The Corruption Paradox: Assessing Environmental Impacts in the GCC Region

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Abstract

This study examines the impact of corruption on environmental quality in GCC countries from 2003 to 2021, focusing in particular on direct and indirect impacts on CO2 emissions. We use two-stage least squares (2SLS) panel regression analysis to account for potential endogeneity and provide robust empirical evidence. The results show that corruption has a direct and significant positive effect on environmental quality. This suggests that some corrupt practices can lead to short-term emission reductions by delaying or distorting large, environmentally harmful projects. However, it also has indirect negative effects: corruption undermines economic growth and institutional integrity and ultimately worsens long-term environmental impacts. Overall, the positive effects of corruption on environmental quality are positive, although they are differentiated and context-dependent. In addition, the Environmental Kuznets Curve (EKC) hypothesis is tested. This suggests that after an initial decline in emissions, environmental destruction could resume as income levels rise. These findings provide valuable insights for policymakers seeking to strengthen institutional governance, eradicate corruption, and promote sustainable environmental policies in resource-dependent economies.

Keywords: Corruption, environmental quality, CO2 emissions, EKC, Economic Growth
JEL Classification : D73, Q58, O40

1. Introduction

Environmental degradation has become a central concern for both policymakers and researchers, particularly in regions where economic expansion coexists with institutional fragility. The Gulf Cooperation Council (GCC) countries, Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates represent a unique context in this regard. While these nations enjoy high income levels and rapid economic development largely driven by oil and gas exports, they also face persistent environmental challenges, including high carbon emissions and fragile regulatory frameworks. In this setting, the role of corruption in shaping environmental outcomes raises important questions for sustainable development.

Corruption can influence environmental quality through two distinct mechanisms. The first is a direct effect**,** where corruption weakens environmental regulation and enforcement, allowing polluting activities to escape oversight (Zhang, 2021). The second is an indirect effect, in which corruption hampers economic growth by misallocating public resources and reducing institutional efficiency. Since economic development itself has a complex relationship with environmental quality, this indirect channel adds another layer of complexity. Prior studies have explored these dynamics in various contexts. For example, Haseeb and Azam (2021) found that corruption significantly increases CO_2 emissions, particularly in lower-income countries. Shahbaz and Sinha (2019) observed that corruption diminishes the environmental benefits of renewable energy while amplifying the negative effects of non-renewable sources. Wang et al. (2018) further demonstrated that corruption moderates the relationship between urbanization, trade, and pollution, emphasizing the need for institutional reform.

Despite these insights, limited attention has been paid to the GCC region, where the intersection of high-income status, fossil fuel dependence, and institutional opacity creates a distinct dynamic. This study addresses this gap by examining the direct and indirect effects of corruption on environmental quality in GCC countries between 2003 and 2021. Using Ordinary Least Squares (OLS) and Generalized Least Squares (GLS) estimations, the analysis corrects for endogeneity, autocorrelation, and heteroscedasticity, ensuring robust results. The findings show that corruption negatively affects economic growth by diverting public resources for private gain, which undermines long-term prosperity. While economic growth contributes to environmental degradation, the study uncovers a paradox: corruption has a direct beneficial effect on environmental quality, likely due to delays or distortions in development projects. However, these apparent gains are offset by harmful indirect effects stemming from weaker institutions and reduced economic performance.

This study offers a novel contribution by disentangling the opposing effects of corruption on the environment within a high-income, resource-rich region. It also provides policy guidance, recommending the strengthening of judicial and administrative institutions, greater transparency and accountability in governance, and stricter enforcement of environmental regulations. In addition, it calls for future research to explore other mechanisms beyond economic growth through which corruption may influence environmental outcomes.

The remainder of the paper is organized as follows: Section 2 presents the methodology, Section 3 reports the empirical results, and Section 4 concludes with policy implications and suggestions for further research.

2. Methodology

This study aims to examine the links between corruption, economic growth, and CO2 emissions, based on the models of (Welsch 2004; J. Zhang 2021) we estimate the following equations:

$$\mathrm{GDP}_{it} = \gamma_i + \delta_t + \alpha_1 \mathrm{Corruption}_{it} + \alpha_2 X_{it} \qquad (1)$$

$$\mathrm{LnCO2}_{it} = \gamma_i + \delta_t + \beta_1 \mathrm{Corruption}_{it} + \beta_2 \mathrm{GDP}_{it} + \beta_3 (\mathrm{GDP}_{it})^2 + \beta_4 (\mathrm{GDP}_{it})^3 + \beta_5 Z_{it} + \zeta_{it} \ (2)$$

GDP_{it} : represents GDP per Capita, X_{it}: is a vector of other explanatory variables.

CO2: the variable is expressed in natural logarithms, ${GDP_{it}}^2$: the square of GDP per capita helps to provide evidence of the existence of the EKC. ${GDP_{it}}^3$: the cubic model of the EKC helps to detect deviations from the parabolic curve at higher levels of GDP per capita.

