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Is Foreign Direct Investment Good or Bad for the Environment? Times Series Evidence from ECOWAS Countries

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Abstract

Foreign direct investment (FDI) is often accused of being one of major factors that may harm the host country's environment. This study contributes to the debate by examining the long run effect of FDI inflows on Carbon dioxide (CO2) emissions in the Economic Community of West African States (ECOWAS). It uses the bounds test of cointegration proposed by Pesaran et al. (2001). FDI inflows,Gross Domestic Product (GDP) and population are used as explanatory variables. Results are mixed across countries. We find evidence supporting that FDI increases CO2 emissions in some countries while it reduces them in others. Evidence of no significant influence of FDI on CO2 emissions is also found. With respect to GDP, the results indicate that an increase in economic growth intensifies CO2 emissions in most countries.

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1. Introduction

Foreign direct investment (FDI) is regarded as a source of economic growth and job creation for developing countries. It can fill the resource gap between domestic savings and investment requirements. In addition, FDI stimulates transfer of skills and technology that lead to greater productivity and economic growth (Borensztein *et al*. 1998, De Mello 1997, UNCTAD 2006). However, it is also claimed that foreign investments may have negative effects on host country economic growth[1]. One of the most important concerns is that FDI can have a crowding out effect on domestic investment. This effect takes place when local enterprises abandon their investment plans to avoid competing with more efficient foreign firms (UNCTAD 1999). There are also concerns that the outflows of earnings from foreign investment lead to the deterioration in the balance of payments of the host country. It is also pointed out that corporate income tax revenues in the host country may be adversely affected by transfer pricing or other strategies of transnational corporations to minimize taxes (Gropp and Kostial 2000). The dependency theory suggests that foreign direct investment creates monopolies in the industrial sector, which consequently results in under-utilization of domestic resources and stagnant economic growth (Adams 2009).

Today, it is generally believed that FDI is good for economic development. Consequently, developing countries adopt policies in order to attract more FDI. Over the two past decades FDI inflows to developing countries have increased rapidly. For instance, average FDI inflows to Sub-Saharan Africa as ratio of the region's GDP rose from 0.5% in the 1980s to 1.46% in the 1990s and 3.94% in 2000-2010. In the same time, global warming has become a major global concern as a result of accumulation of human made greenhouse effect gases. These trends have revitalized the long and contentious debate about the social costs and benefits of foreign direct investment. While some economists are investigating the determinants of FDI inflows to developing countries, environmentalists are interested particularly on the environmental effects of these investments. There are concerns that African countries purposely undervalue their environment in order to attract more FDI. The pollution haven hypothesis asserts that multinational firms, particularly those engaged in highly polluting activities move their activities in countries with weaker environmental standards. This hypothesis suggests that FDI inflows to developing countries are associated with higher levels of pollution, which may have negative effects on welfare. On the other hand, the pollution halo hypothesis hypothesizes that FDI to developing countries may have positive effects on environment and welfare through the transfer of cleaner technologies and more developed environmental management systems (Grossman and Krueger 1991). Thus, the relationship between FDI and the environment is theoretically ambiguous.

Based on these two competing views, a burgeoning literature was carried out to investigate the relationship between FDI and the environment. The empirical evidence from this literature is however inconclusive. Some studies reported evidence supporting the pollution haven hypothesis (Waldkirch and Gopinath 2008, Acharyya 2009, McDermott 2009), while some others found support for the optimistic view (Birdsall and Wheeler 1993, Talukdar and Meisner 2001, Zeng and Eastin 2007). A third stream of literature failed to identify any significant relationship between FDI and pollution (Eskeland and Harrison 2002, Hassaballa 2013, Shaari *et al.* 2014). Consequently, one cannot draw any type of generalization of the

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[1]Empirical evidence regarding the impact of FDI on economic growth in Sub-Saharan African countries is mixed. Studies by Sukar *et al.* (2007) and Adams (2009) failed to provide convincing evidence that FDI promote economic growth, while Ndambendia and Njoupouognigni (2010) and Esso (2010) found strong evidence of a positive impact of FDI on economic growth.

impact of FDI on pollution than can be applied to all countries. Most of empirical studies have overwhelmingly focused on developed and non-African countries; evidence on African countries is very rare.

