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EXAMINING THE MEDIATING ROLE OF TRANSPARENCY IN THE RELATIONSHIP BETWEEN JUSTICE AND CARBON REDUCTION: A GLOBAL COMPARATIVE ANALYSIS

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Abstract
This study explores the pivotal role of judicial effectiveness and access to information in mitigating greenhouse gas (GHG) emissions across countries. Utilizing cross-country panel data and employing both Ordinary Least Squares (OLS) regression and Structural Equation Modeling (SEM), the research examines how robust judicial systems and transparency mechanisms impact environmental outcomes. Findings indicate that judicial effectiveness significantly curbs GHG emissions by ensuring the enforcement of environmental regulations, while access to information enhances this effect by promoting accountability and public engagement. The analysis also identifies economic growth, population expansion, and trade as major contributors to emissions, whereas innovation acts as a mitigating factor. These results highlight the importance of reinforcing legal frameworks, improving transparency, and fostering innovation to achieve climate objectives. The study provides actionable policy insights for strengthening judicial institutions and enhancing access to information, enabling countries to implement climate policies more effectively and reduce their environmental footprint.

INTRODUCTION

The urgency of addressing climate change and its environmental, social, and economic consequences has become one of the most pressing global challenges. Greenhouse gas (GHG) emissions, particularly carbon dioxide (CO2), methane (CH4), and nitrous oxide (N2O), are the primary drivers of global warming, leading to rising temperatures, changing weather patterns, and increasing frequency of extreme weather events. Countries around the world have acknowledged the need for collective action to mitigate the effects of climate change, with international frameworks such as the Paris Agreement aiming to limit global temperature rise to well below 2°C above pre-industrial levels (Mani, Hussein, Gopalakrishnan, & Wadhwa, 2018).

Despite the global consensus, progress toward these climate targets has been uneven, with significant disparities in emission levels, the effectiveness of mitigation policies, and the ability to implement environmental regulations(Lidskog & Sundqvist, 2022).

One crucial determinant of how countries manage environmental policies, including those addressing GHG emissions, is the presence and strength of judicial system and more specifically the effectiveness of judiciary and access to information(Mayer, 2022; Novak, 2019). The judicial effectiveness, a fundamental principle in

implementing regulation effectively and easy and quick justice provision to aggrieved party, while publicly disclosed and access to information which enable public to know the decision taken by the government. It ensures that all individuals and institutions, including the government itself, are accountable to the law. The relationship between the judicial effectiveness, access to information and environmental protection, particularly in the context of reducing GHG emissions, is not only complex but also highly critical to understanding how legal systems influence climate change mitigation efforts. The rule of law can play a significant role in shaping how countries implement policies related to environmental protection and climate change. A strong judicial system and access to information ensures that legal frameworks, such as environmental regulations, are effectively enforced and that violators face legal consequences and public know the hazard of policies of the government. On the other hand, weak or ineffective legal institutions often lead to lax enforcement of environmental standards, allowing for unsustainable practices that contribute to environmental degradation. Therefore, a robust understanding of how effective judicial system affects GHG emissions across countries is essential for crafting effective global and national climate policies.

This paper seeks to explore the impact of the judicial effectiveness on greenhouse gas emissions through a cross-country analysis. By examining the relationship between the legal environment and the emission levels across different countries, we aim to uncover whether stronger effective legal system correlates with lower emissions, and how legal institutions might either facilitate or hinder efforts to combat climate change and the mediating role of access to information. The cross-country approach allows for a comparative analysis that takes into account different legal, political, and economic contexts, making it possible to derive more generalizable insights for policymakers and international organizations.

The concept of the rule of law encompasses several key components that contribute to the effective functioning of legal systems and their impact on governance and societal outcomes. According to scholars such as Hayek (1944) the rule of law entails transparency and access to information refer to

predictable, stable, and transparent legal systems that respect individual rights and ensure justice. However, there are various dimensions to the rule of law that can influence environmental outcomes, including access to justice, the quality of legal institutions, the enforcement of laws, and the consistency and access to information with which laws are applied. The creation of laws and regulations that promote environmental sustainability is the first step in ensuring that countries reduce their GHG emissions. Laws that set clear and stringent targets for emissions reduction, promote renewable energy, and incentivize the adoption of cleaner technologies are crucial in shaping the actions of businesses, industries, and individuals but their effectiveness implementation and accountability can only be ensure with effective judiciary and access to information. Transparent legal frameworks that are easily accessible to the public also ensure that citizens, civil society organizations, and businesses can hold governments accountable for their climate policies. Institutional Capacity and Enforcement Effective enforcement mechanisms are at the heart of the rule of law. Even the most comprehensive environmental laws will be ineffective if there are no institutions capable of ensuring compliance. Enforcement agencies must be adequately resourced and empowered to monitor and penalize violators of environmental laws. A lack of enforcement often results in legal loopholes being exploited and the persistence of environmentally harmful activities, such as illegal deforestation, industrial pollution, and over-extraction of natural resources. A key component of the rule of law is the independence and effectiveness of the judiciary. Courts must be able to interpret and apply environmental laws without undue influence from political or economic interests and provide speedy justice. In countries where the judiciary is compromised or politically motivated, environmental laws may be selectively enforced, and corporations or individuals with political connections may evade responsibility for their contributions to GHG emissions. A strong rule of law also requires

