actively pushing FDI in renewable energy and environmentally friendly industries. This study therefore examines the moderating roles of institutional quality in the relationship between FDI and environmental pollution in selected African countries.

LITERATURE REVIEW

Pollution Haven Hypothesis and Pollution Halo Hypothesis

Pollution Haven Hypothesis and Pollution Halo Hypothesis are two important theories that have been used to explain FDI-Pollution relationships in the literature. The Pollution Haven Hypothesis argues that foreign direct investment may increase pollution in the host nations, particularly in countries with inadequate environmental standards (Akbulut & Yereli, 2023). This implies that multinational corporations from nations with stronger environmental rules transfer their polluting activities to countries with looser regulations, resulting in "pollution havens" (Uche *et al*., 2024). This move enables major companies to reduce their manufacturing costs while increasing pollution levels in the host countries.

The Pollution Halo Hypothesis, on the other hand, contends that FDI can improve environmental quality in host countries.According to Xu *et al*., (2021), multinational firms bring cleaner technology, sophisticated managerial methods, and higher environmental standards from their home countries to the host country. This transfer can have a "halo" effect, in which local businesses and industries adopt more sustainable practices, boosting overall environmental outcomes (Duan & Jiang, 2021; Padhan & Bhat, 2024).

Review of Past Studies

Over the years, the relationship between FDI and pollution has been widely examined. For instance, studies such as (Abbas *et al*., 2023; Abdo *et al*., 2020; Adeel-Farooq *et al*., 2021; Achuo & Ojong, 2024; Assamoi *et al*., 2020; Boamah *et al*., 2023; Gharnit *et al*., 2019; Khan & Ozturk, 2020; Nadeem *et al*., 2020; Ren *et al*., 2014; Shao *et al*., 2019; Quang, 2023; Wang *et al*., 2024; Zheng *et al*., 2024) found evidence that FDI increases environmental pollution. They noted that greater FDI inflow is frequently associated with higher levels of industrial emissions and air pollution. They ascribe this to weaker environmental rules in these countries, which make them appealing destinations for corporations looking for cheaper compliance costs. They confirmed that lax environmental regulations allow for polluting industry expansion via foreign investment.

On the other hands, there have been several studies that found a negative effect of FDI on environmental pollution. Studies such as (Balsalobre-Lorente *et al*., 2019; Demena & Afesorgbor, 2020; Hao *et al*., 2020; Jiang *et al*., 2018; Kisswani & Zaitouni, 2023; Mert & Caglar, 2020; Nejati & Taleghani, 2022; Nguyen-Thanh *et al*., 2022; Tayyar, 2022) found evidence that FDI reduces pollution. The studies discovered that foreign direct investment can help to reduce pollution by encouraging the use of cleaner technologies and sustainable practices. They argue that FDI encourages host countries to raise their standards in response to pressures from multinational corporations, which frequently bring advanced, environmentally friendly technologies. They conclude that FDI reduces pollution through technology diffusion,especially in high-regulation economies where environmental norms are actively enforced.

Tayyar (2022), for instance, found that foreign direct investment (FDI) reduces pollution by promoting technology transfer and raising environmental awareness in host nations, and that this effect is stronger in countries with strict environmental rules. Nguyen-Thanh *et al.* (2022) concluded that FDI helped to reduce pollution by boosting industrial modernization and bringing better environmental standards and cleaner manufacturing processes. According to Nejati and Taleghani (2022), FDI is related with a decrease in air pollutants in developing nations due to the adoption of cleaner technology and practices, which is especially beneficial in industries with historically high emissions.

While numerous studies imply that FDI alone leads to increased pollution, the interplay of FDI and environmental control can mitigate this effect. For instance, Fahad *et al.* (2022) investigated the conditional impacts of FDI on environmental quality and found that stricter environmental regulations in host nations increase FDI's positive influence on pollution reduction. It suggested that when laws are strong, FDI firms are more inclined to use cleaner technology to meet local norms. According to Fu *et al.* (2024), the environmental impact of FDI varies with regulatory strictness. FDI in countries with strong environmental policies leads to fewer emissions and improved sustainability practices. In contrast, in less-regulated countries, FDI may contribute to higher levels of pollution, implying that regulatory quality is an important driver. Qian-qian *et al.* (2019) concluded that FDI firms alter their practices in response to the host country's regulatory framework.

