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Causal Interaction between FDI, Corruption and Environmental Quality in the MENA Region

Wajdi Bardi [1],* and Mohamed Ali Hfaiedh [2]

1   Higher Institute of Management of Gabès, University of Gabes, City Riadh Zrig, Gabès 6072, Tunisia
2   Faculty of Economic Sciences and Management of Mahdia, University of Monastir,
    Road Taher Hadded B.P 56, Monastir 5000, Tunisia; hafaiedmedali@gmail.com
*   Correspondence: wajdibardi@gmail.com

Abstract: The present work analyzes the impact of foreign direct investment (FDI) and corruption on the quality of the environment in the MENA region. Indeed, the magnitude of corruption and the quality of institutions are often cited as the main factors affecting the FDI inflow. Here, the Autoregressive Distributed Lag (ARDL) approach was used to examine data on a group of MENA countries from 1990 to 2016. Our findings verify the Environmental Kuznets Curve. Furthermore, the empirical estimates approve the "pollution haven" hypothesis, which postulates that the polluting industrial activities of developed countries shift to developing countries which have less stringent environmental regulations. Based on the study findings, we recommend greater awareness of the harmful effects of corruption among political and economic actors.

1. Introduction

Access to foreign direct investment (FDI) is a priority for the various developing economies and even for developed countries to bridge the savings gap and boost domestic investment (Abdulkadir et al. 2018). Hence, development funding and the sustainability of economic growth have become increasingly related to the opening of borders to multinationals (Trumel and Muhammad 2020). This evolution of economic policy could have technological spin-offs, facilitate global trade integration, contribute to the formation of human capital and foster the creation of a more competitive business climate (Muhammad et al. 2019). However, FDI flow can play a positive role in growth only if they are combined with other complementary factors. These can be explanatory factors of growth such as labor, capital, technical progress, the level of human capital, infrastructure, the level of financial development, etc. Recently, a new factor, which takes account of the quality of the environment, has emerged as a determinant of the location of companies abroad.

This determinant was evoked by Dong et al. (2010), Pao and Tsai (2011), Grossman and Krueger (1995) and Al-Mulali and Tang (2013), stipulating that developed countries, which are concerned about protecting their environment, would give up their polluting activities to the benefit of developing countries, whose environmental regulations are lax. This is illustrated by the hypothesis of "pollution haven". However, other authors claim that this situation is an underestimation of reality and that the classical factor endowment theory remains dominant (Jaffe et al. 1995). Moreover, other works (List and Co 2000; Keller and Levinson 2002; Smarzynska and Wei 2001) found a statistically significant effect of environmental regulation on investment choices. For example, Dean et al. (2009)

validate the hypothesis of pollution haven in the case of China. In fact, they show that a lax environmental policy determines the attractiveness of a province of China.

Over the last few decades, the relationship between FDI and the quality of the environment has attracted much academic interest. Moreover, it has now become clear that this relationship is increasingly dependent on the quality of the institutions and the behavior of the people who compose it. Indeed, corruption can even influence the choices and direction of public spending.

Greenhouse gas emissions are the main cause of global warming, which is damaging the global environmental conditions by depleting the ozone layer and thus affecting the health of the population. Carbon dioxide emissions from developing countries will exceed those of the developed countries of the Organization for Economic Co-operation and Development (OECD) over the next three decades due, in part, to a higher rate of economic growth as well as the continued use of fossil fuels. One of the reasons for choosing MENA countries in this research work is based on the projection that carbon dioxide emissions from these countries' energy will be 127% higher than emissions in advanced economies by the year 2040 (EIA 2016).

The main objective of this work was to study the relationship between FDI, corruption and environmental quality for a number of countries in the MENA region. The remainder of the paper is organized as follows: Section 2 will be devoted to a review of the literature. The methodology of our analysis will be presented in Section 3. In Section 4, we will present the empirical results. A causal analysis will be described in Section 5. Finally, the last section will outline our conclusions.

2. Literature Review

On the theoretical level, the model of Antweiler et al. (2001) shows that, through specialization and trade, rich countries concerned about the quality of their environment should shifting their polluting activities to developing countries which are generally characterized by lax environmental regulations. This is known as the "pollution haven" hypothesis, according to which such havens should be located in developing countries. However, for other authors, such pollution havens do not really exist. Their findings support another theoretical approach based on the classical factor endowment theory. The results will therefore be reversed: capital-intensive activities will generally be the most polluting and should therefore be located in developed countries.

