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The Effect of Foreign Direct Investment on Air Pollution in the Economic Community of West African States Region: What Influence Does Tax Expenditure Have?

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Abstract

Air pollution is one of the crucial environmental challenges facing the countries of the Economic Community of West African States (ECOWAS). The objective of this paper is to examine the effect of an attractive tax policy on the relationship between Foreign Direct Investment (FDI) and air pollution in ECOWAS region over the period 2000 to 2019. By using the Ordinary Least Squares (OLS) method and panel data analyses (fixed effects and random effects), the results show that, in general, FDI does not have a significant effect on air pollution in the region. However, closer analysis reveals that an interaction between FDI and an attractive tax policy has a negative effect on air quality, leading to an increase in air pollution. Thus, companies attracted by tax incentives may not meet rigorous environmental standards. These results highlight the importance for policymakers to balance economic incentives with environmental protection in ECOWAS. Attractive tax policies can stimulate investment, but they must be designed in a way that encourages environmentally friendly practices, thereby helping to improve air quality in the region.

Keywords

Air Pollution, Foreign Direct Investment, Attractive Tax Policy, Ordinary Least Squares, Rendom Effects

1. Introduction

Globalization is considered both a factor of economic prosperity and a source of environmental degradation and loss of market share [1]-[7]. In fact, it has led to the relocation of capital flows and multinational firms, whose aim is to see their disposable income rise more and more in certain territories. For [8] and [9], in addition to its role as a growth factor in developing countries, foreign direct investment (FDI) is seen as a means of transferring new technologies between countries, particularly from developed to developing countries. FDI promotes the economic development of host countries and helps countries reduce their development lag [10]. This has been demonstrated by a significant increase in FDI flows to developing countries. Thus, because of the benefits of FDI, it is the particular focus of major economic concerns for both developed and developing countries. A number of economic policy instruments, such as fiscal policy, governance, infrastructure and major works, strive to attract FDI. However, the presence of FDI is not without consequences for the environment. In Africa, countries with a high volume of FDI are generally those rich in natural resources such as metals, precious minerals, gold and oil reserves. But natural resources are not the only determining factor in the emergence of FDI.

The economic literature has not remained aloof from the analysis of the effect of FDI on the quality of the environment and also the role of fiscal policies, in this case tax competition, in this relationship. Two theoretical hypotheses collide: the pollution haven hypothesis (HHP) and the pollution halo hypothesis. The HHP considers FDI to be vectors of pollution. The emergence of FDI would depend on regulatory conditions in terms of environmental quality control with a favourable profit differential [11] [12]. This hypothesis raises two major economic and legal concerns, the first of which is the weakness of the host country's state standards as a factor mobilizing FDI, which would result in lower costs for the FDI to clean up. The second is the host country's ability to clean up pollution on its own, in which case FDI becomes the price to pay for development. On the other hand, the pollution halo sees FDI as a contributor of depollution technologies and equipment with low-carbon production processes [12] [13]. Thus, the attractiveness of FDI is linked to economic incentives. On the other hand, some voices are indifferent to the relationship between FDI and environmental quality [13] [14] [15].

When these hypotheses are tested, the results are highly controversial. Some studies prove the existence of environmental degradation [10] [16], while others show the influence of FDI in curbing environmental degradation [10] [17]. However, many studies remain ambiguous about the influence of FDI on air pollution.

Given the pre-eminence of economic issues over pollution, it is not unpleasant to explore the relationship between FDI and air pollution. To this end, this article sets out to analyze the effect of FDI on air pollution, while taking into account the contribution of tax expenditure to the FDI-air pollution link. The added value of this article is twofold. On the one hand, it provides an account of the effect of the behaviour of ECOWAS governments in attracting FDI on pollution and, on the other, it contributes to enriching the empirical analysis of the causal link between FDI and air pollution.

The rest of the paper is organized as follows: In the next section, we provide an overview of the literature, then in the third section we discuss the methodology. The fourth section presents the results and in the last section we draw conclusions.