The study argued that in areas with strict environmental legislation, FDI promotes eco-friendly behaviors, whereas in less-regulated environments, investment can occasionally result in "pollution havens." Also, Xie and Zhang (2024) revealed that the environmental impact of FDI depends on regulatory enforcement. In countries with strict environmental legislation, FDI brings in eco-friendly technology and practices, but in countries with laxer restrictions, it may contribute to increased pollution due to inadequate control. According to Yang *et al.* (2021), the impact of foreign direct investment on environmental results is mediated by local regulatory norms. The study highlighted that in countries with strict environmental regulations, FDI has a positive impact on environmental quality, whereas in less-regulated environment, FDI may exploit low standards, causing environmental harm. This study contributes to the debate by building on these findings, notably by investigating the impact of institutional quality in the FDI-pollution link. By adding institutional elements, the study gives a more in-depth knowledge of how governance systems, regulatory efficacy, and institutional strength in host nations may influence FDI environmental consequences.

MATERIALS AND METHODS

Two models were used for the analysis. The first was used to examine the effects of FDI and institutional quality on environmental pollution, while the second model was used to investigate how institutional quality moderate the effect of FDI on environmental pollution in the selected African countries.

Model One

$$LOG\_CO_{2it} = \delta_0 + \delta_1\ LOGFDI_{it} + \delta_2\ IQSTQUAL_{it} + \delta_3\ LOG\_CREDIT_{it} + \delta_4 LOG\_CPI_{it} + \delta\_5\ LOGEXCHA_{it} + \epsilon_{it} \quad \ldots\ldots\ldots\ldots(3.1)$$

Model Two

$$LOG\_CO_{2it} = \delta_0 + \delta_1\ LOGFDI_{it} + \delta_2\ IQSTQUAL_{it} + \delta_3\ INSTFDI_{it} + \delta_4 LOG\_CREDIT_{it} + \delta_5 LOG\_CPI_{it} + \delta_6\ LOGEXCHA\_it + \epsilon_{it} \quad \ldots\ldots\ldots\ldots(3.2)$$

Where LOG_CO2 is the log of CO2 emission, LOGFDI is the log of FDI inflows, IQSTQUAL is institutional quality index, LOG_CREDIT is the log of credit to the private sector which was used as the proxy for financial development, LOG_CPI is the log of consumer price index, and LOGEXCHA is the log of exchange rate, and INSTFDI is moderating variable. INSTFDI = LOGFDI * IQSTQUAL

Institutional quality was measured as the composite index from six governance indicators which are voice and accountability, political stability and absence of violence/terrorism, government effectiveness, regulatory quality, and rule of law. Environmental Pollution was measured as CO_2 emissions (metric tons per capita), FDI Inflows:was measured using FDI inflows as percentage of GDP, Domestic Credit was measured as the domestic credit to the private sector, Consumer Price Index: was used to measure inflation, Exchange Rate was measured as the Official exchange rate (LCU per US$, period average).

This study was based on panel data consisting of time series data from 2002 and 2022. For the cross-sectional data, three countries were chosen from each region in Africa. Hence, the countries that were considered are Tunisia, Egypt, and Morocco, from North Africa, Benin, Nigeria, and Senegal from Western Africa, Cameroon, Chad, and Gabon, from Central Africa, Kenya, Rwanda and Mauritania from Eastern Africa, and Botswana, Namibia, Namibia, and South Africa.

Using the Variance Inflation Factor, the study begins by checking for multicollinearity. The test for heteroskdesticity was followed using modified wald test The Pesaran Cross-Sectional Dependence test was used to test for cross-sectional dependence. The panel unit root tested using Cross-Sectional Augmented ADF (CADF) test. The Panel co-integration test was done using the Pedroni co-integration test, while Panels Corrected Standard Errors was used as the primary estimator.