Z_{it} : is a vector of other explanatory variables, including REC and TO. $\lambda_i, \tau_t, \gamma_i$ et δ_t: represent country-specific effects i and time effects (t). Finally, ε_{it} et ζ_{it} : indicate the error terms.

The total effect of corruption on pollution can be calculated using equation (3):

$$\frac{\partial CO2}{\partial Corruption} = \frac{\delta CO2}{\delta Corruption} + \frac{\delta CO2}{\delta Y} * \frac{\delta Y}{\delta Corruption} \qquad (3)$$

The terms CO2, Y, and Corruption refer to CO2 emissions, GDP per capita, and corruption, respectively, as previously stated.

Table1. Analyzing the Effects of Corruption on CO2 Emissions

$\delta CO2/\delta Corruption$	Direct Effect
$\delta CO2/\delta Y * \delta Y/\delta Corruption$	Indirect Effect
$\partial CO2/\partial Corruption$	Total effect

Source: Author's

Table2. Variable, description, source, and units of measurement

Variable	Description	Units of Measure	Source
GDP	Economic Growth	GDP per capita growth (annual %)	WDI
REC	Energy Consumption	Electric power consumption (kWh per capita)	WDI
PG	Population Growth	Population growth (annual %)	WDI
FDI	Foreign Direct Investment	net investment flows as % of GDP	WDI
TO	Trade Openness	Merchandise trade (% of GDP)	WDI
CFCF	Gross fixed Capital Formation	Gross fixed capital formation % of GDP	WDI
IFR	Inflation	Consumer prices (annual %)	WDI
CO2	CO2 emissions	CO2 emissions (metric tons per capita)	WDI
Corruption	Corruption	Corruption Perceptions Index	Transparency International

3. Empirical Findings

The CO_2 range from 26,836 tons in Bahrain to 452,106.1 tons in Saudi Arabia, with the latter country exhibiting the highest emissions. Regarding GDP, Saudi Arabia has the highest average (1.317) while Oman has the lowest (-0.437). Kuwait shows the highest standard deviation (6.13), while Bahrain has the lowest (1.96). For the Corruption TI, Qatar has the highest average (37.22) and Oman the lowest (28.05), with the United Arab Emirates demonstrating the greatest variation (32.54).

Table3. Summary of statistics

		GDP	Corruption	CO2
Qatar	Mean	0.923	37.215	55691.25
	Median	-0.847	61.000	60549.40
	Std. Dev.	5.555	30.201	16419.89
UAE	Mean	-1.290	39.4684	163012.4
	Median	0.517	66.00000	174220.3
	Std. Dev.	6.911939	32.54419	31312.77
Oman	Mean	-0.437	28.04737	67735.62
	Median	-0.236	44.00000	75430.10
	Std. Dev.	3.470	22.09830	20064.52
Arabia	Mean	1.317	27.83684	452106.1
	Median	1.724	44.00000	492467.1
	Std. Dev.	3.847	23.47233	95521.14
Bahreïn	Mean	0.377	25.67895	26836.01
	Median	0.413	36.00000	27174.20
	Std. Dev.	1.962	20.13208	4784.973
Kuwait	Mean	-0.966	24.58947	81614.20
	Median	-2.128	39.00000	85316.10
	Std. Dev.	6.132	19.60637	10865.27

Source: Authors' computation

The Breusch–Godfrey LM test for autocorrelation indicates an absence of first-order correlation (Chi2(8) = 17.410; p = 0.000). The heteroscedasticity is examined using the Breusch and Pagan test (chi2(1) = 1.58 and Prob > chi2 = 0.2081). Additionally, the results of the Hausman test (chi2(7) = 27.14 and Prob > chi2 = 0.0003) indicate that the test probability is below the 5% threshold, leading to the rejection of the null hypothesis H1. Therefore, we should prefer adopting a random effects model and retain the GLS estimator rather than the OLS.

The estimation results for equation (1) are presented in the first column of table4. Corruption is considered exogenous with respect to GDP per capita, having a negative and significant impact on economic growth (Kaddachi et Benzina 2024). FDI and POP display positive and significant coefficients, indicating that FDI stimulates GDP by bringing in capital and technology, while a growing population enhances domestic demand (Saha 2024) .

In contrast, inflation has a highly significant negative coefficient, suggesting that its increase harms GDP, mainly due to price volatility related to oil markets (Khan 2023). The variable TO does not have a significant impact on GDP, while GFCF shows a positive but insignificant effect, indicating that recent investments are not very productive (Hwang, Kim, et Yu 2024).

