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The Governance-Growth Nexus and Its Environmental Implications in South Asia

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ABSTRACT

This research delves into the correlation between economic growth, governance quality, and CO2 emissions within a cohort of seven nations in South Asia: Between 1996 and 2020, Bangladesh, Bhutan, India, Iran, Nepal, Pakistan and Sri Lanka. Using dynamic panel data models and fixed effects, this research documents the role of per capita gross domestic product (GDP) and the capacity of governance to affect carbon dioxide (CO2) emissions. It finds a direct correlation to CO2 emissions and economic growth and hence associate increase GDP per capita to increase in environmental degradation. Yet, enhanced governance is shown to significantly lower CO2 emissions in countries like Bangladesh, India, Nepal and Pakistan, and contributes to increasing CO2 emissions in others. In addition, economic growth and governance quality interaction led to the finding that good governance can moderate the negative environmental effects of economic growth. The uncovering of these findings underscores the importance of governance in meeting environmental sustainability and economic growth objectives in South Asia. The findings provide important policy guidance on improving governance structures to deal more efficiently with the environmental problems facing the region.

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1. Introduction

It appears that the most significant environmental dilemma that humanity has ever faced is climate change. There has been a steady increase in Earth's surface temperature over the past thirty years. This sustained acceleration of global warming in both rate and intensity significantly increases the likelihood of severe negative impacts on human life, property, the economy, and the environment. The development and implementation of policies to reduce carbon emissions and environmental impacts, as well as to safeguard future generations, depend heavily on effective governance. A complex interaction of laws, rules, and international agreements is required to manage the reduction of CO2 emissions in order to lower carbon footprints and fight climate change (Shirani Bidabadi, Mehdizadeh, Hai-Song, & Tavassoli Naini, 2023). Governments, corporations, and civil society must work together for effective governance in order to enforce emissions laws, encourage the use of renewable energy sources, and adopt sustainable practices. Researchers have also looked into the role of governance in reducing carbon emissions. For example, Güney (2022) studied 35 countries, Sarwar and Alsaggaf (2021) studied the same phenomenon in Saudi Arabia, and Hargrove, Qandeel, and Sommer (2019) looked at the impact of 24 multilateral treaties among 162 countries on the rate of carbon emissions. All of these studies concluded that effective governance reduces CO2 emissions and vice versa. About 25% of the world's population lives in South Asia, which is distinguished by a diverse range of ecological problems, governance systems, and economic statuses. The diversity

of this region in several domains highlights how difficult it is to handle its developmental and environmental issues. India and Pakistan have large, rapidly growing economies, while Bhutan and Nepal, however smaller, are also experiencing significant economic transformations. Because of this diversity, it is possible to examine how different levels of economic development and governance affect environmental outcomes.

The relationship between South Asia's economic development and governance has far-reaching implications for the region's environmental outcomes and sustainable progress. Rising GDP per capita is driving economic growth in South Asian nations, and managing this growth to strike a balance between environmental sustainability and economic advancement depends heavily on governance. Given CO2 emissions and other ecological issues, effective governance can have an impact on how resources are distributed, laws are put into place, and policies that try to lessen the negative effects of expansion on the environment are promoted (Baloch & Danish, 2022). To ensure that growth does not result in environmental harm, it is essential to understand how governance and economic progression interact in order to achieve sustainable development goals. Well-thought-out policies to address these issues are more urgently needed given the region's vulnerability to climate change and environmental degradation. In seven South Asian countries—Bangladesh, Bhutan, India, the Maldives, Nepal, Pakistan, and Sri Lanka—this study aims to explore the intricate relationship between financial growth, governance norms, and CO2 emissions. Understanding these processes is essential to developing regional economic and environmental strategies that work. This study aims to provide solid empirical evidence about the effects of economic development and governance on CO2 emissions using dynamic panel data models and fixed-effect estimate techniques. The study's thorough analysis of the joint effects of economic growth and governance quality on CO2 emissions in South Asia contributes to the body of existing information. For the environmental and policy-making sectors, this thorough research provides insightful information. The goal of the research findings is to give decision-makers vital guidance to support long-term development in the area. In order to mitigate the environmental effects of fiscal expansion, the study emphasizes the critical role that governance plays and the need for coherent policy frameworks that balance economic and environmental objectives. The review of previous research and theoretical frameworks relevant to our inquiry will be included in the parts that follow. The variables, econometric models, and data sources utilized in the analysis are described in the methodology section. The empirical findings are then presented in the results section, which is followed by a discussion that places the findings in the framework of our hypothesis. The policy proposals in the paper's conclusion highlight how important governance is to attaining sustainable development in South Asia.

