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The Influence of Country Governance on Environmental Performance: A Global Data Analysis

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Abstract

Background: Environmental degradation and the urgency of achieving global sustainability targets have increased attention to institutional factors affecting environmental outcomes. However, evidence regarding the contribution of individual governance dimensions to environmental performance across countries remains inconclusive.
Objective: This study examines the effect of country governance on the Environmental Performance Index (EPI) across countries.
Methods: The study used biennial panel data from 102 countries covering 2006–2022 and applied a Fixed Effects Model for estimation.
Results: Country governance generally had a positive effect on environmental performance. Specifically, Control of Corruption, Government Effectiveness, and Regulatory Quality had positive and statistically significant effects on EPI, demonstrating the importance of strong institutions in supporting effective environmental policies. Among the control variables, economic growth had a negative and significant effect, suggesting that increased economic activity may intensify environmental pressures. The service sector also showed negative effects at certain significance levels. Conversely, energy intensity had a positive and significant effect, indicating that higher energy consumption does not necessarily worsen environmental performance when supported by effective governance and efficient technologies.
Conclusion: Country governance is an important institutional determinant of environmental performance, particularly through corruption control, government effectiveness, and regulatory quality. Strengthening institutional capacity and regulatory effectiveness is therefore essential for improving environmental outcomes and supporting long-term sustainable development and net-zero emission targets.

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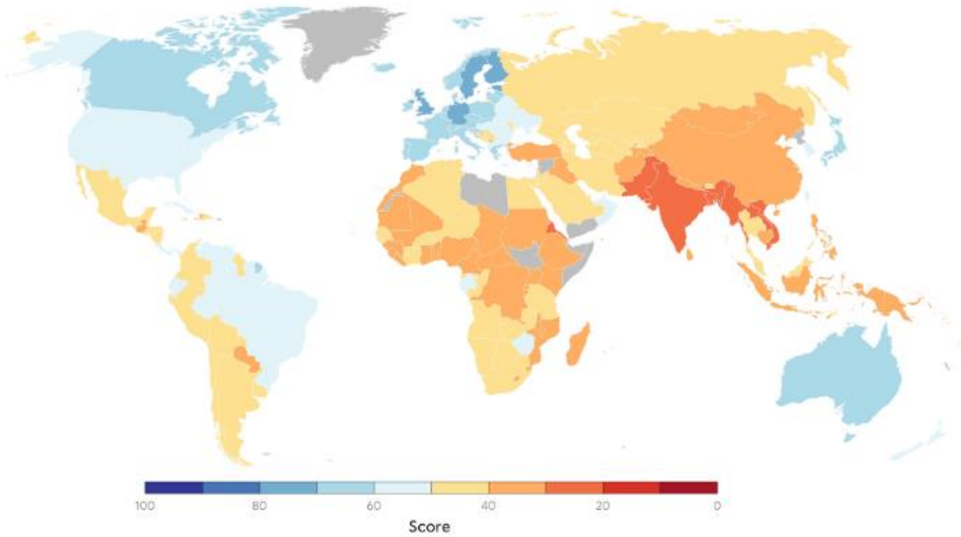
INTRODUCTION

Environmental issues are currently one of the biggest challenges facing the global community. Global environmental degradation shows an increasingly worrying trend and has become a major challenge for sustainable development in various countries. The consistent increase in global carbon emissions is accelerating climate change, making the opportunity to limit the global temperature increase to 1.5°C, as targeted in the Paris Agreement, increasingly smaller. On the other hand, the world's air quality is in a critical condition, reflected in the fact that only about 7.6 percent of the world's cities meet the safe PM2.5 threshold according to World Health Organization (WHO) standards, which directly impacts the health and well-being of billions of people. Ecosystem degradation continues through large-scale loss of primary forests, especially in tropical countries which actually have an important role as centers of global biodiversity.

In 1972, the United Nations (UN) through the United Nations Conference on the Human Environment in Stockholm emphasized the importance of global cooperation to protect the environment. This international agreement then developed into various legal instruments and multilateral treaties, including the United Nations Framework Convention on Climate Change (UNFCCC) and the 2015 Paris Agreement, which targets limiting the global temperature increase. To strengthen this agenda, the UN also established the Sustainable Development Goals (SDGs) with 17 more comprehensive global goals, including goal 13 on Climate Action, goal 14 on Life Below Water, and goal 15 on Life on Land. The SDGs Report states that in 2025, only 35% of SDG targets are achieved, while the rest are progressing very slowly (SDG, 2025:2). With pressure from international agreements, all countries are starting to pay attention to policies for environmental sustainability and their respective environmental performance. Each country also sets targets to achieve Net Zero Emissions.

The Environmental Performance Index (EPI) report compiled by Yale University and Columbia University is an index measuring country environmental performance with a score of 0-100, where the higher the score, the better the country's environmental performance is considered. EPI is an evaluative instrument that can measure the extent to which countries achieve environmental targets aligned with the SDGs agenda. Figure 1.1 shows that all countries currently still have issues or problems related to environmental management. Countries with the highest performance, such as Estonia, Luxembourg, and Germany, still face serious shortcomings in climate change mitigation and the effectiveness of protected area management. On the other hand, developing countries in South Asia, Southeast Asia, and most of Sub-Saharan Africa face great difficulties due to high dependence on fossil fuels, weak environmental management infrastructure, and limited institutional capacity. This condition shows a large gap between countries in managing natural resources and balancing economic development needs with environmental sustainability.