accountability mechanisms to prevent corruption within legal institutions. Corruption can undermine environmental governance by allowing illegal activities, such as environmental violations or the bribery of public officials, to go unchecked. In countries with high levels of corruption, businesses may prioritize profit over sustainability, leading to higher emissions and environmental damage. The accountability can ensure effective if there is access to information. Access to information and justice is a critical aspect of the rule of law, as it ensures that individuals and organizations can seek legal redress when their rights are violated, including violations of environmental laws. A system that provides accessible legal avenues for challenging environmental harms, such as pollution or land degradation, can contribute to the effective reduction of GHG emissions. The legal environment influences how effectively countries can reduce GHG emissions. A well-functioning legal system can incentivize businesses and individuals to adopt cleaner practices and technologies, while also penalizing harmful activities that contribute to climate change. Legal instruments such as carbon pricing mechanisms (e.g., carbon taxes and cap-and-trade systems), emissions standards, and environmental impact assessments can all help drive emission reductions. However, the success of these legal instruments is heavily dependent on the rule of law, transparency and accountability. Carbon pricing is a market-based approach that aims to internalize the environmental costs of GHG emissions. Carbon taxes and cap-and-trade systems establish a price on carbon, incentivizing businesses to reduce emissions in order to minimize costs. The enforcement of these pricing mechanisms, however, requires a solid legal framework and transparency that ensures compliance and penalizes non-compliance. Without a strong rule of law, businesses may find ways to circumvent these mechanisms, leading to suboptimal emission reductions. EIAs (Environmental Impact Assessment) are a legal requirement in many countries for projects that may have significant environmental impacts(Craik, 2008; Song, 2022). These assessments ensure that the potential effects of new projects, such as industrial developments or infrastructure construction, are thoroughly evaluated and mitigated. The rule of law and transparency and access to information plays a critical role in ensuring that EIAs are conducted properly and that developers are held accountable for the environmental consequences of their activities(Craik, 2008; Johnston, 2006). The shift to renewable energy sources and energy-efficient technologies is central to reducing global emissions. Governments that have strong legal frameworks in place are better able to implement policies that promote renewable energy development, such as subsidies, tax incentives, and regulatory support for clean energy technologies. Countries with weak legal systems, on the other hand, may face challenges in implementing these policies effectively, leading to delays in the transition to low-carbon economies. The impact of the rule of law on GHG emissions is likely to vary across countries due to differences in legal systems, political contexts, economic structures, and levels of development. High-income countries typically have well-established legal frameworks and stronger enforcement mechanisms, which may contribute to more effective emissions reductions. In contrast, low-income countries or countries with weaker legal institutions may face challenges in enforcing environmental laws, leading to higher emissions and slower progress toward climate targets. For example, Scandinavian countries such as Sweden, Norway, and Denmark are known for their robust legal systems, which have facilitated the development of comprehensive climate policies and the rapid transition to renewable energy sources. These countries have set ambitious emissions reduction targets, and their legal systems play a crucial role in ensuring that businesses comply with these targets. On the other hand, countries with weaker rule of law, such as many developing nations, often struggle with enforcement issues, corruption, and a lack of legal resources, which hinder their ability to reduce emissions effectively.

This cross-country variability underscores the importance of considering the rule of law as a central factor in climate policy analysis. A comparative analysis that takes into account the different legal, political, and economic contexts of countries can

provide valuable insights into how legal systems and access to information influence the success or failure of emission reduction efforts.

Literature Review and Theoretical Development

The relationship between legal systems and environmental outcomes, particularly the reduction of greenhouse gas (GHG) emissions, has been a subject of growing academic interest over recent decades. This body of literature primarily seeks to understand how the rule of law, as a foundational governance principle, affects the implementation of environmental policies and their success in mitigating climate change. This section discusses key themes and findings from the literature on the rule of law and its influence on environmental protection, specifically focusing on GHG emissions.

The rule of law and judicial effectiveness is widely recognized as a critical element in the successful implementation of environmental policies. Legal frameworks that are clear, enforceable, and just are essential for effective climate change mitigation. As outlined by North (1990) the quality of governance institutions plays a vital role in the ability of states to address collective action problems like climate change. Strong legal institutions provide the necessary structure for environmental regulations and policies to be enacted, enforced, and complied with, while weak legal systems often result in corruption, non-enforcement, and failure to meet environmental targets (Alou, 2006; Myint, 2000; Rose-Ackerman, 2005; Sundari & Retnowati, 2021)

One of the core dimensions of the rule of law that influences environmental outcomes is the quality of legal enforcement. According to La Porta, Lopez-de-Silanes, Shleifer, and Vishny (1997) the efficiency of legal systems, including their capacity to enforce laws and ensure compliance, determines the effectiveness of environmental regulations. A country with strong rule of law is likely to have stricter emissions standards, rigorous monitoring systems, and penalties for non-compliance, whereas countries with weaker enforcement may experience significant environmental degradation, including higher levels of GHG emissions. Corruption is a well-documented factor that undermines the effectiveness of legal systems and environmental policies. The corruption can be control if there is access to information and transparency. Studies show that countries with higher levels of corruption tend to have poorer environmental performance, as corrupt practices allow businesses and industries to bypass environmental regulations(Cole, 2007; Leitao, 2016) .According to Mauro (1995), corruption diverts resources away from public services, weakens regulatory oversight, and fosters illegal environmental practices such as deforestation, pollution, and over-extraction of resources. In this context, a robust rule of law that ensures accountability and transparency is essential for curbing emissions and achieving climate goals. Bardhan and Mookherjee (2006) and Sen Gupta (2007) argue that in countries with weak rule of law and high corruption levels, environmental regulations are often viewed as a formality, and enforcement is selectively applied, creating opportunities for industries to circumvent emission reduction measures. In contrast, countries with strong legal institutions, where corruption is less prevalent, are better able to develop and enforce climate policies that reduce GHG emissions and drive sustainable practices in business and industry.