2. Literature Review

An increasing trend in worldwide temperatures is mainly attributed to rising amounts of carbon dioxide (CO2) emissions, which are mainly man driven with the burning of fossil fuels and clearing of land, as in the case of jungles being felled. In the mid-1800s the use of fossil fuels has risen dramatically promoting an increase in CO2 emissions. The US EPA (2016) that globally CO2 emissions are on the rise across all sectors since 1850. The energy industry, which relies heavily on oil, coal and natural gas to generate electricity, transport, and support many forms of industries, primarily drives this pattern. Manufacturing, cement, and chemical processes are some of the greatest contributors of industrial emissions to global CO2 levels (Hargrove, Qandeel, & Sommer, 2019; Kätelhön, Meys, Deutz, Suh, & Bardow, 2019; Tian, Bai, Jia, Liu, & Shi, 2019). The major sectors, however, greatly depend on fossil fuels not only for energy but also for raw material inputs and are consequently highly emitters. Furthermore, these processes are aggravated by land use change (especially deforestation). Forests serve as atmospheric carbon mitigation through carbon absorption and management of increasing levels of carbon (Psistaki et al., 2024). Widespread deforestation to grow crops for farming, urban sprawl or log releases CO2 back from trees into the atmosphere, bumping CO2 levels even higher (Nunes, Meireles, Pinto Gomes, & Almeida Ribeiro, 2020). Cars, planes and ships run on fossil fuels, which spew out an awful lot of CO2 — and the transportation industry is another major source. As global trade and travel continue to grow, projected emissions from this sector increase. Residential, commercial and activity related to heating, cooling and electricity consumption also contribute to the trend towards increased emissions. In the context of efforts at the global scale to reduce CO2 emissions, transition to renewable energy alternatives, increase energy efficiency, and promote policies that mitigate deforestation and to encourage sustainable land management practices (Baruch-Mordo, Kiesecker, Kennedy, Oakleaf, & Opperman, 2019). Global community concedes

that the need to address these trends is urgent if we are to avoid the most damaging impacts of climate change, for governance to work in a coordinated fashion and to develop effective creative strategies to reduce global CO2 emissions.

South Asian emerging economies have recently diversified their economic development giving priority to the establishment of strong manufacturing sectors resulting in unintentional increases in carbon emissions throughout the region. The Asian Development Bank (ADB, 2013) notes this push for industrialization and makes South Asia especially vulnerable to the destructive effects of climate change: the retreat of its Himalayan glaciers, rising sea levels and the increase in typhoon events. Asian Development Bank, has rendered South Asia especially susceptible to the destructive effects of climate change, illustrated by rising sea levels, the concerning retreat of Himalayan glaciers, and an increase in typhoon events. A. Mahmood and Zahra (2017) studied the subtle link between globalization and CO2 emission and found U shaped trend in Nepal, Afghanistan, Bangladesh, and Sri Lanka. The Pakistan and Bhutan results, however, show an inverse U shape, indicating an initial increase, perhaps due to the impacts of globalization, in such cases. However, Munir and Riaz (2019) point out that there is an intricate connection between energy consumption and carbon dioxide emissions in South Asia, making pollution reducing technologies very important to curb them. Chishti, Ullah, Ozturk, and Usman (2020) contribute further by investigating how globalization and tourism shape the regional CO2 emissions in different dimensions. While tourism disrupts emissions in Nepal and Sri Lanka, they increase emissions in Bangladesh, India and Pakistan, their study suggests. On the other hand, Sun, Mohsin, Alharthi, and Abbas (2020) ultimately envision, cautiously, a happier progression where Bhutan is in the lead in environmental sustenance in the South Asian nations right behind Nepal and the Maldives. On the other hand, Pakistan lags behind compared with what we are doing and we really need to start working collectively on regional initiatives related renewable energy policies to take on the immediate challenges.