Empirically, the link between FDI and the quality of the environment is still not clearly identified. Xing and Kolstad (2002) empirically tested the effect of environmental regulation rigor on the location of polluting industries. They found a negative linear relationship between the outflows of American FDI from the chemical industry and the stringency of environmental regulation of the foreign country. Nevertheless, this relationship is not clear for the FDI of less polluting industries.

Cole et al. (2005) highlight an inverse relationship between FDI and environmental regulation. According to them, FDI influences environmental policy depending on the degree of corruption in the host country. They show that if the level of corruption is high, FDI leads to a less rigorous environmental policy.

Furthermore, lax environmental regulation is a source of attractiveness for polluting FDI flows. This result is confirmed by Cole et al. (2005) in their study of outward FDI from the United States to both developed and developing countries. They studied two types of manufacturing industries using a panel data model covering the period between 1982 and 1992. The results show that the rigor of environmental regulation impacts investment decisions, as there is an inverse relationship between environmental standards and FDI flows to developing countries.

Aliyu (2005) studied, during the period 1990–2000, the effect of environmental standards on outward FDI from 11 developed countries and 14 developing countries. The results show a positive correlation between outward FDI of polluting industries and the rigor of environmental policies in developed countries. According to the author, developing

countries should continue to attract FDI because of their contribution to GDP and economic growth. The empirical study shows that FDI is environmentally friendly; however, in the OECD countries, economic growth and strict environmental policies have increased the production cost and thus the amount of FDI abroad.

Various empirical studies have been conducted oBaekn the relationship between FDI and the quality of the environment in developing countries. The best-known of these studies are Ashraf et al. (2020), Smarzynska and Wei (2001), Eskeland and Harrison (2003), He (2006) as well as Baek and Koo (2009). These studies have attempted to answer this problem. Xing and Kolstad (2002) examined the effect of US FDI on the quality of the environment in developed and developing countries. They found that developing countries practice lax environmental regulations as a strategy to attract polluting industries, thus worsening their environmental problems. He (2006) studied the link between FDI and the environment in China and found that an increase in FDI flows damages the quality of the environment.

Baek and Koo (2009) analyzed the short and long-term relationship between FDI, economic growth (measured by GDP per capita) and environmental quality (measured by CO_2 emissions) in China and India using the ARDL approach. They found a positive and significant relationship between CO_2 emissions and FDI for China. This indirectly confirms the hypothesis of a pollution haven. However, for India, inward FDI has a negative effect on the environment in the short term, but has little impact in the long term. Therefore, there is a positive relationship between CO_2 emissions and GDP for China and India.

Baek (2015) examined the effect of FDI, growth and energy consumption on CO_2 emissions. He studied five ASEAN developing countries (Myanmar, Vietnam, Combodia, Malysia and the Philippines) during the period 1981–2010. He noted that FDI, all things being equal, appears to increase CO_2 emissions. This confirms the negative effect of the pollution haven hypothesis. It was found that, given that FDI is a driver of economic growth in developing countries, if these countries implement environmental regulations to control CO_2 emissions, there will be a corresponding reduction in FDI inflows and thus economic growth. In his econometric study, he split data into two income groups. The results show that FDI increases CO_2 emissions in low income countries, but reduces them in countries with high income levels. Furthermore, he found that income and energy consumption have a negative effect on the reduction of CO_2 emissions. The author concluded that, since growth impacts energy consumption, any attempt to promote economic growth in developing countries causes a corresponding increase in CO_2 emissions. Moreover, if these countries want to maintain the current level of their economic growth, they should try to move from the use of fossil fuels to less polluting technologies so that the global CO_2 emissions decrease.

For the same context, Omri et al. (2015) have analyzed the relationship between CO_2 emissions, financial development, trade, and economic growth using simultaneous-equation panel data models in case of 12 MENA countries over the period 1990–2011. The main findings show evidence of bidirectional causality between CO_2 emissions and economic growth. The neutrality hypothesis is identified between CO_2 emissions and financial development. Unidirectional causality running from financial development to economic growth. The empirical results also verified the existence of the environmental Kuznets curve.