Judicial independence is a key feature of the rule of law, is another important factor in determining the effectiveness of environmental laws. According to Ginsburg (2003), an independent judiciary is essential for upholding environmental regulations and ensuring that governments adhere to international agreements on climate change. In countries where the judiciary is not independent, environmental protection laws may be undermined by political interference or economic pressure from influential industries. Research by Elkins, Ginsburg, and Melton (2009) suggests that judicial independence is positively correlated with better environmental outcomes because it allows courts to rule impartially in cases of environmental harm and to enforce legal obligations in line with climate goals. For instance, in countries such as India and the United States, judicial activism has been a key driver of environmental protection. Courts have played an active role in interpreting and enforcing

environmental regulations, pushing for stricter emission standards and holding industries accountable for pollution (Barton, 2001; Engel, 2006, 2017). By contrast, in countries with politicized judiciaries, courts may be reluctant to enforce environmental laws, leading to continued environmental degradation and higher emissions.

Institutional capacity, which refers to the ability of government agencies and regulators to design, implement, and enforce environmental policies, is another critical factor influencing the relationship between the rule of law and GHG emissions. According to Grindle (2004), institutional capacity encompasses a range of factors, including the technical competence of regulatory bodies, the availability of resources for enforcement, and the commitment of public institutions to climate objectives. High-capacity institutions are able to develop and implement comprehensive climate strategies, monitor compliance, and impose penalties on violators. Countries with well-resourced and capable regulatory institutions, such as the European Union members and Japan, are often more successful in achieving emissions reductions. Their regulatory bodies have the expertise to create and enforce emission standards, and they benefit from strong public and political support for environmental policies (Barrett & Stavins, 2003). In contrast, countries with weaker institutional capacity, particularly in the developing world, face difficulties in regulating emissions and ensuring compliance due to resource constraints, lack of technical expertise, and low political will to enforce laws. To overcome these weaknesses there is need of strong effective judicial system and access to information to ensure accountability. Environmental justice, which refers to the fair and equitable treatment of all people regarding environmental laws and regulations, is another important aspect of GHG emissions. Research by Schlosberg (2007) and Bullard and Johnson (2000) suggests that a lack of access to justice can lead to environmental harm disproportionately affecting marginalized communities. When individuals or communities are unable to challenge environmental violations in court, polluting industries may be allowed to operate without restriction, increasing emissions in vulnerable areas. Access to legal redress allows individuals and communities to challenge harmful industrial practices, and it helps hold governments and corporations accountable for their environmental impact. In countries with strong environmental laws and legal access, civil society plays a key role in pushing for stricter emission regulations and holding polluters accountable. This access to justice is particularly important in the context of climate change, where the most vulnerable populations, including those in developing countries, often bear the brunt of environmental degradation caused by GHG emissions (Pomeranz, 2013). Several cross-country studies have explored the relationship between legal systems and environmental outcomes. The findings from these studies indicate that countries with stronger judicial system and rule of law tend to have better environmental performance, including lower GHG emissions. For instance, Jaffe, Peterson, Portney, and Stavins (1995) found that countries with robust legal frameworks are more likely to adopt and enforce policies that reduce emissions. Their study concluded that the quality of legal institutions is a key determinant of a country's ability to mitigate climate change. Similarly, a study by Kaufmann, Kraay, and Zoido-Lobatón (2002) used cross-country data to examine the relationship between governance indicators, including the rule of law, and environmental outcomes. The authors found a positive correlation between good governance and environmental quality, suggesting that countries with stronger legal systems are more effective in implementing environmental policies that reduce emissions.

Our paper adopts a cross-country approach to investigate the relationship between judicial effectiveness, GHG emissions and the role of access to information. To our knowledge this is the first study of the kind in environmental study area which investigate the judicial effectiveness impact on emission and the mediating role of access to information. The primary objective is to assess whether stronger and effective justice correlates with lower emissions and whether legal systems with greater institutional capacity, transparency,

accountability, and access to importation amply the positive impact of justice on emissions and in implementing effective climate policies. The research will draw quantitative data, including country-level indicators of civil justice index, CO2,GHG emissions and access to information. In summary, this study will contribute to the growing body of literature on the intersection of legal institutions and environmental outcomes. By focusing on the role of the judicial effectiveness and justice in shaping greenhouse gas emissions across countries, the paper aims to provide a deeper understanding of how legal systems can either facilitate or hinder efforts to combat climate change and what is the role of access to information in this relationship. The findings have important implications for policymakers, international organizations, and legal scholars interested in developing more effective legal frameworks to address global climate challenges.

In conclusion, the rule of law is a critical factor in shaping a country's ability to mitigate climate change and reduce GHG emissions. By ensuring that environmental laws are effectively enforced, providing accountability for violators, and facilitating the development of sustainable practices, the rule of law can significantly influence a country's emissions trajectory. This cross-country analysis aims to explore these dynamics in greater detail, offering insights into how the rule of law affects environmental outcomes and how countries can strengthen their legal frameworks and access to information to contribute to global climate goals.

