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The Moderating Effect of Institutions on the Relationship between Financial Development and Environmental Quality: Evidence from GCC countries

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The existing literature does not present a unified perspective on the impact of financial development on environmental quality. Consequently, this study seeks to enhance existing knowledge by investigating how institutions moderate the relationship between financial development and carbon emissions. It uses a dynamic GMM model to estimate a panel data of GCC countries over the period 2010–2020. Financial system development has been proxied by both the development of the banking sector and the development of the financial markets. The findings indicate that there is a significant increase in carbon dioxide emissions as a result of financial development. Nevertheless, the presence of strong institutions mitigates this effect, leading to a reduction in carbon emissions. Indeed, findings reveal that control of corruption, good quality of regulations and a strong rule of law contribute to reduce pollution effects of financial development. In light of this, policymakers should focus on enhancing institutional quality while redirecting their focus towards environmentally responsible financial practices. This approach will bolster the impact of financial development in effectively improving environmental quality.

Keywords: Carbon emissions, Dynamic GMM, Financial development, Institutions, Moderating effects

Introduction

Governments globally have grappled with pressing issues surrounding environmental decline and the impacts of climate change.[1] The focus on reducing carbon dioxide emissions, a key component of greenhouse gases that contribute to climate change, has become a significant priority in worldwide attempts to develop successful energy policy.[2] The modern period has seen a greater emphasis on ensuring sustainable environmental quality, driven by a growing concern for environmental sustainability. The importance of tackling environmental degradation is highlighted by its identification as a significant risk to achieving sustainable development goals.[3,4] There is widespread agreement that the negative impact of carbon dioxide emissions, particularly carbon emissions, presents a substantial threat to human life. According to a World Bank research published in 2022, environmental deterioration cost the globe around 8.1 trillion US dollars in 2019, or 6.1% f global Gross Domestic Product Furthermore, it was responsible for more than 90% of fatalities in low and middle income countries, highlighting the serious implications of unchecked environmental deterioration. Therefore, understanding the impacts of carbon emissions is crucial for mitigating climate change, as these emissions are a primary driver of global warming. By conducting this study, we aim to identify effective strategies to reduce carbon emissions, safeguarding the planet for future generations.

There is a broad acknowledgment that economic expansion significantly impacts carbon emissions, however the available research contains inconsistent conclusions.[5,6] The initial body of literature emphasizes the role of Financial Development (FD) as a catalyst in exacerbating environmental deterioration. It is argued that well-established financial sectors may contribute to environmental damage, attributed to domestic lending to the private sector being channeled into projects that are not environmentally sustainable.[7] Moreover, an upsurge in private borrowing has been associated with an escalation in CO_2 emissions due to heightened energy consumption. Access to finance accelerates manufacturing activity, and due to lenient regulations, they may overlook environmental concerns, relying on polluting technologies such as fossil oil, coal, and natural gas for economic growth.[8] Similarly, the stock

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market serves as a crucial indicator of economic conditions; a robust stock market performance often indicates rapid economic growth and prosperity. This, in turn, increases the assurance of both businesses and consumers, stimulating production and consumption activities and consequently leads to heightened energy usage and carbon emissions.[9,10] FD might also pose a threat to the long-term environment because of allowing new entrants into polluting industries by providing a cheap source of financing.[11] Progress in FD has the potential to reduce financing costs for both firms and individuals, making it simpler to secure loans for the acquisition of machinery and large technological products. However, this facilitation may lead to increased energy usage and enhanced CO_2 emissions.[12]

The second stand of literature contends that FD can play a constructive role in environmental improvement.[13,14] The evolution of financial systems, encompassing banks, capital markets, banking regulations, and laws pertaining to capital markets, aims to diminish obstacles to accessing financing, overseeing, and acquiring financial data at a reduced expense. This, in turn, supports environmental sector activities through these channels, suggesting that FD contributes to environmental benefit by lowering carbon emissions.[15] Stock market expansion reduces CO_2 emissions in industrialized economies as it grants investors entry to alternative funding channels, potentially leading to increased investment in clean energy projects rather than traditional energy sources.[16] Similarly, financial growth diminishes environmental degradation by fostering the development of energy-efficient technology.[17] In a similar vein, certain studies propose that FD may contribute to environmental improvement through flexible planning schedules and economies of scale. Lastly, the argument is made that enterprises listed on the stock market are typically significant entities with a substantial influence on the national economy. Due to stock exchange requirements, they have a duty to regularly share information and are closely monitored by financial regulators and the public. This pushes them to cultivate a favorable reputation, which involves taking on social responsibilities like environmental stewardship by adopting eco-friendly technologies. Ultimately, this helps in lowering carbon emissions.[10] Besides, improvements in the financial industry have the potential to stimulate technical innovation and improve energy efficiency. This might result in a drop in overall energy consumption and a higher dependence on renewable energies, eventually leading to a reduction in CO_2 emissions.[18,19] As a result, a thorough and focused study is required to fully comprehend the genuine nature of the connection between FD and carbon emissions.