This study thus attempts to supplement the empirical literature by examining the environmental impact of FDI in the Economic Community of West African States (ECOWAS) member countries. To this end, we use the bounds testing approach to cointegration developed by Pesaran *et al.* (2001). Contrary to most empirical studies on the subject, we undertake a country-specific investigation instead of a panel data analysis. Country specific investigation is relevant because the assumption of common coefficients is restrictive and unlikely to hold across countries. Indeed, African countries show differences with respect to economic structure, energy consumption, trade and environmental policies, and hence, it is unlikely that findings from a panel analysis apply to all countries in the same way. As suggested by Stern *et al.* (1996), the experience of individual countries should be considered.

The remainder of the paper is organized as follows. Section 2 presents an overview of the theoretical and empirical literature on the FDI-environment nexus. Section 3 deals with the econometric methodology. Section 4 analyses the empirical results. Finally, Section 5 provides summary and gives some policy implications.

2. Theoretical and empirical review

2.1 Theoretical background

The classical explanation of FDI is that capital moves from low rates of return countries to relatively higher marginal rates of return ones. Among the factors that affect the decision of FDI, there are environmental regulations imposed on domestic firms. Thus, from the theoretical point of view, there are two competing views governing the FDI-environment relationship. The pollution haven hypothesis considers environment as a factor of production where stringent environmental regulations increase production costs (Hassaballa 2013). Accordingly, countries with weaker environmental policies will have relatively lower production costs and so they will have comparative advantage in polluting industries. Following this hypothesis, one can hypothesize that the relatively low environmental standards in developing countries may attract inward FDI by profit-driven companies eager to circumvent costly regulatory compliance in their home countries. Opposite to this view, the pollution halo hypothesis states that FDI to developing countries may yield substantial environmental benefits through the transfer of environmental friendly techniques of production from foreign firms to their counterparts in the host countries (Hoffman *et al*. 2005, Birdsall and Wheeler 1993). Indeed, stringent environmental policies in developed countries push firms to innovate and create new technologies that are environmental friendly and to become net exports of these new technologies (Mihci *et al.* 2005). If true, the pollution haven hypothesis suggests that pollution level in developing countries will increase due to FDI-led expansion of dirty industries.

The environmental impact of FDI can be decomposed into scale, technique and composition effects (Groosman and Krueger 1991, Antweiler *et al*. 2001). The scale effect refers to the fact that trade liberalization and FDI lead to an increase in industrial output that requires more energy and generates more pollution. If there were no change in the structure or technology of the economy, pure growth in the scale of the economy would result in a proportional growth in environmental impacts. The technique effect is assumed to improve the quality of the environment because of import of efficient and new environmental friendly technologies in the production process. The composition effect stems from changes in the structure of GDP and suggests that trade liberalization and FDI may reduce or increase pollution depending upon whether the country has comparative advantage in "cleaner" or "dirty" industries. Given the different nature of the individual effects, the overall impact of FDI on the environment depends on which effect is stronger and dominates the others. The Environmental Kuznets Curve (EKC) hypothesizes a sort of inverted U-shape relationship between environmental degradation and economic development. According to this hypothesis, the process of economic growth is expected to improve environmental degradation after the economy has reached an adequate level of economic growth. However, the empirical evidence on the EKC theory is quite mixed. Kaika and Zervas (2013) offer a comprehensive revue on the EKC theory and review the underlying factors that may drive an EKC relationship. They argue that various factors such as the distribution of income, the pollution haven hypothesis, structural changes, technical progress, energy efficiency improvement, institutions and consumer preferences may affect the income-CO_2 relationship.