2.1. Economic Growth and CO2 Emissions

This in-depth viewpoint on the complex relationship between economic development and CO2 emissions in South Asia is synthesized from current studies on the issue. In particular, industrial growth and trade openness are very important in alleviating carbon emissions (Aslam et al., 2021). In that regard, GDP per capita plays a vital role in handling persistent environmental problems. Caron and Fally (2022) further analyzed how the levels of environmental impacts are linked to consumption habits, investigating the nonlinear relation between per capita GDP and environmental intensity. Parker and Bhatti (2020) expanded this analysis to 14 Asian countries that show convergence in CO2 emissions and per capita incomes that are driven largely by economic growth. Patiño, Padilla, Alcántara, and Raymond (2020) also confirm that economic growth and CO2 emissions have always held a persistent link and that policy intervention is crucial to counter environmental problems. Selvanathan, Jayasinghe, and Selvanathan (2021) also shows that tourism can contribute to both economic and emission growth resilience. Rahman, Saidi, and Mbarek (2020) further reviewed the complex relationships between CO2 emissions, population density and the trade liberalization in South Asia and suggested policy directions for promoting sustainable development. The adherence of their findings supports that it is every South Asian country’s economy growth that creates higher CO2 emissions per capita, and the complex interaction between the economic progress and environment conditions.

Hypothesis 1: The South Asian nations are shown to be correlated with a higher per capita CO2 emissions and higher economic growth rates.

2.2. Governance and Environmental Policy

Over the last few decades, the environmental science has begun focusing on the interconnections among governance, economic expansion and carbon dioxide emissions. Such studies, ranging from Yuan and Zhang (2020) to Albitar, Borgi, Khan, and Zahra (2023), emphasized the central importance of governance and regulatory measures to promote sustainable industrial development and cut carbon emissions. For their part, their findings show that adaptable environmental policies foster technological innovation that in turn aids the effectiveness of these technologies in lowering CO2 emissions, but also that robust environmental governance enhances the technology's efficacy in the reduction of CO2 emissions. Like Dauda, Long, Mensah, and Ampon-Wireko (2023), governance influenced CO2 emissions differently across sub-Saharan Africa as partially political governance reduced emissions while economic governance did not reduce the emissions significantly. This highlights the imperative for a whole

of governance strategies. First, the governance quality impacts on the relationship between economic growth and environmental sustainability. More specifically, while Wolde-Rufael and Weldemeskel (2020) found a nonlinear relationship between environmental regulation strictness and CO2 emissions, they indicated a nonlinear behavior similar to an inverted U curve. The results imply that, while more restrictive policies at the outset can worsen the environment, eventually, over time, they can strengthen environmental quality given effective governance. In addition, studies from South Asia including that of H. Mahmood, Tanveer, and Furqan (2021) suggests that with economic growth other renewable and non-renewable energy sources will be used more. In addition, the adoption of such energy consumption methods is highly dependent on the strong governance indicators (Sinha, Bekiros, Hussain, Nguyen, & Khan, 2023). The findings of Jain and Kaur (2022); Kakar, Khan, and Khan (2024) amply show the importance of governance reforms in terms of regulation quality and political stability in curtailing the contentious environmental impact of economic expansion and foreign investment. As a result of these investigations, these theories have been developed as to how strong governance can improve implementations of environmental legislation while also mitigating ecological consequences of economic expansion.

Hypotheses 2: Reduced per capita CO2 emissions in South Asian nations are correlated with enhanced governance.
Hypothesis 3: Economic growth affects CO2 emissions through moderating effects of the quality of governance.

