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ABSTRACT

The rule of law and control of corruption would play an effective role in managing CO_2 emissions in Pakistan. The present research has explored this issue in Pakistan controlling economic growth during 1996-2019. Further, the unit root and cointegration tests are used. We found the long and short-run relationships in the model. Economic growth has a positive effect on CO_2 emissions. The rule of law could not impact in the long run and negatively impacts in the short run. Hence, improving law and order conditions would reduce CO_2 emissions in the short run, and further improvements in the rule of law could have pleasant long-run environmental effects. The control of corruption has a positive impact on CO_2 emissions in the long run. However, the short-run effects of control of corruption with first and second lags are found negative.

Keywords: The rule of law, control of corruption, economic growth, CO_2 emissions
JEL Classification: E02, O43, Q53

1. INTRODUCTION

The role that the rule of law plays in the country's social, economic, political, and diplomatic dynamics is much broader than one can imagine. There are numerous underlying factors in the political and legal system of a country that can impact the current and future economic dynamics on a large scale. These factors can

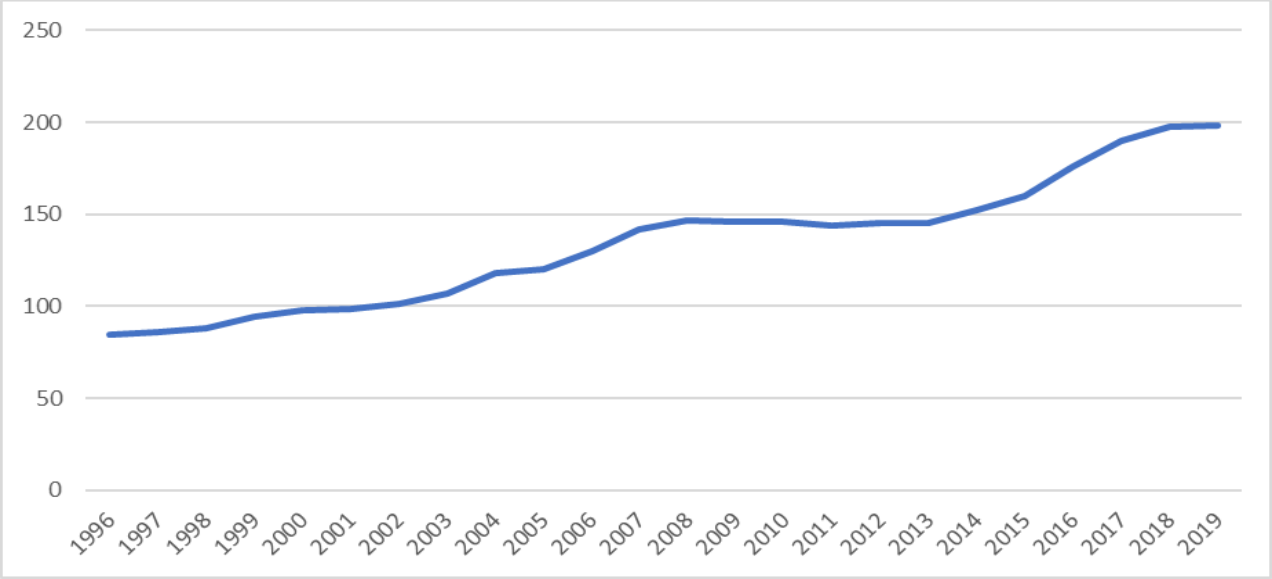
be anything from the control of corruption, corporate or public governance, policymaking, trade dynamics, economic growth, and many more. With the ever-growing environmental debates across the world and conversations about climate change in the developed and developing world, it is crucial to understand how the rule of law changes the country's energy profile and impacts the CO_2 emissions in a state. This paper explores the Rule of Law (ROL) role in shaping the extent of CO_2 emissions in Pakistan.

