The Capacity Paradox: Rethinking When Environmental Human Rights Matter

Anonymised Author

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Abstract

The formal recognition of human rights continues to expand globally, yet the extent to which these commitments produce tangible improvements is unclear. The study addresses this puzzle by focusing on environmental human rights, now present in over half of the world's constitutions. I develop a theory of conditional effectiveness, positioning state capacity—the government's ability to effectively perform core functions—as the key moderator of rights' impact. Using a cross-national panel of 170 countries (1970–2015), the analysis fits a two-stage generalized synthetic control design to estimate the causal effect of constitutional rights recognition on a novel environmental performance index. Results challenge prior correlational findings and reveal nonlinear heterogeneous treatment effects: rights improve outcomes only in moderate-capacity states. I infer that lower-capacity states lack the institutional infrastructure for enforcement, while higher-capacity states face structural rigidity that dilutes reform. These findings refine theories of rights effectiveness and provide insights on tailoring reforms to context.

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1 Introduction

As human rights have become increasingly recognized in constitutions, judicial rulings, and international treaties, the question of whether such formal rights translate into real-world change remains a central issue. The extent of their transformative potential has been met with skepticism. Human rights declarations establish normative foundations that policymakers and advocates can build upon with legislation, litigation, and administrative action (Risse, Ropp, and Sikkink, 1999; Hathaway, 2002; Goodman and Pegram, 2011; Sikkink, 2017). However, implementation is not guaranteed. Many scholars caution that formal human rights remain symbolic without complementary enforcement and political will (Epp, 1998; Simmons, 2009; Fukuyama, 2013; Hafner-Burton, 2013). In such contexts, rights recognition functions more as a political gesture aimed at signaling legitimacy, appeasing international actors, or managing domestic demands without enacting policy change (Hathaway, 2002; Hafner-Burton and Tsutsui, 2005; Hafner-Burton, 2013). Formal recognition may reflect rather than reshape the underlying realities that determine state action.

The case of environmental human rights offers a more optimistic yet puzzling picture. Half of the world's constitutions now guarantee the right to a healthy environment (Boyd, 2012), acknowledging the importance of environmental quality to human dignity. The recognition of environmental rights appears to be broadly associated with improvements in environmental performance (Boyd, 2012; Gellers and Jeffords, 2015; Gellers and Jeffords, 2017; Jeffords and Minkler, 2016; Ondobo, Ndoya, and Okere Atanga, 2024). Meanwhile, descriptive accounts note the persistent obstacles to enforcement within domestic contexts (Bosek, 2014; Dantas, 2018; May, 2021; Umukoro and Ituru, 2022). The widespread nature of environmental human rights—and their possible effectiveness despite implementation challenges—offers an opportunity to uncover the conditions under which formal rights translate into meaningful progress globally.

This study bridges the conflicting evidence on constitutional environmental human rights by advancing a theory of conditional effectiveness. I argue that state capacity, defined as a state's ability to effectively perform core governance functions (Tilly, 1990; Mann, 1984; Hanson and Sigman, 2021; Suryanarayan, 2024), determines the impact of recognition. The argument builds on institutionalist theory that distinguishes formal rules from their practical implementation (March and Olsen, 1989; North, 1990; Helmke and Levitsky, 2004; Hodgson, 2025). In this view, constitutional provisions are formal institutions whose real-world impact depends on complementary enforcement mechanisms and practices. Environmental human rights therefore translate into improved ecological outcomes only when states possess sufficient institutional strength to implement them.

I put forth the following hypotheses, which evaluate the baseline relationship between recognition and performance identified in prior research (e.g., Boyd 2012; Jeffords and Minkler 2016; Gellers and

Jeffords 2017; Ondobo, Ndoya, and Okere Atanga 2024) and anticipate a positive linear moderating role of state capacity:

Hypothesis 1. *The constitutional recognition of environmental human rights, on average, has a positive effect on environmental performance.*

Hypothesis 2. *The positive effect of constitutional recognition on environmental performance is greater in states with higher levels of state capacity.*

Hypothesis 3. *In states with lower levels of state capacity, constitutional recognition of environmental human rights has no effect on environmental performance.*

To evaluate the hypotheses, I use cross-national panel data spanning 1970–2015 alongside a novel index of environmental performance. The multidimensional index reflects a country's commitment to ecological preservation by synthesizing measures of air pollution, renewable energy output, fossil fuel consumption, and carbon dioxide emissions using an inverse covariance weighting approach (Anderson, 2008; Schwab et al., 2020) to capture complementary, non-redundant information. The analysis applies generalized synthetic control (Abadie, Diamond, and Hainmueller, 2010; Xu, 2017), a quasi-experimental method that supports causal inference in contexts with staggered policy adoption and heterogeneous treatment effects. I first estimate the baseline impact of constitutional environmental rights recognition on performance globally, finding no significant effect and thereby challenging prior work. I then stratify countries by average state capacity over the timeframe and re-estimate effects within each tercile.[1] Unlike existing research that typically assumes uniform effects and shows correlation rather than causation, this dual-stage approach enables a more credible assessment of *when* environmental human rights produce progress.

Crucially, the empirical analysis reveals a nonlinear relationship between state capacity and effectiveness: constitutional recognition improves outcomes only in moderate-capacity states. Post-estimation analysis and institutionalist scholarship (e.g., Stigler 1971; Pierson 2000; Tsebelis 2002; Mahoney and Thelen 2010) illuminate the possible mechanisms behind this pattern. In lower-capacity contexts, legal and bureaucratic systems lack the resources, institutional infrastructure, and administrative capacity to operationalize constitutional commitments. Environmental rights remain purely aspirational without the institutional tools to enforce them. Higher-capacity states, by contrast, face complexity-induced barriers. Layered bureaucracies, veto points across government levels, and entrenched organizational interests obstruct policy reform despite adequate resources. The very institutional features that enable state effectiveness in other domains create friction against policy innovation.

[1] Dividing the sample into terciles ensures balanced statistical power for stable estimation, avoids more arbitrary cutoffs, and preserves interpretability across levels of institutional strength.

High-capacity states thus face a paradox: in possessing substantial resources to operationalize environmental rights, they encounter structural obstacles that prevent them from doing so.

Moderate-capacity states likely occupy an optimal institutional equilibrium. They possess sufficient administrative resources, functional legal systems, and basic enforcement mechanisms to operationalize constitutional commitments while retaining organizational flexibility. Often emerging from post-conflict or post-authoritarian transitions (Appendix G), these states maintain evolving institutional frameworks that impose fewer structural constraints (Capoccia and Kelemen, 2007; Mahoney and Thelen, 2010), giving policymakers and administrators greater maneuverability to implement new policies. The flexibility of moderate-capacity states coexists with adequate strength, allowing rights to be enforced without being hampered by rigid organizational structures. The effectiveness of constitutional environmental human rights possibly hinges upon this balance—a dynamic largely absent from broader human rights and institutional performance theories.

The findings both clarify when constitutional rights succeed and challenge prevailing assumptions about state capacity. Capacity is frequently treated as a linear, cumulative good and a straightforward predictor of governance success. Yet this study demonstrates that the relationship between capacity and transformative legal change is more complex. Moderate-capacity states exhibit the greatest ability to translate rights recognition into substantive progress, whereas their lower- and higher-capacity counterparts face distinct challenges that limit effectiveness. The observed nonlinear pattern calls for renewed theoretical attention to the interplay between institutional foundations of capacity, policy implementation, and rights realization. Reconceptualizing capacity as a balance between strength and organizational flexibility offers a more nuanced framework for explaining persistent gaps between rights recognition and effective governance.

These results carry significant implications for theory and practice alike. They challenge the conventional wisdom that treats state capacity as a direct predictor of policy success. The relationship between institutional strength and policy effectiveness is instead conditional, shaped by context and organizational dynamics. This study also deepens our understanding of how formal human rights translate into substantive outcomes, reinforcing that recognition alone cannot ensure change. Effectiveness likely depends on a delicate interplay between capacity and flexibility—an insight that helps identify when legal reforms are likely to generate meaningful progress. More broadly, the findings call for greater nuance in approaches to institutional design and rights enforcement. Scholars across human rights, environmental governance, and institutional development should shift focus from the mere presence of formal rules to the structural conditions that enable or constrain their implementation. For practitioners, the findings emphasize the necessity of tailoring legal reforms to specific institutional contexts rather than assuming universal efficacy.

This paper contributes to several debates. It advances theories of human rights effectiveness by articulating the conditional interplay of capacity and flexibility. By employing generalized synthetic control, a quasi-experimental method robust to heterogeneous treatment effects, it refines methodological approaches to cross-national evaluation. Finally, it improves the credibility of causal inference on the conditions under which constitutional environmental rights yield meaningful ecological improvements. These contributions provide a more complete and robust account of the mechanisms linking rights recognition to implementation, offering guidance for scholars and policymakers striving to translate formal commitments into real-world change.

I proceed by first developing a theory of conditional effectiveness, centering state capacity as a decisive moderator of environmental human rights. Next, I introduce a multidimensional environmental performance index and apply generalized synthetic control to a panel of 170 countries across 1970–2015, first estimating global effects and then assessing heterogeneity across state-capacity terciles. The analysis reveals heterogeneous treatment effects, indicating distinct implementation challenges across different capacity levels. The conclusion discusses broader theoretical implications and policy recommendations for improving rights enforcement.

2 Environment as a Human Right

The right to a healthy environment is the notion that all people are entitled to a clean, healthy, and sustainable environment. This principle was first internationally recognized in 1972 through the United Nations' Stockholm Declaration, which formalized the connection between human well-being and environmental quality (United Nations, 1972). These rights have rapidly gained prominence since. Before 1972, only six countries' constitutions included environmental provisions (Boyd, 2012). Today, roughly half of the world's constitutions guarantee the right to a healthy environment (Daly and May, 2018).

The formal recognition of environmental human rights may be a promising step towards stronger ecological protections and, ultimately, preventing the most severe impacts of climate change. But recognition alone does not automatically guarantee meaningful progress: domestic institutions must translate these commitments into practice. Much of the theoretical and empirical debate surrounding constitutional environmental rights explores whether they can truly shape state behavior and environmental outcomes. However, significant uncertainty remains regarding the extent and conditions of their actual effectiveness.