Another facet of the study underscores the significant impact of institutional quality on environmental outcomes. Robust institutions facilitate the implementation and enforcement of environmental regulations, mitigating environmental damage and promoting sustainability. Furthermore, the caliber of institutions plays a crucial role in attracting investments and advancing renewable energy technologies. Theoretical models like institutional theory and environmental governance highlight the significance of institutional elements such as regulations, property rights, and governance systems in shaping decisions and actions concerning environmental sustainability. These theories elucidate how decisions regarding energy sources, the adoption of renewable energy technologies, and broader environmental sustainability efforts are influenced by institutional aspects. Institutions that ensure property rights and voluntary exchange allow for the implementation of preferred environmental policies by the government, thereby promoting environmental protection.[21] Efforts to reduce carbon emissions through environmental initiatives may face challenges if institutions lack functionality and efficiency. Moreover, institutions are believed to impact environmental quality by serving as conduits for growth and technological advancements. According to the growth effect channel, institutions shape economic growth and the development of various industries, thereby influencing environmental quality. The impact of institutions on carbon emissions can vary, either amplifying or mitigating them due to economic growth.[22] Therefore, in instances where institutions prioritize economic growth over the strict enforcement of environmental policies, carbon emissions may increase. Conversely, institutions advocating for economic evolution toward information-based enterprises, enhanced technology, and greater environmental funding might lead to decreased carbon emissions. Nations with robust property rights protections tend to allocate resources efficiently, fostering economic growth while addressing environmental concerns.[23] Likewise, deficient institutions marked by rampant corruption may enable the growth of the informal economy, consequently escalating carbon emissions.[24] Institutions that advocate for the protection of property rights and the reduction of transaction costs[21] could encourage the advancement and adoption of eco-friendly technology, as suggested by the technological effect channel. This, in turn, may restrict the increase of carbon emissions. Additionally, institutions streamlining the transfer of eco-friendly technologies through foreign direct investment might aid in curbing carbon emissions.

Nevertheless, as far as our knowledge extends, the current body of literature addressing the role of governance and institutional quality in environmental degradation remains somewhat limited. Furthermore, the existing literature presents a divergence of findings concerning the FD on carbon emissions, underscoring the complexity of this relationship. Moreover, a significant gap exists in empirical research regarding the combined influence of FD and institutional factors on CO_2 emissions, necessitating a comprehensive study to elucidate their intertwined impacts.[25] Hence, this research seeks to examine how institutional quality affects the relationships between financial development and carbon emissions, concentrating particularly on the specific context of Gulf Cooperation Council countries (GCC).

This paper makes a distinctive contribution to the existing literature on multiple fronts. First, unlike previous studies, which have centered on analyzing either the effect of institutional quality on CO_2 emissions or the influence of financial development on environmental quality [26], this paper delves into the combined effect of both factors on the environmental landscape of GCC countries. Thirdly, recognizing the significant disparities in governance, financial levels, and carbon emissions between developed and developing countries, this study provides valuable insights into emerging economies, particularly the GCC region. Second, the research adopts a nuanced approach by considering various dimensions of FD which are banks and financial markets, and three facets of institutions: governance, economic and political institutions to ensure a more comprehensive and robust analysis. This categorization and the introduction of interaction terms enable a nuanced understanding of which indicators from each category contribute as the most effective complementary combinations.

Data and Methodology

Data Collection

This research examines how institutional quality influences the relationship between financial system development and carbon emissions in GCC countries from 2010 to 2020. The selection of this timeframe is solely based on data availability for all variables used in the study. Notably, data on carbon emissions is unavailable beyond the year 2020. The sample comprises six GCC countries: Kuwait, Oman, Saudi Arabia, Qatar, the United Arab Emirates, and Bahrain. Data for all variables is sourced from the World Bank World Development Indicators (2023).