2. Literature Review

There are two competing theories on the relationship between FDI and air pollution. These theories expose the virulent controversy between capital flows and air pollution. There is the theory relating to the behaviour according to which FDI are vectors of atmospheric pollution according to the "pollution harbour hypothesis (PHH)" of [18] [19]. The latter explain how air pollution has captured the interest of economics. According to these authors, the displacement of capital flows and therefore of FDI in certain regions, particularly developing countries, is due to the rigorous control of environmental standards in developed countries. The control of environmental standards generates costs when the level of pollution exceeds regulatory standards. This relocation to countries with outdated or less stringent regulations enables them to reduce the costs associated with pollution control. However, this behaviour degrades the environment in the host countries. They consider that the volume of pollution varies according to whether it results from the effects of FDI (gains in trade revenues) or from a country's economic growth. In their analysis, they distinguish between the effects on atmospheric pollution of trade techniques, and therefore of FDI, and those of economic growth, and conclude that international trade exacerbates the degree of pollution.

This theoretical analysis is controversial because of the pollution halo hypothesis [20]. According to this view, FDI is seen as beneficial and responsible in terms of controlling environmental standards. It believes that multinational firms and FDI comply when environmental standards and requirements are strict in the host country. In fact, FDI equips itself with effective pollution control techniques and complies when environmental standards and requirements are strict in the host country [10].

Furthermore, [21] considers that economic policy has a particular influence on environmental degradation through fiscal policy (public spending and fiscal policy). Fiscal policy plays a multiple role in economic activity. On the one hand, it plays a role in regulating economic activity [22] [23], and on the other hand, it plays a competitive role [7] and a role in the attractiveness of territories. Thus, it allows subsidies or exemptions and through this role, it facilitates the correction of a number of behaviours of economic players. Indeed, the effect of tax policy on air pollution can be negative if it is accompanied by a subsidy scheme [24]. When subsidies are high, they stimulate production (by reducing marginal costs), whereas they should help firms to research pollution control techniques. As a result, subsidies do not help to reduce pollution but exacerbate the intensity of pollution per unit of production.

On the competitive aspect, [25] consider that because governments are rated politically by economic performance scores, they have a preference for economic growth to the detriment of environmental quality. Through fiscal behaviour, governments compete to retain or attract FDI to their territory. It is therefore [26] task to point out that the ability of governments to impose regulations with the sole aim of affecting the behaviour of companies by making them relocate the pollution device. This change in the behaviour of firms due to government incentives leads to high levels of pollution abatement costs for neighbouring countries [24].

Empirical testing of the pollution haven and pollution halo hypotheses leads to several controversial results. Indeed, [10] studies the relationship between FDI and carbon intensity over the period 1990 to 2013 in 188 countries. Using a dynamic panel model, the results show that FDI has a significant negative impact on the carbon intensity of the host country. On the other hand, a combination of data such as fossil fuels, industrial intensity, level of urbanisation and trade openness in the model gives a positive impact of FDI on carbon intensity. The inclusion of high-income countries and middle- and low-income countries in the model shows that FDI also has a negative and significant impact on countries' carbon intensity. [27] tests the existence of the pollution haven hypothesis on a panel of 5 Association of Southeast Asian Nations (ASEAN) countries over the period 1981 to 2010. The estimation results show that FDI positively affects the level of pollution intensity. These results are consistent with those found by [16] [28]. [29] study the effects of FDI and government spending on environmental pollution in Korea over the period 1970 to 2018. Their result shows that FDI leads to an increase in per capita carbon dioxide emissions.