Environmental human rights can theoretically drive positive environmental change through multiple mechanisms. First, constitutional recognition can provide a legal foundation for the development of stronger, more comprehensive legislation (Stevenson, 1983). Argentina, for example, formalized the right to a healthy environment for all inhabitants through Article 41 of its 1994 Constitution (Argentina, 1994). The country later adopted the General Environmental Law in 2002, which established nationwide ecological protection standards in direct fulfillment of these constitutional obligations (Argentina, 2002). Portugal, Costa Rica, Brazil, South Africa, and the Philippines similarly followed constitutional recognition with the passage of implementing legislation (Boyd, 2012).

Second, constitutional environmental guarantees may impose enforceable obligations on the states adopting them. These commitments can then be leveraged by courts, civil society, and individuals to uphold environmental standards (Boyd, 2012; De Sadeleer, 2002; May, 2021). Notably, a recent lawsuit before the Constitutional Chamber in Costa Rica cited Article 50 of the country's constitution, a formalization of environmental human rights, to challenge the government's failure to assess climate impacts in environmental procedures (Climate Case Chart, 2025). The plaintiff argued that this had violated the constitutional rights of current and future generations to a safe climate, giving the Constitutional Chamber cause to admit the lawsuit and order state authorities to submit a report on the alleged facts (Climate Case Chart, 2025).

Finally, embedding norms into constitutional frameworks can enhance the durability and legitimacy of environmental governance. Constitutional rights may prevent legislative rollbacks and ensure ecological priorities are balanced alongside economic and social goals (Prieur, 2012; Brandl and Bungert, 1992; De Sadeleer, 2004). They also help increase public awareness and support for environmental stewardship (Birnie and Boyle, 2002). Norway's inclusion of such rights in its constitution via Section 112 has sought to accomplish these goals. The provision, in addition to recognizing that all have a right to a healthy environment, states that citizens are ensured information on environmental interventions and imposes a duty on the government to ensure these rights (Norwegian Human Rights Institution, 2025).

These mechanisms—establishing a legal foundation for legislation, creating enforceable obligations for the state, and embedding norms into constitutional frameworks—have the potential to catalyze meaningful change. However, the effectiveness of constitutional environmental human rights is far from guaranteed. Many provisions require enabling legislation (May, 2021). One such example is Kenya, where the constitutional right to a healthy environment, though strong on paper, initially lacked impact due to delays in passing necessary implementing laws (Bosek, 2014). Courts also struggle to apply these rights due to their broad and sometimes ambiguous wording (Birnie and Boyle, 2002; Theil, 2021; Umukoro and Ituru, 2022; Hanschel et al., 2022). In some instances, the recognition of environmental human rights may be redundant, duplicating existing practices and commitments without offering new value (Hanschel et al., 2022).

Weak institutions, fragmented governance structures, and poor coordination further hinder enforcement (Boyd, 2012; Dantas, 2018; Boyd, 2018; Susanto, Baralaska, and Jaelani, 2024). In Nigeria, overlapping mandates and institutional weaknesses have obstructed the enforcement of environmental protections despite constitutional guarantees (Worluh-Okolie, 2024). Moreover, ongoing social, political, or economic instability can impede the realization of environmental improvements (Boyd, 2018). This is clearly seen in Venezuela. Persistent political and economic crises have significantly undermined the enforcement of environmental regulations, particularly those related to oil extraction, waste management, and deforestation (Burelli and Fernandez, 2021; Torres, 2019). Despite Venezuela's explicit recognition of environmental rights, agencies tasked with ecological protection are often incapacitated or co-opted by political interests, resulting in under-enforced policy (Burelli and Fernandez, 2021; Torres, 2019).

Though there are clear pathways through which constitutional rights can effect change, these challenges complicate their realization. In certain contexts, the recognition of environmental rights may function more as a symbolic gesture than a substantive commitment; in others, these rights have led to reform with meaningful environmental benefits. This disparity demonstrates the critical need for deeper analysis into the factors that influence whether and how these constitutional provisions yield real progress.

3 Evaluating Effectiveness

The recognition of environmental human rights has the potential to improve environmental quality. However, state-level contexts appear to significantly influence what can be achieved. The aforementioned studies provide valuable descriptive insights but leave a key question unanswered. Does the constitutional recognition of environmental human rights truly lead to improved environmental outcomes? Or is recognition strategic, allowing states to project concern without committing to substantive action?

To address this, scholars have employed quantitative methods to assess the relationship between constitutional environmental human rights and ecological performance on a cross-national scale. Boyd (2012) uses an analysis of variance to demonstrate that countries with constitutional environmental rights, on average, have lower ecological impacts than non-recognizers. Using lagged cross-sectional regressions, Gellers and Jeffords (2015) find that people in countries recognizing both substantive and procedural environmental rights have access to better water and sanitation infrastructure. Their approach compares these metrics for recognizing and non-recognizing states in a given year, after controlling for the previous year's value of environmental performance to account for simultaneous causality.

In a subsequent study, Gellers and Jeffords (2017) utilize the same strategy across approximately 150 countries per year to further examine the relationship between recognition and outcomes, including in their analysis Yale University's Environmental Performance Index (Block et al., 2024), GDP per capita, rule of law, and the age of recognitions. The authors find again that the constitutional recognition of environmental human rights is positively correlated with the indicators of the Environmental Performance Index, which include climate change mitigation, biodiversity and habitat protections, and ecological health. Similarly, Jeffords and Minkler (2016), applying a two-stage instrumental variable approach to their lagged cross-sectional regressions, establish a positive relationship between the legal strength of constitutional environmental human rights and the Environmental Performance Index. In this approach, variables such as the number of prior global adoptions, the presence of other economic and social rights, and constitutional age are used in the first stage to predict the likelihood of adopting constitutional environmental rights. These predicted values are then used in the main regression to estimate the effect on environmental performance with the goal of addressing endogeneity.

Finally, Ondobo, Ndoya, and Okere Atanga (2024) employ matching, along with several robustness checks, on a panel dataset of 119 countries from 1990–2020, similarly concluding that constitutional environmental protections have a significant positive impact on environmental quality. Matching is used to make adopters and non-adopters comparable on specified confounders, so that differences in environmental quality can be more confidently attributed to constitutional protections rather than preexisting differences.

Previous quantitative studies all identify a positive association between the constitutional recognition of environmental rights and ecological outcomes. That being said, the actual impact of recognition—and the factors needed for it to translate into progress—is still ambiguous due to the authors' methods and approaches.

Concerns with previous quantitative studies include reverse causality, weak causal inferences, and measurement validity. The issue of reverse causality is present in Boyd (2012), which Boyd himself acknowledges as a limitation of his analysis of variance. Countries with strong environmental protections may be more likely to recognize environmental human rights, which he cannot account for. Gellers and Jeffords (2015, 2017) and Jeffords and Minkler (2016) attempt to address this problem by lagging recognition in their cross-sectional designs; however, this assumes that recognition translates into measurable environmental improvements after the chosen lag period. States often recognize rights for reasons unrelated to immediate change, such as enhancing international legitimacy or status (Hafner-Burton, 2013), and may already display stronger environmental performance prior to recognition. In such cases, the observed correlation between recognition and environmental outcomes may reflect preexisting conditions rather than a causal effect of constitutional provisions. More broadly, cross-sectional designs cannot account for the temporal uncertainty of institutional change or disentangle effects from other trends. Without panel or time-series designs capable of assessing within-country dynamics, causal inferences regarding the impact of constitutional rights remain weak.

To approach the causality issue, Ondobo, Ndoya, and Okere Atanga (2024) employ a panel design with matching techniques to compare countries with similar characteristics over time. However, they do not address potential biases arising from utilizing two-way fixed effects models, their main method of analysis, in contexts with staggered treatment timing. Constitution recognition of environmental rights has unfolded gradually and unevenly across countries, with adoption occurring across the last four decades (Gellers, 2025). In such staggered settings, there are multiple treatment cohorts (e.g., early adopters versus later adopters, both versus non-adopters), creating several distinct comparisons. Two-way fixed effects models combine these comparisons indiscriminately, sometimes using already-treated units as controls for later-treated units (Goodman-Bacon, 2021; De Chaisemartin and d'Haultfoeuille, 2021). This generates positive and negative weights, which can cancel out and bias the average treatment effect. Consequently, the estimated impact may be misleading. Given the highly staggered nature of constitutional recognition across countries, failing to account for this distortion weakens the credibility of causal claims.

Ondobo, Ndoya, and Okere Atanga (2024) also raise concerns about measurement accuracy through their use of carbon dioxide emissions as a proxy for environmental performance. Carbon dioxide emissions are closely tied to economic development, which is not synonymous with a country's commitment to ecological protection. Two countries with similar emissions may differ greatly in other aspects of environmental quality, such as air pollution or biodiversity. A single indicator alone cannot account for these complexities. Even rigorous studies risk drawing incomplete conclusions when key concepts are not clearly specified.

Crucially, these studies do not account for the variation in outcomes across different national contexts either. None of these studies ask when or under what conditions constitutional environmental rights have an impact: they focus solely on whether recognition is associated with better outcomes. Consequently, these rights remain poorly understood. As Gellers and Jeffords (2017) note, additional research is needed to disentangle correlation from causation and to identify the political, legal, and institutional factors that shape the realization of environmental human rights.

The paper addresses the need for further research through its two key contributions. First, it examines the conditions under which constitutional recognition of environmental rights translates into improved environmental outcomes globally, which has been overlooked by previous studies. Second, it employs a quasi-experimental design alongside a novel multi-dimensional measure of environmental performance, strengthening both causal identification and measurement. These contributions aim to enhance our understanding of *when* and *how* constitutional rights can translate into real progress.

4 When Do Environmental Rights Matter?

Though the constitutional recognition of environmental human rights establishes a normative foundation for environmental protection, its effectiveness is not guaranteed. Qualitative research has long documented that implementation is hindered by weak institutions and fragmented governance structures (Boyd, 2013; Dantas, 2018; Susanto, Baralaska, and Jaelani, 2024). In contrast, large-N quantitative studies consistently find a positive association between recognition and environmental outcomes (e.g., Jeffords and Minkler 2016; Ondobo, Ndoya, and Okere Atanga 2024), yet overlook how this relationship may vary across national contexts. These studies assume constitutional rights operate uniformly, despite qualitative studies concluding otherwise. The argument of this paper addresses that disconnect.