Variables

The variable descriptions are briefly outlined in Table 1. The dependent variable in this study is CO_2 emissions measured in metric tons (CO_2), consistent with prior research.[27,28]

As for the independent variables, financial system development is represented by two measures.[29,30] Firstly, the development of the banking sector is gauged by the ratio of domestic credit to the private

Table 1 — Data description

Variables	Measurement	Sources
Carbon emissions (CO_2)	CO_2 emissions in metric tons	WDI
Baking sector development (CPS)	Domestic credit to private sector to GDP	WDI
Stock market development (SMD)	Market capitalization of listed domestic companies to GDP	WDI
Control of Corruption (Corr)	Varies from −2.5 to 2.5	WDI
Government Effectiveness (Gov-Eff)	Varies from −2.5 to 2.5	WDI
Regulatory Quality (Reg)	Varies from −2.5 to 2.5	WDI
Rule of Law (RL)	Varies from −2.5 to 2.5	WDI
economic growth (GDPG)	GDP per capita (constant 2015 US$)	WDI
Foreign direct investment (FDI), net inflows (% of GDP)	Foreign direct investment net inflows (% of GDP)	WDI
Trade openness (TO)	Total of imports and exports in percentage of GDP	WDI

Note: The table furnishes information regarding the sources of data and the techniques used to measure each of the chosen variables in the research, where WDI stands for World Development Indicators.

sector to GDP (CPS). Secondly, FD is assessed through the stock market, specifically using the ratio of market capitalization of listed domestic companies to GDP (SMD) as an indicator of financial market development.

Institutional quality is assessed through several variables, including Control of Corruption (Corr), Government Effectiveness (Gov-Eff), Regulatory Quality (Reg), and the Rule of Law (RL). The Control of Corruption variable gauges perceptions regarding the degree to which public authority is utilized for personal advantage, along with the potential influence of elites and private interests on state affairs. The variable ranges from approximately −2.5 to 2.5 with higher values denoting a strong control of corruption. The second variable, Government Effectiveness, encompasses opinions regarding the quality of public services, the competence of the civil service and its independence from political pressures, and the government's commitment to upholding these policies.

The variable spans from −2.5 to 2.5, with elevated values signifying increased government effectiveness. In the third aspect, the regulatory quality variable assesses perceptions of the government's capacity to formulate and implement effective policies and regulations fostering private sector development. This measure fluctuates between −2.5 and 2.5, with higher values indicative of more robust regulatory quality. Moving on to the fourth aspect, the Rule of Law variable gauges perceptions of individuals' confidence in and adherence to societal rules, particularly concerning contract enforcement, property rights, law enforcement, judicial system, and the probability of criminal activity and violence. This variable also spans from −2.5 to 2.5, with higher values indicating a stronger adherence to the rule of law.

Examining the moderating impact of the aforementioned institutional factors offers a more comprehensive understanding of the distinct influences of institutional quality variables. Additionally, an aggregate measure of the institutional environment is crafted using the principal component analysis method (PCA) to delve deeper into the collective impact of the institutional framework on the connection between FD and carbon emissions.

Finally, the study incorporates several control variables, including GDP per capita (constant 2015 US$) (GDPG) reflecting economic growth, Foreign Direct Investment (FDI), net inflows (% of GDP), and Trade Openness (TO) as a percentage of GDP.

The Empirical Model

The study seeks to assess the influence of financial system development on environmental quality, taking into account the quality of institutions. The model includes extra control factors, like economic growth, trade openness, and foreign direct investments. The suggested model for examining how these factors affect carbon emissions can be stated as follows:

$$CO_2 = f\,(FD, IQ, GDPG, TO, FDI) \qquad \ldots (1)$$

where, CO_2 represents carbon emissions, FD stands for financial system development, IQ indicates institutional quality measured by the various variables discussed above, TO is trade openness, GDPG is GDP growth, and FDI is foreign direct investment.

Following previous studies[31], all the variables have been transformed into natural logarithms to mitigate data volatility and control for heterogeneity. Consequently, the adjusted model can be formulated as:

$$lnCO2_{it} = \alpha_i + \beta_1 lnCO2_{it-1} + \beta_2 lnFD_{it} + \beta_3 lnIQ_{it} + \beta_4 lnFD_{it} * lnIQ_{it} + \beta_5 Z_{it} + \varepsilon_{it} \qquad \ldots (2)$$

Here, the subscript i represents the country, and the subscript t denotes the time. The coefficients β_1 to β_5 represent the elasticities of the respective variables concerning carbon emissions.