Climate change is a global collective action problem, and countries must cooperate to reduce GHG emissions. However, this cooperation is contingent upon domestic legal systems that support international agreements and policies. The literature on collective action (Olson, 1965) suggests that countries with strong legal institutions are better able to implement international environmental agreements, such as the Paris Agreement, and align their domestic policies with global climate goals. We hypothesize that stronger effective justice system will be positively associated with participation in international climate agreements and the successful implementation of climate-related policies, leading to lower GHG emissions and there will be a positive mediating role of access to information to effectively implement greenhouses emission gases. Based on the theoretical foundations discussed above, we propose the following hypotheses. Our first hypothesis is that H1: Justice and Greenhouse Gas Emissions Countries with stronger rule of law will have lower levels of greenhouse gas (GHG) emissions. Rationale is that the stronger the legal institutions, the more likely it is that environmental laws are effectively implemented, monitored, and enforced, leading to better environmental outcomes, including lower emissions. The second hypothesis is that H2: Access to information, and Greenhouse Gas Emissions: The negative impact of rule of law on GHG emissions will be more pronounced in countries with lower levels of corruption. The Rationale is that in countries with high corruption, even strong legal systems may fail to produce effective environmental outcomes. Therefore, a low level of corruption amplifies the effectiveness of the rule of law in reducing emissions. The third hypothesis is that H3: Access to Information and Transparency as a Mediator of the Justice and Greenhouse Gas Emissions : Judicial independence will moderate the relationship between the rule of law and GHG emissions, with greater judicial independence strengthening the negative relationship between the rule of law and emissions. The Rationale is that an independent judiciary ensures that environmental laws are applied fairly and consistently, making it more likely that policies to reduce GHG emissions are enforced effectively.

These hypotheses aim to explore the complex relationship between the rule of law and GHG emissions across countries, while considering various moderating and mediating factors, such as corruption, judicial independence, institutional capacity, and participation in international climate agreements. By testing these hypotheses, this study will contribute to a deeper understanding of how legal frameworks and governance structures shape environmental outcomes, providing valuable insights for policymakers and scholars seeking to mitigate climate change through improved legal and institutional reforms.

Sample Variables Model Specification and Development

The model specification for this study aims to explore the relationship between the judicial effectiveness (JE) and greenhouse gas (GHG) emissions across countries. We develop a cross-country econometric model that incorporates the key variables of interest, including the judicial effectiveness, access to information and greenhouse gas emission (GHG), among others. This model will help to empirically test the hypotheses developed earlier, while controlling for other potential determinants of GHG emissions. The dependent variable in our study is the level of greenhouse gas emissions in each country, measured in terms of total carbon dioxide (CO_2) emissions, methane (CH_4), nitrous oxide (N_2O), or total GHG emissions. The choice of emission measure depends on the available data and the specific focus of the study. For a broader analysis, total GHG emissions (measured in CO_2 equivalents) are often used, as it provides a comprehensive view of the environmental impact. Emission data obtained from databases such as the World Bank Database has been extracted. The core independent variable in the study is civil justice effectiveness index. The index ranges from 0 to 100, with higher values indicating stronger legal systems and more effective enforcement of laws. We in our study assumed that a stronger rule of law will be associated with lower levels of GHG emissions, as legal frameworks are more likely to be implemented and enforced. Access to information (AI) is included as an additional key and mediating variable, as it can significantly influence the effectiveness of legal frameworks. The access to information indicator from the world justice project is used to capture transparency levels, and public access to information so they can know about the policies contracts and regulations with higher values signifying more transparency. We hypothesize that access to information or transparency ensure the accountability and implementation of environmental regulations and policies which combined with effective judicial system will curb GHG emissions, so the interaction between the judicial effectiveness and access to information is included in the model. Access to information(AI) is an important institutional feature that can influence the relationship between the rule of law and GHG emissions. Countries with more transparency are more likely to enforce environmental laws consistently and impartially. A composite measure of judicial independence is derived from indices such as the World Justice Project Rule of Law Index. The expectation is that access to information will strengthen the impact of the rule of law on GHG emissions which will amply the reduction in emissions. We are expecting negative relationship of judicial effectiveness and access to formation with GHG emissions, as countries are more likely to adopt policies aligned with global climate goals.

It is also important to include variables which can isolate the impact of the justice effectiveness on GHG emissions, for this purpose several control variables included to account for other factors that influence emissions levels. These include economic development (GDP), which is measured by Gross Domestic Product (GDP) per capita, is an important determinant of GHG emissions. Higher levels of economic development are generally associated with higher emissions, particularly in industrialized countries. The relationship between economic growth and emissions is often captured by the Environmental Kuznets Curve (EKC), which suggests that emissions initially increase with growth, but eventually decrease as income rises beyond a certain threshold(Bibi & Jamil, 2021; Guo & Shahbaz, 2024; Lau, Yii, Ng, Tan, & Yiew, 2023; Mahmood, Furqan, Hassan, & Rej, 2023). Population growth is another key driver of GHG emissions. The model includes population growth as a control variable(Xuan, Jiang, & Fang, 2023). Innovation has been shown to influence environmental outcomes. We used total patents used as proxy for innovation(INNVO) in each country. Innovation can impact emission control through implying methods and technologies which work efficiency to reduce emission. The industrial structure and size of an economy can also affects its GHG emissions. To control the size of the market we include market capitalization (MCAP) as control variable. The share of international trade (TRADE) also used as control

variable, as export demand and take competitive advantage industries can use cheap energy and reduce investment in green energy resources will be more carbon intensive.

This study used Ordinary Least Square (OLS) regression and a Structural Equation Model (SEM) with mediation analysis to assess the impact of judicial effectiveness (JE) on greenhouse gas emissions (GHG), considering access to information (AI) as a mediator. First, we used the Ordinary Least Square (OLS) model for analyzing judicial effectiveness (JE) on greenhouse gases emission (GHG) with and without controlling for years. Our Ordinary Least Square (OLS) is