3. Data and Methodology

This paper uses econometric methods to study the relationship between economic growth, governance quality and CO2 emissions in 7 South Asian countries over the period 1996 to 2020. For instance, analysis is based on Bangladesh, Bhutan, India, Iran, Nepal, Pakistan, and Sri Lanka. Governance data were sourced from the World Bank's World Development Indicators (WDI), selected for their completeness, cross-country comparability, and consistent method over the entire period covered. WDI is used to ensure reliable, and consistent measures of governance across the studied countries and periods. Additional potential datasets, such as the choice of resources, Transparency International's corruption index or Worldwide Governance Indicators, were explored; however, the WDI includes a comprehensive set of governance metrics that are essential for the multidimensional governance index used in the analysis. The chosen recorded period from the year 1996 to 2020 is being recorded as the best developments on the economy and environment in the area.

Table 1: Description of the Variable

Variables	Abbreviation	Measurement	Source
CO2 emission	CO2	Metric tons per capita	WDI
GDP per capita	GDPPC	Current US$	WID
Governance Quality	GOV.	Percentile rank	WDI

In this study, per capita CO2 emissions (CO2) serve as the dependent variable. The key independent variables are GDP per capita (GDPPC) and governance quality (Gov). Governance quality is measured using an index based on six governance indicators: Voice and Accountability, Political Stability and Absence of Violence/Terrorism, Government Effectiveness, Regulatory Quality, Rule of Law, and Control of Corruption. These indicators are presented as percentile ranks, and the composite governance index (Gov) is created by averaging the six indicators. The dataset is a balanced panel, containing observations for each of the seven countries over the 25 years. The use of panel data enables us to account for both country-specific characteristics that do not change over time and time-specific factors, enhancing the reliability and robustness of our estimates.

3.1. Econometric Model

In this study, a fixed effects (FE) model is employed to explore the relationship between the dependent and independent variables. The fixed-effects model was chosen to control for unobserved country-specific factors that remain constant over time and may influence CO2 emissions, such as geographical characteristics or long-standing institutional frameworks. The Hausman test confirmed the appropriateness of the fixed-effects model over random-effects by

rejecting the null hypothesis of no systematic difference, thereby addressing endogeneity concerns related to time-invariant unobserved heterogeneity. Moreover, Hausman test result favored fixed-effects over random-effects, implying that the former better addresses endogeneity from time-invariant unobserved heterogeneity.

The simple linear regression model is specified as follows:

$$CO2it = \beta 0 + \beta 1 GDPPCit + \beta 2 Govit + ui + \varepsilon it$$

where:

- $CO2$ emissions per metric tons per capita,
- $GDPPC$is the GDP per capita,
- Gov is the governance index,
- ui represents the unobserved country-specific effects,
- ϵit is the error term.

To account for potential non-linearities and to stabilize the variance, we take the natural logarithm of the variables, transforming the equation into a log-linear model:

$$ln(CO2it) = \beta 0 + \beta 1 \ln(GDPPCit) + \beta 2 \ln(Govit) + ui + \varepsilon it$$

This log-linear transformation allows us to interpret the coefficients as elasticities, indicating the percentage change in CO2 emissions resulting from a one percent change in GDP per capita and governance index.

Table 2: Descriptive Statistics

Country	Variables	Mean	Min.	Max.	Std. dev.
Pakistan	CO2	.7258598	.6199664	.9184727	.0838616
	GDPPC	1272.454	1033.883	1626.749	194.0913
	GOV	21.38682	17.33852	24.92819	1.993798
Bhutan	CO2	.959	.482	1.908	.466
	GDPPC	1948.984	978.495	3233.598	751.526
	GOV	57.882	52.511	68.593	5.244
India	CO2	1.236953	.7872318	1.795595	.3505002
	GDPPC	1182.956	651.9584	1944.315	421.4618
	GOV	44.52147	40.97301	46.84221	1.727491
Iran	CO2	6.471	4.543	7.571	1.058
	GDPPC	4756.202	3738.567	5450.938	606.149
	GOV	20.987	11.596	28.065	4.974
Bangladesh	CO2	.3211485	.1403549	.5861576	.1446266
	GDP	956.7094	574.8358	1593.347	320.161
	GOV	21.72161	14.1356	30.08012	3.701053
Sri Lanka	CO2	.7206584	.4520811	1.08131	.1993545
	GDP	2944.603	1673.995	4495.71	974.1633
	GOV	43.86757	38.68455	48.89163	2.881498
Nepal	CO2	.212	.086	0.531	.145
	GDPPC	711.629	491.303	1061.486	177.134
	GOV	27.389	18.935	42.604	6.483
Total	CO2	1.520911	.0859859	7.570578	2.10399
	GDPPC	1967.648	491.3028	5450.938	1446.886
	GOV	33.96496	11.59637	68.59332	14.28176