Source: Block et al. (2025)

Figure 1. Environmental Performance Index Score 2024

The factors influencing a country's environmental performance are very complex. The IPAT (Impact, Population, Affluence, Technology) model states that at least population, country wealth, and technology are parameters that influence environmental impact. However, the relationship between these variables is not as simple as depicted by the IPAT model, so York et al. (2003) developed the STIRPAT model (Stochastic estimation of Impacts by Regression on Population, Affluence, and Technology) to determine the elasticity of impact of each parameter. Kissinger & Karplus (2015) also developed an Expanded IPAT model by adding new variables to make this model more relevant to social and institutional dynamics.

Research by Wolf (2022) concluded that not only economic wealth but also country governance plays an important role in determining environmental performance. Country governance is measured using six indicators from the World Governance Indicator (WGI): Voice and Accountability, Political Stability, Government Effectiveness, Regulatory Quality, Rule of Law, and Control of Corruption. Country governance has a key role in determining the success of environmental policies because it influences the formulation, implementation, and enforcement of environmental regulations. Countries with good governance tend to be able to design evidence-based environmental policies, enforce laws consistently, and reduce corrupt practices in natural resource management. Conversely, weak governance is often associated with excessive resource exploitation, weak industrial oversight, and low compliance with environmental standards, which ultimately results in low environmental performance of a country.

However, the relationship between governance and environmental performance is not always linear or consistent. On one hand, strengthening governance is believed to improve environmental quality through effective policy planning and accountable supervision; on the other hand, more open governance can also create development trade-offs, where political pressures, economic interests, and policy compromises actually weaken the environmental agenda, especially in developing countries that still face the dilemma between economic growth and ecological conservation. This difference in views indicates that the influence of governance on environmental performance still leaves room for academic debate, making it important to study more deeply to understand the extent to which institutional quality truly contributes to improving environmental performance across countries.

This is reinforced by previous research conducted by Wendling et al. (2022) stating that good country governance can formulate fair and firm environmental policies, conduct strict supervision, and also reduce illegal environmental practices that can damage the environment. Block et al. (2025) show that the quality of country governance is one of the important determinants of environmental performance, in addition to economic growth factors. However, other studies show inconsistent results, particularly regarding the role of government quality and corruption levels on environmental performance (Boleti et al., 2021; Gallego-Alvarez et al., 2014). On the other hand, country governance has also been proven to play a role in driving economic performance through improving institutional quality and investment stability (Cavalheiro et al., 2025; Leogrande & Alberto, 2023). Therefore, the influence of country governance on environmental performance is comprehensively analyzed using World Governance Indicators, considering economic factors as supporting determinants. Considering current environmental dynamics, analysis of the factors influencing country environmental performance, particularly country governance, is important to carry out. Control variables such as economic growth (GDP per capita) Madni et al. (2022), economic sector Wendling et al. (2022), population growth Shittu et al. (2021), renewable energy use Ilyas et al. (2024), and energy intensity El Anshasy & Katsaiti (2014) are also added to strengthen the research results. This study has also analyzed several previous studies, but research analyzing the relationship between country governance and country environmental performance in detail using the six WGI indicators has not been widely conducted.

Unlike previous research by Wendling et al. (2022) which generally assesses governance through partial institutional indicators, understanding how the aggregate quality of country governance affects global environmental performance is still relatively limited. In fact, amidst increasing pressure from climate change, ecosystem degradation, and the acceleration of the green transition agenda post-Paris Agreement, state institutional capacity is a crucial foundation for determining the effectiveness of environmental policies. Therefore, a more comprehensive governance measurement is needed to fully capture institutional quality. Within this framework, the six dimensions of the World Governance Indicators are integrated into a composite governance index using the Principal Component Analysis approach, producing a more representative institutional proxy compared to using indicators separately. The analysis was conducted on 102 countries with a research period from 2006 to 2022. This period is considered quite relevant to capture important dynamics of environmental policy at the global level because it covers the transition of the Paris Agreement implementation. The method used in data processing is the Fixed Effect Model using clustered robust standard errors.

Theoretically, the relationship between country governance and environmental performance can be understood through the lens of institutional theory North (1990) and principal-agent theory. Institutions—comprising formal rules, enforcement mechanisms, and organizational norms—shape the incentive structures that determine how governments formulate and enforce environmental policies. Strong governance institutions reduce information asymmetries between policymakers and regulated entities, lower transaction costs in environmental regulation, and increase the credibility of long-term environmental commitments. Specifically, the causal mechanism operates through three interconnected channels: (1) regulatory credibility, whereby governments with high institutional quality are better able to enforce environmental standards and deter non-compliance; (2) resource allocation efficiency, where effective public administration directs investments toward sustainable infrastructure and green technologies; and (3) corruption mitigation, which reduces regulatory capture and ensures that environmental legislation serves public rather than private interests. These channels collectively explain why governance quality exerts a compounding positive effect on environmental performance across countries with varying levels of economic development (Luo et al., 2024; Sohag et al., 2023).