From a theoretical standpoint, there are many dimensions that rule of law can impact CO_2 emission production in a country. For instance, Mahmood and Alanzi (2020) discussed how the ROL affects the environment in Saudi Arabia. They used data from 1996-2014 and concluded that the ROL reduces CO_2 emissions and improves the environment while energy consumption deteriorates the environment. It is crucial to understand how and why the ROL reduced CO_2 emissions in a country, leading to an improved environment. It is mentioned in the paper that the ROL leads to more trust in the people towards the government, which tends to make them more law-abiding. More tendencies to follow the rules come with a sense of responsibility, and citizens try to adopt practices that improve the environment. For instance, when the people trust the government and what it is doing, they would like to take their part in making their country cleaner and better in multiple domains. In that effort, the environment does not go unnoticed. In another paper, Mahmood (2021) mentioned that governance improved growth while the impact of control of corruption is seen as insignificant. Considering this from an environmental perspective and taking the indirectly positive impact of economic growth on the environment into context, countries can focus on improving their governance segment. It can lead to more economic growth and result in a better environment.

Muhammad and Long (2021) studied the relationship between the ROL and pollution from 2000-2016. It explored the ways in which corruption control, political stability, and the ROL can result in either increasing or decreasing CO_2 emissions. The results showed that these factors play a robust role in reducing CO_2 emissions, proving a positive role of the ROL in declining emissions and improving the environment. In low- and high-income countries, trade openness was seen to reduce CO_2 emissions, and in lower-middle-income countries, the effect is opposite. The authors make an argument that a strong ROL makes it easier to implement environment-friendly rules and regulations on polluters, which results in lower emissions. They also discuss the possibility of a spatial effect of these political factors, resulting in better environmental policies in the neighboring countries.

It is crucial to understand how strongly CO_2 emissions can impact the overall sustainable growth patterns of Pakistan as they set the stage for further discussion on keeping these emissions at a lower level. A large chunk of CO_2 emissions in Pakistan comes from its transportation sector and have a negative impact on the overall growth. On the other hand, if emissions are reduced, they ensure economic growth not only on a short-term basis but in the longer term as well, which produces promising results (Rehman et al., 2021). In addition, declining Foreign Direct Investment (FDI) tends to reduce CO_2 emissions in Pakistan, and renewable energy consumption improves the environment (Rehman et al., 2021). Rehman et al. (2021) argued that technology leads to economic growth in Pakistan, and so does renewable energy. On the other hand, FDI can adversely affect economic growth. Ullah et al. (2021) used an ARDL approach to conclude that technological innovation has an asymmetrical effect on the environment in Pakistan. There is a further scope to expand this analysis and see how other factors in the technology and policy domain can impact CO_2 emissions and the environment in the country.

Figure 1: Pakistan's CO_2 emissions in million tonnes



Since 1996, Pakistan's CO_2 emissions have seen a gradual and steady increase, and these emissions are at their record high (see figure 1). According to Zofeen (2021), in order to maintain a global temperature, there is a need to reduce CO_2 emissions by at least 50% by 2030, which is a pretty hefty goal. However, by 2030, Pakistan's per capita CO_2 emissions are expected to rise by 300 percent, which does not seem very promising. Considering the overall context of climate change and the country's commitment to the Paris Agreement, there is a need to identify dynamic factors that can impact CO_2 emissions and result in a more sustainable environment. In the context of Pakistan, there are a handful of studies conducted that analyze the role of these political and economic factors on CO_2 emissions and the environment. Nevertheless, one that specifically addresses the role of the ROL on CO_2 emissions has not been thoroughly conducted, which is a research gap this current paper aims to fill. In this paper, the role of the ROL will be analyzed in context of CO_2 emissions and how it impacts the environment. The rest of the paper is divided into multiple sections, including a literature review, methods, analysis and discussion, and concluding remarks.

2. LITERATURE REVIEW

There is not any extensive literature studying the role of the rule of law on CO_2 emissions in Pakistan. Still, various studies explore a similar idea. For example, Ozturk et al. (2021) conducted analysis on the economy and environmental impact in India, China, and Pakistan. Growth has led to higher CO_2 emissions in Pakistan in the past, but the 2008 financial crisis led to an economic decline, resulting in lower emissions. This pattern points to a positive relation. Nevertheless, due to the energy crisis of 1990, coal prices increase, leading to people switching from coal to renewable sources, reducing emissions. Overall, expensive negative decoupling is seen between growth and emissions, which leads to a policy recommendation for the government to promote renewable energy in the form of sustainable economic growth plans and energy intensity seems to play a vital role in decoupling these variables.