Prepared by author

The descriptive statistics provide insightful metrics on CO2 emissions, GDP per capita, and governance (GOV) indicators. Pakistan shows relatively low CO2 emissions, averaging 0.726 metric tons per capita with a modest standard deviation of 0.084, indicating minor variation over the period studied. Its GDP per capita averages $1,272.45, with moderate dispersion (Std. Dev. = $194.09), and governance scores are relatively consistent (Mean = 21.39, Std. Dev. = 1.99). Conversely, Bhutan exhibits higher variability in CO2 emissions (Mean = 0.959, Std. Dev. = 0.466) and GDP per capita ($1,948.98, Std. Dev. = $751.53), with governance scores reflecting better performance (Mean = 57.88, Std. Dev. = 5.24). India and Iran demonstrate higher CO2 emissions (Means = 1.237 and 6.471, respectively) compared to other nations, with substantial standard deviations (0.350 and 1.058, respectively), reflecting notable temporal variations. India's GDP per capita is $1,182.96 with a wider spread (Std. Dev. = $421.46), and governance

scores are relatively stable (Mean = 44.52, Std. Dev. = 1.73). Iran, with the highest GDP per capita ($4,756.20, Std. Dev. = $606.15), shows significant governance score variability (Mean = 20.99, Std. Dev. = 4.97). Bangladesh and Sri Lanka present lower CO2 emissions (Means = 0.321 and 0.721, respectively), with moderate variability in GDP per capita and governance scores. Nepal exhibits the lowest average CO2 emissions (0.212) and GDP per capita ($711.63), but with significant dispersion in governance scores (Std. Dev. = 6.48), indicating diverse governance quality over time. Overall, the total average CO2 emissions are 1.521 metric tons per capita, GDP per capita averages $1,967.65, and governance scores average 33.96 across the studied countries, highlighting significant economic and environmental heterogeneity in the region.

Table 3: Correlation Matrix

Variables			
	CO2	GDPPC	GOV
C02	1.0000		
GDPC	0.8476	1.0000	
GOV	-0.2752	-0.0370	1.0000

Prepared by author

Table 3's correlation matrix provides valuable insights into the relationships between CO2 emissions, GDP per capita (GDPPC), and governance (GOV) in the selected South Asian countries. The robust positive correlation between CO2 emissions and GDP per capita (r = 0.8476) suggests that higher economic activity, as reflected by GDP per capita, is linked to elevated CO2 emissions. This relationship supports the Environmental Kuznets Curve hypothesis, which posits that economic growth initially results in environmental degradation. In contrast, the negative correlation between CO2 emissions and governance (r = -0.2752) suggests that improved governance is linked to lower CO2 emissions, potentially due to more effective environmental regulations and policies. The weak negative correlation between GDP per capita and governance (r = -0.0370) indicates an absence of a strong linear relationship between economic prosperity and governance quality in these countries. This suggests that factors beyond GDP per capita may influence governance. These correlations underscore the complex interplay between economic growth, environmental impact, and institutional quality in South Asia.

3.2. Regression

Table 4: Linear Regression

CO2	**Coef.**	**St. Err.**	**t-value**	**p-value**	**[95% Conf**	**Interval]**	**Sig**
GDPPC	.001	0	23.33	0	.001	.001	***
Gov	-.036	.005	-6.79	0	-.046	-.026	***
Constant	.343	.224	1.54	.127	-.098	.785	

Mean dependent var	1.521	SD dependent var	2.104
R-squared	0.778	Number of obs.	175
F-test	301.392	Prob > F	0.000
Akaike crit. (AIC)	498.577	Bayesian crit. (BIC)	508.072