[30] use a spatial econometrics approach to study the link between local taxation and environmental pollution in a panel of 31 provinces in China over the period 2003 to 2017. The environmental pollution index and the environmental regulation index are two types of pollution index. The Durbin Spatial Model is used with a Moran I Index to capture the positive spatial distribution of environmental pollution. Tax expenditure and tax revenue are used as an indicator of local taxation and the space factor is captured by the distance weighting matrix and the mixed economic distance matrix. While tax competition between provinces is suspected, the estimation results show a positive correlation between local taxation and environmental pollution. This is confirmed by the fact that FDI significantly affects environmental quality, with a coefficient of 0.4. This influence of FDI exacerbates the level of environmental pollution and confirms the pollution haven hypothesis. Furthermore, a spatial shift in FDI has a positive influence on environmental pollution. This means that FDI in China has a high pollution intensity with a significant pollution drag effect. On the other hand, an interaction between local taxation and FDI has a negative influence at the 1% threshold. This indicates that FDI behaviour under the decentralisation system reduces environmental pollution. This influence reveals that the more

local governments when they gain financial autonomy, they harden environmental quality control in order to reduce the pollution level. [28] use a spatial approach to test the pollution haven hypothesis in China and Korea. [29] found that FDI positively influences CO_2 emissions in ASEAN. Alluding to the role of fiscal policy in influencing FDI on pollution, [31] empirically examine the effects of fiscal policy instruments on environmental quality and find a negative influence of fiscal policy on environmental quality in 10 Asian countries. Their study highlights the link between fiscal policy instruments and carbon emissions over the period 1981 to 2018. However, they make no mention of the cross-influence with FDI. Using an ARDL model, they show that any shock to government revenue has a negative impact on carbon emissions in these economies.

While some studies find a positive influence of FDI on environmental pollution, others find a negative effect of FDI on pollution. [32] examined the impact of foreign direct investment (FDI) on air pollution in China using 286 cities between 2001 and 2007. As the data used by the authors was both cross-sectional and temporal, panel data analyses (fixed effects and random effects) were applied. The results show that FDI does not have a negative impact on air quality in China. Contrary to expectations, the presence of FDI reduces air pollution. The authors explain this result by the role of FDI in the Chinese economy, perceived as the main sources of advanced technology in China. These results are no less different from those of [33] in South East Asian countries (ASEAN), [34] in less developed countries (LDCs) and [35] in the Korean provinces. The latter consider that FDI tends to increase the level of environmental management in host countries.

It is also possible to observe a correlation between mainly fiscal fiscal policy and environmental pollution. [31], in their study of China over the period 1980 to 2016, show that expansionary fiscal policy, which is essentially fiscal, intensifies the level of degradation of environmental quality. Through an ARDL model, [36] considering the link between fiscal policy for environmental quality in Turkey over the period 1960-2013, show that fiscal policy significantly influences environmental quality management in Turkey by causing the reduction of carbon emissions. [37] study the correlative relationship between local taxation on polluting waste discharge in a panel of 69 large cities in China over the period 2001 to 2011. These authors conclude that tax revenues are likely to reduce the level of pollution in industry structures.

However, some studies have detected a non-linear relationship between taxation and air pollution. Indeed, [22] study in an endogenous growth theoretical framework the relationship between tax policy, economic welfare and air pollution on a panel of 30 provinces and municipalities in China. The regression method used is threshold regression. Authors determine an inverted U shape between the two variables. Using a neoclassical model, [38] arrive at the same result.

Furthermore, [39] test the pollution haven hypothesis using the ordinary least squares method and panel regressions in Mediterranean coastal countries over the period 1980 to 2016. They find a result that invalidates the pollution haven hypothesis. These results are consistent with those found by [40] in a panel of 14 countries in the MENA region over the period 2004 to 2016. On the other hand, [41] find a mixed result in their work and it is difficult for them to confirm whether it is the pollution haven that prevails or whether it is the pollution halo. The study area is the BRICS region and these authors use an ARDL model. [42] found the opposite result. Using an ARDL model, authors show that the pollution haven hypothesis is verified in Côte d'Ivoire over the period 1980 to 2014. FDI in Côte d'Ivoire tends to leave environmental management to the country. [43] confirm these results in their study of ASEAN countries over the period 1981 to 2014. The results of [44] do not deviate from the above findings in Turkey over the period 1974 to 2011. They use causality in the sense of Granger augmented by Toda-Yamamoto. [45] reveal a bidirectional relationship between FDI and carbon emissions. They find a strong two-way Granger causality between these two variables.