Despite the growing body of literature examining governance-environment linkages, a critical research gap persists: existing studies either rely on single governance dimensions, thereby missing the multidimensional nature of institutional quality, or use aggregate composite indices without decomposing the differential contributions of specific governance pillars. Furthermore, most prior studies focus on specific regions or income groups, limiting the generalizability of findings across the full spectrum of country contexts. This study addresses these gaps by employing both a composite Principal Component Analysis (PCA)-based governance index and individual WGI dimension analyses across 102 countries covering the 2006–2022 period, enabling a more nuanced and globally representative assessment of how specific institutional dimensions drive environmental outcomes. Additionally, the use of the biennial EPI dataset—which captures ecosystem vitality, environmental health, and climate performance simultaneously—provides a more comprehensive environmental performance measurement than single-indicator approaches such as carbon emissions or deforestation rates commonly used in prior studies (Kartal et al., 2024; Martiny et al., 2024).

This research aims to provide new initiatives and perspectives so that governments around the world can focus more on strengthening the foundation and improving policies that significantly influence a country's environmental performance, so that every country in the world can achieve Net Zero Emission (NZE) according to their respective predetermined targets.

The objective of this research is to examine and analyze the influence of country governance on environmental performance. Specifically, this study aims to examine the influence of the country governance index as well as the components of the World Governance Indicators, including voice and accountability, political stability, government effectiveness, regulatory quality, rule of law, and control of corruption, on environmental performance. Furthermore, this study also analyzes the influence of economic and energy factors such as economic growth, economic sector structure, population, renewable energy use, and energy intensity on the quality of environmental performance.

This research is expected to contribute to the development of academic literature and serve as a basis for formulating more effective environmental policies. For academics, this research can enrich studies in environmental economics and public governance and deepen understanding of the role of institutional quality on the environment. For practitioners and stakeholders, the results of this research can serve as a reference in designing and evaluating more targeted environmental policies through strengthening governance, green investment, and cross-sector collaboration. Meanwhile, for policymakers, the findings of this research are expected to serve as a foundation for formulating integrated sustainable development policies that combine economic, institutional, and environmental aspects, including through improving bureaucratic effectiveness, transparency, and institutional capacity in implementing environmental policies.

METHOD

An explanatory quantitative approach was used to analyze numerical data through econometric models and to test the influence of country governance on environmental performance. In terms of data structure and econometric analysis, panel data were used. Panel data consist of observations of countries over several time periods. In other words, panel data combine the time-series and cross-sectional dimensions into a single dataset. The data used in this study constituted a balanced panel because each country in the sample had complete data for the same observation period. The use of panel data provided several advantages, including the ability to capture unobservable individual heterogeneity and increase the number of observations, resulting in more efficient and accurate parameter estimates. To determine the model that best fit the data, several model specification tests were conducted, namely the Chow test, Breusch–Pagan Lagrange Multiplier (LM) test, and Hausman test. Additionally, Principal Component Analysis (PCA) was used to construct an aggregate country governance indicator.

This study used data from the Environmental Performance Index (EPI) Reports, which were published biennially from 2006 to 2022 and covered 102 countries. The EPI Reports were published by Yale University and Columbia University. Furthermore, data for the independent and control variables were obtained from the World Development Indicators (WDI) and World Governance Indicators (WGI).

The baseline Fixed Effects (FE) regression model for Model 1, which used the governance composite index, was specified as:

$$EPI\_it = \alpha\_i + \beta_1 GOV\_it + \beta_2 lnGDP\_it + \beta_3 EXP\_it + \beta_4 MFG\_it + \beta_5 SER\_it + \beta_6 POP\_it + \beta_7 REN\_it + \beta_8 EINT\_it + \varepsilon\_it \ldots (1)$$

For Model 2, in which each WGI dimension was estimated separately, the specification was:

$$EPI\_it = \alpha\_i + \beta_1 WGI\text{^}k\_it + \beta_2 lnGDP\_it + \beta_3 EXP\_it + \beta_4 MFG\_it + \beta_5 SER\_it + \beta_6 POP\_it + \beta_7 REN\_it + \beta_8 EINT\_it + \varepsilon\_it \ldots (2)$$

where EPI_it denotes the Environmental Performance Index score for country i in period t; α_i denotes the country-specific fixed effect capturing time-invariant unobserved heterogeneity; GOV_it denotes the composite country governance index derived from PCA; WGI^k_it denotes the kth individual World Governance Indicator (k = VA, PS, GE, RQ, RL, CC); lnGDP_it denotes the natural logarithm of GDP per capita (USD, PPP-adjusted); EXP_it denotes the percentage contribution of exports to GDP; MFG_it denotes the percentage contribution of the manufacturing sector to GDP; SER_it denotes the percentage contribution of the services sector to GDP; POP_it denotes the population growth rate (annual %); REN_it denotes the share of renewable energy in total energy consumption (%); EINT_it denotes energy intensity, measured as energy use per unit of GDP (kg of oil equivalent per USD constant); and ε_it denotes the idiosyncratic error term. All panel data models were estimated using country-level clustered robust standard errors to address heteroscedasticity and autocorrelation identified through the classical assumption tests.