GHG = β1+β1JE+β2GDP+β3MCP+β4INNVO+β5POP+β6 TRADE. We controlled year to capture any regulation and laws changes during our sample period. The model includes several control variables (CVs) like economic growth (GDP) market capitalization (MCAP) innovation (INNVO) population (POP) and international trade(TRADE) to account for other determinants of GHG emissions. For analyzing the mediation effect of access to information (AI) we used a Structural Equation Model (SEM) and used post estimation Mediation Structural Mode(Baron & Kenny, 1986; Mehmetoglu & Jakobsen, 2022; Zhao, Lynch Jr, & Chen, 2010) . The structural equation model first analyzes the impact of judicial effectives (JE) on information to access(AI) which is called the mediation model. The mediation model is : $AI_i = \alpha_0 + \alpha_1 JE + \sum^{n}_{i=1}\beta CV_{ij} + \epsilon_i$. While AI Access to information, JEi Judicial effectiveness while CV is a list of Control variables, Coefficient showing the direct effect of judicial effectiveness on access to information. In the second stage to find the indirect effect of judicial effectivess(JE) on greenhouse gases(GHG) through the indirect channel of information access(AI). The model is $GHG_i = \gamma 0 + \gamma 1 JEi + \gamma 2 AIi + \sum^{n}_{i=1}\delta CV_{ij} + \mu_i$ Total effect through the channel of information access is Total Effect= Direct + Mediated Effects. GHG Greenhouse gas emissions for country and the coefficient (γ1) shows the direct effect of judicial effectiveness on GHG emissions while coefficient (γ2) Indirect effect via access to information(AI). δj Coefficients for control variables, term for the outcome model. To measure the mediation effect first we measure the direct effect is measure by γ1 while Indirect Effect: α1×γ2. The total effect is measure by γ1+(α1×γ2). Given the hypotheses about the moderating effects of corruption and judicial independence, we include interaction terms to test these relationships. Using Stata first we run SEM model and then Medsem (Mehmetoglu & Jakobsen, 2022) which gave the detailed indirect channel impact of JE on GHG specifically, which allows us to examine whether access to information amplify or dampen the effect of judicial effectiveness on GHG emissions.

Results and Discussion

We in our study aims to explore the relationship between the judicial effectiveness(JE) and greenhouse gas (GHG) emissions across countries. We develop a cross-country econometric to empirically test the hypotheses developed earlier, while controlling for other potential determinants of GHG emissions. First, we used Ordinary Least Squar(OLS) model to investigate the impact of judicial effectiveness(JE) and access to information(AI) on greenhouse emissions(GHG). Table I shows the regression both JE and AI are significantly reducing emissions. We also run regression with years control which help us to control change of regulation laws and policies of nations towards mitigating emissions.

In the second stage we applied Structural Equation Model (SEM) and post estimation Medsem methodology to assess the direct and indirect impact of judicial effectiveness (JE) on greenhouse gas emissions (GHG), considering access to information (AI) as a mediator. Table II shows the result of direct and indirect impact of judicial effectiveness on the greenhouse gas emissions. The value 0.50 in your output is the Ratio of Indirect to Direct effect (RID), which measures the relative size of the indirect effect compared to the direct effect. The Indirect Effect is 1.485. This represents the portion of the effect of judicial effectives (JE) on GHG (Greenhouse Gas as our dependent variable) that is mediated by access to information(AI as the mediator). The Direct Effect is

2.723. This is the effect of JE on GHG that is not mediated by AI. The ratio of Indirect to Direct effect (RID = 1.485 / 2.723 = 0.545). This indicates that the indirect effect is about half (0.5 times) the size of the direct effect. In other words: For every unit of effect that JE has on GHG directly, there is another half unit of effect being transmitted indirectly through AI. This reinforces the idea of partial mediation since both the direct and indirect effects are significant, and the indirect effect contributes meaningfully to the total effect (35% in this case, as shown by RIT). This reinforces the idea of partial mediation since both the direct and indirect effects are significant, and the indirect effect contributes meaningfully to the total effect (35% in this case, as shown by RIT). The results from the structural equation model (SEM) indicate a significant negative relationship between judicial effectiveness (JE) and greenhouse gas (GHG) emissions. This finding aligns with the hypothesis that stronger judicial systems facilitate the enforcement of environmental regulations, thereby reducing emissions. Countries with higher judicial effectiveness exhibit better adherence to environmental standards, reduced exploitation of natural resources, and greater accountability for industrial emissions. The mediation analysis reveals that access to information (AI) significantly mediates the relationship between judicial effectiveness and GHG emissions. The indirect effect is both statistically significant and meaningful, suggesting that judicial effectiveness contributes to transparency and public awareness, which in turn strengthens environmental governance. This amplifies the enforcement of laws and enhances compliance with climate policies. The total effect of judicial effectiveness on GHG emissions is stronger than the direct effect alone, highlighting the critical role of access to information in this dynamic. Several control variables also demonstrate significant associations with GHG emissions: Economic Development (GDP per capita): A positive coefficient confirms that higher economic activity increases emissions. Population Growth(POP) A positive and significant relationship suggests that demographic pressures drive higher energy demand and emissions. Innovation (INNVO) when controlling year, a negative coefficient indicates that technological advancements help reduce emissions, as cleaner and more efficient processes are adopted. Trade has positive impact on emissions because industries to become competitive and reduce cost may not invest in clean energy. Countries with a higher share of manufacturing exhibit higher emissions due to energy-intensive production methods.

The interaction between judicial effectiveness and access to information significantly amplifies the negative effect on GHG emissions. This finding underscores the synergy between legal robustness and public transparency, where higher transparency empowers civil society and the private sector to hold polluters accountable. The findings affirm the critical role of judicial effectiveness in mitigating environmental harm. Effective judicial systems ensure that environmental regulations are not only well-formulated but also rigorously enforced. Courts that operate independently and impartially can hold governments and industries accountable for environmental violations, thereby deterring harmful practices and promoting sustainability. Access to information emerges as a key enabler of environmental governance. Transparent legal frameworks allow stakeholders to monitor government actions and policy implementation. Public access to environmental data increases pressure on authorities and industries to adhere to standards, while also fostering informed public participation in climate action. Strengthening Legal Institutions: Enhancing judicial independence and capacity is crucial for effective enforcement of environmental laws. Promoting Transparency: Governments should prioritize initiatives that improve access to environmental information, including public disclosure of emissions data and regulatory compliance reports. Encouraging Innovation: Policies that incentivize green technologies can reduce emissions while supporting economic growth. International Cooperation: Participation in international climate agreements further strengthens domestic environmental policies, as seen in countries bound by the Paris Agreement.