2.2 Empirical review

On the empirical level, many studies have investigated the FDI-environment relationship and tested the pollution haven hypothesis. The empirical evidence from this literature remains controversial and ambiguous to date. Results vary across countries, methodologies and pollution indicators. Birdsall and Wheeler (1993) tested the pollution havens hypothesis in the case of Latin America and found that protected economies are likely to favor pollution intensive industries, while openness to trade and FDI encourages cleaner industry through the importation of developed-country pollution standards. They concluded that pollution havens can be found, but not where they have generally been sought. They are in protectionist economies. Levinson (1996) used a conditional logit model of plant location choice to show that interstate differences in environmental regulations do not systematically affect the location choices of most manufacturing plants. For a panel of 44 developing countries, Talukdar and Meisner (2001) reached the conclusion that FDI improves the air quality in the host country. Eskeland and Harrison (2002) analyzed the relationship between pollution abatement costs and the pattern of foreign investment in four developing countries (Mexico, Morocco, Cote d'Ivoire and Venezuela). They found that pollution abatement costs have no significant impact on the pattern of foreign investment. Only in the case of Morocco, they found that foreign investors are concentrated in the cement industries. Foreign firms are found to be less polluting than their peers in developing countries as they are significantly more energy efficient and use cleaner types of energy than local firms. Hoffmann *et al.* (2005) tested for Granger causality between FDI and CO_2 emissions in an unbalanced panel data of 112 countries classified in terms of income. Their findings indicate that in low-income countries, CO_2 emissions cause inward FDI flows. For middle-income countries, FDI causes CO_2 emissions. For high-income countries, no causality was found. He (2006) used a five-equation simultaneous model to study the relationship between FDI and sulfur dioxide (SO_2) emissions in a panel of 29 Chinese provinces over the period 1994 to 2001. FDI is found to have a positive impact on industrial SO_2 emissions. He also found evidence supporting the pollution haven hypothesis. Zeng and Eastin (2007) examined the effects of trade openness and FDI on industrial pollution levels across China's regions over the period 1996-2004. They found that increased trade openness and FDI are positively correlated with environmental protection in China. Rather than leading to environmental degradation, increased openness to trade and FDI encourages more stringent policy enforcement and compliance that results in an overall improvement in environmental quality. This good environmental effect of FDI operates through superior regulatory standards and environmental technology utilized by multinationals. Merican *et al*. (2007) studies the impact of FDI on pollution in five Asian countries. They found that FDI contributes to pollution in Malaysia, Thailand, and the Philippines. On the contrary, FDI is inversely related to pollution in Indonesia while it has no impact in the case of Singapore. Waldkirch and Gopinath (2008) examined the extent to which the pollution intensity of production helps explain FDI in Mexico. Examining several different pollutants, they reported evidence supporting the pollution haven hypothesis, that is foreign firms locate operations in Mexico as a result of low environmental standards. McDermott (2009) tested the pollution haven hypothesis for 26 OECD countries from 1982 to 1997 using a gravity model. He concluded that firms do seek out countries with weaker environmental regulations for production. Acharyya (2009) examined the costs and benefits of foreign direct investment in India using data covering the period 1980-2003. The results revealed that FDI has a quite large long-run positive impact on CO_2 emissions through GDP growth. This finding suggests that FDI inflows in India have caused degradation of air quality as measured by CO_2 emissions. A similar conclusion has been reached by Beak and Koo (2009) in the case of China and India. The Authors found that FDI inflows in both countries have a detrimental effect on environmental quality in both the short and long-run. They also found a unidirectional causality from FDI inflow to economic growth and the environment.

Pao and Tsai (2011) examined the effect of FDI on CO_2 emissions using a panel cointegration technique for Russia, Brazil, India and China over the period 1980 to 2007. Their results showed a positive relationship between FDI and CO_2 emissions. In addition, they conducted Granger causality tests that showed that there is a two way causal relationship between the two variables. Rezza (2013) studied the relationship between FDI and the pollution havens hypothesis in the case of the Norwegian manufacturing sector. The author found that the environmental stringency of a host country and its enforcement have no effect on the average investment. However, He found statistically significant negative effects of environmental regulations on multinationals with efficiency-seeking FDI. Hassaballa (2013) investigated the impact of FDI inflows on pollution emissions in a dynamic panel data of 24 developing countries over the period 1970-2005. Her results indicated that FDI did not affect the environment in most of the cases. Only three countries showed evidence of a two way causal relationship. However, Hassaballa (2014) found that lax environmental laws are the most influential determinants of FDI inflows in developing countries. In a large panel of 181 countries over 1980-2009, Chakraborty and Mukherjee (2013) found that both FDI inward and outward stock is positively related to pollution. Finally, Shaari *et al.* (2014) analyzed the effects of foreign direct investment and economic growth on CO_2 emissions in a panel of 15 Asian countries over the period of 1992 to 2012. They found that in the long run foreign direct investment does not have any effect on CO_2 emissions. However an increase in economic growth can intensify CO_2 emissions. Results from Granger causality suggest that there is no effect of FDI and GDP on CO_2 emissions in the short run.