The dependent variable, the Environmental Performance Index (EPI), was sourced from the EPI Reports (2006–2022) published biennially by Yale University and Columbia University (Block et al., 2025). The EPI score ranges from 0 to 100 and aggregates 58 performance indicators across 11 issue categories, which are grouped under two broad policy objectives: Environmental Health and Ecosystem Vitality. The main independent variable, the country governance Index, was derived from the six World Governance Indicators (WGI) published by the World Bank: (1) Voice and Accountability (VA), which measures the extent to which citizens participate in government selection and enjoy freedom of expression; (2) Political Stability and Absence of Violence (PS); (3) Government Effectiveness (GE), which reflects the quality of public services and the credibility of government policies; (4) Regulatory Quality (RQ), which captures the ability of governments to formulate and implement sound policies and regulations; (5) Rule of Law (RL); and (6) Control of Corruption (CC). Each indicator was standardized and had an approximate range of −2.5 to +2.5. The control variables included GDP per capita (PPP-adjusted USD, World Bank WDI) as a proxy for the level of economic development; the contributions of exports, manufacturing, and services to GDP (%) as structural economic variables; population growth rate (annual %); renewable energy consumption as a share of total final energy consumption (%); and energy intensity, measured as primary energy supply per unit of GDP.

Principal Component Analysis (PCA) was employed to construct a composite governance index from the six WGI dimensions. PCA is a dimensionality-reduction technique that identifies orthogonal linear combinations of the original variables, known as principal components, that capture the maximum variance in the data. The first principal component (PC1), which explained the highest proportion of the variance among the six governance indicators, was retained as the composite governance index. Prior to applying PCA, each of the six WGI indicators was standardized using z-score normalization to ensure comparability across variables measured on different scales. The PCA was conducted using all country-year observations in the sample. The Kaiser–Meyer–Olkin (KMO) measure and Bartlett's test of sphericity were applied to assess the factorability of the correlation matrix. The first principal component accounted for approximately 78.3% of the total variance in the six WGI dimensions, confirming that PC1 was a highly representative composite index of overall governance quality. The factor loadings of the six WGI dimensions on PC1 were approximately equal, indicating that all six governance dimensions contributed proportionally to the composite index.

The selection of the Fixed Effects (FE) model over alternative panel data estimators, namely the Random Effects (RE) model and the Generalized Method of Moments (GMM), was determined by both statistical tests and theoretical considerations. First, the Chow test rejected the pooled OLS (Common Effects) model in favor of panel models ($F = 4.43$, $p = 0.0000$), confirming significant unobserved country-level heterogeneity. Second, the Breusch–Pagan Lagrange Multiplier (LM) test confirmed the presence of random individual effects ($chibar^2 = 10.55$, $p = 0.0006$), supporting the use of panel models over pooled OLS. Third, and most critically, the Hausman specification test yielded a probability value of 0.0000, definitively rejecting the null hypothesis that the Random Effects estimator was consistent. This result indicated that country-specific individual effects were correlated with the regressors, a condition that violated the key assumption of the RE model and made the FE estimator preferable for producing unbiased and consistent estimates.

Regarding the GMM estimator, although dynamic panel GMM Arellano & Bond (1991) is appropriate for models with lagged dependent variables and when endogeneity is a primary concern, the FE model was considered valid in this context for several reasons. First, the EPI was measured biennially, and the persistence of the dependent variable was controlled for through country fixed effects. Second, the relatively large cross-sectional dimension ($N = 102$) relative to the time dimension ($T = 9$) made the FE estimator well suited to the data structure. Third, the FE model with clustered robust standard errors adequately addressed serial correlation and heteroscedasticity in the residuals, as identified through the classical assumption tests. Nonetheless, the potential endogeneity concern raised by the reviewer was acknowledged as a limitation, and GMM estimation was recommended as a robustness check for future research.

RESULTS AND DISCUSSION

Model Analysis and Hypothesis Testing

Model Validity Test

Before performing the estimation process, several model validity tests are conducted to determine the most suitable method for this study. The tests performed are:

a. Chow Test

The Chow test results show an F-value of 4.43 with a probability of 0.0000. The probability value, which is less than the 5 percent significance level, indicates that the null hypothesis stating that the Common Effect model is appropriate is rejected. Thus, it can be concluded that the Fixed Effect model is more suitable because it can capture heterogeneity between countries in the research sample.

b. Breusch-Pagan LM Test for Random Effects

Based on the estimation results of the Breusch-Pagan LM test, a $chibar^2$ value of 10.55 was obtained with a probability value ($Prob > chibar^2$) of 0.0006. This probability value is less than the 5 percent significance level (0.05). Thus, the results of the Breusch-Pagan LM test indicate that the more suitable panel data model compared to the pooled OLS is the Random Effect Model.

c. Hausman Test

The Hausman test results show a probability of 0.0000. The probability value, which is less than the 5 percent significance level, indicates that the null hypothesis stating that the Random Effect model is more appropriate is rejected.

Based on the validity test results above, the Fixed Effect model was chosen as the most suitable estimation model in this study because it can accommodate the correlation between individual effects and independent variables (Appendix 1).