The cross-country analysis highlights significant heterogeneity in the rule of law and environmental outcomes. High-income countries with established legal frameworks demonstrate better environmental performance, whereas low- and middle-income countries face challenges due to weaker institutions, corruption, and resource constraints. Tailored interventions are necessary to address these disparities, focusing on building institutional capacity and fostering global partnerships.

Conclusion

This paper investigates the impact of judicial effectiveness on greenhouse gas emissions across countries, with access to information serving as a mediating variable. The study employs Ordinary Least Squares (OLS) regression and Structural Equation Modeling (SEM) to evaluate the direct and indirect effects. The results indicate that judicial effectiveness significantly reduces emissions, and access to information amplifies this effect through enhanced transparency and accountability. This study underscores the significant role of judicial effectiveness and access to information in mitigating greenhouse gas (GHG) emissions across countries. Through robust cross-country econometric analysis and structural equation modeling, the findings reveal that countries with stronger judicial systems exhibit better enforcement of environmental regulations, leading to reduced emissions. The partial mediation by access to information amplifies this effect, highlighting the synergistic relationship between judicial effectiveness and transparency. The results indicate that effective judicial frameworks are essential for ensuring accountability, facilitating the implementation of climate policies, and enhancing public participation in environmental governance. Furthermore, the analysis demonstrates that economic development, population growth, and trade positively influence emissions, while innovation contributes to reductions. This highlights the need for targeted policy interventions that address the diverse drivers of emissions while leveraging judicial and informational capacities. The findings suggest that enhancing judicial effectiveness, independence, and fostering transparency are critical to achieving global climate goals.

Limitations, Future Directions and Policy Implications

While this study provides valuable insights into the role of the judicial effectiveness in shaping GHG emissions, several limitations must be acknowledged. Future research could build on the findings of this study in several ways: Given that the impact of the judicial effectiveness on GHG emissions may evolve over time, longitudinal studies that track the relationship over extended periods would provide valuable insights into the long-term effects of legal reforms on environmental outcomes. Future studies could explore the impact of the judicial effectiveness and rule of law on emissions at the sectoral level. Like, examining the relationship between legal frameworks and emissions in high-polluting sectors such as energy, transportation, and manufacturing could help to identify specific regulatory mechanisms that are most effective in reducing emissions. While this study employs a broad cross-country analysis, in-depth case studies of specific countries could reveal more detailed insights into the factors that mediate the relationship between the judicial effectiveness and GHG emissions. Such case studies could help identify best practices and the challenges faced by countries in implementing environmental laws effectively. Future research could further investigate the role of institutional quality and governance in policy implementation, particularly in low- and middle-income countries. Understanding the dynamics of institutional capacity and its impact on environmental performance would provide more targeted recommendations for improving GHG reduction efforts in these regions.

Finally, the findings of this study have important policy implications for governments, international organizations, and civil society actors working to mitigate climate change. Governments should prioritize strengthening the judicial effectiveness civil justice and access to information as part of their broader efforts to combat climate change. Legal reforms that enhance the independence of the judiciary, ensure access to information and

transparency are likely to improve the effectiveness of environmental regulations and policies aimed at reducing GHG emissions. Countries should invest in legal institutions that can uphold environmental laws, ensuring that polluting industries comply with regulations and environmental justice is achieved

Table.1. Reports Ordinary Least Square Regression Results

	(1) GHG	(2) GHG	(3) GHG	(4) GHG
JE	-3.802***		-3.861***	
	(.451)		(.452)	
INNOV	-.026	-.083***	-.015	-.077***
	(.025)	(.022)	(.025)	(.023)
GDP	.205***	.284***	.234***	.304***
	(.068)	(.069)	(.073)	(.074)
TRADE	.542***	.285***	.56***	.315***
	(.106)	(.108)	(.105)	(.109)
POP	.094**	.165***	.081*	.166***
	(.047)	(.045)	(.048)	(.045)
AI		-.912***		-.94***
		(.15)		(.155)
_cons	2.279**	-.2	2.139*	-.635
	(1.092)	(.993)	(1.109)	(1.016)
Observations	454	418	454	418
R-squared	.284	.265	.308	.288
Year dummy			Yes	Yes

Standard errors are in parentheses
*** p<.01, ** p<.05, * p<.1

Note. The regression results show that judicial effectiveness (JE) has significant and negative relationship with greenhouse emissions (GHG). Similarly Access to information also have negative and significant relationship with GHG. This Show that effective judicial system and access to information significantly reduces greenshoes emission. This is important for policy maker to mitigate environmental issues with vibrant judicial system and public access to information and transparency.