The paper advances a theory of conditional effectiveness, arguing that constitutional environmental human rights translate into improved environmental quality only when state capacity is sufficiently strong. State capacity is defined as the state's ability to effectively perform its core governance functions, such as maintaining order, delivering services, enforcing laws, and generating revenue (Mann, 1984; Tilly, 1990; Hanson and Sigman, 2021; Suryanarayan, 2024). Environmental performance is broadly conceptualized as a state's observable environmental outcomes, including fossil fuel energy consumption, air pollution levels, renewable energy output, and carbon dioxide emissions. Essentially, the mere adoption of environmental human rights is not enough—these rights must be activated and enforced by capable institutions.

This argument builds upon institutionalist theory that differentiates between formal rules and their real-world implementation. Constitutional provisions serve as formal institutions, but their effectiveness depends on the presence of complementary norms, informal practices, and enforcement mechanisms (March and Olsen, 1989; North, 1990; Helmke and Levitsky, 2004). Where institutional strength is lacking, environmental rights risk being symbolic rather than influencing state behavior.

Legal scholars have similarly noted the importance of institutional activation: the process by which normative commitments become operational through legal and administrative processes (Sabel and Simon, 2012; Epp, 1998). Without such activation, rights remain aspirational. Notably, constitutional environmental rights may also serve as "opportunity structures" (Gauri and Brinks, 2008), enabling litigation and accountability, but these benefits too depend on responsive and effective state institutions. This institutionalist logic is consistent with broader theories of human rights effectiveness, which emphasize that the realization of legal commitments ultimately depends on state capacity and political will (Simmons, 2009; Hafner-Burton, 2013; Fukuyama, 2013).

Accordingly, the impact of constitutional environmental human rights is expected to vary with context. Where institutions are weak or fragmented, constitutional recognition alone is unlikely to result in meaningful environmental improvements. Conversely, in states with strong institutions and enforcement capabilities, constitutional environmental human rights may serve as a powerful tool to promote and sustain environmental recognition.

To test this empirically, the paper begins by evaluating the baseline relationship between recognition and environmental performance found in prior quantitative studies. It then examines whether this relationship is conditioned by state capacity level, anticipating a positive linear relationship between capacity and the impact of recognition. The following hypotheses are proposed:

Hypothesis 1. *The constitutional recognition of environmental human rights, on average, has a positive effect on environmental performance.*

Hypothesis 2. *The positive effect of constitutional recognition on environmental performance is greater in states with higher levels of state capacity.*

Hypothesis 3. *In states with lower levels of state capacity, constitutional recognition of environmental human rights has no effect on environmental performance.*

These hypotheses seek to reconcile the seemingly contradictory findings of existing qualitative and quantitative research by positioning state capacity as a critical enabling force. The study argues that constitutional environmental human rights are effective only when domestic institutions possess sufficient administrative, legal, and fiscal strength to translate adoption into consistent practice. Without such capacity, constitutional provisions remain symbolic declarations rather than meaningful tools of environmental governance. The question of when formal rights yield practical improvements lies at the center of broader debates about human rights and institutional effectiveness.

5 Methods

I employ the generalized synthetic control estimator (Abadie, Diamond, and Hainmueller, 2010; Xu, 2017) to assess **(1)** the impact of constitutional environmental human rights recognition on environmental performance and **(2)** the extent to which capacity moderates this relationship. I evaluate the baseline relationship of recognition and environmental performance by applying the method to the full sample, estimating the average treatment effect on the treated (ATT). To examine the role of capacity as a moderator, I stratify countries into terciles based on their mean state capacity across the time series and estimate the average treatment effect separately within each group. This particular manner of testing moderation reduces reliance on functional form assumptions and ensures sufficiently large sample sizes for stable estimates. Additionally, the broad time-span reflects enduring state capacity rather than short-term fluctuations. The analysis uses a balanced panel of countries observed annually between 1970–2015, yielding approximately 7,800 observations.[2]

The generalized synthetic control method is designed for causal inference, extending the synthetic control framework to panel data, even when unobserved and time-varying confounders are present. Conceptually, generalized synthetic control utilizes the underlying patterns in the data to construct unit-specific counterfactuals. These counterfactuals represent what would have occurred in recognizing countries had recognition not taken place, which allows for the estimation of individual treatment effects and the aggregation of the average treatment effect on the treated.

5.1 Advantages of Generalized Synthetic Control

Generalized synthetic control offers several methodological advantages. It does not rely on the parallel trends assumption between the treatment and control groups, unlike difference-in-differences designs. As a result, the method allows for flexible causal inference. Generalized synthetic control is also well-suited to handle multiple treated units and variable treatment timing in contexts with unobserved heterogeneity—features that characterize the global adoption of constitutional environmental rights. The method is a strong alternative to traditional two-way fixed effects models, which risk biased estimates in such settings (Goodman-Bacon, 2021; De Chaisemartin and d'Haultfoeuille, 2021).

It is worth noting that new staggered difference-in-differences estimators (e.g., Callaway and Sant'Anna 2021; Sun and Abraham 2021) also avoid the biases of two-way fixed effects. Preliminary event studies indicate that the treatment and control groups of this study exhibit pre-treatment parallel trends, suggesting that a staggered difference-in-differences design could be viable. These staggered difference-in-differences estimators work by first estimating treatment effects separately for each group of units treated at the same time and then aggregating the group-specific effects. However, performance suffers when treatment timing is highly dispersed. If a group consists of only a few units, then its estimated effect may be extremely noisy or unstable, in turn affecting the quality of the aggregated estimates.

Highly dispersed treatment timing is certainly the case with countries' recognitions of environmental human rights. For example, only Nicaragua recognized such rights in 1986, whereas Bulgaria, Burkina Faso, Colombia, Gabon, Macedonia, Mauritania, and Slovenia all recognized in 1991 (Boyd, 2012). Staggered difference-in-differences estimators are ill-equipped to handle this level of variabil-

[2] Though the full panel includes 7,800 observations, units with fewer than seven pre-treatment years were excluded to ensure adequate data for the reliable estimation of latent factors and counterfactuals: this resulted in 7,500 observations utilized within the actual analysis.

ity. Contrastingly, generalized synthetic control does not rely on group-level aggregation: it produces unit-specific estimates, which ensures its precision for this context.

5.2 Estimation Procedure and Parameters

I now provide a detailed overview of the generalized synthetic control estimation procedure and its specifications within this study. The method first extracts the latent factors from the control group using an interactive fixed effects model. A built-in cross-validation scheme is used to select the optimal number of latent factors to reduce the risk of overfitting. Then, pre-treatment outcomes of treated units are projected onto these factors to estimate unit-specific loadings. These loadings and factors are used to impute counterfactual outcomes. Finally, unit-specific treatment effects are calculated as the difference between observed and imputed values, which can be aggregated across time for the overall average treatment effect on the treated.

The equation below models the data-generating process for the observed outcomes, where Y_{it} is the outcome of interest for unit i at time t; τ_{it} is the unit- and time-specific treatment effect; D_{it} is a binary treatment indicator; x_{it} is a vector of observed covariates with corresponding unknown parameter vector β; λ_i and f_t are vectors of unknown factor loadings and unobserved common factors, respectively; and ε_{it} is an idiosyncratic error term. The interactive fixed effects term (λ_i, f_t) captures unobserved time-varying heterogeneity that cannot be accounted for by traditional fixed effects models.

Here, the vector of covariates x_{it} is included to improve the accuracy of counterfactual outcome imputation by capturing observed time-varying confounders. Unlike traditional regression models, where covariates directly adjust treatment effect estimates, these variables within the generalized synthetic control framework function primarily to refine predictions of untreated potential outcomes.

$$Y_{it} = \tau_{it} D_{it} + x'_{it}\beta + \lambda'_i f_t + \varepsilon_{it}$$

For each treated unit i and post-treatment time t, the treatment effect is calculated as the difference between the observed outcome $Y_{it}(1)$ and the imputed counterfactual $Y_{it}(0)$.

$$\tau_{it} = Y_{it}(1) - Y_{it}(0)$$

The overall average treatment effect on the treated (ATT) is computed by averaging the unit-specific treatment effects across all treated units and post-treatment periods. Let N_{tr} denote the number of treated units, T_{post} the number of post-treatment periods for each unit, $\mathcal{T}$ the set of treated units, and

T_{0i} the last pre-treatment period for unit i.

$$\text{ATT} = \frac{1}{N_{tr}T_{post}} \sum_{i \in \mathcal{T}} \sum_{t > T_{0i}} (Y_{it}(1) - Y_{it}(0))$$

The specific estimation parameters used in this study is summarized as follows. To determine the appropriate number of latent factors and avoid overfitting, I used cross-validation over a range of zero to five factors. The estimation incorporates two-way interactive fixed effects, unit and time factors, to account for unobserved heterogeneity varying across countries and years. Standard errors were calculated via parametric bootstrapping with 1,000 replications. Only units with at least seven pre-treatment years were included in the analysis in order to ensure adequate pre-treatment information for reliable counterfactual construction (Xu and Liu, 2021). The estimation procedure includes state capacity, liberal democracy, log-transformed population size, and log-transformed GNI per capita as covariates. Additional model specifications that varied the factor range, bootstrapping methods, and minimum pre-treatment periods produced similar results, as detailed in Appendix E.

5.3 Assumptions and Limitations

For valid causal inference, generalized synthetic control requires several assumptions to hold. These include functional form correctness, strict exogeneity, weak serial dependence of the error terms, regularity conditions, and homoscedastic and cross-sectionally independent error terms. Although no observational design can fully guarantee that all these assumptions are satisfied, several features of the study help to mitigate concerns about violations: the long pre-treatment period, balanced panel structure, and the inclusion of relevant covariates. A full discussion of these assumptions is provided in Appendix C.