Moreover, to explore whether institutional quality influences the relationship between financial development and carbon emissions, we employ the methodology of interactive variables, assessing its effect in connection to various institutional factors. This methodology is commonly employed in the literature[32]and is justified by the notion that interactions enhance comprehension of economic and social dynamics.[33] Therefore, we introduce the interactive term defined as the FD variable multiplied by the institutional variable. These variables are also introduced separately alongside the interaction term

In Eq. 2, our primary focus lies on two coefficients: β_2 and β_4. We anticipate that β_2 and β_4 are expected to be > 0 and < 0, respectively. This implies that FD worsens environmental quality when institutions are weak, while it mitigates carbon emissions when a strong institutional framework is established. Specifically, the overall impact of FD on environmental sustainability is contingent on the specific value of the institutional variable. This effect is more significant when β_4 is > 0 and is expressed as:

$$d(CO2) = \frac{dCO2_{it}}{d(FD_{i,t})} = (\beta_2 + \beta_4 IQ_{it})d\,(FD_{i,t}) \quad \ldots (3)$$

We employ the Dynamic Generalized Method of Moments (GMM) estimation method to estimate Eq. 2. The dynamic specification is used because the dependent variable is included as a lagged explanatory factor. The GMM estimator will be employed to estimate Eq. 1.[34–36] The inclusion of the lagged dependent variable raises concerns regarding the validity of statistical inference derived from Ordinary Least Squares (OLS) regression estimation. This is due to the correlation between the autoregressive term and individual-specific effects, leading to residual autocorrelation.[37]

Empirical Results

Descriptive Statistics

We start by interpreting the descriptive statistics stated in Table 2. Analyzing Table 2, it is evident that GCC countries display a relatively high level of carbon emissions (mean 22.15). On the other hand, GCC countries exhibit a comparable level of development of the banking sector as well as the financial market. However, in terms of risk, financial markets demonstrate the highest standard deviation (53.23), suggesting elevated volatility and indicating higher risk in their equity markets. Finally, Table 2 shows that GCC countries are characterized by a relatively weak institutional framework as demonstrated by the intuitional variables respective average values.

Table 2 — Descriptive statistics

Variables	Obs	Mean	Std. dev	Min	Max
CO_2	65	22.159	6.615	14.266	39.582
CPS	53	66.371	22.937	33.828	138.857
SMD	52	68.739	53.236	19.440	330.818
Corr	67	0.381	0.493	−0.359	1.400
Gov-Eff	67	0.448	0.492	−0.317	1.500
Reg	67	0.422	0.348	−0.194	1.096
RL	67	0.450	0.262	−0.020	0.978
GDPG	67	32688.28	16782.96	17366.19	73493.27
TO	65	113.184	36.424	49.713	191.872
FDI	67	1.794	2.188	−2.760	11.455

Correlation Matrix

The correlations among the proxies under investigation are displayed in Table 3. The data in Table 3 indicate that the institutional variables exhibit a negative correlation with CO_2 emissions, thereby providing initial evidence supporting the beneficial impact of institutional quality on mitigating environmental pollution. Additionally, the negative correlation observed between financial system development and CO_2 emissions suggests that advancements in the financial system could contribute to a reduction in carbon emissions. Furthermore, the high correlation coefficients between financial system development variables and between the various institutional variables, as depicted in Table 3, justify their separate inclusion in the model. Notably, no outliers were identified among the chosen variables, and the correlation coefficients among the explanatory variables are all less than 0.5, suggesting that multicollinearity is not present.

Discussion

The findings from estimating the models using credits to the private sector and stock market development as proxies for financial system development are presented in Tables 4 & 5 respectively. The columns in these tables display different model specifications, with each institutional variable included separately. First, the results in Tables 4 & 5 consistently reveal that the coefficient associated with the lagged dependent variable (LCO_2) is positive and statistically significant across all specifications, thereby confirming the justification for employing a dynamic specification. Furthermore, the Arellano–Bond and Hansen tests demonstrate the absence of second-order autocorrelation and confirm