Another empirical observation involving 110 countries over the period between 2005 and 2012 by Tamat et al. (2015) examined the dynamic relationship between inward FDI, pollution regulation and corruption. The authors used the Generalized Moments Method (GMM) in the dynamic panel. The results suggest that stringent environmental regulation has a negative effect on FDI, and that high levels of corruption attract FDI, contrary to previous works which show that strict environmental regulations associated with low levels of corruption attract more FDI.

Lau et al. (2014) investigated the impact of institutional quality and economic growth on carbon dioxide emissions in Malaysia during the period 1984–2008. The results of the cointegration test show that the variables have a long-term relationship. In fact, variables measuring the quality of institutions, carbon emissions and exports have a positive and significant impact on economic growth. When the variables of carbon dioxide and institutional quality emission interact, a positive and significant effect on economic growth is detected. Thus, the quality of institutions can effectively reduce carbon dioxide emissions and, thus, improve the quality of the environment and the economic growth. In addition, the Granger causality test demonstrates the contribution of institutional structures to the reduction of carbon dioxide emissions. Moreover, institutional quality influences economic growth both directly and indirectly through the continuous decrease of carbon dioxide emissions. Ben Jebli et al. (2014) examined the link between energy consumption, air pollution and climate change using the panel cointegration approach between 1990–2012. The results of the estimates state that energy consumption and air quality have a significant and positive impact on climate change. In fact, a 1% increase in energy consumption increases greenhouse gas emissions by 0.124%, carbon dioxide emissions by 0.652%, methane emissions by 0.123% and nitrous oxide emissions increase greenhouse gas emissions by 0.105%. However, the fixed and random effects regression shows a weak effect of air quality indicators on climate change. Seker et al. (2015) analyzed the impact of FDI, economic growth and energy consumption on carbon dioxide emissions in Turkey between 1974 and 2010 using an ARDL model. They proved that there is a long-term relationship between the variables. In addition, the long-term coefficient shows that the impact of FDI on carbon dioxide emissions is positive, although relatively low. However, its effects on economic growth and energy consumption are quite important. The short-term result confirms that of the long-term.

Ali et al. (2019) empirically investigated the dynamic impact of institutional quality on carbon dioxide emissions across 47 developing countries, using dynamic panel GMM estimations. The empirical finding reveals that institutional quality reduces carbon CO_2 emissions and more quality institutions will help enhance the level of environmental quality. Effective functioning of institutions in selected countries will deliver proper laws, regulations, and property rights as well as ways to combat corruption, which will reduce carbon dioxide emissions. Similarly, Ibrahim and Law (2016), studying the case of countries in sub-Saharan Africa, show that the effects of trade on the environment depend on a country's institutional framework. Thus, trade and economic openness is harmful to the environment in countries with low institutional quality and beneficial to the environment in countries with high institutional quality. Trade openness, which is linked to a solid institutional framework, brings better trade, more economic growth and better environmental quality.

Mavragabi et al. (2016) claimed that normative, cognitive, and regulative factors have a positive effect on openness of an economy. Indeed, they drive economic actors to change their behavior to be more environmentally friendly in high-income countries. They conclude that economic openness provides the conditions for "destructive creation" and the free movement of economic agents, as well as less state intervention and costs.

Ben Kheder and Zugravu-Soilita (2012) and Abid (2017) found that lax environmental regulations in host countries prevent the influx of multinationals. Investors with environmental awareness would innovate in green technology for their production instead of looking for a pollution haven (Costantini and Crespi 2008, Al-Mulali and Tang 2013).

Umer et al. (2014) examined the relationship between trade openness, public sector corruption and environmental degradation using data from 12 Asian countries over the period 1995–2012. The results of their different estimates have shown that trade openness generated by government efficiency implies that corruption in the public sector positively influences trade policies. The government can import pollution-reducing devices. Moreover, the economic growth generated by trade openness has a negative impact on pollution, and thus trade openness is good for the environment. Finally, the implementation of envi-

ronmental regulation depends on the level of corruption. Indeed, if government policies are effective, the consumers are willing to pay in order to have a healthy environment.

Neequaye and Oladi (2015) find that the environmental Kuznets curve (EKC) exists for carbon dioxide (CO_2) and does not exist for nitrous oxide and the greenhouse gases (GHG). Moreover, the authors determined that if there is a "race to the bottom" by developing countries in order to attract more FDI inflows, then an influx of environmental aid might not be enough to improve environmental quality.