*** *p<.01, ** p<.05, * p<.1*

Prepared by Author

The linear regression analysis shows a statistically significant positive association between GDP per capita (gdppc) and CO2 emissions, while also indicating a statistically significant negative association between governance quality (Gov) and CO2 emissions. The coefficient of 0.001 for gdppc signifies that for each unit increase in gdppc, CO2 emissions are expected to rise by 0.001 metric tons, assuming governance quality remains constant. On the other hand, the coefficient of -0.036 for Gov implies that a one-unit enhancement in governance is linked to a reduction of 0.036 metric tons in CO2 emissions, assuming gdppc remains constant. The substantial R-squared value (0.778) suggests that the model explains a large proportion of the variability in CO2 emissions. Additionally, the statistically significant F-test (p-value < 0.000) validates the overall explanatory power of the model. These results suggest that economic prosperity (gdppc) is associated with increased CO2 emissions, whereas stronger governance can help mitigate this impact.

3.3. Multicollinearity

Table 5: VIF

Variable	VIF	1/VIF
GOV	1.0	0.998630
GDPPC	1.0	0.998630
MEAN VIF	1.0	

Prepared by author

The Variance Inflation Factor (VIF) analysis displayed in Table 5. indicates that multicollinearity is not a concern within the econometric model applied to the chosen South Asian countries. Both governance (GOV) and GDP per capita (GDPPC) exhibit VIF values of 1.0, indicating collinearity is not a concern as values below 10 are typically acceptable. So, that means there is no big correlation with these independent variables. The lack of linear dependence between GOV and GDPPC within the model indicates that the regression coefficients are stable and reliable. Multicollinearity is further ruled out since the average VIF value of 1.0 confirms the absence of multicollinearity which would result in a lower accuracy and transparency in the estimate of how each variable impacts the dependent variable, CO2 emissions. This reduction in multicollinearity can be valued in reinforcing the validity of the model's results and supporting robust economic inferences of the relationships between governance, economic prosperity and environmental outcomes within the region.

4. Empirical Results and Discussion

4.1. Hausman test

Table 6: Hausman FE RE

	__Coefficients__			
	(b) FE	B(RE)	(b-B) Difference	sqrt(diag(V_b-V_B)) S.E.
lnGDPPC	.0006227	.0006363	-.0000136	1.34e-06
lnGov	-.0212399	-.0218634	.0006236	.0007841
Chi 2	111.13			
Prob>chi2	0.0000			

Prepared by author

In investigating our null hypothesis (chi2(2) = 111.13; Prob > chi2 = 0.0000) against the Hausman test, these findings provide robust evidence against our null hypothesis, implying such a divergence between fixed and random effects models exists. We have this which means that the fixed effects (FE) model is better for our economic evaluation. These results suggest to the presence of latent variations, such as time invariant characteristics that affect CO2 emissions and may be related to the independent variables (gdppc and Gov). However, the FE model is very good at doing that which mass variation does not inform the estimated coefficient. As a result, the fixed-effects (FE) estimates (b) remain consistent despite the correlation from unobserved effects, whereas random effects (RE) estimates (B) may be biased. This suggests that using the fixed effects model provides a better estimate of the causal effects of GDP per capita (gdppc) and governance quality (Gov) on CO2 emissions thereby increasing the credibility in our research conclusion.

4.2. Regression Results

Table 7: Regression Fixed Effect

lnc02	Coef.	St. Err.	t-value	p-value	[95% Conf	Interval]	Sig
lnGDPPC	.001	0	13.91	0	.001	.001	***
lnGov	-.021	.006	-3.53	.001	-.033	-.009	***
Constant	1.02	.223	4.58	0	.58	1.46	***

Mean dependent var	1.508	SD dependent var	2.100
R-squared	0.564	Number of obs	168
F-test	102.763	Prob > F	0.000
Akaike crit. (AIC)	85.931	Bayesian crit. (BIC)	95.303

