Foreign direct investment and carbon emissions in ECOWAS: does good governance matter?

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Abstract

Purpose – The present study investigates the effect of foreign direct investment (FDI) and governance quality on carbon emissions in the Economics Community of West African States (ECOWAS).

Design/methodology/approach – To achieve the objective of this research, panel data for dependent and explanatory variables over the period 2005–2016, collected in the World Development Indicators (WDI) database and World Governance Indicators (WGI), are analyzed using the generalized method of moments (GMM). Also, the panel-corrected standard errors (PCSE) method is applied to the four segments of the overall sample to analyze the stability of the results.

Findings – The findings of this study are (1) FDI inflows have a negative effect on carbon emissions in ECOWAS and (2) The interaction between FDI inflows and governance quality have a negative effect on carbon emissions. These results show the decreasing of environmental damage by increasing institutional quality. However, the estimation results on the country subsamples show similar and non-similar aspects.

Practical implications – This study suggests that policymakers in the ECOWAS countries should strengthen their environmental policies while encouraging FDI flows to be environmentally friendly.

Originality/value – The subject has rarely been explored in West Africa, with gaps such as the lack of use of institutional variables. This study contributes to the literature by drawing on previous work to examine the role of good governance on FDI and the CO2 emission relationship in the ECOWAS, which have received little attention. However, this research differs from previous work by subdividing the overall sample into four groups to test the stability of the results.

Keywords CO2 emissions, Foreign investment, Governance quality, GMM, ECOWAS

Paper type Research paper

1. Introduction

Foreign direct investment (FDI) has emerged as a source of private external finance for developing countries and a crucial driver of their economic growth (Bose and Kohli, 2018; Hagan and Amoah, 2020). The economic gains of FDI materialize through increased available capital and capital formation, and more importantly, through the transfer of advanced technologies, new skills and managerial practices (Lee, 2013). It also allows less developed countries to develop international relations and integrate into the global economy (Zugravu-Soilita, 2017). Developing countries, aware of the importance of FDI, have liberalized their national policies to create a regulatory framework conducive to the investment by relaxing the regime applicable to market entry and improving the treatment accorded to foreign firms,

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for example, some governments have created investment and export processing zones by offering tax exemptions and other investment incentives (Abdul-Mumuni *et al.*, 2023).

While foreign investment flows promote economic development, they can affect the environment of host countries (Abdouli and Hammami, 2017). Two controversial hypotheses have shown a link between FDI and carbon emissions. The first « pollution haven » hypothesis asserts that FDI exacerbates environmental damage in developing countries because developing countries attract FDI by lowering environmental regulations (Copeland and Taylor, 1994). In contrast, the « pollution halo » hypothesis states that the development of FDI not only has a positive impact on the host country's economy but also results in environmental benefits through the diffusion of good practices and technologies used by multinational enterprises and their subsequent spillover effects on local firms (Birdsall and Wheeler, 1993). Therefore, in the current context of globalization, to mitigate the FDI effects on the environment in recipient countries, good governance is essential for developing, adopting and implementing rigorous environmental laws (Welsch, 2004).

FDI flows into the Economics Community of West African States (ECOWAS) have increased rapidly in recent decades, for example, according to the United Nations Conference on Trade and Development (UNCTAD) statistics, FDI flows to ECOWAS increased more than fivefold over the past decade, from $1.5 bn in 1990 to $7.9 bn in 2020 (UNCTAD, 2023). These FDI inflows from high trade openness, political stability and the discovery of oil in some countries have fostered rapid economic growth, exceeding any other in the Africa's regions in recent years (Halliru *et al.*, 2021). Real gross domestic product (GDP), which increased by more than 87% between 1990 and 2020, has been accompanied by a significant rise in carbon emission levels, which have increased by 53%. Over the period 1980–2015, carbon intensity also increased from 7.11 Kg (per kg of oil equivalent energy) to 8.12 Kg. All ECOWAS countries except Cape Verde and Ghana show governance efficiency below zero over the same period (World Bank, 2022a). To promote environmental efficiency and sustainable development in the West African region, the following question is important:

Q1. What is the effect of FDI and good governance on CO2 emissions in the ECOWAS?

This research aims to assess the effect of FDI and good governance on CO2 emissions in the ECOWAS. While there is abundant literature on FDI effects on CO2 emissions in developed and emerging countries, very little research has examined this topic in the context of developing countries in general and in the West African region in particular. Moreover, there are gaps concerning the use of institutional variables in research conducted in this region. Contributing to the recent literature, this research, following Bakhsh *et al.* (2021) and Omri and Hadj (2020), examines the moderating role of good governance on FDI and the CO2 emission relationship in the ECOWAS. However, this research differs from previous work by subdividing the overall sample into two (02) groups (energy exporters and energy importers), according to the International Energy Agency and two zones (the countries of West African Economic and Monetary Union [WAEMU] and other countries of ECOWAS) to test the robustness of the results. Furthermore, this research will help economic and political decision-makers in West Africa to fear the role of institutional quality in the relationship between FDI and CO2 emission on the one hand and on the other hand, to take environmental protection measures to anticipate the effect of climate change.

By employing data from 14 countries in the ECOWAS over the period spanning 2005–2016, findings from our generalized method of moments (GMM) reveal that, while FDI and the interaction between FDI and governance effectiveness (GOE) significantly reduce carbon emissions, in the particular case of institutional quality, the GOE does not significantly reduce carbon emissions in the ECOWAS. However, governance quality acts as a moderator of the relationship between FDI inflows and environmental efficiency. Specifically, our

evidence suggests that policymakers in the ECOWAS countries should strengthen their environmental policies while encouraging FDI flows that are environmentally friendly.

The rest of this research is as follows: Section 2 presents a brief literature on the relationship between FDI, governance quality and carbon emissions. Section 3 outlines the methodology used. Section 4 presents the analysis and interpretation of the results. A conclusion with policy recommendations closes this research.

2. Literature review

This section presents a theoretical and empirical literature review of the impact of FDI on CO2 emissions and the link between governance quality, FDI and CO2 emissions.