The impact of FDI and corruption on environmental degradation can vary depending on the country or groups of countries and the indicators used. Indeed, there is no consensus among studies investigating this relationship. Our study participates in this debate by testing this thesis.

Here, we analyzed econometrically the effects of corruption and FDI on the quality of the environment for the case of 12 MENA countries. The countries of our study sample were Algeria, Bahrain, Egypt, Iran, Jordan, Kuwait, Morocco, Oman, Qatar, Saudi Arabia, Syria and Tunisia.

3. Empirical Analysis

3.1. Methodology and Data

Our model consisted of examining the nature of the relationship between FDI, corruption and the quality of the environment. It is largely inspired from the empirical works of Kim and Baek (2011) and Pao and Tsai (2011). The equation to be estimated has the following structure:

$$lnY_{ti} = \alpha_0 + \alpha_1 GDP_{it} + \alpha_2 ln(GDP_{it})^2 + \alpha_3 lnKL_{it} + \alpha_4 lnFDI_{it} \\ + \alpha_5 lncor_{it} + \alpha_6 lnhc_{it} + \alpha_4 lnouv_{it} + \alpha_4 lndev_{it} + \varepsilon_{it}$$

(1)

We used a panel data analysis in which the index t refers to observation years 1990–2016 and i refers to a group of MENA countries. The variable (CO_2) is a measure of the environmental quality estimated by CO_2 emissions. The variable (GDP) measures per capita income; in addition to its role of capturing the scale effect, it is a pollution reduction factor, i.e., a measure of the technical effect. The K/L ratio describes the composition effect (we expect a positive coefficient of this relationship). The variable (Cor) quantifies the effects of corruption on pollution emissions. In addition, it is important to note that all our variables are logged. The variables used in our econometric study are presented in Table 1.

Table 1. Variable definitions.

Variables	Definitions	Source
CO_2	CO_2 emissions (metric tons per capita)	World Development Indicators (WDI), 2018
FDI	Net inflows of FDI per capita	World Development Indicators (WDI), 2018
COR	Corruption index	ICRG Annual Data, 2017
HC	Human capital index	Penn World Table, 2018
GDP	GDP per capita, (constant 2011 international PPP $)	World Development Indicators (WDI), 2018
KL	Capital-labor ratio	Penn World Table, 2018
OPN	Imports + exports as a percentage of GDP	World Development Indicators (WDI), 2018
DEV	Loans granted by banks to private sectors	World Development Indicators (WDI), 2018

Table 2 summarizes the descriptive statistics of the sample.

Table 2. Descriptive statistics.

	lnCO_2	lnGDP	lnCOR	lnDEV	lnOPN	lnFDI	lnHC
Mean	−0.2067	8.887	0.8455	3.6259	11.8888	4.7042	0.6887
Median	−0.1645	8.422	0.9162	3.7709	11.826	5.0023	0.7127
Maximum	0.2959	11.1937	1.3862	4.5192	13.0278	8.1186	1.0563
Minimum	−0.9443	7.316	0.0000	1.3628	10.1989	2.9191	0.2831
Std, Dev	0.2741	1.1313	0.3416	0.6161	0.6928	1.7443	0.1823
Skewness	−0.3933	0.4637	−0.9381	−1.3251	0.5682	1.29	0.1933
Kurtosis	2.6699	1.832	3.5246	4.7758	3.0187	5.284	2.2721
Jarque–Bera (JB)	7.3382	22.4271	38.2732	102.6289	13.0272	119.7254	6.8495
JB Probability	0.0254	0.0000	0.0000	0.0000	0.0014	0.0000	0.0325

3.2. Econometric Methodology

We used the panel data ARDL approach. This approach was proposed by Pesaran et al. (1996) and modified by Pesaran et al. (2001). This technique was chosen for two main reasons. First, it is effective for the study of short and long-term relationships between the different variables that do not have the same order of integration during the study of the stationarity of the variables. Thus, the essential condition is that these variables are stationary in levels, i.e., I (0) and/or that they are in first differences, i.e., I (1). Second, the ARDL approach can remove problems related to omitted variables and autocorrelation problems between variables.