From this review, we notice that studies on single countries especially on Sub-Saharan African countries are rather rare. The present work contributes to the above literature by looking at the long-run relationship between FDI and CO_2 emissions in ECOWAS countries.

3. Methodology

3.1 Empirical model

Following the empirical literature (Stern *et al.* 1996, Talukdar and Meisner 2001, Chakraborty and Mukherjee 2013, Shaari *et al.* 2014), our empirical model is specified as follows:

$$CO2_t = \theta_0 + \theta_1 GDP_t + \theta_2 GDP_t^2 + \theta_3 FDI_t + \theta_4 POP_t + \mu_t \quad (1)$$

where CO2 represents the carbon dioxide emissions as the proxy for the level of air pollution; GDP is per capita real gross domestic output, FDI is foreign direct investment inflows and POP is population.

We include the square of per capita GDP to test for the Environmental Kuznets Curve. Most empirical studies use CO_2 per capita as dependent variable, assuming implicitly that population has a unitary elasticity and that this elasticity is the same for all countries. This usual assumption may not be imposed *a priori*. In fact, dividing variables by a given variable may change greatly the results and lead to misleading conclusion regarding the true relationship between variables. For example, if two variables X and Y are positively related and one divides them to a third variable Z which has a growth rate lying between the growth rate of X and that of Y, then X/Z and Y/Z will be negatively related. A possible explanation of the ambiguity in the empirical results across studies lies in the measurement of variables. When interpreting their results, many authors do not take into account how variables were measured. In this study, we relax the assumption of unitary elasticity and introduce population among the explanatory variables.

3.2 Estimation technique

The long-run relationship among the variables given by (1) is estimated using the bounds testing approach to cointegration developed by Pesaran *et al*. (2001). We utilize this appaoch because it has better small sample properties in comparison to other widely used alternatives (Inder 1993). The main advantage of this approach is that it can be applied irrespective of whether the regressors are purely I(0) or I(1). This allows us to avoid the problem associated with conflicting results of the conventional unit root tests and the low power of these tests in small samples. The bounds test generally provides unbiased estimates of the long-run coefficients even when some of the regressors are endogenous (Pesaran *et al*. 2001).

The bounds test for cointegration involves estimating by least square the following equation:

$$\Delta CO2_t = \phi_0 + \phi_1 CO2_{t-1} + \phi_2 GDP_{t-1} + \phi_3 GDP_{t-1}^2 + \phi_4 FDI_{t-1} + \phi_5 POP_{t-1} + \sum_{i=1}^{m} \gamma_{1i} \Delta CO2_{t-i} + \sum_{i=0}^{m} \gamma_{2i} \Delta GDP_{t-i}$$
$$+ \sum_{i=0}^{m} \gamma_{3i} \Delta GDP_{t-i}^2 + \sum_{i=0}^{m} \gamma_{4i} \Delta FDI_{t-i} + \sum_{i=0}^{m} \gamma_{5i} \Delta POP_{t-i} + e_t \quad (2)$$

The presence of cointegration between the variables is tested by restricting the lagged levels variables in (2) equal to zero. Therefore, the null hypothesis for no cointegration is: $\phi_1 = \phi_2 = \phi_3 = \phi_4 = \phi_5 = 0$. This hypothesis is tested by the mean of the *F-s*tatistic. However, its asymptotic distribution is non-standard under the null hypothesis. The critical values are provided by Pesaran *et al*. (2001) for large samples. We are aware of the fact that these critical values are not suitable for our small sample size. Hence, we calculate exact critical values using stochastic simulations based on 40 000 replications, following the procedure recommended by Pesaran *et al*. (2001). Once cointegration is found, the long-run coefficients are computed as the coefficient of the one lagged level explanatory variable divided by the coefficient of CO_2 and then multiplied by a negative sign.