2.1 FDI and CO2 emissions

The theoretical basis of the relationship between FDI and carbon emissions in countries is based on two assumptions: the "pollution haven hypothesis" and the "pollution halo hypothesis." According to the pollution haven hypothesis proposed by Copeland and Taylor (1994) in the North–South trade model, FDI positively affects carbon emissions in developing countries with low levels of environmental regulation. Indeed, to attract more FDI and ensure high growth, developing countries compete in terms of environmental standards. Thus, the least developed countries and those with the most relaxed environmental standards will become pollution havens as foreign companies relocate their most polluting activities there. These firms compete with firms with low-carbon technologies, leading low-carbon environmental firms to forgo research and development investments in environmental protection technologies. The halo pollution hypothesis proposed by Birdsall and Wheeler (1993) states that the development of FDI can bring more environmentally friendly high-production technologies and environmental protection ideas to host countries, thus contributing to reducing carbon emissions.

Several empirical studies have examined these two hypotheses. These studies can be classified into three groups: The first group includes studies that show that FDI positively affects carbon emissions in host countries. Abdouli and Hammami (2017) investigated the causal relationship between environmental quality, FDI and economic growth using a simultaneous equation VAR model for a panel of 17 MENA countries from 1990 to 2012. Their empirical results indicate the existence of a unidirectional causality between FDI stocks and CO2 emissions. Using a linear autoregressive distributed lag (ARDL) approach, Seker *et al.* (2015) analyzed the effect of FDI on environmental degradation in Turkey from 1974 to 2010. Their result reveals that the long-term impact of FDI on carbon emissions is positive but relatively small.

Similarly, using the ARDL bootstrapping approach, Shahbaz *et al.* (2018) analyzed the determinants of environmental degradation in France from 1955 to 2016. They find that FDI inflows increase carbon emissions in France, supporting the pollution haven hypothesis. Abdul-Mumuni *et al.* (2023) used the nonlinear panel ARDL approach to examine the asymmetric effect of FDI on carbon emissions in 41 sub-Saharan African countries from 1996 to 2018. They found that a positive FDI shock increases carbon emissions in the long run. Similarly, Gao *et al.* (2022) studied the relationship between FDI, terrorism and carbon emissions in ten fragile economies from 1973 to 2019, using the ARDL and nonlinear autoregressive distributed lag (NARDL) approaches. They found that positive changes in FDI have a significant positive impact on carbon emissions.

The second group finds that FDI negatively affects carbon emissions. Using a spatial econometric model, Cheng and Yang (2016) assessed the effects of FDI on carbon emissions in China from 2001 to 2012. The results indicate that FDI and carbon emissions in China exhibit

significant spatial autocorrelation and that the cluster effect of FDI fully reduces carbon emissions in China. Shao (2017), using the GMM, evaluated the effect of FDI on carbon intensity using the panel data from 188 countries from 1990 to 2013. The results show that FDI significantly negatively impacts the carbon intensity of the host country. Zugravu-Soilita (2017) studied the impact of FDI on industrial pollution and emissions over a large sample of highly heterogeneous countries. The author finds that FDI is associated with a pollution reduction, i.e. a predominant effect of the pollution halo, in countries where the capital/labor ratio is low or medium but where environmental regulation is not too lax. Paramati *et al.* (2017) examined the effect of stock market growth on CO2 emissions per capita in the case of G20 countries. The results indicate that FDI reduces CO2 emissions in the long run. Wang and Zhang (2022) measured the effect of FDI on carbon emission efficiency in China. The authors find that FDI harms carbon emissions. Vitenu-Sackey (2020) evaluated the effect of financial development and FDI on carbon emissions by conducting a comparative study of the West and Southern African regions. The results indicate that FDI negatively affects carbon emissions in both regions. Using a quantile regression method, Zhu *et al.* (2016) concluded that FDI helped host countries reduce pollution levels.

Finally, the third group involves studies highlighting the threshold effect of FDI on carbon emissions by the nonlinear or mixed model (Awodumi, 2021; Halliru *et al.*, 2021). Alshubiri and Elheddad (2020) examined the nonlinearity between CO2 emissions and foreign financing for 32 OECD economies using the GMM and fixed-effect methods. They find that FDI significantly increases CO2 emissions in the early stages, but after reaching a certain level of FDI, CO2 emissions comment to be reduced. Similarly, Wang *et al.* (2021) constructed the dynamic spatial econometric model and evaluated the effects of FDI on carbon emissions through energy intensity and moderating effects of the emissions trading scheme in 30 provinces in mainland China from 2004 to 2016. They found a nonlinear "inverted U" shaped relationship between FDI and carbon emissions. Keho (2015) examined the long-term effect of FDI inflows on CO2 emissions in ECOWAS and found that FDI increases CO2 emissions in some countries while it reduces them in others.

2.2 The link between governance quality, FDI and CO2 emissions

Given that polluting firms invest in countries with weak environmental regulations, it is believed that there is a link between political institutions and environmental degradation. However, very little research has analyzed the role of institutions in attracting FDI flows and, thus, their influence on environmental quality. Islam *et al.* (2021), through the dynamic simulation model ARDL, examined the effect of globalization, FDI and energy consumption on CO2 emissions in the presence of institutional quality in Bangladesh from 1972 to 2016. The results show that FDI has a negative effect on CO2 emissions by improving environmental quality, while institutional quality measured by the political terror scale positively affects CO2 emissions and thus, degrades environmental quality in the long and short run. Sabir *et al.* (2020), using the ARDL method, assessed the impact of FDI on environmental degradation by considering the role of institutional quality in the South Asian region. The results reveal that FDI has a positive effect on environmental degradation. Institutional quality, as measured by the rule of law, does not significantly impact the environmental footprint in the short or long term. However, government stability decreases environmental degradation, while corruption significantly increases environmental risks.