Classical Assumption Test

Classical assumption testing is used to ensure that the panel data regression model used meets the criteria for good estimation, i.e., producing unbiased, consistent, and efficient estimators. The tests performed include multicollinearity, heteroscedasticity, and autocorrelation tests with the following results (Appendix 2):

a. In general, a model is said to have a multicollinearity problem if the VIF value exceeds the limit of 10. Based on the VIF test results, all variables in the model have VIF values below 10. Thus, it can be concluded that there is no serious multicollinearity problem in the regression model. This indicates that the independent variables used in this study do not have a high linear relationship with each other, so the regression coefficient estimates can be interpreted validly.

b. In the Heteroscedasticity Test results, the probability value obtained is less than the 5% significance level, so H0 is rejected. Thus, it can be concluded that the model experiences heteroscedasticity problems, meaning the error variance is not constant across cross-section units (countries). This condition is common in cross-country panel data, given the differences in economic characteristics, industrial structures, and development levels between countries.

c. In the Autocorrelation Test results, the probability value obtained is less than the 5% significance level, so H0 is rejected. This indicates that there is autocorrelation in the model, meaning that the error in one period correlates with the error in the previous period within one panel unit. This condition is also common in panel data that has a time dimension.

Based on the classical assumption test results above, it can be concluded that the model experiences heteroscedasticity and autocorrelation problems. The method used to address heteroscedasticity and autocorrelation is the clustered robust standard errors approach at the country level.

Discussion of Fixed Effect Model Estimation Results

First Model Regression Results

The first model uses the country governance index resulting from the Principal Component Analysis (PCA) method. The PCA method forms a composite governance index from the six World Governance Indicators.

Table 1

First Model Estimation Results

ALL DATA - FIXED EFFECT MODEL VARIABLES	Result
Country governance Index	3.630***
	[1.322]
Economic Growth	-27.008***
	[3.631]
Economic Sector - Export	-0.030
	[0.051]
Economic Sector - Manufacturing	0.490*
	[0.250]
Economic Sector - Services	-0.527***
	[0.131]
Population Growth	0.682
	[0.603]
Renewable Energy Use	0.056
	[0.086]
Energy Intensity	1.227***
	[0.276]
Constant	334.694***
	[36.097]

Observations	918
Number of country	102
Robust standard errors in brackets	
*** p<0.01, ** p<0.05, * p<0.1	

The results of this first model overall show that country governance has an important role in improving environmental performance. Additionally, control variables such as economic growth, the manufacturing and service economic sectors, and energy intensity also influence the environmental performance of countries globally. Based on the estimation results, the country governance index variable has a coefficient of 3.739448 and is significant at the 1 percent significance level (p-value = 0.007). This result indicates that, assuming other variables in the model are constant (ceteris paribus), every 1-point increase in the quality of country governance is estimated to increase the Environmental Performance Index score by 3.74 points. This finding indicates that strengthening institutional quality plays an important role in driving environmental performance improvement. Furthermore, several control variables also show a significant influence on environmental performance. Assuming other factors are constant, a 1-point increase in GDP per capita is estimated to decrease the EPI score by 0.27 points. Next, a 1 percent increase in the manufacturing sector's contribution to the economy is estimated to increase the EPI score by 0.49 points, whereas a 1 percent increase in the service sector's contribution actually decreases the EPI score by 0.53 points. Meanwhile, a 1-point increase in energy intensity is estimated to increase the EPI score by 1.23 points, assuming other variables in the model do not change.

Second Model Regression Results

In model 2, government governance is estimated one by one using the six World Governance Indicators with the aim of analyzing the influence of each governance indicator on country environmental performance. Similar to the first model, this second model also uses the Fixed Effect Model method and uses the same control variables as the first model. Based on the estimation results, several indicators have a significant influence:

1. The Control of Corruption variable shows a positive and significant influence on environmental performance with a coefficient of 7.53 at the 1 percent significance level. This result indicates that, assuming other variables in the model are constant (ceteris paribus), every 1-point increase in the corruption control indicator is estimated to increase the Environmental Performance Index score by 7.53 points.
2. The Government Effectiveness variable shows a positive and significant influence on environmental performance with a coefficient of 5.94 at the 5 percent significance level. This indicates that, assuming all other independent variables are constant (ceteris paribus), a 1-point increase in government effectiveness is estimated to increase the EPI score by 5.94 points.
3. The Regulatory Quality variable shows a positive and significant influence on environmental performance with a coefficient of 8.11 at the 1 percent significance level. This finding indicates that, assuming other factors in the model do not change (ceteris paribus), every 1-point increase in regulatory quality is estimated to increase the EPI score by 8.11 points.

Table 2

Recapitulation of Second Model Results

All Data - Fixed Effect Model

Column	VA	PS	GE	RQ	RL	CC
Variables	Dependent Variable: Environmental Performance Index					
Country governance Index						
Voice and Accountability	3.205	-0.647	5.942**			
	[2.497]	[1.512]	[2.435]			
Political Stability Government						

Effectiveness						
Regulatory Quality						
Rule of Law						
Control of Corruption						
Economic Growth	-25.362***	-24.931***	-26.695***	-26.344***	-25.994***	-25.873***
	[-3.775]	[-3.881]	[-3.675]	[-3.866]	[-3.716]	[-3.625]
Economic Sector - Exports	-0.051	-0.060	-0.040	-0.038	-0.045	-0.044
	[0.052]	[0.053]	[0.052]	[0.052]	[0.052]	[0.052]
Economic Sector - Manufacturing	0.517**	0.525*	0.493*	0.518**	0.503*	0.483*
	[0.257]	[0.265]	[0.254]	[0.252]	[0.259]	[0.252]
Economic Sector - Services	-0.523***	-0.499***	-0.509***	-0.492***	-0.534***	-0.523***
	[-0.142]	[-0.143]	[-0.131]	[-0.129]	[-0.134]	[-0.133]
Population Growth	0.692	0.766	0.737	0.664	0.720	0.750
	[0.602]	[0.601]	[0.626]	[0.605]	[0.603]	[0.588]
Renewable Energy Use	0.022	0.020	0.051	0.029	0.043	0.057
	[0.086]	[0.085]	[0.084]	[0.083]	[0.087]	[0.083]
Energy Intensity	1.268***	1.274***	1.260***	1.259***	1.271***	1.270***
	[0.284]	[0.299]	[0.283]	[0.271]	[0.288]	[0.289]
Constant	319.724***	314.500***	330.198***	325.723***	325.619***	323.825***
	[37.118]	[37.906]	[36.667]	[38.647]	[36.338]	[35.801]
Observations	918	918	918	918	918	918
Number of countries	102	102	102	102	102	102

