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The Rule of Law, Political Stability and Environmental Pollution: An Empirical Analysis of Institutional Quality and Environmental Sustainability for Pakistan

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Abstract

The objective of this study is to investigate the impact of rule of law and political stability on environmental pollution in Pakistan controlling for economic growth, foreign direct investment, gross fixed capital formation and trade openness. The autoregressive distributed lag (ARDL) bounds-testing approach is employed to analyses time-series data from the World Development Indicators. Carbon dioxide emissions are a representation of environmental pollution, and rule of law and political stability reflect the quality of institutions. The unit-root findings show a combination of level and first-difference integration in the ARDL framework. We applied the bounds test for cointegration to verify the long-run relationship

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between environmental pollution, institutional quality and the macroeconomic variables. Meanwhile, stronger rule of law and political stability decrease carbon dioxide emissions significantly in the long-run estimates where legal enforcement, regulatory credibility, and continuity enshrined in laws are respectively found to facilitate environmental sustainability. The lower emissions are also correlated with economic growth, which suggests the presence of structural transformation and cleaner production. In contrast, foreign direct investment and trade openness aggravate environmental pollution, suggesting that investment and trade activities may be focused on energy intensive industries. The gross fixed capital formation has considerable effect. The recommendations are to strengthen the environmental institutions, enforcing national emission standards, screening foreign investment on green deposition and natural resources governance, along with promoting green trade while diverting capital towards renewable energy and low-carbon infrastructure in Pakistan.

Keywords: Rule of Law; Political Stability; Environmental Pollution; ARDL bounds testing

JEL Classification Codes: K10, D72, Q53, C22

Introduction

Environmental pollution return is a persistent economic danger because the nature of production and consumption generates social costs that are not usually incorporated into market prices. The air pollution and greenhouse gas emissions affect labor productivity, harm health, reduce agricultural production and lead to fiscal costs. In institutional economics, the impact of significant variables such as income and uses of energy, industrialization and technology is negated by explicitly stating the rules (incentives and enforcement) that determine environmental consequences. In the words of North (1990), institutions are "the rules of the game" in economic life, and comprise informal constraints on human interaction. More generically, these bounds are the point at which polluters start

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to internalize externalities and property rights matter thus ultimately leading to regulation in environmental policy. According to Jordan & Lenschow (2010), policy integration and institutional coordination is encompassed by the broader concept of environmental governance.

The rule of law can improve environmental quality through legislation, independent courts, credible monitoring, enforceable contracts and penalties for non-compliance. Predictable legal rules give firms stronger incentives to adopt cleaner technologies and encourage investment in renewable energy and pollution-control infrastructure. Conversely, weak judicial enforcement allows polluters to evade compliance and transfer environmental costs to society. Muhammad and Long (2021) show that the rule of law and political stability are important for reducing CO_2 emissions across Belt and Road economies. Their evidence indicates that the environmental effect of economic activity depends partly on whether institutions can enforce standards consistently.

Political stability is another important institutional channel. Stable governments are better positioned to sustain green policies, coordinate agencies, finance environmental infrastructure and maintain regulatory continuity. Instability shortens policy horizons and may divert public resources from environmental oversight toward immediate political or security pressures. For Pakistan, Sohail et al. (2022) find that political instability imposes environmental costs, while political stability supports lower emissions and cleaner energy use in the long run. Comparable time-series evidence from Turkey also associates political stability with improved environmental quality (Kirikkaleli & Osmanlı, 2023).

Recent research further supports a multidimensional view of institutional quality. Li et al. (2022) report that stronger institutions improve environmental sustainability in G7 economies, although the effects of trade, investment and growth remain asymmetric. Karim et al. (2022) find that corruption control,

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regulatory quality and the rule of law reduce carbon emissions in sub-Saharan Africa. Using explainable artificial-intelligence models, Stef et al. (2023) likewise show that institutional dimensions have heterogeneous effects on CO_2 emissions. These studies suggest that composite governance measures may conceal the distinct roles of legal enforcement, political continuity and regulatory capacity.

This literature is not without its weaknesses. Most studies hide the individual effects of legal enforcement and political continuity by employing composite governance proxies. These findings differ by country, income level, pollutant and estimation method on both the direction (positive or negative) and magnitude of unresolved institutional effects. In addition, the link between rule of law and political stability (after accounting for the most important economic factors) is a quite overlooked field as well. This study bridges these gaps through face validation of the role of rule of law and political stability on pollution from a political economy perspective. This is achieved by decomposing the two institutional channels, studying their effects separately and improving our understanding of whether better institutions lead to a greener economy. It should help ensure continuity of policy, match economic development with sound and enduring environmental protection, assist governments to draft credible regulations and enhance enforcement.