Bakhsh *et al.* (2021) examined the moderating role of institutional quality and technological innovation on the relationship between FDI inflows and four CO2 emission indicator variables in 40 Asian countries from 1996 to 2016, using the GMM method. The noninteractive regression results reveal that FDI inflows positively impact CO2 emissions. However, the interaction between institutional quality indicators and FDI flows significantly

reduces the level of CO2 emissions. Omri and Hadj (2020), through the GMM method, examined how good governance and technological innovation complement FDI in mitigating carbon emissions in 23 emerging economies from 1996 to 2014. The results of the noninteractive regressions show that FDI inflows positively affect all four carbon emission indicators, while increasing governance quality hurts these indicators. The results of the interactive regressions indicate that interactions between FDI and political and institutional governances decrease the level of CO2 emissions.

We did not find a study on West African countries that examined the impact of FDI and political institutions on CO2 emissions. However, West African countries have particular characteristics in terms of their business climates (institutional weaknesses and embryonic industries) and in terms of FDI, predominantly in the extractive industries. Therefore, to contribute to the existing literature, this research draws on the work of Bakhsh *et al.* (2021) and Omri and Hadj (2020), to examine the role of institutions and FDI on CO2 emissions in the ECOWAS.

3. Methodology and data

3.1 Data and variables

This study uses a balanced panel data set for 14 countries of the ECOWAS from 2005 to 2016. These countries are Benin, Burkina Faso, Cote d'Ivoire, Cape Verde, Ghana, The Gambia, Guinea, Guinea Bissau, Mali, Niger, Nigeria, Senegal, Sierra Leone and Togo. All the data are retrieved and merged from the World Development Indicators (WDI) database (World Bank, 2022a) and World Governance Indicators (WGI) (World Bank, 2022b). We consider the period according to the data availability of carbon emissions and institutional indicators. The definition of variables and source of data are presented in Table 1.

The endogenous variable of this paper is carbon dioxide (CO2) emission. This variable is a traditional proxy variable that measures environmental pollution: CO2 emissions from electricity and heat production, CO2 emissions from liquid fuel consumption and CO2 emissions from CO2 intensity (kg per kg of oil equivalent energy use). However, we use carbon emission (metric tons per capita) as a dependent variable because it remains the global representative indicator of pollution in countries, growing with population size.

The variables of interest are FDI net inflows and GOE. Indeed, FDI net inflows refer to direct investment equity flows in the reporting economy. It is the sum of equity capital, reinvestment of earnings and other capital (World Bank, 2022a). We predict, as Hanif *et al.* (2019), the positive effect of FDI on CO2 emission. The second variable is institutional quality. Among the six institutional indicators of WGI (voice and accountability, political stability, no violence, government effectiveness, regulatory quality, rule of law and control of corruption), we use GOE because it reflects perceptions of the degree of its independence from political pressures, the quality of policy formulation and implementation and the credibility of the government's commitment to such policies, including policy for FDI (World Bank, 2022b). We

Variables	Sign	Definition	Source
Carbon emissions	CO2	Carbon emissions per capita metric tons	WDI
Foreign direct investment	FDI	Foreign investment net inflows (% of GDP)	
GDP per capita (growth)	GPP	GDP per capita (annual growth)	
Domestic private credit	DPC	Private credit by banks (% of GDP)	
Exports (growth)	EXP	Indicator of trade openness (% annual)	
Urban population	POP	Urban population (% of total population)	
Government effectiveness	GOE	Indicator of government (estimate value)	WGI

Source(s): Authors

Table 1. Variables, definitions and sources

predict the negative effect of GOE on CO2 emissions (Ali *et al.*, 2020; Vincent and Mariani, 2020). The third variable is the interaction between FDI net inflows and governance quality.

According to the literature, this study included other independent variables as control variables: (1) Gross domestic product (GDP) per capita annual growth indicates the economic performance per year. It is calculated without making deductions for the depreciation of fabricated assets or for the depletion and degradation of natural resources. We predict the positive effect of GDP on CO2 emission. (2) Urban population (POP) refers to people living in urban areas as defined by the national statistical offices. We predict, as Cole *et al.* (2011), the positive effect of POP on CO2 emission in ECOWAS. (3) Domestic private credit (DPC): an annual growth of claims on other sectors of the domestic economy. A positive effect of this variable on CO2 emission is expected. (4) Trade openness (EXP): it refers to the annual growth of exports of goods and services. A positive effect of EXP on CO2 emissions is expected (Mardani *et al.*, 2019).

The descriptive statistics and correlation matrix are presented in Table 2. For the CO2 emissions indicator, the values vary between 5.30 and 114.2, with a mean of 35.24 and a standard deviation of 25.28. This indicates that the emissions of carbon per capita of the different countries are very high in terms of volatility. The FDI varies between −0.840 and 32.301, with a mean of 3.967 and a standard deviation of 4.202. It shows that countries have almost a low volatility of FDI inflows. Besides, the mean of governance indicators was between −2.5 and 2.5 for each country of the sample and otherwise, the correlation between all the variables does not present a risk of multicollinearity.

Figure 1 presents the evolution of CO2 emissions and the FDI net inflows in the sample of this study. We note that CO2 emissions increased over the period 2005–2016. This indicates the evolution of the population in the ECOWAS. Besides, FDI increases over the period 2005 to 2011 and decreases over the period 2011–2016. It shows the volatility of FDI in this area.

Figure 2 presents the evolution of GOE in each country. These countries have a low level of governance quality (less than 2.5, i.e. the perfect quality of governance). Except for the governance effectiveness of Cape Verde and Ghana, the governance quality of other countries is less than 0 over the period 2005–2016. Therefore, they have to improve their institutional quality in the context of increasing their carbon emissions.