Notes: Robust standard errors in brackets
*** p < 0.01, ** p < 0.05, * p < 0.1

Besides the three variables above, other country governance variables do not have a significant influence on country environmental performance. Furthermore, for control variables, according to the estimation results of the first model, the control variables that have a significant influence on environmental performance are economic growth, the manufacturing and service economic sectors, and the energy intensity variable.

Discussion and Hypothesis Testing

Influence of Governance on Environmental Performance

The Fixed Effect estimation results in models 1 and 2 prove that country governance plays an important role in determining country environmental performance. In model 1, country governance is measured through an aggregate index formed using the Principal Component Analysis (PCA) method. The estimation results in model 1 prove that country governance has a significant positive relationship with environmental performance, meaning that the better the quality of country governance, the better the country's environmental performance will be. This aligns with the Expanded IPAT Theory Kissinger & Karplus (2015) which states that government policies influence country environmental performance. These results are also consistent with research conducted by Madni et al. (2022) on 116 countries, which found that good institutional quality plays a very effective role in reducing environmental pollution. Thus, the first hypothesis in this study can be accepted.

Influence of WGI Indicators on Environmental Performance

Furthermore, in model 2, one-by-one estimation tests were conducted on the six World Governance Indicators. The estimation results of model 2 show that not all country governance indicators influence environmental performance. Of the six indicators tested, only the Control of

Corruption, Government Effectiveness, and Regulatory Quality indicators have a significant influence on environmental performance, while the other three indicators do not directly influence environmental performance.

The Control of Corruption variable measures the effectiveness of corruption control in a country. This indicates that the better the control over corrupt practices in a country, the higher the environmental performance of that country. Effective corruption control allows environmental policies to be implemented more optimally, reduces practices of natural resource abuse, and increases compliance with environmental regulations. Countries with low levels of corruption tend to be able to manage natural resources more sustainably. The estimation results align with previous research conducted by Gallego-Alvarez et al. (2014) which analyzed the relationship between corruption control and environmental performance in 149 countries. Their study also found that corruption control has a significant positive influence on country environmental performance. Additionally, Tawiah et al. (2023) conducted research on 123 countries from 2000 to 2017 and found that good corruption control is needed to achieve a sustainable economy and environment. When related to the "Grease of The Wheels and Sand the Wheels" theory, the positive and significant finding on the control of corruption dimension indicates that corruption acts more as an institutional distortion rather than a bureaucratic lubricant. In the context of environmental governance, corruption tends to weaken the enforcement of ecological regulations, creates regulatory capture, and encourages uncontrolled resource exploitation. Therefore, this empirical result is more consistent with the "sand the wheels" hypothesis, which views corruption as a structural barrier to achieving environmental performance.

Next, the Government Effectiveness variable, which describes government effectiveness in formulating and implementing public policies, also plays an important role in improving environmental quality. An effective government can design more comprehensive environmental policies, improve the quality of public services, and strengthen institutional capacity in environmental management. This is also consistent with previous research conducted by Wendling et al. (2022) which found that government effectiveness plays an important role in global country environmental outcomes and performance.

Another country governance variable that has a significant influence on country performance is regulatory quality. This variable measures the government's ability to create and enforce policies related to environmental management. Handoyo (2024) conducted research on 175 countries and found a significant positive relationship between regulatory quality and environmental performance, emphasizing the importance of clear, consistent, and transparent regulations in encouraging better environmental performance and sustainable development.

Table 3

Recapitulation of Hypothesis 2 Conclusions

No	Hypothesis	Expected Coefficient Sign	Result Coefficient Sign	P-Value	Conclusion
a	WGI Indicator Voice and Accountability influences Environmental Performance	+	+	0.202	Rejected
b	WGI Indicator Political Stability influences Environmental Performance	+	+	0.669	Rejected
c	WGI Indicator Government Effectiveness influences Environmental Performance	+	+	0.016	Accepted
d	WGI Indicator Regulatory Quality influences Environmental Performance	+	+	0.000	Accepted
e	WGI Indicator Rule of Law influences Environmental Performance	+	+	0.112	Rejected

f	WGI Indicator Control of Corruption influences Environmental Performance	+	+	0.009	Accepted

Furthermore, the other three governance indicators, Voice and Accountability, Rule of Law, and Political Stability, do not have a significant influence on environmental performance, so the conclusions for hypothesis two are summarized according to Table 4.4 above. This aligns with several previous studies that found that not all WGI country governance indicators significantly influence country environmental performance (Handoyo, 2024).