There are two main limitations of generalized synthetic control which ought to be addressed. First, there must be sufficient pre-treatment data to accurately estimate latent factors and reduce bias in counterfactual imputation. Second, the method's results are sensitive to model assumptions, which may influence the accuracy of the estimated counterfactuals. Given the extensive temporal coverage and balanced nature of the dataset, the first limitation is unlikely to pose a problem in this study. To account for the second limitation and ensure the robustness of my findings, I conduct several sensitivity analyses (Appendix E). Generalized synthetic control is nevertheless a powerful and flexible approach for causal inference in contexts characterized by staggered policy adoption and unobserved heterogeneity.

6 Data and Measurement

The panel dataset used in this study comprises approximately 7,800 country-year observations for 170 countries spanning the period 1970–2015. This duration captures the full range of countries' constitutional recognitions of environmental human rights, which began in the mid-1970s (Boyd, 2013). The year 2015 serves as the endpoint due to the temporal limitations of the state capacity variable (Hanson and Sigman, 2021). All data sources were harmonized and merged using standardized Correlates of War country codes (Singer and Small, 1994) to ensure consistent identification.

6.1 Constructing the Dependent Variable

To construct the dependent variable, an original index of environmental performance, I first compiled data on four key indicators: **(1)** fossil fuel energy consumption as a share of total energy consumption; **(2)** total $PM_{2.5}$ (particulate matter $\leq 2.5\,\mu$m) aggregated across sectors, reflecting air pollution levels; **(3)** renewable electricity output as a share of total electricity; and **(4)** carbon dioxide emissions per capita. $PM_{2.5}$ emissions were obtained from the European Commission's Emissions Database for Global Atmospheric Research (Crippa and Solazzo, 2020; Povitkina, Pachon, and Dalli, 2021), while the remaining indicators were sourced from the World Bank's World Development Indicators (World Bank, 2024). These indicators were selected because of their conceptual relevance to ecological preservation, as well as their temporal breadth and cross-national comparability. Additional indicators, such as biodiversity level or water quality, would have ideally been included: however, selection was constrained by data availability, as many valuable environmental metrics were not published until the 1990s or later.

The decision to construct an original environmental index, rather than using an off-the-shelf measurement or including several indicators in the analysis, was motivated by both methodological and practical considerations. First, no existing index covers the full time series required for this study. The environmental index employed in previous studies (e.g., Gellers and Jeffords 2017; Jeffords and Minkler 2016), Yale University's Environmental Performance Index (Block et al., 2024), has changed its indicators and weighting schemes over time: as a result, it is incompatible with panel designs. Second, including multiple indicators in the analysis as several dependent variables introduces the multiple comparisons problem, inflating the risk of Type I errors. Constructing a composite index avoids these issues by providing a consistent, across-time measure of environmental performance while reducing statistical noise from repeated hypothesis testing.

I addressed missing values in the four indicators by employing multiple imputation by chained equations (MICE) with a two-level normal model, clustering imputations at the country level to preserve the panel structure (Van Buuren and Groothuis-Oudshoorn, 2011; Van Buuren, 2018). After imputation, I combined the four indicators into a single index using the inverse-covariance weighted average approach, which assigns greater weight to variables that contribute unique and non-redundant information (Anderson, 2008; Schwab et al., 2020). This method provides an efficient and information-rich summary measure, particularly when indicators are correlated but not perfectly collinear. All indicators were z-scored prior to index construction to ensure comparability across different time periods. Additionally, I reverse-coded all variables except for renewable electricity output so that higher values uniformly indicate better environmental performance. The resulting index is centered near zero, with positive values reflecting above-average environmental performance and negative values indicating below-average performance relative to the sample. The index's loadings, along with the full imputation procedure, are reported in Appendix A.

Figure 1: Environmental Performance Trends Across Countries

Note: This figure shows the environmental performance over time, captured by the constructed index, for six countries. Higher index values correspond with better environmental performance. The index is standardized with a mean of 0.

6.2 Independent, Moderating, and Covariate Variables

The independent variable, constitutional recognition of environmental human rights, is coded as a binary indicator: it takes the value of one beginning in the year a country adopted such provisions and zero otherwise. Recognition years were drawn from Boyd (2012) and University of North Florida's *Enviro Rights Map* (Gellers, 2025), a digital database of constitutional environmental human rights recognitions.

State capacity, which serves as both a moderating variable and covariate, is operationalized using the State Capacity Index developed by Hanson and Sigman (2021). They define state capacity as a government's ability to perform its necessary functions, including protection from external threats (Tilly, 1990), maintenance of international order, provision of infrastructure necessary for economic activity (Mann, 1984), and effective revenue extraction (Levi, 1988; North, 1981; Tilly, 1990). The index operationalizes state capacity through 21 indicators across three dimensions: extractive capacity, coercive capacity, and administrative capacity (Hanson and Sigman, 2021). Hanson and Sigman (2021) employ Bayesian latent variable analysis to combine these indicators into a comprehensive measure of a state capacity.

Additional covariates included in the models account for other factors that may independently influence environmental performance. I include liberal democracy using the University of Gothenburg's V-Dem Liberal Democracy Index (Coppedge et al., 2025), which captures institutional features such as electoral competition, judicial independence, and civil liberties. Log-transformed GNI per capita and log-transformed total population also serve as covariates, as reported in the World Development Indicators. As the generalized synthetic control method requires complete covariate data, I again use multiple imputation by chained equations (Van Buuren and Groothuis-Oudshoorn, 2011; Van Buuren, 2018) to retain the full sample and avoid bias from listwise deletion. The full imputation procedure is detailed in Appendix B. As a robustness check, I replicated the baseline[3] analysis using a complete-case sample (Appendix B.3). Results were consistent in direction and magnitude, supporting that the baseline finding is not unduly sensitive to the treatment of missing data.

7 Results

Generalized synthetic control is first used to assess the baseline relationship between constitutional environmental rights recognition and environmental performance: in other words, the analysis estimates the average treatment effect on the treated (ATT) of constitutional environmental rights recognition on environmental performance across all countries in the sample. This yields a positive average treatment effect estimate of 0.153. However, the effect is statistically insignificant, indicating limited precision despite the large sample size. The null finding suggests that, on average, recognition does not lead to improved environmental outcomes. In reality, this average masks substantial heterogeneity in the effect of recognition across different institutional contexts.

[3]Due to insufficient sample sizes and excessive unit removal within the capacity strata, a complete-case robustness check was not feasible for the subgroups.

Table 1: Baseline Estimated Effect of Constitutional Environmental Rights on Environmental Performance

Variable	
Constitutional Environmental Rights Recognition	0.153
	(0.132)
Covariates	
GNI per Capita (log)	✓
Total Population (log)	✓
Liberal Democracy Score	✓
State Capacity	✓
Fixed Effects	
Country Fixed Effects	✓
Year Fixed Effects	✓
Sample Characteristics	
Number of Treated Units	72
Number of Untreated Units	92
Years	1970–2015
Total Observations	7,585

Note: The coefficient reports the average treatment effect on the treated (ATT) estimated using the Generalized Synthetic Control method (Xu, 2017). Bootstrapped standard errors (1000 replications) are reported in parentheses. ✓ indicates inclusion in the estimation procedure. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

To examine the role of capacity as a moderator, I then stratify countries into terciles based on their average state capacity across 1970-2015 and estimate the average treatment effect on the treated separately (ATT) separately within each group. The results indicate a clear pattern of conditional effectiveness. Among countries in the lowest capacity stratum, constitutional recognition has no discernible impact on environmental performance. Estimates are small and statistically indistinct from zero throughout the post-treatment period. In the medium-capacity group, however, recognition yields substantive and statistically significant gains in environmental performance. These effects become visible several years after recognition and persist overtime (Appendix D). Contrastingly, in the highest-capacity countries, recognition again shows no meaningful effect.

Table 2: Estimated Effect of Constitutional Environmental Rights on Environmental Performance by State Capacity Level

Variable	Low Capacity	Medium Capacity	High Capacity
Constitutional Environmental Rights Recognition	0.140	0.280**	0.023
	(0.151)	(0.123)	(0.151)
Covariates			
GNI per Capita (log)	✓	✓	✓
Total Population (log)	✓	✓	✓
Liberal Democracy Score	✓	✓	✓
State Capacity	✓	✓	✓
Fixed Effects			
Country Fixed Effects	✓	✓	✓
Year Fixed Effects	✓	✓	✓
Sample Characteristics			
Number of Treated Units	29	36	22
Number of Untreated Units	28	20	29
Years		1970–2015	
Total Observations	2,622	2,576	2,387

Note: The coefficients report the average treatment effect on the treated (ATT) estimated using the Generalized Synthetic Control method (Xu, 2017). Bootstrapped standard errors (1000 replications) are reported in parentheses. ✓ indicates inclusion in the estimation procedure. Countries are stratified into capacity terciles based upon their mean state capacity across 1970-2015. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

These stratified estimates suggest that the observed null effect in the general sample results are not from an absence of impact; rather, this is likely due to underlying heterogeneity. Recognition appears effective only in contexts with moderate state capacity. The findings indicate a more nuanced relationship between constitutional recognition and environmental performance, where capacity plays a key moderating role.

Robustness checks further support these results. Alternative model specifications across all parameters yield consistent treatment estimates. Expanding the medium capacity group to countries within the 20th to 80th percentiles of mean state capacity (1970–2015) preserves and even strengthens the positive association between environmental human rights recognition and outcomes ($ATT = 0.285, SE = 0.085, p = 0.001$). These robustness checks, along with diagnostic plots comparing the models' treatment and counterfactual trajectories, are located in Appendix E.

The results indicate that constitutional environmental rights do not exert a uniform influence across countries. Their effectiveness is conditional, emerging only within specific institutional contexts. These findings challenge the prevailing view in the literature of a broadly positive effect.

8 Rethinking Capacity

The conditional, non-linear relationship between capacity and the effectiveness of recognition is an unexpected but key finding. Though qualitative research has emphasized the importance of capacity to the implementation of environmental human rights (e.g., Boyd 2012; Susanto, Baralaska, and Jaelani 2024), this relationship is assumed to be positive and linear. The results of the generalized synthetic control analysis find otherwise, however. But why do medium-capacity countries appear to be the "sweet spot" for translating environmental human rights into real progress?