4. Data and empirical results

The empirical investigation uses annual time series data for a sample of 12 member countries of the Economic Community of West African States (ECOWAS)[2]. The variables under study include CO_2 emissions measured in kilo tonnes (kt), per capita real GDP in constant 2005 US dollars, foreign direct investment inflows as share of GDP (FDI) and total population (POP). Data cover the period 1970 to 2010 and are obtained from the World Bank's World Development Indicators. The data for CO_2 emissions, GDP and POP were converted into natural logarithms for estimation purposes so that they can be interpreted in growth terms after taking first difference. Table 1 presents the average for CO_2 emissions and FDI over the sample period. From this Table, we see that CO_2 emissions show an increasing trend over the sample period in all countries. FDI as share of GDP has also increased over time. From this picture, we hypothesize a positive long run relationship between FDI and CO_2 emissions.

Table 1: Average of CO_2 emissions and FDI in ECOWAS

	CO_2 (kt)				FDI (% of GDP)			
Countries	1970-80	1981-90	1991-00	2001-10	1970-80	1981-90	1991-00	2001-10
Benin	363.69	580.11	1233.58	3383.54	0.54	0.76	2.05	0.83
Burkina Faso	245.02	562.88	750.63	1336.25	0.18	0.09	0.40	0.58
Côte d'Ivoire	3946.02	6527.62	6505.99	6837.48	1.179	0.51	1.53	1.86
Gambia	95.34	171.98	222.95	361.19	1.51	0.95	2.31	7.33
Ghana	2648.24	3271.33	5469.69	8013.12	0.81	0.18	2.03	4.25
Liberia	1602.14	814.07	348.36	624.49	13.51	21.83	8.49	23.96
Mali	323.69	398.96	487.71	574.98	0.14	0.17	1.30	4.26
Niger	347.69	915.65	923.72	928.85	1.02	0.42	0.25	3.84
Nigeria	49733.19	62242.19	49653.38	91333.2	1.33	1.99	4.62	3.3
Senegal	2091.19	2970.63	3596.59	5350.52	0.71	0.28	1.22	2.00
Sierra Leone	627.39	561.05	314.63	639.16	1.14	-1.96	0.62	3.56
Togo	484.04	694.16	1043.62	1363.02	2.08	0.78	1.26	3.16

Source: World Development Indicators Online, World Bank

Before proceeding to the estimation of the long run relationship, we test for the order of integration of the series. To test for unit-roots in the series, we apply the well-known Phillips and Perron unit-root test. This test has been performed under the models with constant and trend for the level series and with constant for series in first difference. The results reported in Table 2 reveal that all series contain unit roots, save for POP which is a trend stationary. All variables become stationary after taking the first difference.

[2] The countries include Benin, Burkina Faso, Cote d'Ivoire, Gambia, Ghana, Liberia, Mali, Niger, Nigeria, Senegal, Sierra Leone and Togo. Cape Verde, Guinea and Guinea-Bissau are excluded because of unavailability of data.

Table 2: Results of Phillips-Perron unit root test

Country	Level				First difference			
	CO2	GDP	FDI	POP	ΔCO2	ΔGDP	ΔFDI	ΔPOP
Benin	-2.360	-2.826	-3.558	-3.380	-7.640*	-7.759*	-8.405	-2.114
Burkina Faso	-2.322	-1.393	-5.826	-8.119	-6.575*	-7.407*	-15.131	-2.850
Côte d'Ivoire	-2.758	-2.490	-3.199	0.612	-8.009*	-4.312*	-8.613	-0.667
Gambia	-2.856	-2.114	-3.063	-1.393	-6.755*	-5.922*	-8.750	-1.861
Ghana	-3.949	-0.598	-2.367	-1.816	-18.042*	-4.298*	-6.375	-2.320
Liberia	-1.258	-1.383	-6.605	-1.398	-5.440	-3.641	-26.172	-2.050
Mali	-3.829	-1.510	-3.784	1.071	-6.293*	-6.632*	-13.552	-0.777
Niger	-1.874	-2.199	1.018	0.375	-4.782*	-6.027*	-5.752	-1.128
Nigeria	-3.076	-0.244	-3.840	-1.493	-6.748*	-5.454*	-17.108	-2.433
Senegal	-3.122	-1.242	-4.787	-1.546	-8.581*	-7.551*	-16.843	-2.068
Sierra Leone	-1.919	-0.726	-5.897	-1.723	-6.710*	-7.516*	-22.005	-1.954
Togo	-4.963*	-2.815	-4.286	-1.414	-14.236*	-6.359*	-8.983	-2.318

