DO HUMAN CAPITAL AND GOVERNANCE THRESHOLDS MATTER FOR THE ENVIRONMENTAL IMPACT OF FDI? THE EVIDENCE FROM MENA COUNTRIES[1]

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Abstract

This paper investigates whether the impact of foreign direct investment (FDI) on CO_2 emissions may change depending on the data-driven estimated threshold levels for the country characteristics (CC) including human capital and governance in a panel of 13 Middle East and North Africa (MENA) economies over the 1996-2019 period. Our results strongly suggest that endogenously estimated CC thresholds matter for the environmental impact of FDI inflows. The pollution haven hypothesis which maintains that FDI inflows lead to pollution, appears to be valid for economies with weak CC. On the other hand, the pollution halo argument suggesting FDI lowers the emissions appears to be hold in countries with strong CC. The empirical findings in this study suggest that policies aiming to improve human capital and governance may be expected not only to increase the economic benefits of FDI in terms of growth but also mitigate the negative environmental impacts of FDI in the MENA region.

JEL Classification: Q3, G1

Keywords: Foreign Direct Investment, CO_2 Emissions, Human Capital, Governance, Middle East and North Africa Economies, Panel Threshold Model.

ملخص

تبحث هذه الورقة فيما إذا كان تأثير الاستثمار الأجنبي المباشر (FDI) على انبعاثات ثاني أكسيد الكربون قد يتغير اعتمادا على مستويات العتبة المقدرة القائمة على البيانات لخصائص البلد (CC) بما في ذلك رأس المال البشري والحوكمة في لجنة من 13 اقتصادا في الشرق الأوسط وشمال أفريقيا (MENA) خلال الفترة 1996-2019. وتشير النتائج التي توصلنا إليها بقوة إلى أن عتبات CC المقدرة داخليا مهمة بالنسبة للأثر البيئي لتدفقات الاستثمار الأجنبي المباشر الواردة. ويبدو أن فرضية ملاذ التلوث التي تؤكد أن تدفقات الاستثمار الأجنبي المباشر تؤدي إلى التلوث، صالحة للاقتصادات ذات التغير المناخي الضعيف. ومن ناحية أخرى، يبدو أن حجة هالة التلوث التي تشير إلى أن الاستثمار الأجنبي المباشر يخفض الانبعاثات ثابتة في البلدان التي لديها مقاومة قوية. تشير النتائج التجريبية في هذه الدراسة إلى أنه من المتوقع ألا تؤدي السياسات الرامية إلى تحسين رأس المال البشري والحوكمة إلى زيادة الفوائد الاقتصادية للاستثمار الأجنبي المباشر من حيث النمو فحسب، بل أيضا إلى التخفيف من الآثار البيئية السلبية للاستثمار الأجنبي المباشر في منطقة الشرق الأوسط وشمال أفريقيا.

1. Introduction

Environmental degradation has emerged as a serious concern for developing countries, especially for the Middle East and North Africa (MENA) economies. Abumoghli & Goncalves (2020) draws attention to the extensive use of fossil fuels and non-renewable energy sources in production along with prevailing environmental issues such as air pollution, loss of biodiversity and inadequate waste management. According to World Development Indicators (WDI) database, CO_2 emissions per capita in 1975 were 0.48 kg in the MENA and it is around 0.56 in Organization for Economic Co-operation and Development (OECD) countries. However, the carbon emissions of MENA have been increased to 0.73 in 2017 while the carbon emissions of the OECD decreased to 0.22.

High CO_2 emissions may prevent developing countries to achieve their development goals, particularly the Sustainable Development Goals which focus on promoting a green economy. "Greening" is associated with the low-carbon energy transitions aiming not only access to renewable energy sources but also reduction in poverty along with job creation (Siciliano et al., 2021). Therefore, mitigation of CO_2 emissions is crucially important to provide the sustainability of environment. Implementing proactive strategies to mitigate ecosystem vulnerability and ensure the environmental sustainability matter for policymakers in developing countries, including MENA.

The environmental economics literature investigates the possible determinants of environmental degradation. The earliest of these studies consider income per capita (Grossman & Krueger, 1995; Heil & Selden, 1999) and energy consumption (Pao & Tsai, 2010) as the most important determinants of CO_2 emissions. Afterwards, the effects of many other variables such as technological innovation (Khan et al., 2020), trade openness (Copeland & Taylor, 2005), financial development (Ozturk & Acaravci, 2013), urbanization (Zhang et al., 2017) and foreign direct investment, FDI, (Levinson & Taylor, 2008; Lee, 2009) on pollution are investigated. Among these variables, one of the most important, especially for developing countries, is the FDI. The international economics literature maintains that FDI often leads to better growth episodes not only by providing efficient allocation of capital, access to financial markets and new technology but also by increasing total factor productivity. While FDI inflows have often been associated with high growth rates, the bulk of the environmental economics literature maintains that FDI provides deleterious results for the environment. This paper aims to investigate the relationship between pollution and FDI for the MENA economies.