Limited effectiveness in low-capacity countries is relatively straightforward to explain. Where institutional strength is lacking, environmental human rights remain abstract: legal and bureaucratic systems are simply too weak to operationalize them. In these contexts, constitutional recognition is destined to be symbolic. Medium- and high-capacity countries, by contrast, possess sufficient institutional infrastructure to put these commitments into practice.

Yet environmental rights recognition has no significant effect in high-capacity countries—this is the puzzle underlying the empirical findings. Two main explanations warrant consideration. It is possible that high-capacity countries may already maintain high environmental standards before recognition, having reached a ceiling in terms of what further progress they can achieve. To examine this, I conduct two additional models. An analysis of pre-recognition environmental performance[4] shows that the high-capacity countries began with significantly *worse* environmental performance relative to others, even when controlling for log-transformed GNI per capita and other relevant covariates. This suggests that high-capacity countries were not constrained by previous success. Moreover, a model of environmental performance over time[5] indicates that capacity is associated with worse environmental outcomes ($\hat{\beta} = -0.872$, $p < 0.001$), further challenging the idea that these countries had already exhausted potential gains prior to constitutional recognition.

The more compelling explanation is that the limited impact in high-capacity countries may instead stem from institutional inertia. Higher-capacity contexts often develop more complex and layered institutional structures, with large bureaucracies and specialized organizational hierarchies designed to solve a wide range of administrative problems (Snowberg and Ting, 2023). However, these same bureaucratic structures can foster policy sclerosis and regulatory capture, as entrenched routines and established interests can impede the internalization and effective implementation of new commitments (Pierson, 2000; Stigler, 1971). A similar logic applies within the legislative sphere. Complex institutional arrangements—such as multiple legislative chambers or coalition governments—may proliferate "veto players", each with the power to block or dilute policy change (Tsebelis, 2002). This could make policy implementation more difficult in high-capacity states, suggesting why I find an insignificant

[4] OLS regression of capacity group on environmental performance, controlling for log GNI per capita, liberal democracy index, log population, and centered year, with interactions between capacity group and year to capture differences in trends.

[5] OLS regression of continuous state capacity level on environmental performance, controlling for log GNI per capita, log total population, and liberal democracy index with year fixed effects.

effect of constitutional recognition and environmental outcomes among those countries.[6] For instance, Brazil's complex institutional structures, characterized by overlapping federal, state, and municipal responsibilities alongside a fragmented bureaucracy, has undermined the enforcement and coordination of environmental laws despite constitutional guarantees (Braga and Melo, 2016; OECD Watch, 2022).

Medium-capacity countries, however, likely combine enough institutional strength to enforce policy with sufficient flexibility to adopt and integrate new norms. Here, flexibility refers to actors' ability to efficiently navigate governance processes—essentially, reduced institutional inertia. These states are neither at the low end of capacity nor fully mature, rigid bureaucracies; rather, they function within evolving institutional frameworks that impose fewer structural constraints, giving actors greater maneuverability to shape and implement policy. An examination of the medium-capacity countries that saw statistically significant and positive treatment effects supports this characterization. Many are post-Soviet or post-conflict states, such as Moldova and Rwanda, that have undergone substantial transitions in recent decades (Appendix G). Institutional change theories argue that transitional periods disrupt established routines and reduce bureaucratic inertia, creating openings for policy innovation and reform (Mahoney and Thelen, 2010; Capoccia and Kelemen, 2007). Accordingly, these states-in-transition exemplify the dynamic nature of medium-capacity contexts: their combination of particularly high flexibility and sufficient strength enables real environmental improvements.

Political will is undoubtedly another determining factor of successful implementation, though beyond the operational scope of this study. A conducive institutional context on its own cannot bring about progress. Policymakers must be willing to build upon the normative framework of recognition with activating legislation and directives. Recognition may even still be effective in states with severe organizational complexity if political will is particularly strong. This dynamic is clear from the subset of high-capacity countries that nonetheless saw positive and significant treatment effects following environmental rights recognition: France, Slovakia, North Macedonia, Croatia, Slovenia, and Turkey. In all of these cases but France, the European Union accession process uniquely incentivized policymakers to prioritize environmental governance. [7] [8] Strong will on its own, however, cannot compensate for crippled institutions—implementing policy must *actually* be implementable.

In sum, medium-capacity countries appear to be the "sweet spot" for progress due to two complementary institutional qualities: reduced institutional inertia and sufficient strength. Reduced inertia reflects the absence of rigid and complex governance structures with numerous veto points that can

[6] The theorized relationship between capacity, institutional complexity, and resulting inertia may be present within the data. Though purely descriptive, a Welch two-sample t-test of V-Dem's political constraint levels supports the plausibility that high-capacity countries face significantly greater institutional barriers ($\mu = 0.43$) to enacting change than their medium-capacity counterparts ($\mu = 0.11$).

[7] To become member states, the European Union requires candidate countries to align their environmental legislation, standards, and enforcement capacity with the EU acquis communautaire.

[8] These countries all had recognized environmental human rights in their constitutions years before formally beginning the EU accession process.

dilute or obstruct policy. Sufficient capacity, in turn, enables the state to effectively implement commitments and produce tangible outcomes. Political will remains essential even in these contexts, as it provides the momentum necessary to translate the constitutional recognition of environmental rights into real improvements. These factors together explain the empirical puzzle of capacity and its diminishing returns.

9 Conclusion: From Formal Rights to Effective Governance

The constitutional recognition of environmental human rights has expanded rapidly, mirroring growing global demands for stronger ecological protections. These rights have the potential to catalyze meaningful progress by codifying enforceable state obligations (Boyd, 2012; De Sadeleer, 2002; May, 2021), raising public awareness (Birnie and Boyle, 2002), and establishing a legal framework for legislation and advocacy (Prieur, 2012; Brandl and Bungert, 1992; De Sadeleer, 2004). However, the domestic conditions under which this potential translates into real environmental improvements have remained poorly understood. Existing scholarship offers conflicting views. Some accounts emphasize persistent obstacles to implementation (Bosek, 2014; Dantas, 2018; May, 2021; Umukoro and Ituru, 2022), while others identify a broadly positive association between recognition and outcomes (Gellers and Jeffords, 2015; Gellers and Jeffords, 2017; Jeffords and Minkler, 2016; Ondobo, Ndoya, and Okere Atanga, 2024). This study resolves those tensions by demonstrating that constitutional environmental human rights yield measurable environmental improvements primarily within medium-capacity states, challenging conventional assumptions about the relationship between state capacity and governance effectiveness. Rather than improving outcomes, greater capacity exhibits diminishing returns in translating right recognition into substantive progress.

Post-estimation analysis alongside an examination of institutionalist scholarship (e.g., Stigler 1971; Pierson 2000; Tsebelis 2002; Mahoney and Thelen 2010) points towards a plausible explanation for the counterintuitive finding. Medium-capacity states appear to strike a balance between enforcement strength and organizational adaptability. They possess the sufficient capacity to operationalize constitutional environmental rights while retaining the flexibility to innovate and circumvent bureaucratic rigidity. In contrast, low-capacity contexts lack the administrative strength required for effective operationalization. High-capacity states, despite their strength, often experience policy dilution through complex institutional architectures and multiple veto points (Pierson, 2000; Stigler, 1971; Tsebelis, 2002). The findings suggest that the relationship between state capacity and effective rights realization is conditional rather than linear. The effectiveness of constitutional recognition therefore hinges on the dynamic interplay between institutional strength and flexibility.

Environmental governance presents unique challenges that likely amplify these dynamics, which may explain why the observed pattern emerges most clearly in this domain. Powerful economic interests tied to extractive industries frequently resist environmental regulation, exerting influence that fosters regulatory capture and entrenches veto players within complex bureaucracies (Humphreys, 2004; Feng et al., 2024; Carpenter, 2025). The multilevel structure of environmental governance introduces coordination problems that can further exacerbate institutional friction (Hooghe and Marks, 2023; OECD Watch, 2022). These conditions intensify the tradeoffs between organizational strength and flexibility, thereby increasing the relative implementation advantage of moderate-capacity states.

The complexities revealed by the analysis point to the necessity of revising conventional conceptions of state capacity, which often portray it as a uniform, additive resource. The study employs a comprehensive state capacity index encompassing core governance functions across extractive, coercive, and administrative dimensions (Hanson and Sigman, 2021), drawing upon foundational theories (e.g., Tilly 1990; Mann 1984; Levi 1988). These frameworks largely conceptualize capacity as an accumulative good that linearly enhances governance performance. However, the findings suggest that capacity exhibits diminishing returns. Though institutional strength is necessary to enforce constitutional rights, excessive institutionalization can increase veto points and foster policy inertia. Medium-capacity states thus occupy an optimal equilibrium, possessing adequate strength to fulfill constitutional obligations while retaining flexibility to innovate and adapt. This dynamic conceptualization of capacity clarifies the observed empirical puzzle and advances theoretical debates on the multifaceted nature of effective governance.

The insights regarding institutional capacity, organizational flexibility, and their interaction extends broadly across rights implementation and regulatory policy domains. This research reveals a critical principle: formal legal commitments may require institutions characterized by a particular balance of strength and adaptability to translate into meaningful implementation outcomes. The findings challenge the dominant view that greater state capacity uniformly enhances governance. Importantly, optimal governance capacity may be moderate rather than maximal. The dynamic interplay between enforcement capacity and institutional adaptability may be a critical condition for effective realization of rights and policies beyond environmental governance, with potential applications to health, civil, and social rights. Policymakers and international development organizations must therefore recalibrate their approach to institutional development. Instead of pursuing expansive capacity-building, reform efforts should prioritize streamlining decision-making processes and reducing bureaucratic friction, ensuring that formal commitments can be effectively operationalized without incurring the institutional rigidity that characterizes mature, complex bureaucracies. This reoriented approach has profound implications for constitutional reform, rights enforcement, and the design of effective regulatory institutions globally.

There are important limitations of the study to address. First, while the causal inference method employed robustly estimates heterogeneous treatment effects, it does not directly test the theorized mechanisms—like institutional inertia or regulatory capture—that explain these effects. The mechanisms remain inferred rather than causally validated within this framework, suggesting a need for future research employing in-depth case studies or process tracing better suited to analyze these complex institutional dynamics. Second, other factors critical for the realization of constitutional environmental rights, such as judicial independence and political will, are beyond the scope of the study due to operationalization challenges. Finally, while generalized synthetic control enhances the credibility of the causal estimation with staggered treatment timing and heterogeneity, it relies on assumptions that may not fully hold and cannot account for all unobserved confounders. Future research should validate these findings and examine the relational mechanisms mediating rights implementation.