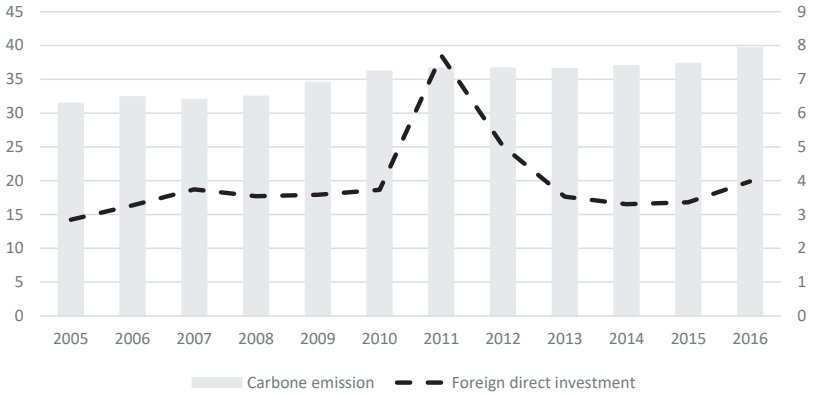
3.2 Model and research approach

This study investigates the relationship between FDI inflows, governance quality and carbon emissions. This endeavor sets a baseline model, where carbon emission is conditioned on its

	CO2	FDI	GPP	DPC	EXP	POP	GOE
Obs.	168	168	168	168	168	168	168
Mean	35.24	3.967	1.826	16.821	24.869	41.151	−0.802
Std. Dev.	25.28	4.202	3.877	13.352	8.410	11.465	0.430
Min	5.30	−0.840	−22.312	1.596	9.218	16.208	−1.682
Max	114.2	32.301	18.053	65.741	46.476	64.784	0.285
CO2	1.000						
FDI	0.092	1.000					
GPP	0.0902	0.2430*	1.000				
DPC	0.7533*	0.1621*	0.0578	1.000			
EXP	0.4921*	0.2220*	0.1924*	0.5748*	1.000		
POP	0.6972*	0.0915	−0.0261	0.4670*	0.4296*	1.000	
GOE	0.5967*	0.1548*	0.1170	0.5404*	0.1265	0.3639*	1.000

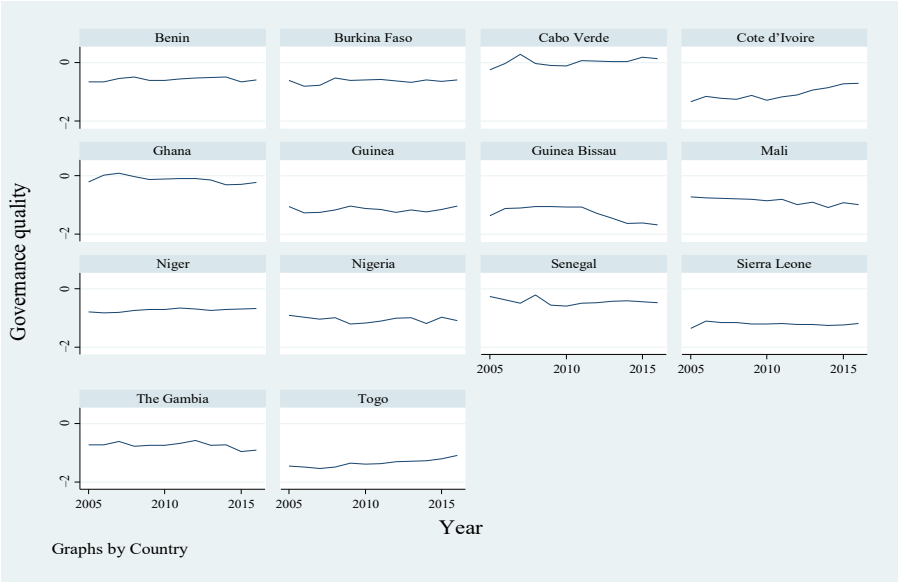
Table 2.
Descriptive statistics and correlation matrix

Note(s): *$p < 0.05$ shows significance at 5%
Source(s): Authors



Source(s): Authors

Figure 1.
Evolution of CO2 emission and FDI in the ECOWAS over the period 2005–2016



Source(s): Authors

Figure 2.
Evolution of governance effectiveness in the ECOWAS over the period 2005–2016

lag, FDI, GOE and control variables. We also examine the effect of the interaction between FDI and GOE on carbon emissions. In other words, GOE is an institutional quality that moderates the effect of FDI on carbon emissions in ECOWAS. The specified model is:

$$CO2_{it} = \alpha_i + \beta_1 FDI_{it} + \beta_2 GOE_{it} + \beta_3 FDI_{it} GOE_{it} + \beta_4 \sum_{j=1}^{P} X_{ijt} + \varepsilon_{it} \quad (1)$$

where i represents each country (i = 1, 2 . . .N), t represents each period (t = 1, 2 . . .T). $CO2_{it}$ is the carbon emissions. α_i is an individual effect. FDI_{it} is the foreign investment inflows. GOE_{it}

measures the governance quality indicator. $FDI_{it}GOE_{it}$ shows the interaction between governance quality and FDI inflows. X_{it} express the vector of other independents variables, β are the parameters of independent variables, ε_{it} the error term.

This study analyzes the relationship between FDI inflows, governance quality and carbon emission through a balanced panel data method. According to Baltagi (2008), this method provides some advantages: controlling the heterogeneity of the predictions, increasing the degree of freedom levels and reaching more reliable parameters. Besides, including the lagged dependent variable in Equation (1) suggests a potential correlation between the factors driving carbon emission and the error term since the lagged carbon emission depends on ε_{it-1} which is a function of the country-specific effect (α_i). The new Equation (2) suffers, therefore, bias due to the correlation. It is estimated to rely on the GMM proposed by Arellano and Bond (1991), which eliminates α_i or any related time-invariant country-specific variable eminent in the data. Thus, this method is indicated for this study, where T = 12 years, which is less than the number of countries (N = 14). The specification for GMM is presented below:

$$CO2_{it} = \alpha_i + \beta_1 CO2_{it-1} + \beta_2 FDI_{it} + \beta_3 GOE_{it} + \beta_4 FDI_{it}GOE_{it} + \sum_{j=1}^{P} \beta_j X_{ijt} + \varepsilon_{it} \qquad (2)$$

where $CO2_{it-1}$ shows the lagged value of CO2 emissions for each country and each time. It allows the dynamic nature of the model.

4. Results and discussion

The next phase of the analysis presents the results: first, a difference in the GMM estimation presents the effect of FDI and GOE on carbon emissions. Then, the estimation focuses on the effect of the interaction between FDI and governance quality on carbon emissions by considering two positions composing the global sample (energy exporters and energy importers) and two zones (the countries of West African Economic and Monetary Union [WAEMU] and other countries of the ECOWAS). The second estimation is carried out using the panel-corrected standard errors (PCSE) developed by Beck and Katz (1995). They show that this procedure – controlling for serial correlation in some (simple) way before final estimation and relying on robust standard errors, i.e. PCSE's – has admirable small sample properties relative to alternatives.