RESULTS AND DISCUSSION

Testing for the Multicollinearity

The variance inflation factor (VIF) and tolerance factor (TF) are measures used to assess multicollinearity among the predictor variables in models. Table 1 shows that the variance inflation factor is low with the highest value of 2.21 while the tolerance factor has the lowest value of 0.45 in the first model. The second model has the highest value of 2.29 and lowest tolerance factor value of 0.43. Given that the VIF values are below 5, there is no significant multicollinearity issue among the predictor variables in the two models (Shrestha, 2020).

Table 1: Results of the VIF Test of Multicollinearity

	Model One		**Model Two**	
Variable	VIF	TF	VIF	TF
LOG_CREDIT	2.21	0.451662	2.29	0.437020
LO_GEXCHA	1.83	0.545362	1.84	0.542995
IQSTQUAL	1.76	0.569608	2.56	0.391313
LOG_CPI	1.18	0.844904	1.18	0.844742
LOG_FDI	1.03	0.974278	1.12	0.890316
INSTFDI			2.16	0.462577

Source: Computed by the Author

Testing For Serial Correlation in the Models

Table 2 shows that the Woodrige Test of Serial Correlation has probability values that is less than 5% in both models, implying that there is evidence of serial correlation in the residuals. Because the probability value is less than 5%, the null hypothesis of no serial correlation is rejected in the two models.

Table 2 : Woodrige Test of Serial Correlation

	Model One	Model Two
F(,20)	346.156	355.181
Prob > F	0.0000	0.0000

Source: Computed by the Author

Testing For Heteroskedasticity in the Models

Table 3 reveals that the Modified Wald test for groupwise heteroskedasticity for the two models yields probability value of less than 1%. It provides significant evidence for rejecting the null hypothesis of no groupwise heteroskedasticity. It implies that the error variances in regression models are not uniform across groups or clusters. This breach of the homoscedasticity assumption may result in biased coefficient estimations and wasteful standard errors. As a result, our work solved this issue by determining the optimal estimator that is robust to heteroskedasticity.

Table 3: Result of the Modified Wald Test for Groupwise Heteroskedasticity

	Model One	Model Two
F(,20)	346.156	355.181
Prob > F	0.0000	0.0000

Source: Computed by the Author

Slope Homogeneity Test

Table 4 shows that the probability value for this test is less than 1% for the two models. It suggests strong evidence against the null hypothesis of slope homogeneity, indicating that the coefficients vary significantly across different units.

Table 4: Result of the Pesaran and Yamagata.Test

	Model One		Model Two	
Delta	13.983	16.934	12.376	15.514
Prob Value	0.000	0.000	0.000	0.000

Source: Computed by the Author

Testing for Cross-Sectional Dependence

The Pesaran cross-sectional dependence test findings demonstrate that most of the variables in the two models have probability values less than 1%, indicating strong evidence against the null hypothesis of no cross-sectional dependence. Cross-sectional dependence can cause coefficient estimates to be biased and standard errors to be erroneous in panel data models. This study addressed this challenge by considering the estimator that is robust to cross-sectional dependence.

Table 5: Results of the Cross-Sectional Dependence

	Model One		Model Two	
Variable	CD-test	p-value	CD-test	p-value
LOG_CO2	+ 47.372	0.000	47.372	0.000
IQSTQUAL	+ 3.096	0.002	3.096	0.002
LOGFDI	+ 4.014	0.000	4.014	0.000
INSTFDI			-.175	0.861
LOG_CREDIT	+ 35.397	0.000	35.397	0.000
LOG_CPI	+ 65.949	0.000	65.949	0.000
LOGEXCHA	+ 31.22	0.000	31.22	0.000

Source: Computed by the Author

Panel Unit Root Test

The CADF test results provide insight into the stationarity of the variables in the panel data model. The results demonstrate that the CADF probability values were greater than 5% when the variables were not diferrenced. When they were differenced ones, the probabilities were less than 5%. This means that when the variables were not diferrenced, they were non-stationary, i.e. they showed trends or had unit roots. After differencing, the variables became stationary, which means they no longer showed trends or unit roots.