3.2.1. The Wald Test

Before proceeding with the unit root tests, it is necessary to use the Wald test to check if there is a long-term relationship between the different variables. The Wald test places some restrictions on long-term estimates. As can be seen in Table 3, the value of the F statistic shows that it is significant at 1%. Thus, the long-term (non-cointegrating) null hypothesis is rejected. Hypothesis H1 is accepted, which means that there is a long-term relationship.

Table 3. Wald test results.

Test Statistic	Value	df	Probability
F-statistic	32.3085	(2, 136)	0.0000 *
Chi-square	64.617	2	0.0000 *

* indicate a significance at 1% significance.

The model is verified under Hypothesis H1, which means that there is a long-term relationship between the variables of the model.

3.2.2. Unit Root Tests

Before estimating our model, it is useful to proceed to the stationarity tests of the variables retained as necessary conditions. Thus, all variables have upward or downward trends and show breaks. To test the stationarity of the series, we applied a battery of unit root tests. In particular, we used the tests of Levin et al. (2002) [LLC], Im et al. (2003) [IPS], Breitung (2000) and Hadri (2000). All these tests are considered as first-generation unit root tests because they assume cross-sectional independence among units. Thus, we must mention that under the test null hypothesis of Hadri (2000) the series is stationary. However, the null hypotheses of the other tests are those of the unit root. The use of the two types of tests may be advantageous to avoid the power loss noted when each cross-sectional variant is close to the unit root. Finally, we chose among the second-generation tests, that of Choi (200), namely the Z and the Fisher statistics.

Since the ARDL model does not apply to the series exceeding an integration order of 2 (I (2)), we applied unit root tests to ensure that the series are I (0), I (1) or I (1) and I (0) (Pesaran et al. 1996; Pesaran et al. 2001). Tables 4 and 5 illustrate the results of unit root tests.

Table 4. Unit Root Test Results: Level Series.

	LNCO$_2$	LNGDP	LNCOR	LNFDI	LNKL	LNHC	LNDEV
LLC	−1.7960 **	1.0229	1.5253	−3.4737 *	0.3578	−1.7234	−3.797 *
IPS	−2.7489 *	1.37082	1.7476	−2.9157 *	0.0778	0.2517	−3.301 *
Breitung	−2.3243 *	1.87125	1.5342	1.5889 *	0.6219	1.5172	−1.57 **
Hadri	2.9196 *	5.04045	5.9942	4.4488 *	8.5930	8.9040	6.6386 *
Choi:Z	−2.7585 *	1.46884	1.8160	−2.8179 *	0.1963	0.2307	−2.55 **
Choi Fisher	−2.8054 *	0.93827	1.5963	−3.6757 *	0.1720	1.9700	−3.31 **

** and * indicate, respectively, a significance at 5% and 1%. Source: Authors' Estimates.

Table 5. Unit Root Test Results: First-Difference Series.

	ΔLNCO$_2$	ΔLNGDP	ΔLNCOR	ΔLNFDI	ΔLNKL	ΔLNHC	ΔLNDEV
LLC	−16.4587 *	−12.4213 *	−12.4213 *	−14.9387 *	−2.307 **	2.3795 **	−5.4049 *
IPS	−15.6605 *	−10.4646 *	−10.6629 *	−15.4813 *	−1.918 **	2.3034 **	−6.0527 *
Breitung	−8.2832 *	−4.16238 *	−6.5817 *	−7.5182 *	−2.322 **	−2.2059 **	−1.3231 **
Hadri	3.3135 *	2.77759 *	4.0042 *	4.2513 *	5.0349 **	5.3255 **	4.6563 *
Choi:Z	−11.8641 *	−8.37656 *	−8.9719 *	−12.4309 *	−1.868 **	2.4781 **	−5.3791 *
Choi Fisher:	−12.2880 *	−8.67198 *	−9.4681 *	−15.8769 *	−5.223 **	3.7045 **	−7.4649 *

** and * indicate a significance at 5% and 1%, respectively. Source: Authors' Estimates.

Tables 4 and 5 show that the unit root null hypothesis cannot be rejected for the following series: GDP per capita, the measure of corruption, the capital/labor ratio and the human capital index. However, the CO$_2$ emissions, the FDI variable and loans granted by banks to private sectors are stationary in levels.

In short, we note that our data are I (0) and I (1), which enables us to estimate both the short-term and the long-term relationships between environmental quality, corruption index and FDI flows using the ARDL approach.