Literature Review

In pollution, as environmental economics and theorizing about it refined, the concern with institutional quality became paramount, because income per head, energy per dollar and industrialization alone did not account for pollution. Institutions structure the rules, incentives and enforcement mechanisms for production or natural-resource use. According to North (1990), institutions are the rules of the game that constrain economic and social interactions, implying that good institutions could effectively control environmental externalities. The early work on the environmental Kuznets curve concentrated on the income-pollution

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relationship (Grossman & Krueger, 1995), but later studies showed that institutional capacity was an important determinant of whether economic development would improve or worsen environmental quality (Esty & Porter, 2005; Castiglione et al., 2012).

The effect of rule of law on environmental pollution operates through pathways of regulatory certainty, property-right protection, judicial independence and credible penalties. The firms are incentivized to comply with environmental laws and adopt cleaner technologies when those laws are predictable and courts work. By contrast, weak enforcement allows illicit appropriation of resources, regulatory evasion and rent-seeking. Corruption alters the relationship of income and pollution (Cole, 2007), while Corruption and Political Instability hinder Environmental policymaking (Fredriksson & Svensson 2003). Castiglione et al. (2012) examined that the carbon-emissions Kuznets curve is influenced by rule of law. In a similar context, Ibrahim and Law (2016) demonstrates that institutional quality moderates the link between international trade and environmental pollution.

The Political stability may improve environmental sustainability by lengthening the time horizons of policymakers, maintaining continuity in regulation and encouraging long-term green investment. The long-established governments are more equipped to finance renewables, pollution monitoring systems and infrastructure resilient to climate change. This means that political instability, violence and high frequency of policy changes will always lead to public resources being used for existing security and limit environmentally friendly investment. The political institutions have a large impact on urban air pollution as found by Bernauer and Koubi (2009). It has been shown that political and institutional state characteristics shape the development of energy choices and their consequent environmental effects (Adams & Sarkodie, 2018). They mention that political stability, control of corruption and rule of law are among emerging

key determinants from cross-section analysis on carbon emissions, as highlighted in Belt and Road Initiative countries (Muhammad & Long 2021).

However, the institutional effects are not merely homogeneous or purely linear. The better property rights may only speed up industrial production and resource extraction in the short run, before environmental laws tighten. The political stability can benefit existing fossil-fuel businesses rather than facilitating the environmental changes. In comparison, heterogeneous relationships between institutional indicators and emissions are identified by Abid (2016). Hassan et al. (2019) and Sabir et al. (2020) analyzed that it is not only governance but also natural resources and globalization, human capital, and technological innovation that interacts with the environmental footprints.

Recent studies therefore encourage researchers to examine institutional dimensions separately. Muhammad and Long (2021) distinguish the environmental roles of rule of law, political stability and corruption control across Belt and Road economies. Li et al. (2022) identify an asymmetric relationship between institutional quality and environmental sustainability in G7 countries, while Karim et al. (2022) show that individual governance indicators do not exert identical effects on emissions. Stef et al. (2023) further demonstrate, through explainable artificial-intelligence models, that institutional variables differ in both importance and direction across countries.

Particular attention is also given to interaction and nonlinear effects. Li et al. (2022) show that institutional quality interacts with foreign direct investment, trade openness and economic growth in shaping environmental sustainability. Karim et al. (2022) place institutional quality within the Environmental Kuznets Curve framework and find that the rule of law, regulatory quality and control of corruption can reduce emissions. These results imply that institutional improvements may alter the environmental consequences of structural change,

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investment and energy use rather than operating only through a direct emissions channel.

Country and regional evidence nevertheless remains mixed. For Pakistan, Sohail et al. (2022) associate political stability with lower long-run environmental damage, whereas instability weakens clean-energy and environmental outcomes. Kirikkaleli and Osmanlı (2023) reach a similar conclusion for Turkey, finding that political stability and renewable energy improve environmental quality. In contrast, Stef et al. (2023) document substantial heterogeneity in the contribution of different institutions to emissions. Such differences may reflect national economic structures, energy composition, measurement choices and estimation methods.

The recent literature also moves beyond a simple direct relationship between institutions and emissions. It treats institutional quality as a condition that shapes the effects of trade, foreign investment, economic growth and energy transition (Li et al., 2022; Karim et al., 2022). Political stability can lengthen the policy horizon needed for renewable-energy investment and environmental innovation (Sohail et al., 2022; Kirikkaleli & Osmanlı, 2023), while credible legal institutions can strengthen monitoring and compliance (Muhammad & Long, 2021). This perspective supports estimating rule of law and political stability separately for Pakistan.