Table 6: The Result of the CADF Unit Root

	Without Difference		With Difference	
Variable	t-bar	P-value	t-bar	P-value
LOG_CO2	-2.595	0.080	-2.735	0.018
IQSTQUAL	-2.510	0.162	-3.422	0.000
LOGFDI	-2.334	0.453	-3.588	0.000
LOG_CREDIT	-2.585	0.088	-3.780	0.000
LOG_CPI	-2.070	0.067	-2.780	0.000
LOGEXCHA	-2.489	0.189	-2.764	0.013
INSTFDI	-2.618	0.064	-3.508	0.000

Source: Computed by the Author

Testing for the Co-integration in the Models

Table 7 displays the Pedroni Co-integration test results for the models. The test provides three statistics: modified Phillips-Perron, Phillips-Perron, and augmented Dickey-Fuller. All the three statistics have probability values that are less than 1%. This provides extremely strong evidence against the null hypothesis of no co-integration in the two models. This implies a long-run relationship between the variables in the model.

Table 7: The Result of Pedroni Co-integration Test

	Model One		Model Two	
Statistics	Statistic	P-value	Statistic	P-value
Modified Phillips -Perr -on	4.9890	0.0000	6.0836	0.0000
Phillips-Perron	-3.0077	0.0013	-2.0945	0.0181
Augmented Dickey-Fuller	-2.4268	0.0076	-1.2297	0.1094

Source: Computed by the Author

Results of The Panels Corrected Standard Errors

Table 8 shows that in model one, there is a negative relationship between institutional quality and CO_2 emissions. This shows that higher institutional quality leads to lower CO_2 emissions. This implies that improving institutional quality, such as upgrading governance structures, strengthening regulatory frameworks, and fostering openness and accountability, may contribute to minimizing environmental deterioration. Similarly, there was a positive relationship between FDI and CO_2 emissions, but it is not statistically significant at the 5% level. This shows that an increase in foreign direct investment is connected with higher levels of CO_2 emissions. The lack of significance suggests that although FDI has the potential to increase pollution in Africa, the effect is relatively weak. This may imply that FDI has not grown enough to significantly contributes to pollution in Africa.

In model two, there is also a negative relationship between institutional quality and CO_2 emission. This suggests that higher institutional quality is associated with lower levels of CO_2 emissions. Similarly, a positive relationship between Foreign Direct Investment (FDI) and CO_2 emissions was found, but the effect was not statistically significant at the 5% level. The moderating effect of institutional quality with FDI on CO_2 is negative, but it is not statistically significant. The negative coefficient suggests that improved institutional quality may dampen the effect of FDI on CO_2 emissions.Stronger institutional quality, as evidenced by good governance and regulatory frameworks, may reduce the environmental effect of FDI by encouraging cleaner technologies, sustainable behaviours, and compliance with environmental standards. However, the lack of significance in the moderating effect of FDI on the relationship between FDI and CO_2 emissions may indicate that FDI levels are too low to have a noticeable effect on CO_2 emissions.It may also imply that institutional quality must improve to a certain level for it to be able to have a significant effect on the way FDI affects pollution in Africa.

Table 8: Results Of The Panels Corrected Standard Errors

	Coef.	**P>z.**	**Coef.**	**P>z.**
IQSTQUAL	-.0897178	0.000	-.1774559	0.000
LOGFDI	.0024163	0.655	.0021982	0.816
INSTFDI			-.0012278	0.755
LOG_CREDIT	.181255	0.001	.2327117	0.004
LOG_CPI	.3883593	0.000	.50382	0.000
LOGEXCHA	-.4233512	0.000	-.5277795	0.000
_cons	8.53751	0.000	220.69	0.0000
Wald chi2(5)	128.64		220.69	
Prob > chi2	0.0000		0.0000	
Source: Computed by the Author				

Summary and Conclusion

This study was conducted to examine the effects of FDI and institutional quality on environmental pollution in selected African countries. The findings showed that institutional quality had negative effects on environmental pollution, while the effect of FDI was positive but insignificant. Also, the effect of moderating effect showed that moderating FDI with institutional quality reduced pollution, but the effect was insignificant. The study concludes that FDI has the potential to increase pollution in Africa. Also, institutional quality has the potential to mitigate the potential effects of FDI on environmental pollution in Africa. This implies that higher levels of institutional quality may mitigate the CO_2 emissions associated with FDI activities through stricter environmental regulations. It is therefore recommended that African governments should strengthen institutional quality by strengthening environmental governance frameworks, regulatory institutions, and enforcement mechanisms.

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