In the context of political stability and the ROL, the role of governance in mitigating pollution in a country cannot be ignored. In their analysis, Danish et al. (2019) analyzed emissions and governance. A panel data analysis showed that governance tends to decline CO_2 emissions and, hence, improve environmental quality. Governance can, directly and indirectly, impact the rule of law indicator being studied in this current study because governance means that institutions, businesses, and the government in a country

follow a strongly structured legal framework that can help keep things orderly. A better governance system cannot only bring economic and social prosperity to a country. Still, it can help the nation control the rapidly deteriorating environmental condition by enforcing environment-friendly regulations on aggressive polluting entities in the country.

Mahmood (2021) studied the role that oil prices, governance, and corruption control on economic growth. The results showed that good governance could result in better growth in the short and long run. Oil prices also seemed to have a positive impact, indicating a strong link between the two. While an environmental aspect was not provided in the paper in-depth, it did point to the importance of corruption control and good governance in the overall sustainable growth of the country, which should be kept into account while devising policies. Another study by Khan and Rana (2021) conducted an analysis of the impact of Institutional Quality (IQ) on emission-output association in Asia. Effects of IQ were explored for CO_2 emissions. It was shown that institutional quality tends to reduce CO_2 emissions and hence improves the environment. Additionally, an indirect effect of IQ was also seen on emissions through income since it moderates the adverse income effects, which then lead to lower CO_2 emissions and a better environmental profile of the country. These results need to be kept into account while analyzing the role of the rule of law in CO_2 emission reduction since they are part of the same political and governance framework in a democratic country. Acheampong et al. (2021) also conducted an analysis on institutional quality in Africa. They used data from 45 Sub-Saharan African countries from 1960-2017. Results showed that renewable energy reduced emissions but also reduced economic growth by 0.014%. Growth seemed to reduce renewable energy and, as a result, also reduce CO_2 emissions. CO_2 emissions were seen to worsen institutions. It is an interesting result and suggested that improved liberal economic growth and sustainable energy policies can lead to better institutional quality in this region.

Khan et al. (2021) studied the IQ and CO_2 emissions determination and included the aspect of human capital and fiscal decentralization to provide a wider context. The results showed that fiscal decentralization has an indirect effect on pollution through IQ. The authors provide an argument that as a result of fiscal decentralization, there will be an inevitable competition between organizations to use resources efficiently, which will, in turn, lead to more eco-friendly manufacturing activities, resulting in lower emissions. It will also be easier to implement governance rules that will enforce stricter environmental regulations on companies, and monitoring will become more manageable, and environmental goals will be met at a faster rate. This discussion is similar to the argument provided on how the rule of law can lead to a better environment since it will be easier to implement more eco-friendly regulations on companies and take advantage of this compounding effect that Hargrove et al. (2019) talked about in their study on how multiple regulations can help achieve environmental goals faster.

Haini (2021) studied human capital and Information & Communication Technology (ICT) on carbon emissions in ASEAN countries. ICT was seen to reduce CO_2 emissions as a better technological profile of a nation can help make the energy sector more efficient. This result corroborates with other studies that argue about the promising role of technology in ensuring a more sustainable environment. However, human capital was seen to improve emissions and deteriorates the environment. It is so because as human capital improves in the country, there are more jobs, more rigorous industrial activities, and more manufacturing and construction that can deteriorate the environment. Therefore, there is a need to further analyze this impact and identify factors that can help mitigate this negative effect of human capital and make them more environment-friendly. Liu et al. (2021) also tested ICT in reducing emissions and using panel data for their analysis. It was shown that both ICT and corruption in a country could increase CO_2 emissions, but an interaction between the two variables tends to reduce pollution.