The literature investigating the environmental effect of FDI has been centered around two views: The first one is the "pollution haven" hypothesis maintaining that the impact of FDI is environmental degradation. This may be consistent with the fact that advanced economies locate pollution-intensive activities to developing countries with lax environmental restrictions and regulations by FDI linkages (Levinson & Taylor, 2008). The second one is the "pollution halo" hypothesis suggesting the impact of FDI is environmental improvement (Cole et al., 2011). This may be in line with the argument that international firms with high environmental quality may bring sophisticated, energy-efficient, environmentally cleaner technologies to host economies along with better environmental management systems (Wang & Chen, 2014). Although it has been widely studied by the literature, the investigation of FDI inflows and pollution is still one of the most important research topics in environmental economics.

The bulk of the literature often maintains that the impacts of FDI on pollution are invariant to the country characteristics (CC) including human capital and institutional quality and governance levels. However, the investment decisions of multinational firms may be affected by the prevailing CC (Mengistu & Adhikary, 2011; Noorbakhsh et al., 2001; Cantwell et al., 2010). In this context, conventional wisdom maintains that more educated labor demands clean environment, promotes the use of renewable energy products, energy efficiency and tends to better adopt environmental regulation as well as greener technology. On the other hand, economies with well-established rules, norms and regulations allow them to implement environmental protection policies. In this vein, the empirical findings by Wang & Chen (2014), Bokpin (2017), Omri & Hadj (2020), and Bouchoucha (2021) show that improvements in institutions mitigates the effect of FDI on pollution. The empirical findings by Tang et al. (2021) suggest the crucial importance of human capital and institutions for sustainable development prioritizing lower pollution. Considering all these issues, we may plausibly assume that the level of CC matters in explaining the effect of FDI on pollution. Furthermore, the CC may provide a data-driven estimated threshold for the effect of FDI on pollution. The literature often tackles the nonlinearity either by some interaction specifications or *ad hoc* sample splitting procedures which maintain that the threshold level is exogenous. As an alternative, the threshold levels for the effect of FDI on pollution may better be investigated by employing data-driven estimation procedures. To our knowledge, this is the first study that investigates the FDI-pollution relation by subjecting it to data-driven estimated threshold level of CC. In this novel empirical context, we examine the thresholding effect of CC in explaining the FDI-pollution relation by employing panel fixed effects threshold procedure of Hansen (1999) for a balanced panel of 13 MENA economies over the 1996-2019 period.

Our panel fixed effects threshold estimation results suggest that CC including human capital and institutional quality and governance provide data-driven estimated thresholds in explaining the impact of FDI on pollution. Accordingly, FDI leads to pollution in economies with weak CC consisting of less educated labor and unfavorable institutional quality and governance. On the other hand, the impact of FDI is environmental quality enhancement in economies with better CC including more educated labor and favorable institutional quality and governance. The empirical findings in this study suggest that pollution haven hypothesis appears to be hold in economies with weak CC while pollution halo is the case for the economies with strong CC. The findings of this study suggest that to reap the environmental enhancing effect of FDI, MENA countries, whose growth requires the promotion of FDI inflows, may implement policies aiming to improve human capital and institutional environment.

The plan for the rest of this paper is as follows. Section 2 provides a brief literature review on FDI-pollution relation. Section 3 explains the data and reports some descriptive statistics. Section 4 introduces the panel fixed effects threshold estimation procedure by Hansen (1999) and reports the estimation results. The empirical methodology is introduced in Section 4.1. Section 4.2 provides estimation results for the thresholding effect of human capital and Section 4.3 presents the results for the thresholding effect of institutional quality and governance. Finally, Section 5 concludes and provides some policy implications.

2. A Brief Literature Review

The literature suggests that FDI is crucially important for growth while the environmental effect of FDI is mixed. The literature investigating the impact of FDI inflows on pollution points to the "pollution haven" and "pollution halo" hypotheses.

According to the "pollution haven" hypothesis, FDI inflows increase CO_2 emissions in the host country (Bommer, 1999; Cole & Neumayer, 2005; He, 2006). This is mainly related with not only higher production caused by FDI but also prevailing lax environmental restrictions and exemptions in developing economies. The former leads to more energy consumption and CO_2 emissions (Frankel & Romer, 1999). The latter suggests that developed countries shift their emission intensive economic activities to developing countries leading them to have a comparative advantage in pollution-intensive productions (Aliyu, 2005). It is argued that FDI inflows from developed to developing countries are used to finance pollution-intensive, environmentally inefficient production and infrastructure projects. (Jorgenson, 2009).