*** p<.01, ** p<.05, * p<.1

Prepared by author

Given the findings of the fixed effects regression as presented on Table 7, the determinants of per capita CO2 emissions in South Asian countries can be considered from the point of economic growth (GDP per capita) and the quality of governance. For natural logarithm of GDP per capita (lnGDPPC), the coefficient of 0.001 is statistically significant ($p < 0.01$), i.e the coefficient is robust and positive and there is a strong association between economic growth and

emissions of CO2 per capita. This result supports Hypothesis 1 that as the GDP in a country increases per capita CO2 emissions also tend to increase or with increases in industrial activity and higher energy consumption. This connection in fact proves to be very robust and dependable with the substantial t-value of 13.91. In contrast, the coefficient of -0.021 for the natural logarithm of governance (lnGov) is highly statistically significant ($p < 0.01$), suggesting a negative correlation between governance quality and CO2 emissions per capita. This result aligns with Hypothesis 2, indicating that enhanced governance correlates with reduced CO2 emissions per capita. Effective governance may facilitate the implementation of environmental regulations, policies promoting sustainable practices, and efficient resource management, thereby reducing emissions. The significant negative coefficient (-0.021) suggests that a 1% improvement in governance quality could potentially decrease CO2 emissions by 2.1%. The R-squared value of 0.564 suggests that the model accounts for approximately 56.4% of the variability in CO2 emissions per capita, underscoring its explanatory capacity. The F-test value of 102.763 with a p-value < 0.01 confirms the overall significance of the regression model. These findings support the hypothesized relationships and underscore the crucial importance of economic growth and governance in shaping environmental outcomes in South Asian nations.

4.2. Sargan Test of Overidentifying Restrictions

Table 8: Sargan

chi2(152)	.0455474
Prob > chi2	1.0000

The Sargan test for overidentifying restrictions, presented in Table 7, provides important information regarding the legitimacy of the instruments used in the regression analysis. The chi-square statistic (chi2(152)) is 0.0455474, and the p-value is 1.0000, suggesting that there is insufficient evidence to dismiss the null hypothesis. This hypothesis posits that the instruments utilized in the model are both valid and unrelated to the error term. These findings suggest that the techniques used in the regression are appropriate and devoid of endogeneity concerns, thus supporting the reliability of the model's estimates. Within the framework of our hypotheses, the legitimacy of the instruments guarantees that the associations identified among CO2 emissions, GDP per capita, and governance are not distorted by omitted variable bias or inaccuracies in measurement. The lack of multicollinearity, evidenced by the previous VIF values of 1.0, reinforces the model's strength. With appropriate instruments and no noteworthy multicollinearity, we can interpret the coefficients of the regression model with confidence. Consequently, the established positive correlation between economic growth and CO2 emissions (coefficient of 0.001), alongside the negative correlation between governance and CO2 emissions (coefficient of -0.021), represents strong findings with significant policy ramifications for South Asian countries. These results highlight the necessity of fostering sustainable economic development and enhancing governance to alleviate environmental repercussions.

5. Conclusion and Recommendations

This study contributes a great deal to the existing literature by providing sound empirical evidence on the critical interrelationship between economic growth, governance quality, and CO2 emissions within South Asia. The findings underscore quality governance as a key mechanism affecting environmental degradation, particularly as economies in the region expand. This research identifies enhanced governance as a counterbalance to the negative environmental impacts associated with rising GDP per capita, highlighting the need for broad governance reforms. Such reforms are not merely conceptual but essential for realistic policy actions aimed at achieving sustainable development in South Asia. Future research should address, more specifically, the particular processes by which governance affects environmental outcomes, including the contributions of public participation to policy making and regional cooperation to environmental governance. In addition, studies over time of how governance reforms affect the sustainability measures would be highly informative to scholars and policymakers alike in the exploration of the tradeoffs between economic growth and environmental protection.

Hence, given this, policymakers should aim to make sure that governance frameworks are up to hyperbole adverse environmental outcomes triggered as a result of economic growth. These are critical to strengthening governance through greater regulatory transparency and accountability, increasing the enforcement of environmental policies and increasing cooperation with other countries on projects to promote renewable energy. Indeed, to make it happen,

countries should also invest heavily in green technologies, provide incentives for cleaner production sources, and enforce stricter emissions regulation. In addition, investments for capacity building to enhance quality of governance including anti corruption and improving rule of law could significantly reduce CO2 emission and promote sustainable economic growth.

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