According to Mahmood et al. (2020), rapid urbanization can lead to higher CO_2 emissions and deteriorate the environment at a faster pace. On the other hand, oil prices can also improve these emission rates, resulting in worse environmental conditions. Dauda et al. (2021) studied the role of innovation, trade openness on pollution in Africa. The purpose of the study was to analyze any non-linear relationship between the variables using a fixed-effect. The Environmental Kuznets Curve (EKC) was seen between innovation and CO_2 emissions, indicating that as innovation improves, CO_2 emissions first rise and then eventually start declining. This relationship is similar to EKC curve where economic growth first increases CO_2 emissions, and then as a country keeps making economic progress, emissions start falling. Innovation seems to have this effect because as the country improves in innovation and technology, there will be higher production levels resulting in higher pollution. However, with more innovative methods in the energy and other sectors, emissions start to decline. This dimension of the emissions problem to an innovation-oriented policy that can help reduce CO_2 emission without imposing a hefty taxes policy which might be much more complicated to handle and enforce. Renewable energy consumption is also seen to improve the environment and lead to lower emissions. Mutascu (2018) said that in the short term, there doesn't seem to be a significant relationship between trade and pollution. Still, in the long run, business cycles drive the relationship between the two.

Another study conducted on the role of innovation and governance in emerging countries mentioned that more investment in innovative technologies and related activities could lead to a better and more sustainable environment (Bukhari et al., 2021; Haq et al., 2021, 2021; Hassan et al., 2013, 2018, 2021). Although the study did not talk about EKC between innovation and pollution, it did point to the fact that countries with better technologies have lower emissions than less innovative countries, and emission reduction patterns are also more pronounced in these countries than their less innovative counterparts. In addition, the moderating role of governance, the ROL, and regulation quality was also analyzed. It is so because when a country is innovation-oriented, it required a sound governance system and quality institutions to ensure that these innovation policies are supported. Companies coming up with innovative technologies have all the support they need to do their business and flourish their investments. Without a sound governance system and the rule of law, it will be harder for innovation to thrive and result in economic and environmental sustainability (Afrifa et al., 2020; Ahmad et al., 2013; Aldhebaib et al., 2021; Alkhateeb et al., 2016, 2019).

Adom et al. (2018) studied the long-term impact of political indicators on CO_2 emissions and mentioned that financial development could reduce emissions and democracy is having a similar impact, but that impact is limited to the transport sector. Taking this in the context of Pakistan, which is the primarily sample of this current study, a significant chunk of CO_2, as mentioned by Rehman et al. (2021), so implementing more democratic policies decreased these emissions and helped the country to achieve its environmental goals in a timely and efficient fashion. Tanveer and Hassan (2020) argued that Pakistan would work on ideas. Moreover, artificial intelligence would help to follow law and order (Tanveer et al., 2020; Khan et al. 2021; Maalel and Mahmood, 2018; Mahmood and Alkhateeb, 2017, 2018).

In a robust analysis of determinants of CO_2 emissions, Aller et al. (2021) mentioned that per capita income would identify the determinants of pollution. Gross Domestic Product (GDP) per capita, fossil fuels, industrialization, trade, and political polarization have a significant role in determining CO_2 emissions in a country. Interestingly, the impact of all these variables was seen to be negative on the environment and indicated that improvement in these variables results in higher CO_2 emissions and hence, ruin the environment. Additionally, income per capita plays a role in how much these variables affect emissions. For instance, in low-income countries, FDI can result in higher emissions and higher environmental degradation, while in higher-income countries, more tourists have that negative impact on the environment. Kocak et al. (2020) also showed that tourism could lead to pollution. Mahmood et al. (2019) studied FDI

and trade in terms of the environment of Egypt. They tested the significance of EKC in the country from 1990-2014 and validated its prevalence. Higher energy consumption was seen to increase CO_2 emissions per capita, while FDI was found to reduce it (Mahmood and Zamil, 2019; Mahmood et al., 2018, 2019, 2020; Mahrosh, 2021).