On the other hand, FDI provides a positive impact on the environment through the transfer of environment-friendly production techniques and management practices from developed to developing countries, as suggested by the "pollution halo" hypothesis (Levinson & Taylor, 2008; Eskeland & Harrison, 2003). FDI inflows may lead to the expansion of less polluting labor-intensive industries by taking advantage of the cheap labor in emerging market economies (He, 2006).

The bulk of the empirical literature investigates the validity of pollution haven/halo hypotheses. However, there is no consensus on the environmental effects of FDI. Some of the studies suggest the validity of the "pollution haven" hypothesis. Mukhopadhyay (2006) finds that Thailand was a pollution haven for OECD countries in 2000. The cointegration-based empirical results by Acharyya (2009) suggest that FDI leads to environmental degradation in India during the 1980-2003 period. Zhang (2011) notes that FDI inflows increase carbon emissions in China. This appears also to be the case for Africa (Kivyiro & Arminen, 2014; Bokpin, 2017). The empirical findings by Seker et al., (2015), Salahuddin et al., (2018) and Abdouli & Hammami (2017) suggest the environmental degradation effect of FDI is also the case for the members of MENA. Shahbaz et al., (2015) find that "pollution halo" hypothesis appears to be hold in high-income countries while "pollution haven" hypothesis is the case for low-income countries. Their results also suggest that FDI inflows increase carbon emissions up to a certain threshold level of FDI beyond which FDI decelerates carbon emissions in middle-income countries. The empirical results by Wang & Chen (2014) show that FDI from OECD countries supports the pollution haven hypothesis while FDI from Hong Kong, Macao, and Taiwan has an insignificant impact on environmental degradation in China. Shahbaz et al., (2019) find an N-shaped relationship between FDI and CO_2 emissions in MENA countries by using the generalized method of moments (GMM) approach.

On the other hand, some other studies provide empirical support to the validity of the "pollution halo" hypothesis (List & Co, 2000; Mielnik & Goldemberg, 2002, Wheeler, 2001, Zhu et al., 2016, Al-Mulali & Tang, 2013). List & Co (2000) and Mielnik & Goldemberg (2002) support the "pollution halo" hypothesis by arguing that FDI inflows from developed countries contribute to the promotion of energy efficiency in developing countries. Similarly, Wheeler (2001) demonstrates that FDI inflows lead to reductions in air pollution in Brazil, China, and Mexico. Using panel quantile regressions, Zhu et al. (2016) also support the "pollution halo" hypothesis for the Association of Southeast Asian Nations (ASEAN) economies. The panel fixed effects threshold estimation results by Aluko et al. (2021) suggest that the level of income and globalization provide data-driven estimated thresholds for the effect of FDI on pollution. They find that the impact of FDI is environmental enhancing in economies with lower levels of income and globalization while it leads to environmental degradation in countries with higher levels of income and globalization.

Conventional wisdom maintains that more educated labor demands clean environment, promotes the use of renewable energy products, energy efficiency and tends to better adopt environmental regulation as well as greener technology. As consistent with this argument, the empirical literature investigating the relationship between human capital and the environment suggests that pollution is lower in economies with better educated labor. For instance, Bano et al. (2018) find that human capital leads to an improvement in environmental quality in Pakistan. Also, the results by Ahmed & Wang (2019) show that human capital decreases ecological footprint in India. Lan et al. (2012) find that FDI leads to an improvement in environment for the provinces of China with better educated labor.

According to institution-based approach, the institutional structure of the host country is effective for the environmental impacts of FDI inflows (Cantwell et al., 2010; Zhu et al., 2013; Wang & Chen, 2014; Tamazian & Rao, 2010; Abid, 2016; Ali et al., 2019). In economies with better institutions, environmental rules are clear, transparent, consistent and strict. (Wang & Chen, 2014). The presence of a good institutional environment which is an indicator for the implementation of better environmental protection policies, has been led multinational corporations to invest in environmentally friendly technologies and implement more responsible waste creation and management (King & Shaver, 2001; Christmann, 2004). In this vein, it may be plausible to assume the impact of FDI is environmental enhancing in economies with better institutions. In a more institutionally sound environment, local businesses tend to increase their efficiency and innovation to compete with multinational firms (Wang & Chen, 2014). Bokpin (2017), Omri & Hadj (2020) and Bouchoucha (2021) find that good governance is essential for FDI inflows to decrease carbon emissions.