3. Methodology

We present in turn the theoretical model of air pollution that will be estimated, the data used and the estimation strategy for the empirical model.

3.1. Specification of the Model

In order to highlight the influence of fiscal expenditure on the effect of FDI on air pollution in ECOWAS countries, the article is based on the methodology proposed by [16]. This involves estimating the relationship that defines CO_2 emissions as a function of its main determinants. This relationship is summarised by the following function:

$$\mathrm{CO}_2 = f\left(\mathrm{FDI}; \mathrm{TE}; \mathrm{FDI} * \mathrm{TE}; X\right) \quad (1)$$

By linearising (1) we have an equation of the form:

$$\ln\left(\mathrm{CO}_{2it}\right) = \beta_0 + \beta_1 \ln\left(\mathrm{FDI}_{it}\right) + \beta_2\left(\mathrm{TE}_{it}\right) + \beta_3 \ln\left(\mathrm{FDI} * \mathrm{TE}\right)_{it} + \beta_4 \ln\left(X_{it}\right) + u_{it} \quad (2)$$

where $u_{it} = \alpha_i + \varepsilon_{it}$ with $\varepsilon_{it} \underset{iid}{\sim} N\left(0, \sigma^2\right)$

Where CO_2 is the pollutant output in the economy, FDI_{it} is foreign direct investment; TE_{it} is tax expenditure and $\left(\mathrm{FDI} * \mathrm{TE}\right)_{it}$ is the interaction between FDI and tax expenditure and $\left(X_{it}\right)$ a set of vector of explanatory variables. β_0 is a constant, $\beta_j\left(j = 1, \cdots, k\right)$ are the respective elasticities of the variables and u_{it} is the error of specification. $i\left(i = 1, \cdots, N\right)$ and $t\left(t = 1, \cdots, T\right)$ represent the country index and the year index, respectively.

3.2. Definition of Variables and Source

Table 1 below present the dependent variables, the explanatory variables (of interest and control) and the data sources. The study covers the period from 2000 to 2019 and the number of countries included in the study is all 13 ECOWAS countries: Benin, Burkina Faso, Côte d'Ivoire, Gambia, Ghana, Guinea, Liberia, Mali, Niger, Nigeria, Sierra Leone, Senegal and Togo.

Table 1. Variable definition and data source.

Variables	Definition	Sources
Atmospheric pollution	This is CO_2 (in kilotonnes).	WDI (world development indicators) https://data.worldbank.org/indicator
Foreign Direct Investment (FDI)	This is capital invested to create, develop or maintain a subsidiary abroad or to exercise control or significant influence over the management of a foreign company or firm. It is measured by FDI flows	WDI (world development indicators) https://data.worldbank.org/indicator
Tax Expenditure (TE)	These are revenue losses resulting from a policy of incentives through tax deductions. It is a variable for promoting economic activity or seeking social equity.	Budget evaluation reports.
Growth in Gross Domestic Product (GDP)	An economic indicator that measures the wealth created in a country over a given period.	WDI (world development indicators) https://data.worldbank.org/indicator
Renewable Energy Consumption (CER)	The share of renewable energies in total final energy consumption.	WDI (world development indicators) https://data.worldbank.org/indicator
Domestic Investment (IDO)	Tangible or intangible assets used in the production process for at least one year.	WDI (world development indicators) https://data.worldbank.org/indicator
Renewable Electricity Generation (PER)	This is the share of electricity generated by renewable power plants in the total electricity generated by all types of power plants.	WDI (world development indicators) https://data.worldbank.org/indicator
Industrial Sector (INDUS)	These are economic activities that combine production factors (facilities, supplies, labour, knowledge) to produce material goods for the market.	WDI (world development indicators) https://data.worldbank.org/indicator
Commercial Opening (OUV)	It is the relationship between an economy and the rest of the world through trade.	WDI (world development indicators) https://data.worldbank.org/indicator

Source: Authors (2023).