Consequently, there remains a gap in knowledge. The majority of papers used composite governance indices, cross-country panels or carbon emissions alone, which makes it impossible to untangle the separate impacts of legal enforcement or political stability. Less attention has been paid to their joint impact, time series properties and robustness to different pollution measures. Thus, a model that separates rule of law and political stability but controls for income, energy use, trade, investment and urbanization together can give better insights on how institutional quality promotes environment sustainability.

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Data and Methodology

This study utilizes time series data of World Development Indicators (WDI) for Pakistan from1996 to 2022. A few values of institutional variables are missing which are interpolated. The variables that are going to be included in the analysis are CO_2 emissions, GDP per capita annual percentage growth, the rule of law and political stability indexes (scaled from 0 to100, higher values indicate stronger institutions), Foreign direct investment (FDI), growth rate of gross fixed capital formation (GFC) and trade openness (TOP) the share trade to GDP.

$$CO_2 = f(GDP, RL, PS, FDI, GFC, TOP) \quad (1)$$

$$CO_2 = \alpha_0 + \alpha_1 GDP + \alpha_2 RL + \alpha_3 PS + \alpha_4 FDI + \alpha_5 GFC + \alpha_6 TOP + \varepsilon_t \quad (2)$$

The ARDL approach is suitable for small samples and a relatively large number of variables of types I(0) and I(1) (It can be used as long as none is of type I(2). The newer generation cointegration analysis bounded testing procedural approach for time-series studies estimates, any dissimilarity between the short-run and long-run relationships simultaneously.

Table 1: *Source and Data Description.*

Variables	Unit of Measurement	Source
CO_2	Metric tons per capita	WDI
GDP	Annual % growth	WDI
RL	Scaled from 0 to 100	WDI
PS	Scaled from 0 to 100	WDI
FDI	Net inflows as % of GDP	WDI
GFC	Annual % growth	WDI
TOP	% of trade share in GDP	WDI

Notes: CO_2= Carbon dioxide emission, GDP=GDP per capita, RL= Rule of Law, PS=Political Stability, FDI=Foreign direct investment flow, GFC=Gross fixed capital formation, TOP= Trade openness.

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The stationary values of all variables are presented in table 2 which shows that some variables are stationary at first difference and some are at level. This support to apply the ARDL bound testing methodology for regression.

Table 2: *The Findings of ADF Test*

Variables	Parameters	ADF Calculated	At 5%	Trend/ Intercept	Conclusions
CO_2	-0.75	-3.65	-4.59	Trend	I(0)
GDP	-0.45	-3.12	-2.14	Trend	I(0)
RL	-0.26	-2.48	-3.69	Intercept	I(0)
PS	-0.54	-3.78	-2.87	Intercept	I(1)
FDI	-0.84	-2.98	-3.27	Intercept	I(1)
GFC	-0.65	-4.51	-3.16	Trend	I(0)
TOP	-0.86	-3.19	-2.49	Intercept	I(1)

Note: The Results of the Table 2 are based on author's self-calculations

In table 3, the F-statistics values, Critical Bound values and variables are included.

Table 3: *Bound Testing Results for Co-integration*

Model	F-statistics Calculated	Critical Bound		Conclusion
		Iowre-Bound Value	Upper Bound Value	
CO_2,GDP, RL, PS, FDI, GFC, TOP	7.54 (0.0025)	5.65 (98%)	6.55 (98%)	Co-integration exists

Note: The calculated value of F-statistic is 6.49 (Significant at 1% level). Critical Value at k =7-1=6 is coded from Pesaran et al. (1999), Table CI.V: Unrestricted Trend and Intercept. The parenthesis value is the probability of F-statistics.

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Results and Discussion

In table 4, long-run relationship is presented between CO_2 emissions and selected economic and institutional variables. The coefficient for GDP is –0.35 (absolute t-ratio = 2.18), which suggests a statistically significant negative relationship at the 5% level. This indicates that in return for higher GDP per capita, there is a decrease emission of CO_2 over the long-term. From an economic point of view, this outcome could imply that increasing income facilitates the use of cleaner technologies, better energy efficiency and a higher demand for environmental protection.

The rule of law has a coefficient of –0.36 and t-ratio 4.00, indicating that rule of law has a strong and statistically significant negative effect on CO_2 emissions. As a result, improved legal institutions and enforcement of environmental regulations and protection of rights may play important comparative role in reducing environmental pollution. In the same way, political stability has a coefficient of –0.55 and t-ratio 2.39. Political stability seems to curtail emissions by allowing for stable climate policy and green investment and implementation.