3. FDI-CO_2 Emissions: The Data and Some Descriptive Statistics

This study aims to investigate the relationship between foreign direct investment (FDI) inflows and CO_2 emissions. We investigate this crucially important question for a balanced panel of 13 Middle East and North Africa (MENA) economies (Algeria, Bahrain, Egypt, Iran, Israel, Jordan, Kuwait, Morocco, Qatar, Saudi Arabia, Tunisia, Turkey and the United Arab Emirates) over the 1996-2019 period. The choice of the sample is mainly determined by data availability. Considering that MENA cannot be treated as a single unit because of the heterogeneity in natural resource endowments, we investigate the relationship between FDI-CO_2 emissions also for the samples of oil-exporting (Algeria, Bahrain, Egypt, Iran, Kuwait, Qatar, Saudi Arabia and the United Arab Emirates) and -importing (Israel, Jordan, Morocco, Tunisia and Turkey) MENA.

In this study, CO_2 is the natural logarithm of CO_2 emissions per tones per capita, GDPpc is the natural logarithm of real GDP per capita, REC is the renewable energy consumption as a percent of total energy consumption, GOV is the institutional quality and governance, HC is the human capital index and FDI is the foreign direct investment inflows as a percent of GDP. The data for CO_2 emissions are from Joint Research Centre Emissions Database for Global Atmospheric Research. Real GDP per capita and FDI inflows data are taken from United Nations Conference on Trade and Development database. Governance and institutional quality data are taken from World Bank Governance Indicators. The governance and institutional quality data consider the six characteristics including voice and accountability, political stability and violence, government effectiveness, regulatory quality, rule of law and control of corruption (Kaufmann et al., 2005). These variables are between -2.5 and 2.5 with higher values denoting better institutional quality and governance. We consider a simple average of six variables as a proxy for institutional quality and governance. HC is the human capital index constructed based on years of schooling and returns to education and the data are taken from Penn World Table (Feenstra et al., 2015). HC has values between 1.00 and 4.35 with higher values representing more educated labor.

Table 1. Some Descriptive Statistics

	CO_2	FDI	GDPpc	REC	HC	GOV
	Whole Sample					
Mean	13.141	2.661	18858$	4.636	2.355	0.539
Median	7.486	1.808	8312$	0.907	2.273	0.545
St. Dev.	13.4	3.309	19043	6.048	0.473	0.243
	Oil-exporting MENA					
Mean	18.825	2.149	24171$	0.962	2.298	0.500
Median	19.732	1.096	20688$	0.062	2.262	0.490
St. Dev.	14.252	3.244	20668	2.113	0.307	0.274
	Oil-importing MENA					
Mean	4.046	3.481	10357$	10.515	2.445	0.603
Median	3.036	2.597	4141$	11.875	2.335	0.560
St. Dev.	2.774	3.259	11988	5.640	0.647	0.167

Note: St. Dev. represents standard deviation for the corresponding variable.

Table 1 reports some descriptive statistics for our variables of interest. Accordingly, the mean of CO_2 emissions per tones per capita[3] is around 13.14 for the whole sample, 18.83 for the oil-exporting MENA and 4.05 for the oil-importing MENA. As compared to the oil-importing MENA, CO_2 emissions are much higher and more volatile in oil-exporting MENA. The mean FDI inflows is around 2.7 for the whole sample, albeit it is slightly much higher in oil-importing MENA economies. The volatility of FDI is almost the same both in oil-exporting and -importing MENA. The mean income per capita is around 19000$ for the whole sample. In comparison to the oil-importing MENA, the mean and volatility of income are much higher for the oil-exporting MENA. On the other hand, the average renewable energy consumption is substantially much higher in oil-importing MENA economies. The means of human capital and institutional quality and governance are almost the same in both sub-samples.

4. Empirical Methodology and Estimation Results

4.1. Empirical Methodology

To investigate the effect of FDI on CO_2 emissions, we consider the following benchmark equation:

$$CO2_{it} = \alpha_i + \alpha_1 GDPpc_{i,t-1} + \alpha_2 REC_{it} + \alpha_3 GOV_{it} + \alpha_4 HC_{it} + \alpha_5 FDI_{it} + u_{it} \qquad (1)$$

In eq.(1), the subscript i and t denote, respectively, country and time, CO2 is the natural logarithm of CO_2 emissions per tones per capita, GDPpc is the natural logarithm of real GDP per capita, REC is the renewable energy consumption as a percent of total energy consumption, GOV is the average of six aspects of institutional quality and governance, HC is the human capital index and FDI is the foreign direct investment inflows as a percent of GDP.