Table 3 — Correlation matrix

	CO_2	CPS	SMD	Corr	Gov-Eff	Reg	RL	GDPG	TO	FDI
CO_2	1	—	—	—	—	—	—	—	—	—
CPS	−0.418	1	—	—	—	—	—	—	—	—
SMD	−0.748	0.522	1	—	—	—	—	—	—	—
Corr	−0.606	0.385	0.352	1	—	—	—	—	—	—
Gov-Eff	−0.546	0.325	0.387	0.941	1	—	—	—	—	—
Reg	−0.394	0.389	0.188	0.776	0.820	1	—	—	—	—
RL	−0.635	0.412	0.288	0.903	0.839	0.824	1	—	—	—
GDPG	−0.936	0.440	0.105	0.790	0.718	0.491	0.759	1	—	—
TO	0.068	0.275	0.031	0.238	0.249	0.133	0.105	0.131	1	—
FDI	−0.475	−0.182	−0.550	−0.032	0.005	0.027	−0.048	−0.382	0.299	1

Table 4 — Estimation result using credits to the private sector

VARIABLES	(1)	(2)	(3)	(4)
LCO_2	0.917***	0.999***	0.983***	0.952***
	(0.0336)	(0.0399)	(0.0318)	(0.0428)
CPS	0.131***	0.0951***	0.100***	0.0891***
	(0.0106)	(0.0340)	(0.0250)	(0.0269)
GDPG	0.0716***	0.00810	0.0269	0.0330
	(0.0255)	(0.0254)	(0.0187)	(0.0234)
FDI	0.0158***	0.0155***	0.0123**	0.00996
	(0.00442)	(0.00400)	(0.00590)	(0.00675)
TO	0.0319***	0.0140	0.0543***	0.0274
	(0.0107)	(0.0223)	(0.0169)	(0.0179)
Corr	−0.184***	—	—	—
	(0.0512)			
CPS*Corr	−0.0485***	—	—	—
	(0.0119)			
Gov-Eff	—	0.0190	—	—
		(0.0622)		
CPS*Gov-Eff	—	−0.00353	—	—
		(0.0157)		
Reg	—	—	−0.0876***	—
			(0.0326)	
CPS*Reg	—	—	−0.0247***	—
			(0.00821)	
RL	—	—	—	−0.0805**
				(0.0392)
CPS*RL	—	—	—	−0.0211**
				(0.00879)
Constant	−0.121	0.236**	−0.0929	0.0268
	(0.163)	(0.115)	(0.0722)	(0.132)
Observations	30	32	32	39
Number of counties	6	6	6	6
AR(1) (p-value)	0.020	0.017	0.016	0.014
AR(2) (p-value)	0.194	0.156	0.250	0.216
Hansen's (p-value)	0.628	0.520	0.522	0.867
Number of instruments	28	28	28	29

Note: The dependent variable is carbon emissions. Specifications 1, 2, 3 and 4 include respectively the various institutional variables separately.CPS represent the measure of bank sector development AR(1) (p-value):Test for first-order serial correlation. AR(2) (p-value): Test for second-order serial correlation. Hansen's (p-value): Test the null hypothesis of the appropriate set of instruments. The standard errors, denoted within parentheses have been adjusted for heteroscedasticity. *, **, and *** denote significance levels at 10, 5, and 1%, respectively.

Table 5 — Estimation result using stock market development

VARIABLES	(1)	(2)	(3)	(4)
LCO_2	0.998***	0.966***	0.940***	0.946***
	(0.0381)	(0.0380)	(0.0335)	(0.0340)
SMK	0.0444***	0.0273*	0.0138**	0.0133
	(0.00573)	(0.0213)	(0.0243)	(0.0146)
GDPG	0.0298	0.0315**	0.0175	0.0243*
	(0.0343)	(0.0138)	(0.0107)	(0.0133)
FDI	0.0140***	0.0141***	0.00816	0.0174***
	(0.00524)	(0.00479)	(0.00770)	(0.00321)
TO	0.0206	0.0283***	0.0433***	0.0285***
	(0.0134)	(0.00658)	(0.00581)	(0.00744)
Corr	−0.113***	—	—	—
	(0.0125)			
SMK*Corr	−0.0331***	—	—	—
	(0.00235)			
Gov-Eff	—	0.0574	—	—
		(0.0501)		
SMK*Gov-Eff	—	−0.0180	—	—
		(0.0130)		
Reg	—	—	−0.0598*	—
			(0.0717)	
SMK*Reg	—	—	−0.0117**	—
			(0.0178)	
RL	—	—		−0.0679*
				(0.0541)
SMK*RL	—	—	—	−0.0119**
				(0.0130)
Constant	−0.252	−0.270***	−0.281**	−0.306***
	(0.198)	(0.0586)	(0.124)	(0.0866)
Observations	33	40	38	42
Number of counties	5	5	6	6
AR(1) (p-value)	0.013	0.010	0.011	0.034
AR(2) (p-value)	0.248	0.123	0.201	0.230
Hansen's (p-value)	0.912	0.802	0.711	0.633
Number of instruments	24	24	32	31