In terms of a political framework, governance, institutional quality, and the rule of law and their impact on the environment, the role of global governance of environmental policies cannot be ignored. There are some studied that discuss the topic from a global point of view and provide practical insight. For instance, Hargrove et al. (2019) conducted a cross-national CO_2 emissions analysis in the context of global governance and climate justice. It was shown that GDP per capita, population, and manufacturing activities could lead to higher CO_2 emissions while state governance can play a moderating role for emission treaties. This result leads to the discussion on global governance and formulating an effective system to enforce these environment treaties so that the global effort to reduce the pace of global warming can be materialized (Rasool et al., 2021; Senan et al., 2018; Siddiqui et al., 2020; Tanveer et al., 2020, 2021; Xue et al., 2021). The study also provided an interesting result that these environmental treatises have a compounding effect which means that for a country to improve its role in enforcing environment-friendly policies, signing up for multiple policies is a better option as it will help with governing these laws and strengthening rules around CO_2 emissions.

Literature shows that corporate social responsibility may impact pollution. Kudlak (2019) mentioned that corporate social responsibility could make companies impose self-regulating environmental measures for themselves and make it easier for them to keep track of their manufacturing and environmentally degrading activities. As a result, it can improve the environment since companies can reduce their carbon footprint without any rigorous external pressure. This result has a strong implication in the context of institutional quality, the rule of law, and governance as well since it is an indirect way to govern companies and make it easy for them to impose, monitor, and follow environment-friendly business activities.

3. METHODS

To find the effects of economic growth, the ROL and Control of Corruption (COC) on CO_2 emissions, we hypothesize the following model:

$CO2_t = f(GDPC_t, ROL_t, COC_t)$

$CO2_t$ is CO_2 emissions in million tonnes. $GDPC_t$ is GDP per capita in constant US dollars. ROL_t and COC_t are from -2.5 to +2.5. A higher value shows the higher quality of institutions. All data are sourced from World Bank (2021). The data are tested for unit root using Augmented Dickey and Fuller (ADF) (1981) with the following equations:

$$\Delta y_t = a_1 y_{t-1} + \sum_{i=0}^{p} a_{2i} \Delta y_{t-1} + e_{1t} \quad (2)$$

$$\Delta y_t = b_0 + b_1 y_{t-1} + \sum_{i=0}^{p} b_{2i} \Delta y_{t-1} + e_{2t} \quad (3)$$

$$\Delta y_t = c_0 + c_1 T + c_2 y_{t-1} + \sum_{i=0}^{p} c_{2i} \Delta y_{t-i} + e_{3t} \quad (4)$$

After the ADF test, we apply the Autoregressive Distributive Lag (ARDL) of Pesaran et al. (2001) in the following way:

$$\Delta CO2_t = d_0 + d_1 CO2_{t-1} + d_2 GDPC_{t-1} + d_3 ROL_{t-1} + d_4 COC_{t-1} + \sum_{i=1}^{m} d_{5i} \Delta CO2_{t-i} + \sum_{i=0}^{m} d_{6i} \Delta GDPC_{t-i} + \sum_{i=0}^{m} d_{7i} \Delta ROL_{t-i} + \sum_{i=0}^{m} d_{8i} \Delta COC_{t-i} + e_{4t} \quad (5)$$

$$\Delta CO2_t = fECT_{t-1} + \sum_{i=1}^{m} d_{5i}\Delta CO2_{t-i} + \sum_{i=0}^{m} d_{6i}\Delta GDPC_{t-i} + \sum_{i=0}^{m} d_{7i}\Delta ROL_{t-i} + \sum_{i=0}^{m} d_{8i}\Delta COC_{t-i} + e_{5t} \quad (6)$$

In equation 5, $d_1=d_2=d_3=d_4=0$ will be tested to validate the cointegration, and d_2-d_4 will be normalized with d_1 for long-run effects. ECT_{t-1} is an error correction term in equation 6, and its negative coefficient would validate the short-run relationship. d_{5i}-d_{8i} would capture the short-run impacts.