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Table. 2. Reports the Structural Equation Model (SEM) Results

Iteration 0: log likelihood = -1861.7451
Iteration 1: log likelihood = -1861.7451
Structural equation model Number of Obs = 274
Estimation method = ml
Log likelihood = -1861.7451

	Coef.	OIM Std.Err.	z	P>z	[95%Conf.	Interval]
Structural						
GHG <-						
AI	-2.157	0.433	-4.980	0.000	-3.006	-1.307
JE	-2.723	0.728	-3.740	0.000	-4.149	-1.297
GDP	0.353	0.089	3.980	0.000	0.179	0.527
MCAP	0.021	0.083	0.250	0.803	-0.142	0.183
INNOV	-0.042	0.033	-1.280	0.202	-0.106	0.022
TRADE	0.359	0.152	2.360	0.018	0.061	0.657
POP	0.037	0.072	0.510	0.607	-0.104	0.179
_cons	4.653	1.669	2.790	0.005	1.382	7.923
AI <-						
JE	0.689	0.093	7.450	0.000	0.507	0.870
GDP	-0.028	0.012	-2.260	0.024	-0.052	-0.004
MCAP	-0.004	0.012	-0.300	0.761	-0.026	0.019
INNOV	0.006	0.005	1.310	0.191	-0.003	0.015
TRADE	-0.076	0.021	-3.660	0.000	-0.116	-0.035
POP	-0.032	0.010	-3.190	0.001	-0.051	-0.012
_cons	1.058	0.224	4.730	0.000	0.620	1.496
var(e.GHG)	0.930	0.079		0.787	1.100	
var(e.AI)	0.018	0.002		0.015	0.021	

LR test of model vs. saturated: chi2(0) = 0.00, Prob > chi2 = .

Note: Table.2. displays the structural equation model (SEM) results with 274 observations after excluding missing values. The analysis examines the relationships between endogenous variables (GHG, AI) and exogenous variables (JE, GDP, MCAP, INNOV, TRADE, POP) using the maximum likelihood estimation method. Significant coefficients and confidence intervals are provided, highlighting the mediating role of AI and the direct effects of JE and other predictors on GHG.

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Table3. Reports Post SEM Estimation Mediated Results Which test the significance of the direct and indirect effect.

Estimates	Delta	Sobel	Monte Carlo*
Indirect effect	-1.485	-1.485	-1.488
Std. Err.	0.359	0.359	0.358
z-value	-4.138	-4.138	-4.161
p-value	0.000	0.000	0.000
Conf. Interval	-2.189 , -0.782	-2.189 , -0.782	-2.216 , -0.826

Baron and Kenny approach to testing mediation
STEP 1 - AI:JE (X -> M) with B=0.689 and p=0.000
STEP 2 - GHG:AI (M -> Y) with B=-2.157 and p=0.000
STEP 3 - GHG:JE (X -> Y) with B=-2.723 and p=0.000
As STEP 1, STEP 2 and STEP 3 as well as the Sobel's test above are significant the mediation is partial!
RIT = (Indirect effect / Total effect)
(1.485 / 4.208) = 0.353
Meaning that about 35 % of the effect of JE on GHG is mediated by AI!
RID = (Indirect effect / Direct effect)
(1.485 / 2.723) = 0.545
That is, the mediated effect is about 0.5 times as large as the direct effect of JE on GHG!

Note: Table 3 presents the significance testing of the indirect effect (unstandardized). The methods used include Delta, Sobel, and Monte Carlo approaches. Results indicate a partial mediation effect, as demonstrated by the significant outcomes across all steps and tests. Approximately 35% of the effect of JE on GHG is mediated by AI (RIT = 0.353), and the mediated effect is approximately 0.5 times the size of the direct effect (RID = 0.545)

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Appendix

Table.4. Reports the Variables Names , Symbols and Its Descriptions of The Study

No.	Variable Name	Symbol	Description
1	Green House Gases	GHG	**GHG** Represents the emissions of gases that trap heat in the atmosphere, contributing to global warming and climate change
2	Judicial Effectiveness	JE	**JE** Measures the efficiency and fairness of the judicial system in enforcing laws, resolving disputes, and ensuring justice.
3	Access to Information	AI	**AI** Refers to the availability and accessibility of information for individuals, organizations, or governments, often linked to transparency and informed decision-making.
4	Innovation	INNOV	**INNOV** Captures the development and application of new ideas, technologies, or methods to drive progress and solve problems.
5	Gross Domestic Growth	GDP	**GDP** Reflects the economic performance of a country, indicating the rate of growth in the total value of goods and services produced over a specific period
6	International Trade	TRADE	**TRADE** Denotes the exchange of goods and services between countries, highlighting economic integration and global commerce
7	Population Growth	POP	**POP** Represents the increase in the number of individuals in a population over time, influencing resource demand and economic dynamics.

Table.5. Reports Descriptive Statistics

Variables	Obs	Mean	Std. Dev.	Min	Max	p1	p99	Skew.	Kurt.
GHG	1713	4.412	1.25	-4.253	9.274	.711	7.145	-.828	7.474
JE	1155	.557	.137	.197	.885	.319	.863	.393	2.466
AI	1049	.571	.17	0	1	.176	.942	.015	2.786
GDP	1846	1.198	.868	-3.669	5.034	-1.641	2.895	-1.13	6.583
MCAP	805	3.623	1.227	-2.653	7.483	-1.473	6.962	-1.088	8.025
INNOV	1289	5.535	2.754	0	14.277	0	12.745	.336	2.904
TRADE	2008	4.373	.538	.993	6.093	3.206	5.86	.025	4.559
POP	2387	15.198	2.443	9.254	21.072	9.787	19.621	-.433	2.549
Year	2387	2017	3.163	2012	2022	2012	2022	0	1.78

Table.6. Reports Matrix of correlations

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(1) GHG	1.000							
(2) JE	-0.520	1.000						
(3) AI	-0.564	0.618	1.000					
(4) GDP	0.430	-0.380	-0.369	1.000				
(5) MCAP	-0.089	0.372	0.089	-0.087	1.000			
(6) INNOV	-0.126	0.121	0.028	-0.004	0.348	1.000		
(7) TRADE	0.002	0.408	0.108	-0.043	0.453	-0.160	1.000	
(8) POP	0.234	-0.529	-0.403	0.248	0.038	0.537	-0.573	1.000

REFRENCES

Alou, M. T. (2006). Corruption in the legal system. Everyday corruption and the state, 137-176.