4.1 Effect of FDI and governance quality on carbon emissions in the ECOWAS

Table 3 presents the results of the GMM estimation. Arrelano and Bond correlation tests are verified based on the first- and second-order autocorrelation of residuals and Sargan over the identification restriction test. The results show the effect of the traditional variables on CO2 emissions in the ECOWAS. The effect of GDP per capita on CO2 emissions is positive and significant at 5%. When GDP per capita increases to 1%, CO2 increases to 0.15%. The development of countries contributes to increased environmental damage. This means that the region's countries have not sufficiently advanced their production techniques to achieve sustainable growth. This result is in line with those of Mardani *et al.* (2019), Halliru *et al.* (2021) and Waqih *et al.* (2019).

The results also show that the effect of the urban population on CO2 emissions is positive and significant at 5%. When the urban population increases by 1%, CO2 emissions rise by 0.57%. This relationship can be explained by the fact that increasing urbanization leads to higher energy demand and therefore higher pollution levels in urban areas. The theories of ecological modernization and urban environmental transition also argue that urbanization generates harmful impacts on the environment (Poumanyvong and Kaneko, 2010). Indeed,

	GMM model
Carbon emissions per capita (t−1)	0.541* (0.000)
Urban population	0.573** (0.013)
Exportation (% of GDP)	0.012 (0.879)
Gross domestic product per capita (annual growth)	0.152** (0.013)
Domestic private credit	−0.039 (0.763)
Foreign direct investment inflows (% of GDP)	−0.683* (0.000)
Government effectiveness	−0.680 (0.888)
Foreign direct investment*Government effectiveness	−0.653* (0.000)
Constant	−6.621 (0.430)
AR (1)	−2.1699** (0.0300)
AR (2)	−0.61079 (0.5413)
Sargan test	66.99783 (0.1102)

Note(s): AR (1) and AR (2) are the first- and the second-order autocorrelation of residuals. *, ** and *** show, respectively, the significance at 1, 5 and 10% level. Sargan test is the over-identifying restrictions test
Source(s): Authors

Table 3.
Relationship between FDI inflows, governance quality and CO2

according to this theory, one of the characteristics of urban cities is rapid industrialization, which is a major cause of CO2 emissions. The consumption pattern of urban residents is predominantly carbon-intensive compared to their rural counterparts. Higher levels of urbanization are associated with stronger economic growth, leading to higher per capita incomes. Wealthier consumers demand more energy-intensive products (cars, air conditioning, refrigerators, washing machines, etc.), which can increase CO2 emissions in the sub-region (Musah *et al.*, 2020). This result corroborates with those of Musah *et al.* (2020), Franco *et al.* (2017) and Ali *et al.* (2019), who found that urbanization is a main promoter of CO2 emissions in West Africa, India and Pakistan, respectively.

The effect of exports and domestic private credit on banks' carbon emissions is negative and insignificant. These results contradict those of Bakhsh *et al.* (2021), who found a positive effect of trade openness and domestic credit on CO2 emissions in Asia. Concerning the effect of FDI inflows on carbon emissions, it is negative and significant at 1%. When FDI inflows increase to 1%, CO2 emissions decrease to 0.68%. Therefore, FDI does not cause damage to the environment in ECOWAS. FDI inflows allow for the reduction of environmental pollution in this community. FDI inflows reduce environmental pollution in this community. This result is consistent with Hoffmann *et al.* (2005) and Jalil and Feridun (2011), who show that FDI hurts environmental quality. The authors argue that the host country benefits from transferring environmentally friendly technologies through FDI flows and indirectly by attracting higher R&D investments using cleaner technologies in production. A similar result is also found by Vincent and Mariani (2020). Their study was based on 64 low-income and high-income countries between 1990 and 2014. For these authors, less developed countries, including some countries of ECOWAS, are negatively affected by FDI inflows. However, this result contrasts with the findings of Ashraf *et al.* (2021) and Doytch and Uctum (2016), who observe an increase in pollution in the manufacturing industry and low- and middle-income countries and a beneficial effect on the environment in high-income countries. The result also disagrees with the work of Gao *et al.* (2022), Hanif *et al.* (2019) and Seker *et al.* (2015), who assert that the effect of FDI inflows is positive on environmental degradation in host countries. The authors explain this positive effect because host economies are pollution havens for certain pollution-intensive industries that escape the high environmental costs in their home economies.

Concerning the effect of the interaction between institutional quality and FDI on CO2 emissions, the sign of coefficients is negative and significant at 1%. When the interaction

between governance quality indicators and FDI inflows increases to 1%, CO2 decreases to 0.65%. Therefore, good governance affects FDI and reduces pollution in the ECOWAS. This interaction protects the environment in this community. Omri and Hadj (2020) find a similar result. They show that FDI negatively affects carbon emissions in the context of good governance quality. The result is also similar to those of Mody and Srinivasan (1998) and Li and Filer (2007), who find that FDI is determined by country-specific political uncertainty, meaning that countries with institutional efficiency, prudential regulations and laws can better attract FDI, which in turn reduce CO2 emissions by transferring clean technologies to host countries or by enabling host countries to innovate their environmentally friendly technologies by attracting R&D investment (Hoffmann *et al.*, 2005). Besides, the effect of governance quality on carbon emission is negative but nonsignificant. This result means that the level of governance quality in the ECOWAS is low enough to have a significant negative influence on CO2 emissions. All ECOWAS countries, except Cape Verde and Ghana, have governance efficiency below 0 over the study period. This would explain the low coefficient (0.65%) of the combined effect of the interaction between the governance quality indicator and FDI inflows on CO2 emissions, compared with the coefficient (0.68%) of the effect of FDI inflows. This insignificant result for GOE differs from the work of Omri and Hadj (2020) and Wingqvist *et al.* (2012), who show that good governance encourages sustainable use of the environment, thereby reducing CO2 emissions.