Eq. (1) maintains that CO_2 emissions can be explained by income, renewable energy consumption, governance and institutional quality, human capital and FDI inflows. Considering the conventional environmental Kuznets curve maintaining that CO_2 emissions increase with income up to a certain threshold level beyond which pollution decreases with income, real GDP per capita may be potentially endogenous for the evolution of CO_2 emissions. To tackle this issue, we prefer to use lagged income per capita.

In Eq. (1), a positive (negative) and significant coefficient for FDI provides empirical support to the validity of pollution haven (halo) hypothesis. According to Eq. (1), the impact of FDI on CO_2 emissions is invariant to the country characteristics (CC) including human capital and institutional quality levels. The conventional wisdom maintains that more educated labor demands clean environment, promotes the use of renewable energy products, energy efficiency and tends to better adopt environmental regulation. Kwon (2009) notes that better educated labor provides efficiency related solutions like employment of emission reduction technologies. On the other hand, well-established rules, norms and regulations for the environment may affect

[3] The mean of pollution is substantially much higher in oil-exporting countries. This may provide a support for the division of whole sample as oil-exporting and -importing countries.

the sensitivity of CO_2 emissions to FDI inflows. In this vein, economies with better institutional quality and governance implement policies to protect the environment. All of these may indicate that the effect of FDI on pollution may not be the same in economies with better CC and weak CC. Furthermore, the CC consisting of human capital (HC) and institutional quality and governance (GOV) may provide data-driven estimated thresholds in explaining the impact of FDI on pollution. To this end, we consider the following specification:

$$CO2_{it} = \alpha_i + \alpha_1 GDPpc_{i,t-1} + \alpha_2 REC_{it} + \alpha_3 GOV_{it} + \alpha_4 HC_{it} + \alpha_5 FDI_{it}(CC_{it} \leq \lambda) + \alpha_6 FDI_{it}(CC_{it} > \lambda) + u1_{it} \quad (2)$$

Alternatively, eq.(2) can also be written as the following:

$$CO2_{it} = \alpha_i + \alpha_1 GDPpc_{i,t-1} + \alpha_2 REC_{it} + \alpha_3 GOV_{it} + \alpha_4 HC_{it} + \begin{cases} \alpha_5 FDI_{it} & if\ CC_{it} \leq \lambda \\ \alpha_6 FDI_{it} & if\ CC_{it} > \lambda \end{cases} + u2_{it} \quad (3)$$

Under the null hypothesis that $\alpha_5 = \alpha_6$ in eq.s (2) and (3), there is no significant thresholding effect of CC in explaining the impact of FDI on pollution, and we obtain the linear model in eq. (1). After trimming the smallest and largest 5% of the observations, we search for the threshold by considering the rest of all variables as a potential candidate. For each potential candidate, we employ panel least squares to the de-meaned sample and select the threshold that gives the minimum sum of squared residuals. The observations in the sample are partitioned into the low and high regimes based on the data-driven estimated CC threshold value for λ. For instance, if CC ≤ λ, then the estimated coefficient α_5 shows the effect of FDI on pollution in the low regime containing weak CC. Otherwise, if CC > λ, the estimated parameter α_6 represents the impact of FDI on CO_2 emissions in the high regime consisting of better CC. The low and high regimes are differentiated from each other with different slope parameters.

We estimate the Eq. (2) for a balanced panel of 13 MENA economies over the 1996-2019 period by employing panel fixed effects threshold estimation procedure by Hansen (1999). Considering the heterogeneity in the whole sample in terms of natural resource endowments, we estimate this equation also for the oil-exporting and -importing MENA. Our results (not reported to save the space but available on request) suggested not to reject the null hypothesis that two thresholds (three regimes) are insignificant for all the specifications considered in this paper. The trimming parameter for the Hansen procedure is set to be 0.05 at both ends of the threshold variable.

4.2. Thresholding Effect of Human Capital

First, we investigate whether human capital (HC) provides data-driven estimated threshold in explaining the effect of FDI on CO_2 emissions. To this end, we consider the following equation:

$$CO2_{it} = \alpha_i + \alpha_1 GDPpc_{i,t-1} + \alpha_2 REC_{it} + \alpha_3 GOV_{it} + \alpha_4 HC_{it} + \alpha_5 FDI_{it}(HC_{it} \leq \lambda) + \alpha_6 FDI_{it}(HC_{it} > \lambda) + u3_{it} \quad (4)$$

Eq.s (4.1), (4.2) and (4.3) in Table 2 provide the estimation results of Eq. (4), respectively, for the whole sample, oil-exporting and oil-importing MENA. Accordingly, human capital provides data-driven estimated threshold for the effect of FDI on CO_2 emissions. The endogenously estimated threshold level of human capital is around 2.7 for the whole sample, 2.6 for the oil-exporting MENA and 3.4 for the oil-importing MENA. Table 1 reports that the mean of human capital is around 2.4. The data-driven estimated threshold value is almost the same with the mean of human capital for the whole sample and oil-exporting MENA, albeit it is slightly higher for oil-importing MENA. Almost 20 percent of the observations are in the high regime including more educated labor episodes.