Ultimately, the effective implementation of environmental human rights is far from guaranteed. Though these rights have significant potential to enact change, meaningful progress likely hinges on both the strength and adaptability of state institutions. Interdisciplinary and mixed-method scholarship should analyze these dynamics across diverse domestic contexts and forms of legal commitments. Such work can further inform institutional strategies for rights enforcement and normative change amid an increasingly complex global landscape.

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A Environmental Index Construction and Validation

A.1 Index Loadings and Rankings

Table 3 presents the loadings of the four constituent indicators of the constructed environmental index, derived using the inverse covariance matrix weighting approach (Anderson, 2008; Schwab et al., 2020). All indicators are reverse-coded as necessary to ensure consistent interpretability, where higher index values correspond to better environmental performance. This weighting strategy enhances the index's capacity to emphasize non-redundant, complementary components of environmental quality.

Table 3: Environmental Index Loadings

Indicator	Loading Weight	Interpretation
Fossil Fuel Share (*wdi_fossil*)	0.3443	Moderately positive weight, indicating a unique and meaningful contribution to the index construct.
PM2.5 Concentration (*edgar_pm25*)	0.2394	Positive weight reflecting unique pollution-related impact.
Renewable Electricity Output (*renew_output*)	0.4292	Highest positive weight, marking it as most uniquely informative.
Carbon Dioxide Emissions Per Capita (*wdi_co2*)	-0.0129	Negligible negative weight, meaning minimal unique contribution controlling for other variables.

Note: Loadings are derived from the inverse covariance matrix approach, which emphasizes variables contributing unique, non-redundant information by penalizing shared variance with other components. Renewable electricity output is reverse coded to ensure consistent directionality across indicators.

The top five countries according to the constructed environmental index are Tajikistan, Bhutan, Lesotho, Central African Republic, and Afghanistan. Conversely, the bottom five countries include the United States, China, South Africa, Poland, and Australia. These rankings highlight substantial cross-national variation in environmental performance captured by the index.

A.2 Leave-One-Out Robustness Checks for Medium Capacity Group

To evaluate whether the significant treatment effect in the medium-capacity group depends on any single indicator, I performed leave-one-out analyses excluding each indicator in turn from the environmental index. None of these leave-one-out variants produces a statistically significant effect when estimated separately.

Table 4 shows the estimated ATT, bootstrap standard errors, and p-values for each specification. The estimated effects remain positive but statistically insignificant when fossil fuel share or CO2 emissions are excluded. Omitting $PM_{2.5}$ concentration most nearly eliminates the estimated effect

($ATT = 0.038, p = 0.781$), underscoring this indicator's unique contribution to the composite index.

Table 4: Leave-One-Out Robustness of GSC Estimated Treatment Effect for Medium-Capacity Group

Index Variant	ATT Estimate	Bootstrap S.E.	p-value
Full Environmental Index	0.280	0.123	0.030
Excluding Fossil Fuel Consumption	0.174	0.141	0.218
Excluding $PM_{2.5}$ Concentration	0.038	0.138	0.781
Excluding CO_2 Emissions	0.163	0.140	0.244
Excluding Renewable Energy Output	0.183	0.154	0.235

Note: ATT estimates from the Generalized Synthetic Control method for the medium-capacity group. Bootstrapped standard errors and two-sided p-values are shown. None of the leave-one-out models reach statistical significance.

These findings show that the significant baseline effect is not driven by any individual indicator, but is especially sensitive to the inclusion of $PM_{2.5}$ concentration. The composite index thus captures complementary information across environmental outcomes, supporting its use as a robust measure for causal analysis of constitutional rights.

A.3 Indicator Imputation Procedure and Diagnostics

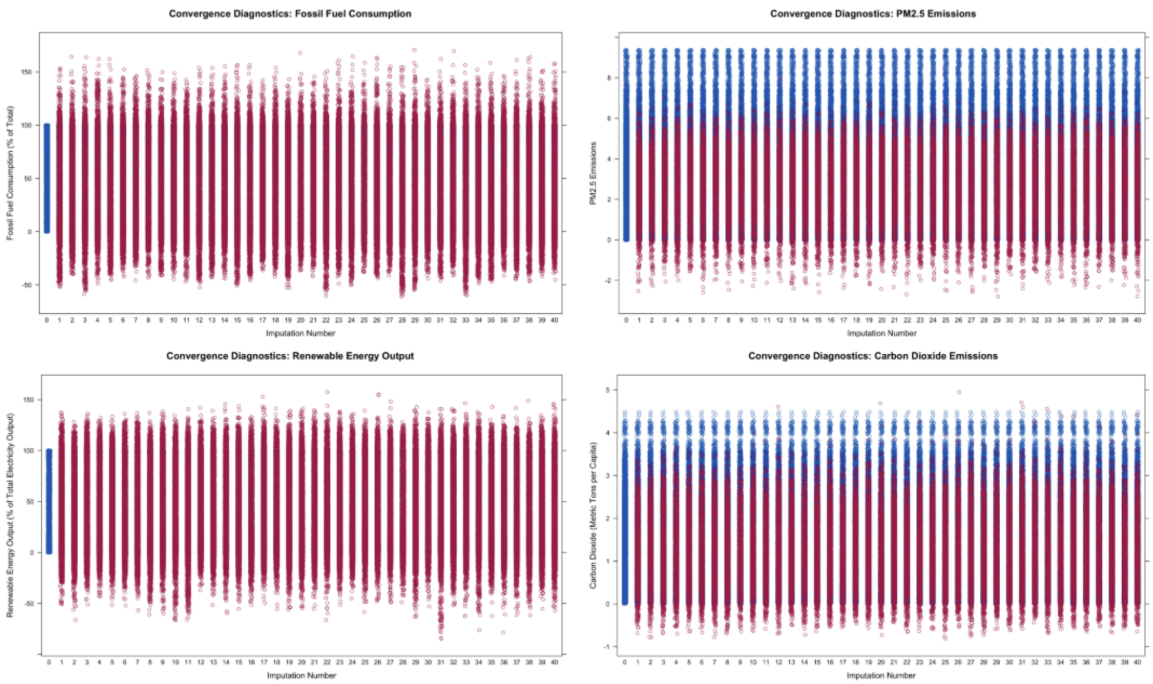
The environmental index, the dependent variable of the paper, was created utilizing four indicators: **(1)** fossil fuel energy consumption as a share of total energy consumption; **(2)** total $PM_{2.5}$ (particulate matter $\leq 2.5\,\mu$m) aggregated across sectors, reflecting air pollution levels; **(3)** renewable electricity output as a share of total electricity; and **(4)** carbon dioxide emissions per capita. I addressed missing values in these measures by employing multiple imputation by chained equations (MICE) with a two-level normal model, clustering imputations at the country level to preserve the panel structure (Van Buuren and Groothuis-Oudshoorn, 2011; Van Buuren, 2018). Forty imputations were generated with ten iterations each.

To improve the predictive accuracy of the imputations, I constructed an auxiliary dataset by filtering theoretically relevant variables from the University of Gothenburg's Quality of Government (QoG) Environmental Dataset (Povitkina, Pachon, and Dalli, 2021) and the World Bank's World Development Indicators based on their correlation with the four key indicators. I retained variables that had less than 65% missingness, a moderate correlation ($|r| > 0.3$) with at least one target variable, and excluded those highly collinear ($|r| > 0.95$) with any target variable. This process yielded 38 auxiliary variables from the Quality of Government Environmental Dataset and 2 from the World Development Indicators. All skewed variables, including carbon dioxide emissions and $PM_{2.5}$ emissions, were log-transformed prior to imputation and index construction to ensure approximate normality.

The choice of multiple imputation rests on the assumption that data are missing at random

(MAR)—that is, the probability of missingness depends only on observed data and is conditionally independent of the unobserved values. Though this assumption cannot be directly tested, I took several steps to minimize the risk of bias from data potentially missing not at random (MNAR). These included incorporating a wide range of theoretically-relevant auxiliary variables, inspecting the distribution of imputed values, and evaluating convergence diagnostics.

Figure 2: Imputation Diagnostics for Environmental Index Construction



Some variables (e.g., fossil fuel consumption, CO_2 emissions) are conceptually nonnegative. Minor negative values occasionally appear in the imputations due to the 2-level normal model used by MICE. These values are small and do not indicate a failure of convergence. All variables were z-scored prior to index construction, so these minor negatives do not affect the resulting index. These diagnostics nonetheless support the inclusion of the environmental index in subsequent analysis, while also indicating areas for potential future improvement in missing data handling for complex environmental datasets.

B Covariate Imputation Procedure and Diagnostics

B.1 Covariate Imputation Procedure

The main method of this paper, generalized synthetic control, requires that all observations must have full completion of all variables included in the analysis. Without addressing missing data, this reduces the data from the 7,800 observations to 3,500. To retain the full sample and avoid bias due to list-wise deletion, I again use multiple imputation by chained equations (MICE) with a two-level normal model clustered at the country level (Van Buuren and Groothuis-Oudshoorn, 2011; Van Buuren, 2018). I followed the same process as the previous use of imputation; however, I adjusted the construction of the auxiliary dataset to align with the variables of interest.