4.2 Effect of FDI and governance quality on carbon emission according to the two zones in the overall sample

To test the robustness of the results, we extracted four (04) cylindrical panels from the overall sample, according to the energy export and import and according to the geographical location of the countries (these groups are presented in the Appendix – Table A1). Since the sample is small, the condition for using the GMM no longer holds. The fixed-effects model and the random-effects models each have their specificity relevant to different data. Thus, the small sample presents possible autocorrelation and heteroscedasticity. Beck and Katz (1995) suggest estimating standard errors according to a robust procedure incorporating potential contemporaneous correlation information into the coefficient variance–covariance matrix without adjusting the coefficient estimate. The estimation results are reported in Table 4.

The estimation results for the country subsamples show similar and non-similar aspects. The effects of FDI and GOE on carbon emissions in the overall sample are similar to those in energy exporters. This indicates that the interaction between FDI net inflows and GOE reduces the environmental damage. However, these results are not non-similar for the countries' energy importers, which present the positive effects. This indicates the possible threshold of these variables to reduce the environmental damage. Concerning the results of geographic zones, the effects of FDI and governance effectiveness on carbon emissions are non-similar for the WAEMU countries and the other members of the ECOWAS. Finally, these results could be explained by regional heterogeneity in terms of institutional quality and foreign investment.

5. Conclusion and implications

This research aimed to identify the role of good governance in the relationship between FDI and CO2 emission in ECOWAS over the period 2005–2016. The GMM was used. The empirical results show that FDI negatively affects CO2 emissions. Good governance has a negative but not significant sign. On the other hand, the interaction between FDI and good governance is significant and negatively affects CO2 emissions. The subsample estimation results show that the effects of FDI and governance effectiveness on carbon emissions in the

Variables	Energy exporters			Energy importers		
	Global	WAEMU	Non-WAEMU	Global	WAEMU	Non-WAEMU
Foreign direct investment (FDI)	−3.512321*** (0.004)	−0.5737466 (0.647)	0.048252 (0.962)	−0.0994111 (0.884)	−6.66836*** (0.000)	1.662949** (0.038)
Governance effectiveness (GOE)	8.612194 (0.162)	2.235602 (0.346)	−12.41384* (0.094)	23.95449*** (0.000)	37.56686*** (0.000)	3.512434 (0.339)
FDI*GOE	−5.389324*** (0.007)	−0.8515005 (0.645)	−4.906431* (0.078)	0.1401301 (0.825)	−5.451884*** (0.001)	1.600362** (0.019)
Gross domestic product per capita	0.2157367 (0.708)	0.102677 (0.315)	0.1941844 (0.712)	0.1090541 (0.504)	−0.5833288* (0.092)	0.0221635 (0.865)
Urban population	1.736004*** (0.000)	0.0244357 (0.846)	1.302624*** (0.000)	0.6726696*** (0.000)	1.38993*** (0.000)	0.1222341** (0.015)
Domestic private credit	−1.056254*** (0.000)	0.4933184*** (0.000)	−1.359832*** (0.008)	0.5599502*** (0.000)	0.3504016** (0.034)	1.051167*** (0.000)
Exports	−0.1413909 (0.455)	0.3231272*** (0.000)	−0.1340774 (0.556)	0.6884349*** (0.000)	0.3420274* (0.079)	0.5028578*** (0.002)
R-squared	0.9610	0.9927	0.9886	0.9532	0.9556	0.9873
Wald $\chi^2(7)$	6073.17	5279.01	3711.05	8139.31	5787.41	2538.64
Prob > χ^2	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Observation	48	24	24	120	72	48

Note(s): (1) Values in parentheses are *p*-values. (2) *** significant at 1%, ** significant at 5% and *significant at 10%
Source(s): Authors

Table 4. Estimate's results of the different samples in the ECOWAS

overall sample are similar to those for energy exporters. However, these results differ for energy-importer countries, which show positive effects. Concerning the results for geographical zones, the effects of FDI and governance efficiency on carbon emissions are not similar for UEMOA countries and other ECOWAS members. Therefore, the ECOWAS governments are called upon to encourage FDI, which is environmentally friendly. It is also recommended that the ECOWAS countries strengthen their environmental policies by improving mechanisms and instruments for reducing CO2 emissions, such as environmental taxes and monitoring the activity of polluting industries. In addition, to ensure environmental efficiency and anticipate the effects of climate change in the region, governments are called upon to adopt strict legislation promoting green energy consumption with little environmental damage. Good urbanization is necessary in these countries.

While this research sheds light on the effects of FDI and good governance on CO2 emissions in the ECOWAS, it is limited to the current data analyzed and the variables of interest used. Future research can include new indicators to examine these relationships for other samples. Future research can also disaggregate the CO2 emissions variables and institutional quality for appropriate policy implications.

References

Abdouli, M. and Hammami, S. (2017), "Investigating the causality links between environmental quality, foreign direct investment and economic growth in MENA countries", *International Business Review*, Vol. 6 No. 2, pp. 264-278, doi: 10.1016/j.ibusrev.2016.07.004.

Abdul-Mumuni, A., Amoh, J.K. and Mensah, B.D. (2023), "Does foreign direct investment asymmetrically influence carbon emissions in Sub-Saharan Africa? Evidence from nonlinear panel ARDL approach", *Environmental Science and Pollution Research*, Vol. 30 No. 5, pp. 11861-11872, doi: 10.1007/s11356-022-22909-w.

Ali, R., Bakhsh, K. and Yasin, M.A. (2019), "Impact of urbanization on CO2 emissions in emerging economy: evidence from Pakistan", *Sustainable Cities Society*, Vol. 48, 101553, doi: 10.1016/j.scs.2019.101553.

Ali, A., Kelley, D.J. and Levie, J. (2020), "Market-driven entrepreneurship and institutions", *Journal of Business Research*, Vol. 113, pp. 117-128, doi: 10.1016/j.jbusres.2019.03.010.

Alshubiri, F. and Elheddad, M. (2020), "Foreign finance, economic growth and CO2 emissions Nexus in OECD countries", *International Journal of Climate Change Strategies and Management*, Vol. 12 No. 2, pp. 161-181, doi: 10.1108/ijccsm-12-2018-0082.