4. DATA ANALYSES

Table 1 shows the ADF results. All variables are level nonstationary except COC_t, which is stationary with intercept. On the other hand, $CO2_t$, $GDPC_t$, ROL_t, and COC_t are stationary after the difference. Thus, mixed order is observed in ADF analyses. However, we use ARDL, which is efficient in this case.

Table 1: ADF results

Variable	Intercept	Intercept & trend	None
Level			
$CO2_t$	-0.5101	-1.6564	1.5100
$GDPC_t$	-0.9113	-2.0387	1.6739
ROL_t	-1.6127	-1.9566	-0.2440
COC_t	-2.7847*	-2.7881	-0.9827
First Difference			
$\Delta CO2_t$	-4.1783***	-4.1219**	-4.7075***
$\Delta GDPC_t$	-2.5759*	-4.5082***	-1.6886*
ΔROL_t	-5.0415***	-5.0943***	-5.1911***
ΔCOC_t	-5.0651***	-5.0198***	-5.0801***

Table 2 shows the ARDL results. The F-value is greater than critical at a 2.5% level of significance and showed a cointegration. Moreover, the coefficient of ECT_{t-1} is negative, which shows a speed of convergence in less than nine years. $GDPC_t$ affects CO_2 emissions. Hence, increasing growth has a negative environmental impact in Pakistan in the long and short run. ROL_t has insignificant long run results and has negative short run impact. It means that improving law and order conditions would reduce CO_2 emissions in the short run. However, further improvements in the rule of law indicators of Pakistan are required to have pleasant long-run environmental effects.

Table 2: ARDL results

Variable	Coefficient	S.E.	t-value	P-value
Long run				
$GDPC_t$	0.2689	0.0062	43.1447	0.0000
ROL_t	-3.0294	7.8832	-0.3843	0.7097
COC_t	2.7050	1.0160	2.6625	0.0259
Intercept	-97.7217	11.3845	-8.5838	0.0000
Short-run				
$\Delta CO2_{t-1}$	0.6662	0.1724	3.8635	0.0038
$\Delta GDPC_t$	0.0803	0.0354	2.2689	0.0494
$\Delta GDPC_{t-1}$	-0.1007	0.0526	-1.9146	0.0878

ΔROL_t	-0.1560	0.0539	-2.8954	0.0177
ΔCOC_t	4.0080	3.7544	1.0675	0.3135
ΔCOC_{t-1}	-15.4914	6.1527	-2.5178	0.0329
ΔCOC_{t-2}	-18.3778	5.7153	-3.2156	0.0106
ECT_{t-1}	-0.1188	0.0202	-5.5428	0.0004
F-value from Bound test			4.2540	
Critical values at:				
10%			2.37-3.20	
5%			2.79-3.67	
2.50%			3.15-4.08	
1%			3.65-4.66	

COC_t has a positive effect in the long run. It means that control of corruption has positive effects on the economic activities, which use the energy to operate and emits CO_2 in turn. In the short run, control of corruption has negative effects from two consecutive years' lags. It means that control of corruption helped to create an inductive environment in the upcoming years to have a check on pollution-related activities. Hence, improving control of corruption help to reduce CO_2 emissions in subsequent years.

5. CONCLUSION

This research investigated the effects of the ROL, economic growth, and COC on CO_2 emissions in Pakistan from 1996-2019. The unit root and cointegration tests are applied to ensure stationarity issues and long-run relationships in the model. Cointegration is corroborated, and a short-run relationship has also been found in the model. Economic growth showed a positive impact. Hence, the growth of Pakistan has negative environmental consequences. The rule of law showed a no-long run effect and was negatively affected in the short run. Hence, improving law and order conditions reduced CO_2 emissions in the short run. Moreover, improvements in the rule of law are required to have pleasant long-run environmental effects. Lastly, control of corruption showed a positive impact on CO_2 emissions in the long run. It means that control of corruption raised the economic activities and increasing economic activities accelerated the CO_2 emissions. However, control of corruption helped to reduce CO_2 emissions in the short run with first and second lag effects. It means that control of corruption needs time to have pleasant environmental impacts in Pakistan. Therefore, we suggest enhancing the ROL and COC indicators for a sustainable environment in Pakistan.

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