3.3. Empirical Model

Taking account of specific individual characteristics in the influence of the FDI on air pollution in the WAEMU requires a specific test of the effects models (fixed or random). These models are appropriate for panel data (cylindrical panel). In fact, they make it possible to take into account several observations for the same individuals and also the influence of certain unobserved time-invariant characteristics of these individuals [46]. The basic model is as follows:

$$y_{it} = x_{it}\beta + z_{it}\alpha + \varepsilon_{it} \tag{3}$$

where x_{it} is a vector of k exogenous variables of dimension (1, k), β is the vector of unknown parameters to be estimated, z_{it} α is the individual-specific effect. z_{it} is a vector that includes a constant term and a set of time-invariant individual-specific variables that may or may not be observed. ε_{it} is the error term. Depending on this and the specific effect, the model demultiplies into three model classes. These are the stacked data, fixed effects and random effects models.

In models based on stacked data, the specific effect is a constant (simple stacking of data in cross-sections). An appropriate method for this model is the Ordinary Least Squares (OLS) method. The model is as follows:

$$y_{it} = x_{it}\beta + \alpha + \varepsilon_{it} \tag{4}$$

where $\varepsilon_{it} \underset{iid}{\sim} N\left(0,\sigma^2\right)$. On the other hand, the fixed-effects model models specific effects or individual heterogeneity. The latter is constant (α_i) over time and the model is written as:

$$y_{it} = x_{it}\beta + \alpha_i + \varepsilon_{it} \tag{5}$$

The individual effects (α_i) can be correlated with the explanatory variables x_{it} and the within estimator remains convergent. Logically, it is possible to test the specification of the model which predominates in the series of data under consideration. The decision rule is as follows:

This test determines whether the model under study is a fixed-effects model (within estimator) or an effects-free model (OLS). The H0 hypothesis (no fixed effect) is tested against the H1 hypothesis (with effect).

With the random effects model, individual heterogeneity is modelled by taking into account random individual specific effects (constant over time). It is usually estimated using the Generalized Least Squares (GLS) method. This unobservable individual heterogeneity is assumed to be uncorrelated with xit (Agha et al. 2018):

$$y_{it} = x_{it}\beta + \alpha + u_{it} \quad \text{where} \quad u_{it} = \alpha_i + \varepsilon_{it} \tag{6}$$

This model has the advantage of providing more precise estimates than those obtained from the fixed-effects model. The decision rule for the test: hypothesis H0 (model with no effects) versus hypothesis H1 (presence of random effects).

3.4. Statistical Analysis

Table 2 below shows that the inflation factors for the variance of the variables are less than 5. This predicts an absence of multi-colinearity between the variables, which reinforces the reliability of the model with an average of 1.85.

Table 3 below shows the correlation matrix between the variables. On the one hand, there is a negative correlation between FDI and the level of carbon dioxide emissions. This suggests that the influence of FDI on air pollution is harmless. On the other hand, there is a positive correlation, significant at the 5% threshold, between tax expenditure and the level of carbon dioxide emissions.

Table 4 below shows the descriptive statistics for the variables. This table shows that some standard deviations are high, indicating that the differences between the values of the variables are not minimal and therefore the dispersion of the data in relation to the mean is high. This is the case, for example, with the variables CO_2, GDP. Variables such as FDI, TE, CER, PER and OUV have individual values relatively close to the mean. As for the variables IDO and INDUS, they show data concentrated around the mean. In the light of these findings, it would be useful to perform a logarithmic transformation to maintain a similar measure for all the variables and for a better discussion of the results.

Table 2. calculation of variance inflation factors (VIF).