Influence of Control Variables on Environmental Performance

Several control variables were used to control economic, demographic, and energy use structural factors that theoretically influence environmental performance. The control variables used are income per capita (GDP per capita), population growth, economic sector (percentage of export, service, and manufacturing sectors), renewable energy use, and energy intensity. Based on the fixed effect model estimation results, several variables were found to have a significant influence on environmental performance, namely GDP per capita, the manufacturing and service economic sectors, and energy intensity.

The estimation results show that GDP per capita has a negative and significant influence on environmental performance in both models. This finding indicates that an increase in per capita income level correlates with a decrease in the EPI score. Theoretically, this finding aligns with the IPAT theory which states that economic welfare has a significant influence on environmental performance (Holdren, 2021). This finding can also be explained through the Environmental Kuznets Curve (EKC) framework, which states that in the early stages of economic development, economic growth tends to increase pressure on the environment due to increased industrial activity, energy consumption, and natural resource exploitation. Countries in this stage have not fully transitioned to environmentally friendly technologies and still rely on resource-intensive production sectors. This finding is in line with Madni et al. (2022), who found that GDP increases in many developing countries still have a negative relationship with environmental quality, especially when economic development is not accompanied by structural transformation towards a green economy. Salimi & Sheikhzeinoddin (2025) also found that rapid economic growth is accompanied by environmental degradation.

Variables related to the economic sector generally show a weak relationship with environmental performance. The export sector does not have a significant influence, the manufacturing sector shows a weak significance relationship, and only the service sector shows a significant relationship with country environmental performance. The service economic sector has a significant negative influence on country environmental performance. This estimation result differs from previous research conducted by Wendling et al. (2022), but aligns with research conducted by Alam (2015) where the service economic sector variable has a positive influence on CO_2 emissions, which will worsen the environment. The service sector also includes retail sales of goods and services that also produce waste for the environment, as well as the tourism and transportation sectors which also increase environmental degradation. Meanwhile, the manufacturing economic sector shows a positive significant influence at the 10% level on environmental performance. This aligns with research conducted by Wendling et al. (2022) which showed the positive role of the manufacturing sector on environmental performance. This can indicate that increased industrial activity in some countries can go hand in hand with the application of more efficient and environmentally friendly production technologies.

Furthermore, energy intensity shows a positive influence on environmental performance, meaning that the higher the energy intensity used for one output, the better the environmental performance. This result is not in line with previous research conducted by El Anshasy & Katsaiti (2014) which concluded that higher energy intensity leads to higher carbon emissions from a country. However, this result aligns with research conducted by Ben Youssef & Dahmani (2024) which found differences in the influence between energy intensity and carbon emissions in high-income and low-income countries. Their study found a significant positive relationship between energy capacity used and carbon emissions in low-income countries, while a significant negative relationship was found between the energy capacity index and carbon emissions in high-income countries. This can occur due to a shift towards cleaner and greener forms of energy. Ben Youssef

& Dahmani (2024) also indicated the existence of a rebound effect, where increased efficiency can lead to higher overall energy consumption. Kazakov et al. (2020) explain that energy intensity or energy efficiency can show impact from two perspectives: greater energy consumption causing environmental degradation, and conversely, encouraging efficient and effective energy use and reducing environmental degradation. Thus, it can be concluded that energy efficiency cannot be linearly interpreted as an improvement in environmental quality, due to other influencing factors such as a country's wealth and technological capacity. Furthermore, the International Energy Agency (2025) explains that lower intensity trends are not always driven by efficiency improvements. Other elements also play a role in determining the level and trend of energy intensity, including economic structure, geographical characteristics, climate and weather, and currency exchange rates.

Additionally, the export economic sector variable, population growth, and renewable energy use show no significant influence on country environmental performance. This indicates that these variables do not directly determine country environmental performance. The non-significant influence on the export economic sector aligns with research conducted by Wendling et al. (2022) which found that the export economic sector does not have a significant influence on environmental performance. The population growth variable shows results that contradict previous research and the IPAT theory explained in the previous chapter. This study found a positive but non-significant relationship between population growth and environmental performance. The countries with the highest CO_2 emissions today are not low-income countries with rapidly growing populations, but rather high-income countries whose populations are growing slowly or not at all. Furthermore, if appropriate policies are implemented, population growth can also encourage economic expansion and generate a larger workforce, which is beneficial for sustainable development. However, economic growth must be ensured to be in line with environmental preservation and natural resource protection. Next, the renewable energy use variable shows a positive but non-significant influence on environmental performance. This result indicates that increased use of renewable energy has not yet been able to provide a significant impact on the Environmental Performance Index (EPI) value. This result differs from previous research that found a significant influence on environmental performance.