Table 2. Thresholding Effect of Human Capital

	Whole Sample Eq. (4.1)	Oil-Exporting MENA Eq. (4.2)	Oil-Importing MENA Eq. (4.3)
Threshold HC	2.699***	2.582***	3.404**
F_B[.]	20.59 [0.00]	9.79 [0.00]	16.73[0.05]
FDI_{it}	0.006**	0.008**	0.003
($HC_{it} \leq \lambda$)	(0.002)	(0.003)	(0.002)
FDI_{it}	-0.016***	-0.017**	-0.026***
($HC_{it} > \lambda$)	(0.005)	(0.008)	(0.007)
$GDPpc_{i,t-1}$	0.681***	0.734***	0.713***
	(0.052)	(0.067)	(0.086)
REC_{it}	-0.003	-0.027	-0.012**
	(0.004)	(0.021)	(0.004)
GOV_{it}	-0.111**	-0.055	-0.232***
	(0.041)	(0.055)	(0.069)
HC_{it}	-0.071*	-0.001	-0.316***
	(0.038)	(0.047)	(0.064)
Constant	-4.118***	-4.500***	-4.102***
	(0.445)	(0.617)	(0.655)
Statistics	N =13 NT =299	N = 8 NT = 184	N = 5 NT = 115
	R^2 = 0.574	R^2 = 0.550	R^2 = 0.799
	F = 62.74[0.00]	F = 34.59 [0.00]	F = 68.88 [0.00]

Note: F_B is the bootstrapped F-test based on 1000 replications to test the statistical insignificance of the threshold level and [.] is the p-value of the test. The values in parentheses are the standard errors. *, ** and *** respectively, denote significance at 10%, 5% and 1% levels. N and NT are, correspondingly, the numbers of countries and the effective number of observations.

The estimation results in Table 2 suggest that, for the oil-exporting MENA and whole sample, the impact of FDI on CO_2 emissions is positive and significant in the low regime including observations with less educated labor. On the other hand, for all equations, the sensitivity of pollution to FDI is negative and significant in the high regime including more educated labor episodes. This empirical finding may suggest that pollution haven tends to be the case for economies with less educated labor while pollution halo appears to be hold in economies with better educated labor. An increase in income which is the aggregated measure of economic activities leads to higher CO_2 emissions. This is consistent with the scale effect explanations by Grossman & Krueger (1995) maintaining higher income is associated with deterioration in environment. An increase in the share of renewable energy consumption leads to a decrease in

CO_2 emissions for the oil-importing MENA. An improvement in institutional quality and governance decreases CO_2 emissions in oil-importing MENA economies and whole sample. There is a negative and significant association between human capital and pollution for the oil-importing MENA and whole sample. This empirical finding is consistent with the results by Lan (2012), Bano et al., (2018) and Ahmed & Wang (2019) suggesting that better educated labor tends to diminish the pollution potentially by promoting the use of renewable energy products, energy efficiency and adopting environmental regulation.

4.3. Thresholding Effect of Governance

We now proceed with the investigation of whether institutional quality and governance (GOV) provides data-driven estimated threshold in explaining the effect of FDI on CO_2 emissions. In this vein, we estimate the following equation:

$$CO2_{it} = \alpha_i + \alpha_1 GDPpc_{i,t-1} + \alpha_2 REC_{it} + \alpha_3 GOV_{it} + \alpha_4 HC_{it} + \alpha_5 FDI_{it}(GOV_{it} \leq \lambda) + \alpha_6 FDI_{it}(GOV_{it} > \lambda) + u4_{it} \quad (5)$$

Eq.s (5.1), (5.2) and (5.3) in Table 3 provide the estimation results of Eq. (5), respectively, for the whole sample, oil-exporting and oil-importing MENA economies.