Notes: Critical values at the 5% level are -3.526 and -2.938 * and ** indicate that the null hypothesis is rejected at the 5% and 10% levels, respectively

The results of the bounds F-test statistics together with the exact critical values are reported in Table 3. From the table we can see that the computed F-statistic exceeds the upper critical values at 5% level of significance for all countries. Accordingly, we reject the null hypothesis of no cointegration among the variables and conclude that there is really a long-run relationship among CO_2 emissions and its determinants. This implies that FDI, economic output, population and CO_2 emissions do not move to far away from each other in the long-run. CUSUM and CUSUMSQ tests for parameter stability reveal no evidence of parameter instability over the period of analysis. In addition, standard assumptions on the residuals are satisfied.

Table 3: Results of bounds test for cointegration

Countries	F-stat	Case	5% exact critical values		Cointegration?
			I(0)	I(1)	
Benin	13.271	Case III	3.221	4.516	Yes
Burkina Faso	7.089	Case III	3.221	4.516	Yes
Côte d'Ivoire	7.057	Case III	3.221	4.516	Yes
Gambia	9.299	Case III	3.221	4.516	Yes
Ghana	14.709	Case I	2.513	3.810	Yes
Liberia	4.522	Case III	3.221	4.516	Yes
Mali	20.137	Case III	3.221	4.516	Yes
Niger	13.919	Case V	3.919	4.103	Yes
Nigeria	4.321	Case I	2.513	3.810	Yes
Senegal	5.001	Case I	2.513	3.810	Yes
Sierra Leone	6.836	Case I	2.513	3.810	Yes
Togo	10.477	Case I	2.513	3.810	Yes

Note: Lag length on each variable is selected using the general-to-specific approach, with maximum lag set to five. Critical values for F-statistics are calculated using stochastic simulations specific to the sample size T = 41 based on 40,000 replications. I(0) refers to the lower critical value bound when all regressors are I(0). I(1) refers to the upper bound when all regressors are I(1).The column headed "Case" indicates how deterministic components (intercepts and tren d) are specified in the bounds test equation.

Given the evidence of cointegration, we present our estimation results concerning the long-run coefficients on each determinant of CO_2 emissions. The results on the long-run coefficients are reported in Table 4. They are mixed across countries. The positive sign for

GDP and the negative sign for GDP squared in three countries (Cote d'Ivoire, Mali and Niger) are supporting the EKC hypothesis that CO_2 emissions initially increase with income and then decrease after income reaches a certain level. In all the other countries, except Liberia, the long-run relationship between per capita GDP and CO_2 emissions follows a U-shaped curve.

With respect to population, the results show that population has a positive and significant impact on CO_2 emissions in all countries except for Benin, Burkina Faso, Cote d'Ivoire and Niger. This result suggests that increasing population leads to more environmental degradation in the long-run. On the contrary, in Burkina Faso and Niger, population has a negative and significant effect on CO_2 emissions. It is worth noting that the coefficient on population is far from unity in most countries. For instance, in Ghana the elasticity of population is larger than one, suggesting that population has positive effect on per capita CO_2 emissions. On the contrary, population has negative impact on per capita CO_2 emissions in Nigeria and Sierra Leone. The heterogeneity in the effect of population on CO_2 emissions can be explained by differences in population structure by rural and urban areas. Indeed, population contributes to the degradation of the environment through increasing use of energy. As the population grows so does the demand for energy for power, industry and transportation; and more energy use from fossil fuel means more greenhouse gas emissions into the atmosphere. Energy use and CO_2 emissions can also be affected by demographic dynamics such as urbanization, aging and household size. In Burkina Faso and Niger, population living in rural areas accounts for about 80% of the total population whereas in the other countries under study this share is less than 70%. Additionally, households in Burkina Faso and Niger are largely dependent upon subsistence agriculture which is less polluting.