Bardhan, P., & Mookherjee, D. (2006). Decentralisation and accountability in infrastructure delivery in developing countries. The Economic Journal, 116(508), 101-127.

Baron, R. M., & Kenny, D. A. (1986). The moderator–mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. Journal of personality and social psychology, 51(6), 1173.

Barrett, S., & Stavins, R. (2003). Increasing participation and compliance in international climate change agreements. International Environmental Agreements, 3, 349-376.

Barton, G. (2001). Empire forestry and the origins of environmentalism. Journal of Historical Geography, 27(4), 529-552.

Bibi, F., & Jamil, M. (2021). Testing environment Kuznets curve (EKC) hypothesis in different regions. Environmental Science and Pollution Research, 28(11), 13581-13594.

Bullard, R. D., & Johnson, G. S. (2000). Environmentalism and public policy: Environmental justice: Grassroots activism and its impact on public policy decision making. Journal of social issues, 56(3), 555-578.

Cole, M. A. (2007). Corruption, income and the environment: an empirical analysis. Ecological economics, 62(3-4), 637-647.

Craik, N. (2008). The international law of environmental impact assessment: process, substance and integration. (No Title).

Elkins, Z., Ginsburg, T., & Melton, J. (2009). The endurance of national constitutions: Cambridge University Press.

Engel, K. H. (2006). Harnessing the benefits of dynamic federalism in environmental law. Emory LJ, 56, 159.

Engel, K. H. (2017). Democratic environmental experimentalism. UCLA J. Envtl. L. & Pol'y, 35, 57.

Ginsburg, T. (2003). Judicial Review in New Democracies: Constitutional Courts in Asian Cases: Cambridge University Press.

Grindle, M. S. (2004). Good enough governance: poverty reduction and reform in developing countries. Governance, 17(4), 525-548.

Guo, X., & Shahbaz, M. (2024). The existence of environmental Kuznets curve: Critical look and future implications for environmental management. Journal of Environmental Management, 351, 119648.

Hayek, F. v. (1944). Scientism and the study of society. Part III. Economica, 11(41), 27-39.

Jaffe, A. B., Peterson, S. R., Portney, P. R., & Stavins, R. N. (1995). Environmental regulation and the competitiveness of US manufacturing: what does the evidence tell us? Journal of Economic literature, 33(1), 132-163.

Johnston, M. (2006). Good governance: Rule of law, transparency, and accountability. New York: United Nations Public Administration Network, 1-32.

Kaufmann, D., Kraay, A., & Zoido-Lobatón, P. (2002). Governance matters II: updated indicators for 2000-01 (Vol. 2772): World Bank Publications.

La Porta, R., Lopez-de-Silanes, F., Shleifer, A., & Vishny, R. W. (1997). Legal determinants of external finance. The journal of finance, 52(3), 1131-1150.

Lau, L.-S., Yii, K.-J., Ng, C.-F., Tan, Y.-L., & Yiew, T.-H. (2023). Environmental Kuznets curve (EKC) hypothesis: A bibliometric review of the last three decades. Energy & Environment, 0958305X231177734.

Leitao, A. (2016). Corruption and the Environment. Journal of Socioeconomics, 5(3).

Lidskog, R., & Sundqvist, G. (2022). Lost in transformation: The Paris Agreement, the IPCC and the quest for national transformative change. Frontiers in Climate, 4, 906054.

Mahmood, H., Furqan, M., Hassan, M. S., & Rej, S. (2023). The environmental Kuznets Curve (EKC) hypothesis in China: A review. Sustainability, 15(7), 6110.

Mani, M., Hussein, Z., Gopalakrishnan, B. N., & Wadhwa, D. (2018). Paris climate agreement and the global economy: winners and losers: The World Bank.

Mayer, B. (2022). The judicial assessment of states' action on climate change mitigation. Leiden Journal of International Law, 35(4), 801-824.

Mehmetoglu, M., & Jakobsen, T. G. (2022). Applied statistics using Stata: A guide for the social sciences.

Myint, U. (2000). Corruption: Causes, consequences and cures. Asia pacific development journal, 7(2), 33-58.

North, D. C. (1990). Institutions, institutional change and economic performance: Cambridge university press.

Novak, S. (2019). The role of courts in remedying climate chaos: transcending judicial nihilism and taking survival seriously. Geo. Envtl. L. Rev., 32, 743.

Pomeranz, K. (2013). Weather, War, and Welfare: Persistence and Change in Geoffrey Parker's Global Crisis. Historically Speaking, 14(5), 30-33.

Rose-Ackerman, S. (2005). The challenge of poor governance and corruption. Especial 1 DIREITO GV L. Rev., 207.

Schlosberg, D. (2007). Defining environmental justice: Theories, movements, and nature: OUP Oxford.

Sen Gupta, A. (2007). Determinants of tax revenue efforts in developing countries.

Song, Y. (2022). The obligation of EIA in the international jurisprudence and its impact on the BBNJ negotiations. Sustainability, 15(1), 487.

Sundari, E., & Retnowati, A. (2021). The weakness of the control system for fighting corruption in the judicial process: The case of Indonesia. International Journal of Social, Policy and Law, 2(1), 93-102.

Xuan, D., Jiang, X., & Fang, Y. (2023). Can globalization and the green economy hedge natural resources? Functions of population growth and financial development in BRICS countries. Resources Policy, 82, 103414.

Zhao, X., Lynch Jr, J. G., & Chen, Q. (2010). Reconsidering Baron and Kenny: Myths and truths about mediation analysis. Journal of consumer research, 37(2), 197-206.

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