Meanwhile, foreign direct investment is positively and statistically significant at 0.54 with a t-ratio of 2.84. These findings lend support to the pollution-haven argument, which states that foreign investment contributes to emissions growth when it enters into pollution-intensive sectors and/or operates with weak environmental standards. Trade Openness has a coefficient of 0.54, which is significant. Indeed, this makes the increase of trade potentially higher carbon by increasing production, transportation and energy consumption, or introducing more specifications for carbon-intensive goods.

The coefficient of gross fixed capital formation is positive (0.46) but the t-ratio indicates that it is not significant at the significance level of 5% (1.17). Hence, there is not enough evidence that domestic capital formation individually

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influences CO_2 emissions in the long-run. The trend coefficient is also found to be insignificant indicating that there is no evidence of an autonomous time-related increase / decrease in emissions post accounting for the variables explaining (steady-state process-leading) variability.

On the other hand, the constant (which is positive and significant) indicates what CO_2 emissions are expected to be when all continuous explanatory variables equal zero. It has little direct economic meaning. In summary, institutional development decreases environmental degradation and pollution levels but FDI and trade openness have positively contributed towards increasing it. Thus, policy should integrate more robust legal and political institutions with foreign investment screening based on environmental grounds, cleaner trade policies and incentives for low-carbon capital formation.

Table 4: *Long- Run Results of ARDL bounding testing. Dependent variable is CO2*

Explanatory Variables	Coefficients	Standard Error Coefficients	T-Ratio
GDP	-0.35	0.16	-2.18
RL	-0.36	0.09	-4.00
PS	-0.55	0.23	-2.39
FDI	0.54	0.19	2.84
GFC	0.46	0.39	1.17
TOP	0.54	0.23	2.34
Constant	4.36	1.39	3.13
Trend	0.097	0.088	1.10

Notes: CO_2= Carbon dioxide emission, GDP=GDP per capita, RL= Rule of Law, PS=Political Stability, FDI=Foreign direct investment flow, GFC=Gross fixed capital formation, TOP= Trade openness.

Conclusion and Policy Implication

The results from the long-run ARDL indicate contrasting effects of economic growth, institutional quality, foreign direct investment, capital formation and

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trade openness on environmental pollution. As a result of growth, an increase in carbon dioxide emissions per capita compared to the progression of income is reduced. This implies that technology advancement and structural transformation, likely with greater environmental awareness, income increases that are more productive than pollution may be useful aides in maintaining environmental sustainability. This result reveals that environmental degradation is not enhanced with economic development as long as resources are parlayed into cleaner production methods and energy-efficient economic activities. On a long-time horizon, rule of law and political stability make large contributions to carbon dioxide emission reduction. The performance of legal institutions can enhance the enforcement of environmental laws, limit some of the activities that harm the environment and punish polluting firms. Likewise, political stability provides the necessary policy continuity for carrying out extensive environmental programs and attracting renewable energy investments. Such results substantiate the nature of quality of institutions as a fundamental ingredient for environmental sustainability and not merely another issue on the political or administrative agenda.

On the contrary, now we can say that foreign direct investment increased carbon emissions. This result may signal the arousal of foreign capital in energy or polluting intensive industries. It further concerns the pollution haven hypothesis according to which foreign firms may relocated polluting activities in countries with relatively weaker environmental standards. The trade openness increases environmental degradation, presumably through higher levels of industrial output and transportation activity multiplied by fossil-fuel consumption and pollution-intensive exports. The gross fixed capital formation has a positive but not statistically significant relationship with emissions, indicating that investment can have either an environmental benefit or negative depending on the type of infrastructure (i.e. clean versus conventional).

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The government must, on the basis of these results, reinforce environmental legislation for effective enforcement. The environmental protection agencies also need adequate budgetary, technical and administrative autonomy to measure emissions levels and penalize violators. The domestic and foreign firms should be subject to the same environmental regulations, and transparent judicial processes must ensure that an environmental dispute can be settled in a timely manner. This provide for political stability in the form of policy consistency, institutional alignment and national environment strategies that are long-term. The renewable-energy projects, climate commitments or pollution control programs should not be interrupted by changes in government. The government should legislate to shield environmental policies and uphold them with measurable implementation goals. The foreign investment policy must encourage environmentally sustainable projects. The environmental screening before allowing foreign investment, require the environmental impact assessment, and conditional on clean technologies, renewable energy and compliance with internationally recognized environmental standards. The environmental objectives should also be integrated into trade policy. Exporters should deliver on more energy efficient production, cleaner transport systems, green certification and low carbon technologies. In conclusion, public and private capital formation should be reoriented in renewable energy, sustainable transport, waste management, green building and climate resilient infrastructure. The essence of this strategy is a combination of strengthened public and private institutions, selective foreign direct investment, and environmentally sustainable trade and investment policies that will be inconsistent with sustained increases in long-run pollution.

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