In equation (2), we begin by estimating a baseline model (REG1), then add an additional explanatory variable (REC) in REG2, and finally include the variable TO in REG3. The results from REG1 indicate that corruption has a positive impact on CO_2 emissions, a finding that is also confirmed in REG2 and REG3. This coefficient is significant at the 1% levels, corresponding to increases in CO_2 emissions of 0.045, 0.039, and 0.035, respectively. These results suggest that corruption could contribute to climate change and cause environmental damage. Previous research by (Khan et al. 2021) has also shown a positive effect of corruption on environmental quality. Furthermore, the coefficients associated with GDP were favorable, those for GDP^2 negative, and those for GDP^3 positive. This supports the presence of the N-shaped hypothesis, corresponding to the EKC curve, as highlighted by recent empirical research conducted by (Bilgili et al. 2024).

REG2 incorporates the REC variable. Consequently, a 1% increase in REC results in a 0.28% increase in CO_2 emissions per capita (0.89% in REG3) (Kaddachi et Benzina 2024). The coefficients for the other factors remain virtually unchanged. This finding is consistent with the empirical studies of (Begum et al. 2015). REG3 incorporates the TO variable. TO is a significant negative determinant of CO_2 emissions.

The results show that the direct effect of corruption on environmental quality is positive. Therefore, the indirect effect is also negative. However, the total effect is positive, meaning that higher levels of corruption lead to poorer environmental quality.

Table 4: Results for equation (1) and (2)

Variables	Model1	Variables	Model2			Robustness check
			REG1	REG2	REG3	REG4
FDI	0.307** (0.163)	GDP	0.0169 (0.011)	0.016 (0.011)	0.025 ** (0.011)	0.024** (0.011)
IFR	-0.675*** (0.117)	GDP^2	-0.000* (0.000)	-0.001* (0.000)	-0.000*** (0.000)	-0.000*** (0.000)
PG	0.2726** (0.1406)	GDP^3	0.000 (0.000)	0.005 (0.007)	0.000 (0.000)	0.000 (0.000)
Corruption TI	-0.039 * (0.019)	Corruption TI	0.004*** (0.001)	0.0039 *** (0.015)	0.003*** (0.001)	-
TO	-0.006 (0.016)	REC	-	0.281 (0.259)	0.893 *** (0.301)	1.179*** (0.296)
GFCF	0.021 (0.063)	TO	-	-	-0.005*** (0.001)	-0.005*** (0.001)
CorruptionWDI			-	-	-	-0.092 (0.090)
$\delta CO2 / \delta Corruption$			0.0045	0.0039	0.0345	-
$\delta CO2 / \delta Y * \delta Y / \delta Corruption$			-0.0000	-0.0000	-0.0000	-
$\partial CO2 / \partial Corruption$			0.0045	0.0039	0.0345	-

*, ** and *** represent significance at 10%, 5% and 1%, respectively. Standard errors are parentheses

Source: Authors' computations

REG4 reveals the robustness of the model, it is based on the inclusion of an additional measure of corruption from the World Bank. The findings demonstrate that all explanatory variables show similar trends to those observed with Transparency International data. The existence of the inverted N-shaped EKC for GCC countries is confirmed. Furthermore, the World Bank's corruption index reveals a negative relationship with the level of CO_2 emissions. A negative coefficient indicates that an increase in the control of corruption is associated with a pollution reduction.

4. Conclusion

This study examines the direct and indirect effects of corruption on environmental quality in GCC countries from 2003 to 2021, adjusting for endogeneity, autocorrelation, and heteroscedasticity using OLS and GLS methods. The survey results highlight the bilateral effects of corruption. In other words, while corruption appears to directly reduce CO_2 emissions through distortions that slow down large-scale industry, it indirectly harms environmental quality by undermining economic growth and institutional effectiveness. Corruption diverts public resources to private ends, thereby undermining long-term development and the institutional framework necessary for sustainable environmental management.

These results highlight the complexity of the relationship between corruption and the environment and underscore the importance of good governance. Policy recommendations include strengthening judicial and executive institutions to increase transparency and accountability, ensuring stricter enforcement of environmental regulations, and improving public access to environmental data and decision-making processes. Given the lack of clear evidence of the effectiveness of anti-corruption measures, policymakers should prioritize institutional reforms that strengthen environmental governance. This includes including environmental aspects in public procurement, planning, and budgeting systems.

Furthermore, regional cooperation among GCC countries could promote harmonized environmental standards and common monitoring systems, thereby helping to mitigate the negative transboundary impacts of environmental degradation. Investments in environmental education, civil society engagement, and digital technologies for transparency (e.g., e-government platforms) may also be effective long-term strategies to limit the environmental impacts of corruption.

A major limitation of this study is the limited availability of comprehensive environmental and institutional data in the GCC region, which may affect the generalizability of the findings.

Future research should attempt to include additional variables such as renewable energy deployment, institutional quality indices, and sector-specific emissions data, and examine other potential transmission channels such as trade, foreign investment, or technological innovation through which corruption may influence environmental outcomes.

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