3.2.3. Cointegration Test

Table 6 presents the result of cointegration test of Pedroni (2004).

Table 6. Pedroni Cointegration Test (2004) Results.

Panel v-Stat	Panel Rho-Stat	PanelP p-Stat	Panel ADF-Stat	Group Rho-Stat	Group PP-Stat	Group ADF-Stat
−0.8121	2.8113	−1.982 **	−3.7675 *	4.0995	−8.0844 *	−3.0228 *
(0.7917)	(0.9975)	(0.0237)	(0.0001)	(1.0000)	(0.0000)	(0.0013)

** and * indicate a significance at 5% and 1%, respectively. Source: Authors' Estimates.

Table 6 presents the results of the Pedroni (2004) cointegration test. Four out of seven statistics indicate the rejection of the null hypothesis of non-cointegration. Among which, the automatic direction finder (ADF) panel and the ADF Statistics group are considered to be the most reliable statistics by Pedroni (2004). In our study, the null hypothesis of non-cointegration is rejected at the 1% level by the ADF-panel statistic and the group-ADF statistic. Therefore, we can conclude that there is a long-term relationship between the variables retained in our analysis of 12 MENA countries.

4. Results and Interpretation

As can be seen in the table below, the first difference of the variables examined is designated by Δ. The term CointEq(−1) defines the delayed residue from our long-term equilibrium equation. The negative sign of the coefficient estimated for the model thus confirms the presence of an error correction tool. The cointegration coefficient of the equation explains the order in which the variable Yt (CO$_2$ emissions) would be mobilized

towards the long-term goal. For our ARDL models, this coefficient is estimated at -0.2770 and -0.5986 for model 1 and model 2, respectively.

The short-term results indicate that the environmental Kuznets curve (EKC) is not validated for both models with respect to our sample. The corruption index is of negative sign and the FDI coefficient is positive.

CointEq(-1): the delayed residue from the long-term equilibrium equation.

In the long run, and based on the results illustrated in Table 7, we note that the EKC is verified for the MENA region in both models with significant coefficients. Indeed, the coefficient of the per capita GDP growth variable is positive and that of the growth of per capita GDP squared is negative. This shows the existence of a relationship of second order and a concave relationship between these two variables.

Table 7. Results of the application of the ARDL approach.

Variables	Dependent Variable: ln CO_2					
	Coef	Std.Err	*p* Value	Coef	Std.Err	*p* Value
	Short-Run Coefficients					
ΔlnGDP	3.7385	8.9104	0.7186	3.7407	5.617	0.5891
ΔlnGDP2	-1.7222	4.9549	0.7286	-1.8027	2.919	0.5397
ΔlnCOR	-0.0067	4.9549	0.9368	-0.0549	0.1691	0.7457
ΔlnFDI	0.0197	0.0108	0.0701	0.0292	0.0184	0.1148
ΔlnKL	0.2752	0.5149	0.5937	-0.3133	0.5012	0.5329
ΔlnHC				-2.0717	3.6733	0.5737
ΔlnDEV				-0.1303	0.1611	0.4201
C	-0.7254	0.3394	0.0341	9.4983	2.1908	0.0000
CointEq(-1)	-0.277 *	0.1235	0.0263	-0.5986 *	0.1377	0.0000
	Long-Run Coefficients					
lnGDP	1.8663 *	0.404	0.0000	4.4575 *	9.3757	0.0000
lnGDP2	-0.0995 *	0.02	0.0000	-0.2325 *	0.598	0.0000
lnCOR	-0.1136 *	0.0313	0.0004	-0.719 ***	0.5658	0.0403
lnFDI	0.055 *	0.0046	0.0000	0.0126 *	0.0326	0.0002
lnKL	-0.5339 *	0.0693	0.000	0.3568 *	0.0861	0.0001
lnHC				0.3808 ***	0.2239	0.0912
lnDEV				0.1215 *	0.0209	0.0000

* and *** indicate 1%, and 10% significance, respectively. Δ: operator of first difference for variables.

The coefficient of the capital/labor ratio variable is positive and significant, showing the composite effect of our sample. Therefore, the capital/labor ratio has a positive effect on the quality of the environment.