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*, Vol. 58 No. 2, pp. 277-297, doi: 10.2307/2297968.

Ashraf, A., Doytch, N. and Uctum, M. (2021), "Foreign direct investment and the environment: disentangling the impact of greenfield investment and merger and acquisition sales", *Sustainability Accounting, Management and Policy Journal*, Vol. 12 No. 1, pp. 51-73, doi: 10.1108/sampj-04-2019-0184.

Awodumi, O.B. (2021), "Does foreign direct investment promote environmental efficiency in developing economies? Evidence from Economic Community of West African States", *Business Strategy and Development*, Vol. 4 No. 2, pp. 70-186, doi: 10.1002/bsd2.137.

Bakhsh, S., Yin, H. and Shabir, M. (2021), "Foreign investment and CO2 emissions: do technological innovation and institutional quality matter? Evidence from system GMM approach", *Environmental Science and Pollution Research*, Vol. 28 No. 15, pp. 19424-19438, doi: 10.1007/s11356-020-12237-2.

Baltagi, B.H. (2008), *Econometric Analysis of Panel Data*, Vol. 4, Wiley, Chichester, pp. 135-145.

Beck, N. and Katz, J.N. (1995), "What to do (and not to do) with time-series cross-section data", *The American Political Science Review*, Vol. 89 No. 3, pp. 634-647, doi: 10.2307/2082979.

Birdsall, N. and Wheeler, D. (1993), "Trade policy and industrial pollution in Latin America: where are the pollution havens?", *The Journal of Environment and Development*, Vol. 2 No. 1, pp. 137-149, doi: 10.1177/107049659300200107.

Bose, S. and Kohli, B. (2018), "Study of FDI trends and patterns in BRICS economies during the period 1990-2015", *Emerging Economy Studies*, Vol. 4 No. 1, pp. 78-101, doi: 10.1177/2394901518769225.

Cheng, S. and Yang, Z. (2016), "The effects of FDI on carbon emissions in China: based on spatial econometric model", *Revista de la Facultad de Ingenieria UCV*, Vol. 31 No. 6, pp. 137-149.

Cole, M.A., Elliott, R.J. and Zhang, J. (2011), "Growth, foreign direct investment, and the environment: evidence from Chinese cities", *Journal of Regional Science*, Vol. 51 No. 1, pp. 121-138, doi: 10.1111/j.1467-9787.2010.00674.x.

Copeland, B.R. and Taylor, M.S. (1994), "North-South trade and the environment", *The Quarterly Journal of Economics*, Vol. 109 No. 3, pp. 755-787, doi: 10.2307/2118421.

Doytch, N. and Uctum, M. (2016), "Globalization and the environmental impact of sectoral FDI", *Economic Systems*, Vol. 40 No. 4, pp. 582-594, doi: 10.1016/j.ecosys.2016.02.005.

Franco, S., Mandla, V.R. and Rao, K.R.M. (2017), "Urbanization, energy consumption and emissions in the Indian context a review", *Renewable and Sustainable Energy Reviews*, Vol. 71, pp. 898-907, doi: 10.1016/j.rser.2016.12.117.

Gao, X., Li, X., Chishti, M.Z., Ullah, S. and Sohail, S. (2022), "Decomposing the asymmetric effects of terrorism and FDI on carbon emission: evidence from fragile economies", *Environmental Science and Pollution Research*, Vol. 29 No. 27, pp. 41125-41139, doi: 10.1007/s11356-021-16955-z.

Hagan, E. and Amoah, A. (2020), "Foreign direct investment and economic growth nexus in Africa: new evidence from the new financial fragility measure", *African Journal of Economic and Management Studies*, Vol. 11 No. 1, pp. 1-17, doi: 10.1108/ajems-05-2019-0180.

Halliru, A.M., Loganathan, N. and Golam Hassan, A.A. (2021), "Does FDI and economic growth harm environment? Evidence from selected West African countries", *Transnational Corporations Review*, Vol. 13 No. 2, pp. 237-251, doi: 10.1080/19186444.2020.1854005.

Hanif, I., Raza, S.M.F., Gago-de-Santos, P. and Abbas, Q. (2019), "Fossil fuels, foreign direct investment, and economic growth have triggered CO2 emissions in emerging Asian economies: some empirical evidence", *Energy*, Vol. 171, pp. 493-501, doi: 10.1016/j.energy.2019.01.011.

Hoffmann, R., Lee, C.G., Ramasamy, B. and Yeung, M. (2005), "FDI and pollution: a granger causality test using panel data", *Journal of International Development*, Vol. 17 No. 3, pp. 311-317, doi: 10.1002/jid.1196.

Islam, M., Khan, M.K., Tareque, M., Jehan, N. and Dagar, V. (2021), "Impact of globalization, foreign direct investment, and energy consumption on CO2 emissions in Bangladesh: does institutional quality matter?", *Environmental Science and Pollution Research*, Vol. 28 No. 35, pp. 48851-48871, doi: 10.1007/s11356-021-13441-4.

Jalil, A. and Feridun, M. (2011), "The impact of growth, energy and financial development on the environment in China: a cointegration analysis", *Energy Economics*, Vol. 3 No. 2, pp. 284-291, doi: 10.1016/j.eneco.2010.10.003.

Keho, Y. (2015), "Is foreign direct investment good or bad for the environment? Times series evidence from ECOWAS countries", *Economic Bulletin*, Vol. 35 No. 3, pp. 1916-1927.

Lee, J.W. (2013), "The contribution of foreign direct investment to clean energy use, carbon emissions and economic growth", *Energy Policy*, Vol. 55, pp. 483-489, doi: 10.1016/j.enpol.2012.12.039.

Li, S. and Filer, L. (2007), "The effects of the governance environment on the choice of investment mode and the strategic implications", *Journal of World Business*, Vol. 42 No. 1, pp. 80-98, doi: 10.1016/j.jwb.2006.11.006.

Mardani, A., Streimikiene, D., Cavallaro, F., Loganathan, N. and Khoshnoudi, M. (2019), "Carbon dioxide (CO2) emissions and economic growth: a systematic review of two decades of research from 1995 to 2017", *Science of the Total Environment*, Vol. 649, pp. 31-49, doi: 10.1016/j.scitotenv.2018.08.229.