	VIF	1/VIF
Growth in Gross Domestic Product (GDP)	3.004	0.333
Tax Expenditure (TE)	2.818	0.355
Commercial Opening (OUV)	1.706	0.586
Renewable Energy Consumption (CER)	1.634	0.612
Industrial Sector (INDUS)	1.533	0.652
Renewable Electricity Generation (PER)	1.48	0.676
Foreign Direct Investment (FDI)	1.36	0.735
Domestic Investment (IDO)	1.285	0.778
Mean VIF	1.853	.

Source: Authors, 2023.

Table 3. Correlation matrix between variables.

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
(1) CO_2	1.000								
(2) FDI	−0.099	1.000							
(3) TE	0.872*	−0.083	1.000						
(4) GDP	0.642*	−0.101	0.536*	1.000					
(5) CER	0.145*	0.171*	0.237*	−0.366*	1.000				
(6) IDO	0.067	0.130*	−0.073	0.035	−0.064	1.000			
(7) PER	0.006	−0.092	−0.040	−0.037	0.097	0.240*	1.000		
(8) INDUS	0.262*	−0.262*	0.293*	0.331*	−0.169*	0.265*	0.321*	1.000	
(9) OUV	−0.228*	0.298*	−0.280*	−0.179*	0.137*	0.110	0.115	−0.230*	1.000

Source: Authors (2023), ***$p < 0.01$, **$p < 0.05$, *$p < 0.1$.

Table 4. Descriptive statistics.

Variable	Obs	Mean	Std. Dev.	Min	Max
CO_2	247	10676.802	25613.983	240	130670
FDI	247	4.918	11.527	−2.545	103.337
TE	99	11.05	16.126	0.81	89.75
GDP	247	830.201	549.283	138.699	3098.986
CER	246	71.714	14.697	36.623	91.767
IDO	247	19.156	6.202	1.097	52.418
PER	207	29.409	27.938	0.00	91.499
NDUS	247	20.124	6.947	3.243	35.192
OUV	247	66.647	37.055	20.723	311.354

Source: Authors, 2023.

4. Estimating and Interpreting Results

Table 5 and Table 6 below show the estimation results for the ordinary least squares method and the random effects method.

Table 5 shows the estimation of the OLS model. The model is globally significant with a high goodness of fit (0.96). With the exception of model 6, FDI has a negative influence on the level of carbon emissions in ECOWAS countries. This influence remains significant in model 3. This indicates that when FDI flows increase, this leads to a reduction in carbon emissions.

Taking into account the tax expenditure variable, the results show that tax expenditure contributes to increasing the volume of carbon emissions. This influence remains significant in models 2 and 5. The interaction between FDI and tax expenditure has a positive and significant effect on carbon levels in ECOWAS countries.

Table 5. Results of the effects of FDI and TE on air pollution (OLS model).

Variables	Volume of CO_2						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Foreign Direct Investment (FDI) (Log)	−0.083 (0.537)	−0.002 (0.963)	0.268*** (0.002)	-	-	0.014 (0.821)	-
Tax Expenditure (TE)	0.017 (0.088)	0.023*** (0.000)	–	0.022 (0.901)	0.023*** (0.000)	-	-
FDI*TE (Log)	0.077*** (0.000)	-	0.259*** (0.000)	0.004*** (0.001)	-	-	0.069*** (0.000)
Growth in Gross Domestic Product (Log)	1.979 (0.601)	1.944*** (0.000)	2.135*** (0.000)	1.95*** (0.000)	1.945*** (0.000)	1.579*** (0.000)	2.268** (0.018)
Renewable Energy Consumptio (Log)	−0.042 (0.81)	0.091 (0.733)	0.407 (0.109)	0.104 (0.704)	0.094 (0.716)	0.243 (0.485)	0.647 (0.768)
Domestic Investment (Log)	−0.042 (0.662)	−0.065 (0.7)	0.017 (0.921)	−0.067 (0.69)	−0.066 (0.69)	0.214 (0.198)	−0.056 (0.941)
Renewable Electricity Generation (Log)	0.024 (0.617)	0.023 (0.675)	0.024 (0.675)	0.022 (0.686)	0.023 (0.673)	0.201*** (0.002)	0.005 (0.263)
Industrial Sector (Log)	0.094 (0.19)	0.157 (0.318)	−0.042 (0.812)	0.159 (0.301)	0.159 (0.297)	0.934*** (0.000)	0.197* (0.056)
Commercial Opening (Log)	−0.313 (0.531)	−0.338 (0.149)	−0.299 (0.221)	−0.34 (0.145)	−0.339 (0.141)	−0.708*** (0.004)	−0.506** (0.032)
Constant	−5.023 (0.071)	−4.476* (0.087)	−7.145 (0.006)	−4.564* (0.085)	−4.492* (0.079)	−4.345* (0.075)	−8.366*** (0.004)
R-squared	0.965	0.965	0.962	0.965	0.965	0.687	0.952
F-test	119.403	136.323	127.376	136.370	159.683	46.786	117.143
Number of obs	49	49	49	49	49	49	49
Prob>F	0.000	0.000	0.000	0.000	0.000	0.000	0.000