Note: The dependent variable is carbon emissions. Specifications 1, 2, 3 and 4 include respectively the various institutional variables separately SMK is stock market development. AR(1) (p-value):Test for first-order serial correlation. AR(2) (p-value): Test for second-order serial correlation. Hansen's (p-value): Test the null hypothesis of the appropriate set of instruments. The standard errors, denoted within parentheses have been adjusted for heteroscedasticity. *, **, and *** denote significance levels at 10, 5, and 1%, respectively.

the adequacy and validity of the included instruments. These findings support the application of the dynamic GMM regression method

Additionally, the findings presented in Tables 4 & 5 demonstrate that the coefficients associated with the CPS variable and SMK variable are positive and highly significant at the 1% significance level. These results are consistent with prior research indicating that the development of the financial system correlates with a deterioration in environmental quality.[7–10,12] This could be explained by the financial sector's contribution to CO2 emissions, facilitated by its role in promoting economic growth through increased savings and investment. Additionally, FD contributes to carbon emissions through industrial pollution and the release of greenhouse gases stemming from industrial operations and energy consumption.[7–10] Conversely, the outcomes regarding the interaction terms are particularly intriguing.

The primary focus of this research lies in the interaction effects, demonstrating how institutional quality and FD collectively mitigate the deterioration of environmental conditions. The analysis reveals a significantly negative coefficient for the interaction term, suggesting that FD can effectively reduce carbon dioxide emissions when supported by strong institutional frameworks. This finding corroborates our hypothesis which stated that FD, when coupled with favorable governance conditions, yields positive effects on environmental quality. Columns (1, 3, and 4) illustrate the impact of the interaction between financial system development and, respectively, control of corruption, regulatory quality, and the rule of law on CO_2 emissions. The empirical findings indicate that while FD contributes to carbon emissions, the coefficients related to various interaction terms are significantly negative. This confirms that the advancement of financial institutions and markets can effectively mitigate carbon emissions within a conducive institutional environment. However, regarding the variable government effectiveness, the results suggest that the coefficient associated with the interaction between FD and government effectiveness is not significant. Thus, government effectiveness does not appear to influence the linkages between financial system development and CO_2 emissions. Lastly, the various institutional variables reaffirm their role in mitigating pollution emissions in GCC countries. As depicted in Tables 4 & 5, institutional variables, apart from government effectiveness, demonstrate negative and significant coefficients. This finding corroborates results from previous studies which demonstrated the positive effect of good institutions on environmental quality.[38–40]

Finally, when examining the outcomes of the control variables, it is evident that the coefficients associated with GDP growth, FDI, and TO are consistently and nearly significantly positive. This reaffirms findings from prior research indicating that GDP, FDI, and TO play a role in exacerbating environmental pollution.

Conclusions

This study explores the moderating role of institutional quality in the relationship between FD and carbon emissions. The findings suggest a notable rise in carbon dioxide emissions attributable to FD. However, the presence of strong institutions mitigates this effect, resulting in a decrease in carbon emissions. Indeed, results indicate that FD accompanied by good institutions improves environmental quality. Hence, the following policy recommendations are proposed. First, policymakers can significantly enhance environmental quality by prioritizing the optimization of institutional quality. This entails initiatives focused on enhancing control of corruption, regulatory quality, and adherence to the rule of law. A robust control of corruption, high regulatory quality, and a strong rule of law are crucial factors in enabling the financial sector to effectively mitigate carbon emissions by bolstering legal and institutional frameworks, enforcing standards, and establishing effective regulatory bodies. Second, given the relatively underdeveloped level and structure of the financial sector in developing countries compared to developed nations, GCC countries should proactively improve their financial structures by developing their financial systems and financial markets. This improvement would empower the financial sector to effectively harness its capabilities in enhancing environmental quality. While this study provides some incremental insights into the existing literature, it also exhibits certain limitations. Indeed, the measurement of environmental pollution in this study solely relies on CO_2 emissions in metric tons, overlooking the potential impact of other gases on the environment. Future studies should strive to integrate comprehensive datasets encompassing various categories of polluting gases.

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