Table 3. Thresholding Effect of Governance

	Whole Sample Eq. (5.1)	Oil-Exporting MENA Eq. (5.2)	Oil-Importing MENA Eq. (5.3)
Threshold GOV	0.445***	0.445***	0.613*
F_B[.]	16.86 [0.00]	14.69 [0.00]	13.95[0.08]
FDI_{it}	0.007**	0.009**	0.004*
$(GOV_{it} \leq \lambda)$	(0.002)	(0.003)	(0.002)
FDIit	-0.019**	-0.023**	-0.011*
$(GOV_{it} > \lambda)$	(0.006)	(0.008)	(0.006)
$GDPpc_{i,t-1}$	0.679***	0.742***	0.690***
	(0.053)	(0.066)	(0.092)
REC_{it}	-0.005	-0.018	-0.015***
	(0.004)	(0.020)	(0.004)
GOV_{it}	-0.088**	-0.041	-0.287***
	(0.042)	(0.054)	(0.071)
HC_{it}	-0.083**	-0.006	-0.364***
	(0.038)	(0.046)	(0.066)
Constant	-4.061***	-4.575***	-3.765***
	(0.448)	(0.608)	(0.698)
Statistics	N =13 NT =299	N = 8 NT = 184	N = 5 NT = 115
	R^2 = 0.568	R^2 = 0.561	R^2 = 0.776
	F = 61.28 [0.00]	F = 36.27[0.00]	F = 60.18 [0.00]

Note: F_B is the bootstrapped F-test based on 1000 replications to test the statistical insignificance of the threshold level and [.] is the p-value of the test. The values in parentheses are the standard errors. *, ** and *** respectively, denote significance at 10%, 5% and 1% levels. N and NT are, correspondingly, the numbers of countries and the effective number of observations.

The results by Table 3 suggest that the impact of FDI on pollution is not invariant to the data-driven estimated threshold values for GOV[4]. The endogenously estimated threshold level is around 0.4 for the whole sample and oil-exporting MENA and 0.6 for the oil-importing MENA. These threshold values are almost the same with the mean of GOV as reported by Table 1. Almost 20 percent of the observations are in the high regime including observations with better institutional environment. FDI inflows lead to higher pollution in the low regimes including weak governance episodes. On the other hand, an increase in FDI diminishes CO_2 emissions in the high regime containing better governance observations. Our estimation results may indicate the validity of pollution haven hypothesis tends to be the case for the economies with weak institutional levels while pollution halo hypothesis appears to be hold in economies with better institutional environment. This finding is mainly in accord with the results by Bokpin (2017) suggesting that institutions have a responsibility to guarantee that FDI's environmental effects remain within a regulated framework. As consistent with the scale effect argument by Grossman & Krueger (1995), we find that income elasticity of pollution is positive and significant suggesting the impact of income is associated with higher pollution. For the oil-importing MENA economies, the higher the renewable energy consumption, it is lower the CO_2 emissions. The direct impact of institutional quality and governance is associated with lower pollution in oil-importing MENA economies and thus whole sample. This finding may suggest that an improvement in institutional quality and governance leads the countries to implement environmental protection policies and diminish the emissions. This result is mainly in accord with the findings by Wang & Chen (2014), Bokpin (2017), Omri & Hadj (2020), and Bouchoucha (2021). Better educated labor tends to decrease the pollution in oil-importing MENA and whole sample.

5. Concluding Notes

The international economics literature maintains that foreign direct investments (FDI) bring many benefits including better growth episodes, access to financial markets and new technology along with higher total factor productivity. However, the bulk of the environmental economics literature reports mix results for the relationship between FDI and pollution. This paper investigates the relationship between FDI and pollution for the Middle East and North Africa (MENA) economies. We especially focus on the MENA because the region has various environmental concerns such as water shortages, arable land depletion, inadequate waste management, air pollution, loss of biodiversity, declining marine resources and degradation of coastal ecosystems (Abumoghli & Goncalves, 2020).

Our panel fixed effects threshold estimation results provide strong support for the argument that the impact of FDI on pollution measured as CO_2 emissions may change depending on the level of country characteristics (CC), including human capital and institutional quality and governance. According to our estimation results, CC provides data-driven estimated thresholds

[4] In the appendix, Table A1 reports that this effect is driven by control of corruption, regulatory quality, rule of law and government effectiveness.

for the effect of FDI on pollution in MENA. This appears also be the case for the samples of oil-exporting and -importing MENA.

We find that FDI leads to more pollution in economies with weak CC containing less educated labor and worse institutional environments. On the other hand, FDI improves the environmental quality in countries with strong CC including better educated labor and stronger institutional environment. These empirical findings may suggest that pollution haven appears to be hold in weak CC economies while pollution halo is the case for the economies with strong CC.

Our findings also indicate that the income elasticity of pollution is positive and significant suggesting an increase in income leads to more pollution. This is consistent with the scale effect explanation by the conventional literature including Grossman & Krueger (1995). Renewable energy consumption (as a percent of total energy consumption) is associated with a decrease in CO_2 emissions. More educated labor and better institutional environment lead to less pollution.