Source: Authors, 2023 ***p < 0.01, **p < 0.05, *p < 0.1.

Table 6. Results of the effects of FDI, TE and their cross-effect on air pollution (fixed effects and random effects models).

Variables	Volume of CO2						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Foreign Direct Investment (FDI) (Log)	−0.001 (0.992)	0.039 (0.208)	−0.049 (0.267)	-	-	0.009 (0.649)	-
Tax expenditure (TE)	0.01 (0.313)	0.016*** (0.001)	-	0.011** (0.28)	0.009** (0.13)	-	-
FDI*TE(Log)	0.041 (0.755)	-	0.078** (0.041)	0.04 (0.137)	-	-	0.039*** (0.01)
Growth in Gross Domestic Product (Log)	1.552*** (0.000)	1.737*** (0.000)	0.91*** (0.000)	1.597*** (0.000)	1.078*** (0.000)	0.41*** (0.000)	0.917*** (0.004)
Renewable Energy Consumptio (Log)	−0.259 (0.56)	−0.079 (0.846)	−1.001*** (0.009)	−0.211 (0.623)	−0.844** (0.048)	−1.123*** (0.000)	−1.075 (0.553)
Domestic Investment (Log)	−0.067 (0.598)	−0.086 (0.536)	−0.023 (0.776)	−0.07 (0.579)	−0.014 (0.884)	0.108* (0.052)	−0.045 (0.763)
Renewable Electricity Generation (Log)	0.015 (0.856)	0.014 (0.848)	0.013 (0.867)	0.014 (0.86)	0.04 (0.63)	0.056 (0.199)	0.023 (0.331)
Industrial Sector (Log)	−0.154 (0.361)	−0.116 (0.505)	−0.107 (0.338)	−0.152 (0.364)	−0.117 (0.393)	0.097 (0.336)	−0.108 (0.815)
Commercial Opening (Log)	−0.178 (0.414)	−0.266 (0.244)	0.036 (0.792)	−0.194 (0.363)	−0.004 (0.979)	0.336*** (0.001)	0.032*** (0.01)
Constant	0.062 (0.984)	−1.642 (0.579)	6.48*** (0.005)	−0.379 (0.898)	4.834* (0.073)	8.488*** (0.000)	6.866*** (0.003)
R^2 within	0.631	0.585	0.809	0.620	0.710	0.750	0.809
R^2 between	0.952	0.964	0.781	0.956	0.867	0.298	0.730
R^2 Overall	0.943***	0.955***	0.767***	0.947***	0.857***	0.310***	0.720***
Prob > F	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Breush-Pagan	0.3420	0.3297	0.2022	0.3081	0.3234	0.000	0.0347
Hausman	1.000	1.000	1.000	1.000	1.000	1.000	1.000

Source: Authors, 2023 ***p < 0.01, **p < 0.05, *p < 0.1.