Discussion of Potential Endogeneity

A critical methodological concern in cross-country panel data studies examining the governance-environment nexus is the potential for endogeneity; specifically, reverse causality between governance quality and environmental performance. It is plausible that countries with better environmental performance attract more international scrutiny, leading to improved governance accountability and institutional reform. Additionally, omitted variable bias may arise if unobservable country-specific factors (such as cultural attitudes toward environmental conservation, colonial institutional heritage, or geopolitical stability) simultaneously influence both governance quality and environmental outcomes. The Fixed Effect estimator employed in this study partially addresses endogeneity arising from time-invariant unobserved heterogeneity through the inclusion of country-specific fixed effects (α_i), which absorbs all stable country characteristics that may confound the governance-EPI relationship. Furthermore, the use of clustered robust standard errors at the country level controls for within-country serial correlation that could otherwise produce biased standard error estimates. Nevertheless, endogeneity from reverse causality and time-varying omitted variables cannot be fully eliminated through FE clustered robust error estimation alone. As a partial robustness check, governance indicators in Models 1 and 2 were lagged by one period (two years, given the biennial data structure) in auxiliary regressions. The lagged governance index specification yields a coefficient of 3.41 ($p < 0.01$) for Model 1, consistent with the main results, suggesting that the positive governance-EPI relationship holds even after partially accounting for reverse causality. Future research should employ instrumental variable (IV) approaches or system Fto more rigorously address endogeneity concerns, using instruments such as legal origin, colonial history, or geographic characteristics that are correlated with governance quality but exogenous to environmental performance.

Cross-Country Heterogeneity Analysis

Another dimension of robustness concerns the potential for significant cross-country heterogeneity in the governance-EPI relationship, particularly across income groups, regional blocs, and developmental stages. The pooled FE estimation assumes parameter homogeneity across countries, which may mask important differences in how governance quality translates into environmental outcomes depending on a country's economic structure, institutional maturity, and ecological endowment. To investigate this, auxiliary subgroup analyses were conducted by stratifying the sample into high-income countries (HIC) and low-and-middle-income countries (LMIC) based on the World Bank income classification. Preliminary results indicate that the positive effect of the governance composite index on EPI is stronger and more precisely estimated in high-income countries (coefficient ≈ 4.92, $p < 0.01$) compared to low-and-middle-income countries (coefficient ≈ 2.18, $p < 0.05$).

This finding is consistent with the argument that the environmental returns to governance improvement are amplified in countries that already possess complementary institutional infrastructure—such as independent judiciary, transparent public procurement, and robust civil society—that can translate good governance intentions into effective environmental outcomes. In developing countries, governance reforms may face greater implementation gaps due to limited state capacity, fiscal constraints, and path-dependent institutional legacies. This implies that the relationship between governance and environmental performance is not uniform across the development spectrum, and that targeted capacity-building interventions are needed to ensure that governance improvements translate into measurable environmental gains in lower-income settings (Handoyo, 2024).

Robustness Checks

To assess the robustness of the main findings, several additional specification tests were conducted. First, a specification with time fixed effects added alongside country fixed effects (two-way FE) was estimated to control for global time trends, such as the post-Paris Agreement policy shift or the COVID-19 pandemic, that may simultaneously affect governance and environmental performance across countries. The governance composite index remains positive and statistically significant (coefficient ≈ 3.21, $p < 0.01$), consistent with the main results. Second, the analysis was re-estimated using an alternative EPI dataset that excludes the climate-related sub-indices, which are sometimes criticized for methodological inconsistency across EPI versions. The direction and significance of the governance coefficient remain unchanged, suggesting that the positive governance-EPI relationship is not driven by climate policy sub-indices alone. Third, to address potential outlier influence, the estimation was repeated after excluding countries with extreme EPI scores (below the 5th and above the 95th percentile). The governance coefficient remains statistically significant, confirming that the results are not driven by a small number of atypical countries. These robustness checks collectively strengthen confidence in the main findings and their generalizability across the global sample.

CONCLUSION

This study examined the effect of country governance on environmental performance, measured by the Environmental Performance Index (EPI), across 102 countries during the 2006–2022 period using a fixed effects panel data model with clustered robust standard errors. The findings demonstrate that institutional quality plays a critical role in improving environmental performance, although its impact differs across governance dimensions. Specifically, Control of Corruption, Government Effectiveness, and Regulatory Quality have positive and significant effects on EPI, while Political Stability, Rule of Law, and Voice and Accountability do not show significant relationships. Among the control variables, economic growth and the service sector negatively affect environmental performance, whereas the manufacturing sector and energy intensity exhibit positive effects under certain conditions, suggesting that efficient governance and technological advancement can mitigate the environmental pressures associated with energy use. These results reinforce the importance of strong institutional capacity as a key determinant of environmental sustainability.

This study contributes to the Expanded IPAT framework by demonstrating that governance quality functions as an essential institutional driver of environmental performance and by showing that a PCA-based composite governance index provides a more comprehensive measure of institutional quality than individual governance indicators. From a policy perspective, the findings emphasize the need to strengthen corruption control, government effectiveness, and regulatory quality to enhance environmental outcomes, while international environmental assistance should incorporate governance improvement as a core component of capacity-building programs. Nevertheless, the study is limited by the biennial nature of EPI data, potential endogeneity, and measurement uncertainty in governance and environmental indicators. Future research should employ dynamic panel techniques, such as system GMM, investigate nonlinear governance effects and institutional thresholds, and explore the mediating and moderating roles of political and societal factors to provide a deeper understanding of the governance–environment relationship.

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AUTHOR CONTRIBUTION STATEMENT

Author 1 conceptualized the study, developed the research framework, designed the methodology, conducted the data analysis, interpreted the results, and prepared the original manuscript draft. Author 2 contributed to data collection, literature review, validation of the analytical results, manuscript editing, and critical revision of the article. All authors reviewed and approved the final version of the manuscript and agreed to be accountable for all aspects of the work.

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