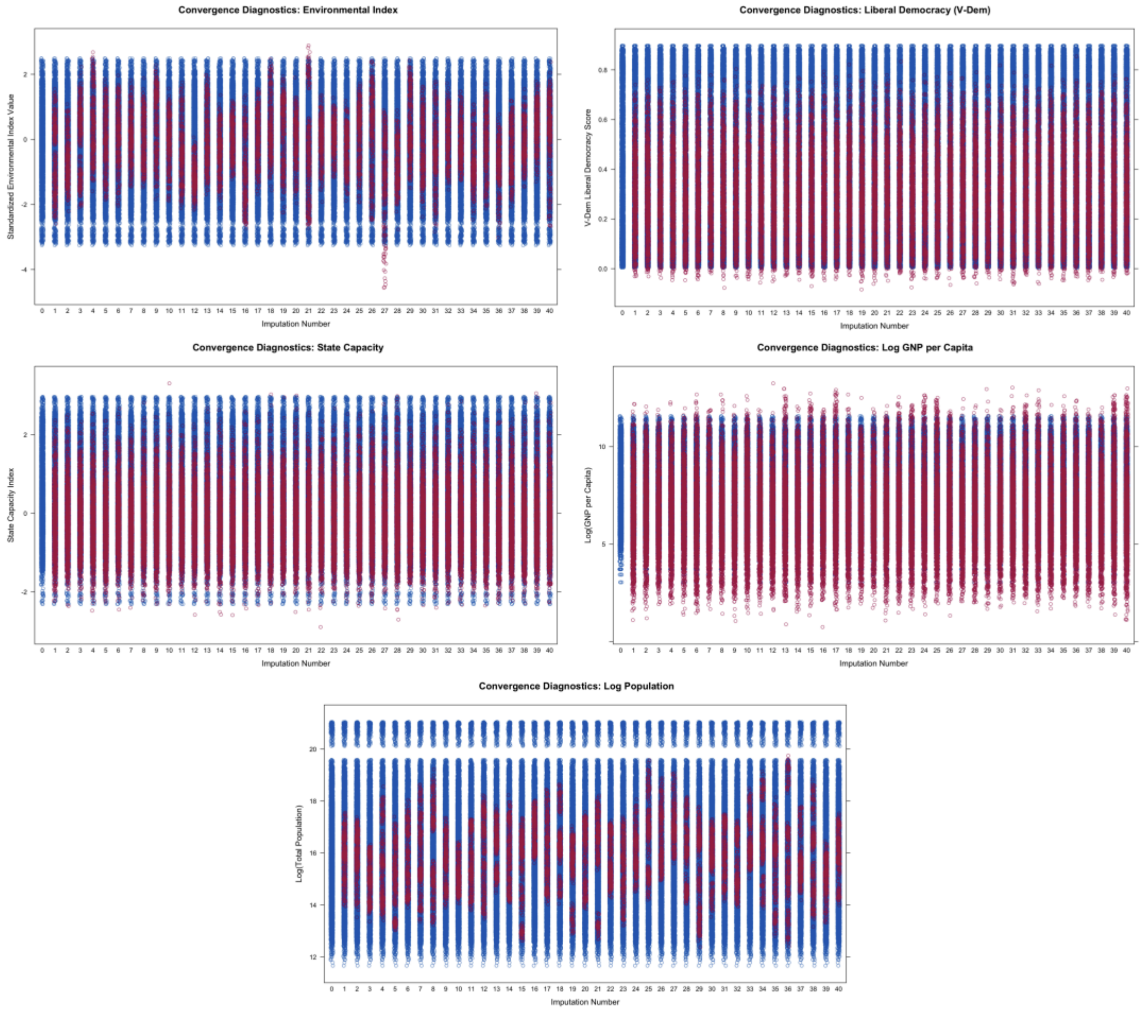
I constructed a new auxiliary dataset based upon the variables included in the final analysis: the environmental index, which serves as the dependent variable; state capacity, a moderator and covariate; and liberal democracy level, log-transformed GNI per capita, and log-transformed total population, which all function as covariates. These are the "target" variables. As the independent variable had no missing values, it is excluded from the imputation process.

The auxiliary dataset consists of theoretically relevant variables from the Quality of Government Environmental Dataset, the World Development Indicators, and the Varieties of Democracy Dataset. From the initial dataset, I retained variables that had less than 40% missingness, a moderate correlation ($|r| > 0.5$) with at least one target variable, and excluded those highly collinear ($|r| > 0.85$) with any target variable. I used these particular thresholds, which are more restrictive than the previous imputation process, as there was a significant number of auxiliary variables related to the targets. Lastly, all collinear variable pairs ($|r| > 0.99$) were dropped from the dataset. The final auxiliary dataset consists of 52 variables, including the targets. All skewed variables were log-transformed to ensure approximate normality.

B.2 Covariate Imputation Diagnostics

Figure 3 below present convergence diagnostics for all covariates included in the analysis: environmental index, liberal democracy index, state capacity, log GNP per capita, and log population. Each plot displays the distribution of imputed values across 40 imputation iterations, enabling visual assessment of the stability and mixing of the imputation chains. The absence of visible trends or systematic drift across iterations for each variable indicates satisfactory convergence and supports the reliability of the imputed data. These diagnostics support that missing data imputation was performed appropriately, yielding a complete panel suitable for rigorous GSC estimation.

Figure 3: Covariate Imputation Convergence Plots



B.3 Complete-Case Baseline Estimation

The complete-case baseline estimation shown in Table 5 produces a negative, but statistically nonsignificant, effect of constitutional environmental rights recognition on environmental performance (-0.092, $SE = 0.070$). This result mirrors findings from the imputed data analysis, supporting the conclusion that the primary null result is robust to alternative handling of missing data and is not driven by the imputation process.

Table 5: Complete-Case Baseline Estimated Effect of Constitutional Environmental Rights on Environmental Performance

Variable	
Constitutional Environmental Rights Recognition	-0.092
	(0.070)
Covariates	
GNI per Capita (log)	✓
Total Population (log)	✓
Liberal Democracy Score	✓
State Capacity	✓
Fixed Effects	
Country Fixed Effects	✓
Year Fixed Effects	✓
Sample Characteristics	
Number of Treated Units	68
Number of Untreated Units	91
Years	1970–2015
Total Observations	3,938

Note: The coefficient reports the average treatment effect on the treated (ATT) estimated using the Generalized Synthetic Control method (Xu, 2017). Bootstrapped standard errors (1000 replications) are reported in parentheses. ✓ indicates inclusion in the estimation procedure. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Estimates using the full imputed sample were directionally positive but not statistically significant, consistent with the complete-case results reported here.

C Assumptions of the Generalized Synthetic Control Method

The generalized synthetic control (GSC) estimator relies on several key assumptions to produce valid causal estimates in panel data contexts characterized by staggered treatment adoption and unobserved heterogeneity. This appendix outlines these assumptions and evaluates their plausibility in the context of this study. The presentation follows foundational methodological work by Xu (2017).

1. Functional Form Correctness

GSC models untreated potential outcomes using a linear interactive fixed effects specification:

$$\mu_{it} = X_{it}\beta + \lambda_i' f_t,$$

where X_{it} denotes observed covariates, β is a vector of unknown coefficients, λ_i are unit-specific factor loadings, and f_t are unobserved common factors. Correct specification of this functional form is essential for accurate counterfactual estimation. Pre-treatment diagnostic plots indicate strong fit, supporting the plausibility of this assumption (Appendix E) .

2. Strict Exogeneity and No Omitted Confounding

The method assumes error terms ε_{it} are strictly exogenous, meaning treatment assignment is conditionally independent of future potential outcomes and errors. This assumption rules out reverse causality and anticipatory effects. More explicitly, no unobserved time-varying confounders simultaneously influence treatment assignment and outcomes once conditioning on observed covariates and latent factors.

Given EU member and candidate countries may experience coordinated institutional reforms and policy harmonization that could violate this assumption, a robustness check was conducted excluding these countries from the sample (Appendix E). This exclusion aims to mitigate potential endogeneity stemming from EU integration dynamics and assess whether estimated treatment effects remain stable. The results reinforce the validity of the exogeneity assumption for the retained sample, as estimated treatment effects remain substantively consistent and statistically robust despite the restricted composition.

3. Stable Unit Treatment Value Assumption

The analysis assumes no interference between units and no hidden variation in treatment, implying that each unit's potential outcomes depend only on its own treatment status. This assumption is standard in panel causal inference applying GSC.

4. Weak Serial Dependence, Homoscedasticity, and Independence

Idiosyncratic errors are assumed to exhibit at most weak serial correlation and to be homoscedastic and cross-sectionally independent conditional on latent factors and covariates. These assumptions facilitate consistent estimation and valid inference for the average treatment effect on the treated (ATT).

5. Extensive Pre-Treatment Data

Reliable estimation of latent factors and unit-specific loadings requires sufficient pre-treatment time periods. The analysis utilizes roughly 7,500 country-year observations spanning 1970–2015, capturing the full range of constitutional recognitions of environmental human rights beginning in the mid-1970s (Boyd, 2013). This extensive, balanced panel allows robust recovery of latent factors and reduces bias in counterfactual estimation.

6. Common Support in Latent Factor Space

A key identification condition is that treated units' latent factor loadings can be approximated by convex combinations of control units' loadings. Given the large and diverse sample and the long time series, this assumption is plausible and supported by pre-treatment goodness-of-fit diagnostics.

Limitations and Robustness

While GSC imposes stronger structural assumptions than traditional two-way fixed effects models, these are justified by its flexibility in modeling unobserved heterogeneity and staggered treatment adoption. Sensitivity analyses, including variation in number of factors, pre-treatment period length, and exclusion of covariates, along with diagnostic plots, demonstrate that the model is robust and that assumptions are reasonably satisfied (Appendix E).

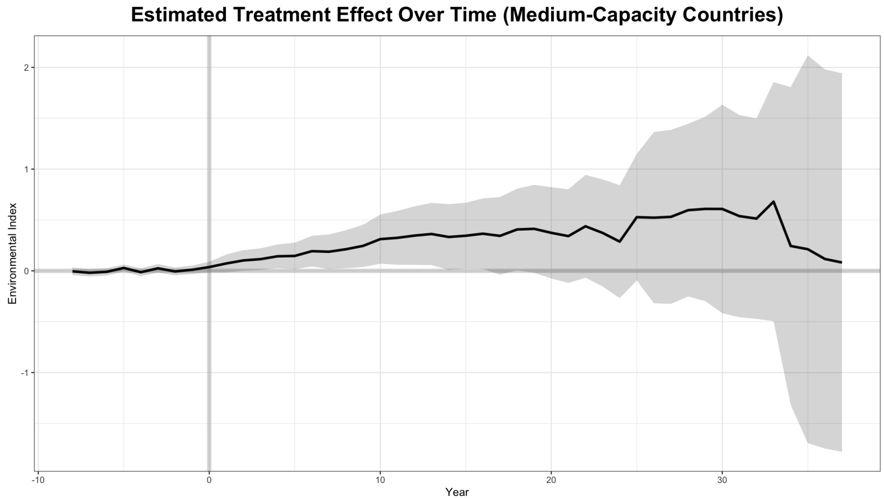
Conclusion

Although the assumptions underlying GSC cannot be fully empirically verified, multiple diagnostics and robustness exercises increase confidence in their plausibility. Extensive sensitivity analyses show that estimated treatment effects remain stable under reasonable alternative specifications. Pre-treatment fit diagnostics demonstrate that the interactive fixed effects model adequately captures unobserved confounders and latent heterogeneity, providing empirical support for functional form correctness and common support. These diagnostics, combined with the balanced and extensive panel dataset and a well-grounded theoretical framework, lend strong support to the validity of causal inferences drawn from the generalized synthetic control method in this study.