Overall, the results show that, with the exception of domestic investment and trade openness, the control explanatory variables exert a threatening pressure on the level of CO_2 in the WAEMU.

On both sides of the different models, Table 6 shows the presence of individual fixed effects (models 6 and 7) and random effects (models (1), (2), (3), (4) and (5)).

For all models, the influence of FDI on carbon emissions is insignificant and the direction of correlation is mixed. Compared with the OLS model, the random effect model appears to be less informative. Considering model (3), the results are in line with those of [39] and [40], who show that the influence of the FDI on environmental quality is insignificant. Their work fails to establish the validity of the pollution haven and pollution halo hypotheses. However, the results are not consistent with the conclusions of [16]. The latter reveal that FDI leads to an increase in per capita carbon dioxide emissions in Korea. The conclusion to be drawn in the ECOWAS countries is that FDI per se is not a threat to the environment.

However, if we take the case of the tax expenditure variable, the results show that it contributes to increasing the volume of carbon emissions. This influence remains significant in models 2, 4 and 5. This means that the ability of governments to put in place tax tools to attract firms is a vector of environmental pollution in ECOWAS countries. Tax expenditure is therefore a sign of the poor quality of institutions in ECOWAS. This result is consistent with the analyses of [30], who use a spatial approach to study the link between local taxes and environmental quality. They show that tax expenditure has a rather aggravating response on the level of carbon emissions in China's provinces. However, the relatively competitive nature of tax expenditure in ECOWAS countries explains the low level of domestic resources.

Concerning the interaction variable between FDI and tax expenditure, the results reveal a positive sign for all models, and significant in models 3 and 7 at the 5% threshold. These results do not contradict the estimates made for the OLS model above. This indicates that FDI in the presence of a tax incentive mechanism intensifies the volume of CO2 emissions. The implementation of the attractiveness factors put in place by the ECOWAS countries would lead to an increase in the volume of carbon emissions. On the other hand, attractive measures that are essentially fiscal are elements of low institutional quality or the softening of environmental controls. Tax expenditure is thus an attractive force for FDI and highlights the weaknesses in tax regulations. This force leads to a high volume of FDI, which threatens environmental quality if nothing is done. These results are in line with the theory of [26]. However, the results are inconsistent with the empirical work of [30]. The latter show that the interaction between local taxation and FDI has a negative influence at the 1% threshold.

The influence of the explanatory variables on the level of CO_2 emitted shows that growth in gross domestic product, domestic investment and trade openness is a vector for carbon emissions in the WAEMU countries. But the influence of GDP growth on CO_2 levels remains very significant. It therefore appears that the quest for prosperity is accompanied by conditions of environmental degradation. Energy consumption also has a negative effect on CO_2 emissions.

5. Conclusion and Policy Implications

The literature on the influence of foreign direct investment on air pollution has been the subject of numerous debates in economics. Futhermore, air pollution remains a sensitive debate nowadays and the determination of the factors that influence it is topical. In the ECOWAS region, we are trying to determine the link between FDI and air pollution. The results of our estimates show that FDI in itself is not an aggravating factor in environmental pollution, even if the direction of the correlation is negative. Moreover, while FDI has no effect on pollution, fiscal expenditure tends to increase the level of pollution in ECOWAS countries. Moreover, the effect of fiscal expenditure on the influence of FDI on environmental pollution remains significant. The interaction between FDI and tax expenditure shows that the latter, other things being equal, plays a decisive role in the influence of FDI on environmental pollution. While it is clear that tax expenditure should be a priority for economic and social policies, this would lead to an increase in environmental pollution in the ECOWAS zone. Thus opening the way for useful criticisms and suggestions for the further development of this study, it concludes by suggesting that governments should work to put in place tax regulations that encourage FDI; however, they must take into account environmental management and pollution reduction in their economic calculations.

Future research on the same issue may be carried out, using other estimation methods and other statistical data.

Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper

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