Mody, A. and Srinivasan, K. (1998), "Japanese and US firms as foreign investors: do they march to the same tune?", *Canadian Journal of Economics*, Vol. 31 No. 4, pp. 778-799, doi: 10.2307/136491.

Musah, M., Kong, Y., Mensah, I.A., Stephen, K.A. and Mary, D. (2020), "The link between carbon emissions, renewable energy consumption, and economic growth: a heterogeneous panel evidence from West Africa", *Environmental Science and Pollution Research*, Vol. 27 No. 23, pp. 28867-28889, doi: 10.1007/s11356-020-08488-8.

Omri, A. and Hadj, T.B. (2020), "Foreign investment and air pollution: do good governance and technological innovation matter?", *Environmental Research*, Vol. 185, 109469, doi: 10.1016/j.envres.2020.109469.

Paramati, S.R., Mo, D. and Gupta, R. (2017), "The effects of stock market growth and renewable energy use on CO2 emissions: evidence from G20 countries", *Energy Economics*, Vol. 66, pp. 360-371, doi: 10.1016/j.eneco.2017.06.025.

Poumanyvong, P. and Kaneko, S. (2010), "Does urbanization lead to less energy use and lower CO2 emissions?", *A Cross-Country Analysis. Ecological Economics*, Vol. 70 No. 2, pp. 434-444, doi: 10.1016/j.ecolecon.2010.09.029.

Sabir, S., Qayyum, U. and Majeed, T. (2020), "FDI and environmental degradation: the role of political institutions in South Asian countries", *Environmental Science and Pollution Research*, Vol. 27 No. 26, pp. 32544-32553, doi: 10.1007/s11356-020-09464-y.

Seker, F., Ertugrul, H.M. and Cetin, M. (2015), "The impact of foreign direct investment on environmental quality: a bounds testing and causality analysis for Turkey", *Renewable and Sustainable Energy Reviews*, Vol. 52, pp. 347-356, doi: 10.1016/j.rser.2015.07.118.

Shahbaz, M., Nasir, M.A. and Roubaud, D. (2018), "Environmental degradation in France: the effects of FDI, financial development, and energy innovations", *Energy Economics*, Vol. 74, pp. 843-857, doi: 10.1016/j.eneco.2018.07.020.

Shao, Y. (2017), "Does FDI affect carbon intensity? New evidence from dynamic panel analysis", *International Journal of Climate Change Strategies and Management*, Vol. 10 No. 1, pp. 27-42, doi: 10.1108/ijccsm-03-2017-0062.

UNCTAD (2023), "UNCTAD database", available at: https://unctadstat.unctad.org/EN/

Vincent, W. and Mariani, F. (2020), "Ide et Environnement: analyse en panel", Faculté des sciences économiques, sociales, politiques et de communication, Université catholique de Louvain, available at: http://hdl.handle.net/2078.1/thesis:27241.

Vitenu-Sackey, P.A. (2020), "Financial development, foreign direct investment and carbon emissions: a comparative study of West Africa and Southern Africa Regions", *International Review*, Vol. 6 No. 1, pp. 1550-1569.

Wang, Q. and Zhang, Q. (2022), "Foreign direct investment and carbon emission efficiency: the role of direct and indirect channels", *Sustainability*, Vol. 14 No. 20, 13484, doi: 10.3390/su142013484.

Wang, Y., Liao, M., Xu, L. and Malik, A. (2021), "The impact of foreign direct investment on China's carbon emissions through energy intensity and emissions trading system", *Energy Economics*, Vol. 97, 105212, doi: 10.1016/j.eneco.2021.105212.

Waqih, M.A.U., Bhutto, N.A., Ghumro, N.H., Kumar, S. and Salam, M.A. (2019), "Rising environmental degradation and impact of foreign direct investment: an empirical evidence from SAARC region", *Journal of Environmental Management*, Vol. 243, pp. 472-480, doi: 10.1016/j.jenvman.2019.05.001.

Welsch, H. (2004), "Corruption, growth, and the environment: a cross-country analysis", *Environment and Development Economics*, Vol. 9 No. 5, pp. 663-693, doi: 10.1017/s1355770x04001500.

Wingqvist, G.O., Drakenberg, O., Daniel Slunge, D., Martin Sjöstedt, M. and Ekbom, A. (2012), *The Role of Governance for Improved Environmental Outcomes- Perspectives for Developing Countries and Countries in Transition*, Swedish Environmental Protection Agency, Report, Vol. 6514.

World Bank (2022a), "World development indicators", available at: http://data.worldbank.org/data-catalog/world-development-indicators

World Bank (2022b), "World governance indicators", available at: http://data.worldbank.org/data-catalog/world-development-indicators

Zhu, H., Duan, L., Guo, Y. and Yu, K. (2016), "The effects of FDI, economic growth and energy consumption on carbon emissions in ASEAN-5: evidence from panel quantile regression", *Economic Modelling*, Vol. 58, pp. 237-248, doi: 10.1016/j.econmod.2016.05.003.

Zugravu-Soilita, N. (2017), "How does foreign direct investment affect pollution? Toward a better understanding of the direct and conditional effects", *Environmental and Resource Economics*, Vol. 66 No. 2, pp. 293-338, doi: 10.1007/s10640-015-9950-9.

Appendix

Overall sample	Sample 1: energy importers		Sample 2: energy exporters	
ECOWAS	WAEMU	Non-WAEMU	WAEMU	Non-WAEMU
Benin, Burkina Faso, Cote d'Ivoire, Cape Verde, Gambia, Ghana, Guinea, Guinea Bissau, Mali, Niger, Nigeria, Senegal, Sierra Leonne and Togo	Benin, Cote d'Ivoire, Guinea Bissau, Mali, Senegal and Togo	Cabo Verde, Gambia, Guinea and Sierra Leonne	Burkina Faso and Niger	Ghana and Nigeria

Source(s): Authors, according to the International Energy Agency

Table A1.
The different groups in the ECOWAS

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