From results of the econometrics regression, we can see that the effect of foreign trade is negative for MENA countries because it increases carbon emissions, and FDI has a significant positive effect on CO_2 emissions. The coefficient means that although the rush of foreign investment can promote economic development, it contributes to high levels of pollution. Therefore, we support the PHH existing. Our results argue that FDI will tend to spread greener technology to host countries for environmental improvement of MENA countries.

The corruption index has a negative and statistically significant coefficient. Thus, corruption has a negative effect on the quality of the environment. We can conclude that the quality of the institutions prevents MENA countries from effectively implementing their environmental policy following an increase in income. The proxy variable indicating the quality of education influences the quality of the environment positively. Finally, the financial development variable has a positive effect on the quality of the environment.

5. Causality Analysis

We used F statistic and the Granger test to study the causality between different variables. As can be seen from Table 8, there is a two-way long-term causality between CO_2 emissions and FDI. Furthermore, there is a unidirectional causality running from the corruption index to the quality of the environment for all the studied countries. Although the conclusions may be contradictory on the basis of specific national studies, the value of using a panel data structure somehow helps to provide a broad or more general view.

Table 8. Panel causality results.

Short-Term Causality	F-Statistic	*p*-Value
DGDP → DCO$_2$	2.69418	0.0495 **
DCO$_2$ → DFDI	2.14988	0.0113 **
DGDP → DKL	7.61632	0.0006 *
DCO$_2$ → DCOR	3.92422	0.0391 **
Long-Term Causality	**F-Statistic**	***p*-Value**
lnFDI → lnCO$_2$	3.83794	0.0231 **
lnCO$_2$ → lnFDI	2.75153	0.0463 **
lnKL → lnCO$_2$	2.98659	0.0424 **
lnCO$_2$ → lnKL	4.59807	0.0110 *
lnCOR → lnCO$_2$	2.03651	0.0356 **

** and * indicate a significance at 5% and 1%, respectively.

With respect to short-term causality, we found a reverse direction to that found in the long-term causality study. There is a direction of causality of CO_2 towards the corruption index. Only the sense of causality running from CO_2 emissions to FDI is verified.

6. Conclusions

In this paper, we examined the question in relation to the environmental situation and the sustainable development should be one of the priorities of the global economy. This is one of the main reasons why we conducted our study on a sample of MENA countries. For this, we used an ARDL method which gives us the opportunity to estimate the long-term effects of several variables such as FDI and Corruption on Environmental Quality.

The major results are as follows: Firstly, the EKC, detected in this work for our sample, assumes that there is an inverted U relationship between pollutants emissions and the level of per capita income. This notion breaks with the pessimistic view that economic growth is a source of environmental degradation. The results can be compared to the work of Doytch and Uctum (2016).

Second, the effects of other variables, such as FDI and corruption, are important for the implementation of the environmental strategy, given that some investments are direct sources of pollution related to CO_2 emissions and that they have consequences on climate change. The rapid economic growth and foreign direct investment, which has been observed in the last few decades and expected to continue will have negative ecological consequences. The MENA countries should choose and privilege the FDI as it is less polluting and a friend of green economics. According to Hakimi and Hamdi (2017) and Helmy (2013), by studying the case of some countries in the MENA region, it can be shown that corruption appears to be an obstacle to economic growth, in the sense that it negatively affects the choice of investments and slows the inflows of foreign direct investment. If we link with our article, we can see that these non-productive investments are a source of pollution, which will be acquired in the countries. To do this, these countries must take anti-corruption measures to promote the inflows of foreign direct investments that bring added value and that provide certain non-polluting technological knowledge. Hence, corruption makes local bureaucracy less transparent and acts as a tax on foreign investors. Therefore, investors control the investment environment over time. Therefore, countries are invited to struggle against all forms of corruption.

A significant difference in environmental policy between countries displaces foreign investment from industrialized countries, where environmental policy is rigorous, to developing countries where environmental policy is lax. This could undermine the process of technology transfer provided by FDI through its positive externalities (Muhammad Hafeez et al. (2020) and Muhammad et al. (2019)). However, for this effect to take place, a level of economic stability and quality of institutions are required. In addition, it is important to develop the knowledge and skills of local businesses so that the country can benefit from the environmental benefits of FDI. Accordingly, developing countries have an interest in attracting better-performing foreign firms to take advantage of technological externalities, thereby promoting their sustainable development.

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