Table 4: Long-run estimates

	FDI	GDP	GDP2	POP
Benin	-0.051 (-1.157)	-721.487* (-3.401)	59.054* (3.407)	-0.736 (-0.687)
Burkina Faso	0.037 (0.263)	-47.248* (-2.869)	4.359* (3.048)	-2.500** (-1.942)
Côte d'Ivoire	-0.366* (-4.527)	131.619* (5.792)	-8.977* (-5.750)	0.212 (0.604)
Gambia	0.030* (2.987)	-360.779* (-2.477)	29.833* (2.488)	0.863* (11.391)
Ghana	-0.065* (-3.105)	-6.931* (-15.365)	0.502* (13.691)	2.040* (19.083)
Liberia	0.017* (2.031)	-7.768 (-0.888)	0.774 (0.964)	0.657 (0.510)
Mali	-0.078* (-6.060)	38.269* (7.184)	-3.187* (-7.135)	0.947* (9.413)
Niger	0.022* (6.555)	37.045* (6.246)	-3.188* (-6.288)	-13.692* (-32.171)
Nigeria	-0.154* (-5.643)	-1.546** (-1.723)	0.133* (2.020)	0.889* (5.817)
Senegal	-0.028(-0.688)	-3.597* (-3.893)	0.319* (3.068)	1.146* (8.814)
Sierra Leone	0.013 (-1.600)	-3.750* (2.504)	0.467* (3.073)	0.782* (3.274)
Togo	-0.056 (-1.433)	-5.977* (-3.587)	0.541* (3.168)	1.533* (6.221)

Notes: Figures in parenthesis are *t*-statistics. * and ** denote statistical significance at the 5% and 10% levels, respectively.

With respect to FDI, the results indicate that the environmental impact of FDI varies across countries. In four countries, namely Cote d'Ivoire, Ghana, Mali and Nigeria, the coefficient of foreign direct investment is negative, meaning that pollution decreases with the scale of foreign investment. For these countries, more FDI inflow is beneficial to the environment. This finding is interesting as it suggests that FDI promotion can be achieved without harming the environment. In contrast, in Gambia, Liberia and Niger, FDI is positively related to CO2 emissions, suggesting that FDI worsens environmental conditions in these countries. This result supports those of Chakraborty and Mukherjee (2013), Beak and Koo (2009) and Acharyya (2009). For Benin, Burkina Faso, Senegal, Sierra Leone and Togo, FDI has no significant effect on CO_2 emissions. This result is consistent with those found by Hassaballa

(2013) and Shaari *et al.* (2014). However, from these results we are unable to directly support or reject the pollution haven or pollution halo hypothesis. The lack of readily available firm level data does not allow us to empirically test these hypotheses.

5. Conclusion

This paper has examined the long run impact of foreign direct investment on air pollution in ECOWAS countries over the period 1970-2010. The empirical analysis used the bounds test to cointegration in a multivariate framework. The usual assumption of unitary elasticity in the emission-population relationship has been relaxed. The empirical results are mixed across countries. We find evidence supporting that FDI causes degradation of air quality in Gambia, Liberia and Niger, while it is compatible with environmental improvements in Cote d'Ivoire, Ghana, Mali and Nigeria. We also found that FDI does not influence significantly the level of CO_2 emissions in Benin, Burkina Faso, Senegal, Sierra Leone and Togo. With respect to GDP, the overall result indicates that an increase in economic growth degrades environment in most of ECOWAS countries.

The results of this study suggest some policy recommendations. As FDI is growth-promoting in most countries, ECOWAS countries should adopt suitable pollution control policies in order to curb CO_2 emissions and achieve economic sustainability. Adopting more environmental friendly policies would be more potent than curbing economic growth. For Gambia, Liberia and Niger, foreign investment restrictions will be an ineffective policy to protect environment. The beneficial effect of foreign direct investment on the environment should be considered as a clean source of economic growth. Consequently, to enhance FDI inflows, countries such as Benin, Burkina Faso, Cote d'Ivoire, Ghana, Mali, Nigeria, Senegal, Sierra Leone and Togo should make the home environment more conducive to investment by reducing the cost of doing business competitive, enhancing the credibility of the reform process, increasing political and macroeconomic stability, as well as the quality of infrastructures. The results of this work clearly suggest the need for more individual country studies in order to provide us with more robust conclusions regarding policy guidelines. We suggest future research to employ firm-level data on FDI inflows so that a direct test could be made between the pollution haven and pollution halo hypotheses. Besides, other measures of environmental degradation such as water pollution, loss to aquatic life, and deforestation could also be explored.

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