The empirical findings in this paper imply that policies aiming to improve human capital and institutional environment may be expected to enrich not only the economic benefits of FDI in terms of growth but also negative environmental effects of FDI in MENA. Acemoğlu et al. (2012) emphasizes the importance of human capital as one of the essential ingredients for green growth. Investing in human capital eases the employment of environment-friendly technologies and increases the environmental awareness. Consistent with an argument maintaining good institutional environment is closely associated with the implementation of better environmental protection policies, enhancing institutional quality and governance is expected to both diminish the emissions and the degradational effect of FDI inflows. Xing & Kolstad (2002) suggests the necessity of cooperative solutions to overcome the pollution since the environmental policy gap leads the movement of pollution-intensive production activities to countries with lax environmental regulations. Considering higher income levels are associated with more pollution, the policies aiming to promote energy efficiency, energy conservation and emissions diminishing technologies may alleviate the procyclicality of pollution to income. These policies may also help to achieve the sustainable development goals which promote the green economy. “Greening” may also be considered as the low-carbon energy transitions aiming not only access to renewable energy sources but also reduction in poverty along with the job creation. All these may contribute to environmental sustainability and sustainable development goals. The environmental management systems aiming to reduce emissions may require the institutional and regulatory reforms, green investment, better governance, regional cooperation, and participation of all stakeholders (Abumoghli & Goncalves, 2020). Therefore, implementing proactive strategies to mitigate pollution is critical for policymakers in developing countries, including MENA countries. Future studies investigating whether our empirical findings for the MENA sample are robust to different samples including developed, emerging market and developing economies may be considered as a promising research agenda. This agenda may be extended by employing sector-specific FDI inflows and other pollution measures. Furthermore, investigating the thresholding effect of country characteristics for the sensitivity of pollution to FDI by using some other alternative endogenously estimated threshold procedures appears to be an important research topic most potentially covering our empirical findings presented by this study.

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Appendix

Table A1. Thresholding Effect of the Main Components of Governance

Thresholding Variable	Voice and Accountability	Control of Corruption	Regulatory Quality	Rule of Law	Government Effectiveness	Political Stability and Violence
	Eq. (5.1)	Eq. (5.1)	Eq. (5.1)	Eq. (5.1)	Eq. (5.1)	Eq. (5.1)
Threshold	0.131	0.678	0.954	0.787	0.785	0.889
F_B[.]	4.36[0.89]	14.54[0.073]	28.9[0.00]	8.63[0.00]	11.73[0.00]	4.40[0.915]
$GDPpc_{i,t-1}$	0.687***	0.675***	0.681***	0.677***	0.649***	0.700***
	(0.054)	(0.053)	(0.052)	(0.053)	(0.054)	(0.054)
REC_{it}	-0.006	-0.005	-0.007*	-0.005	-0.006	-0.005
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
GOV_{it}	-0.223**	-0.185**	-0.178**	-0.187**	-0.194**	-0.227**
	(0.087)	(0.086)	(0.084)	(0.087)	(0.086)	(0.087)
HC_{it}	-0.111**	-0.083**	-0.071*	-0.088**	-0.073*	-0.116**
	(0.039)	(0.038)	(0.038)	(0.039)	(0.039)	(0.039)
FDI_{it}	0.020**	0.006**	0.004**	0.005**	0.006**	0.005**
($HC_{it} \leq \lambda$)	(0.008)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
FDI_{it}	0.003	-0.017**	-0.051***	-0.018**	-0.018**	-0.008
($HC_{it} > \lambda$)	(0.002)	(0.006)	(0.011)	(0.008)	(0.007)	(0.007)
Constant	-3.942***	-3.908***	-3.989***	-3.916***	-3.689***	-4.053***
	(0.467)	(0.549)	(0.450)	(0.464)	(0.466)	(0.472)
Statistics	N =13 NT =299	N =13 NT =299	N =13 NT =299	N =13 NT =299	N =13 NT =299	N =13 NT =299
	R^2 = 0.549	R^2 = 0.565	R^2 = 0.582	R^2 = 0.556	R^2 = 0.560	R^2 = 0.548
	F = 56.76[0.00]	F = 60.51[0.00]	F = 64.87[0.00]	F = 58.3[0.00]	F = 59.47[0.00]	F = 56.59[0.00]

Note: F_B is the bootstrapped F-test based on 1000 replications to test the statistical insignificance of the threshold level and [.] is the p-value of the test. The values in parentheses are the standard errors. *, ** and *** respectively, denote significance at 10%, 5% and 1% levels. N and NT are, correspondingly, the numbers of countries and the effective number of observations.