D Effects Over Time for Medium-Capacity Countries

Figure 4 displays the estimated treatment effect of constitutional environmental rights recognition on the environmental index over time for medium-capacity countries. The trend line remains close to zero before recognition, indicating strong pre-treatment alignment and supporting the credibility of the causal estimates.

Figure 4: Medium-Capacity Countries Estimated Treatment Effects Over Time



Note: Estimates beyond 15 years after recognition are based on extrapolation and should be interpreted with caution.

Following recognition, the estimated effect is generally positive—with confidence intervals widening in the latter years due to extrapolation—highlighting both the potential for a beneficial impact and the need for cautious interpretation when assessing longer-term estimates.

E Sensitivity and Robustness Analyses

E.1 Estimation Sensitivity Analyses

Across all strata and sensitivity checks, estimated average treatment effects (ATTs) are predominately similar in magnitude and statistical significance, indicating that results are robust to variations in factor range, pre-treatment length, bootstrapping method, and covariate inclusion.

Table 6: Generalized Synthetic Control Sensitivity Analyses by Capacity Stratum

Specification	ATT	SE	p-value
Full Sample			
Baseline	0.149	0.133	0.260
r = 0:3	0.192	0.133	0.148
Nonparametric	0.149	0.095	0.117
Min.T0 = 5*	0.137	0.149	0.357
No Covariates	0.178	0.145	0.219
Low-Capacity Countries			
Baseline	0.131	0.140	0.352
r = 0:3	0.108	0.152	0.477
Nonparametric	0.131	0.107	0.221
Min.T0 = 5	0.131	0.133	0.325
No Covariates	0.154	0.125	0.219
Medium-Capacity Countries			
Baseline	0.288	0.137	0.035
r = 0:3	0.288	0.131	0.028
Nonparametric	0.288	0.129	0.026
Min.T0 = 5*	0.288	0.128	0.024
No Covariates	0.313	0.136	0.021
High-Capacity Countries			
Baseline	0.288	0.137	0.035
r = 0:3	-0.013	0.160	0.935
Nonparametric	-0.013	0.146	0.929
Min.T0 = 5*	0.006	0.391	0.982
No Covariates	-0.007	0.162	0.966

Note: ATT = Average Treatment Effect on the Treated; SE = bootstrapped standard error. Each stratum shows the baseline GSC estimate and sensitivity checks: factor range (r), bootstrapping method, minimum pre-treatment years (Min.T0), and exclusion of covariates.

* Because some units had limited pre-treatment data, the factor range was shortened to 0–4 in these cases to allow the generalized synthetic control estimation to compute successfully.

E.2 Excluding EU Member and Candidate States

To address potential violations of the strict exogeneity assumption posed by coordinated institutional reforms and policy harmonization associated with European Union (EU) membership and accession processes, the generalized synthetic control estimation procedure on the medium-capacity stratum was re-run excluding EU member and candidate countries from the sample.

This exclusion serves as a conservative robustness check motivated by the potential endogeneity of treatment timing and assignment often linked to EU integration dynamics, which may correlate with outcomes of interest and thus threaten identification.

Findings

The average treatment effect on the treated (ATT) estimates for the restricted samples excluding EU countries are as follows:

- **33rd to 66th Percentile Capacity Group:** The ATT estimate is 0.2814 (standard error = 0.144), with a 95% confidence interval from -0.00095 to 0.5637, and a p-value of 0.0508. Although this effect is marginally statistically significant, the point estimate remains substantively similar to that of the 20th to 80th percentile group.

- **20th to 80th Percentile Capacity Group:** The ATT estimate is 0.3087 (standard error = 0.09387), with a 95% confidence interval from 0.1247 to 0.4926, and a p-value of 0.0010. This indicates a statistically significant and substantively meaningful positive effect.

Interpretation

The slightly higher uncertainty and marginal significance in the middle tercile group likely reflect increased sample heterogeneity or smaller effective sample size after excluding EU countries. The 20th to 80th percentile group likely comprises more comparable cases with stronger identification, as evidenced by the more precise and significant ATT.

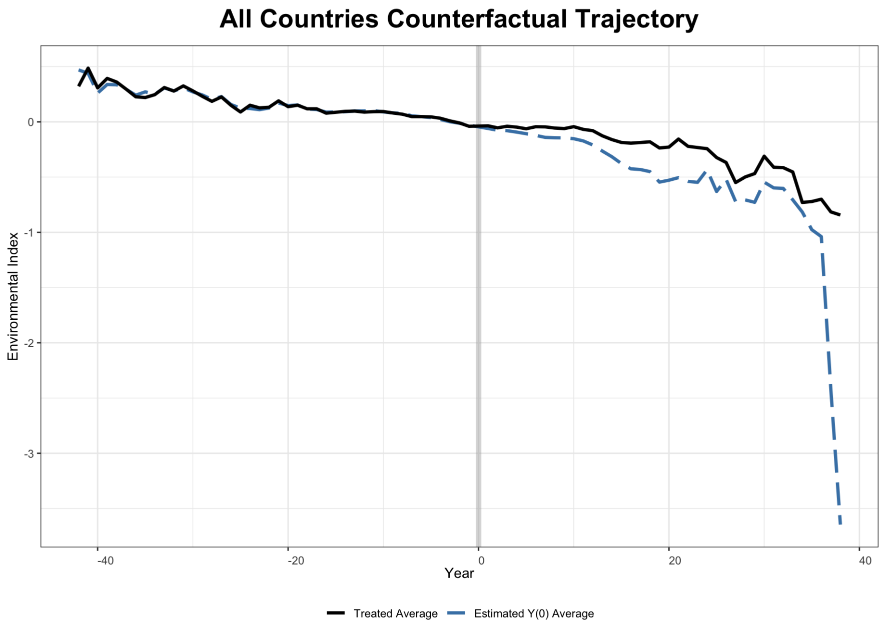
Overall, the substantive similarity of the ATT estimates across these restricted samples supports the robustness of the main findings. Excluding EU member and candidate countries mitigates exogeneity concerns inherent to these units' coordinated institutional trajectories, underpinning the credibility of causal interpretation in the remaining sample. Along with the sensitivity analyses, this robustness check underscores that the estimated treatment effects remain stable under plausible alternative sample compositions and identification assumptions.

E.3 Counterfactual vs Treatment Plots

As a robustness check, these figures primarily assess the quality of pre-treatment alignment between treated units and their synthetic controls. Across all panels, whether for all countries or capacity-specific subgroups, the close correspondence of counterfactual and treated trajectories prior to recognition demonstrates strong pre-treatment fit, reducing concerns about confounding bias and supporting the validity of the estimated treatment effects. This graphical evidence reinforces that post-treatment comparisons are anchored in comparable trends and that the synthetic control method is suitably implemented in this context.

Figure 5 displays the average environmental index trajectory for all countries following the recognition of constitutional environmental rights. The close alignment between the treated average and the synthetic counterfactual prior to the event suggests a good model fit, while divergence post-recognition provides a visual sense of estimated impact. However, estimates lack significance, and those that extend beyond far beyond post-recognition are extrapolated, indicating the need for cautious interpretation.

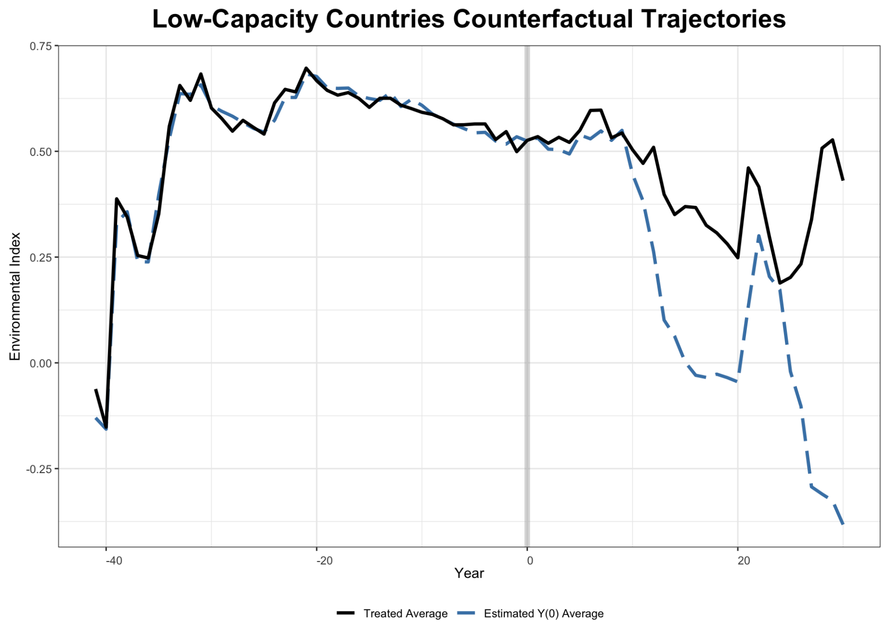
Figure 5: Generalized Synthetic Control All Countries Estimated Counterfactual Trajectory



Note: Estimates extending before and beyond 15 years after recognition are extrapolated and lack statistical significance, warranting cautious interpretation.

Figure 6 focuses on low-capacity countries, revealing a generally higher treated index relative to the synthetic control in the years following recognition. This pattern suggests potential positive though nonsignificant impacts in lower-capacity settings, but as with all groups, long-term extrapolated results should be interpreted with care.

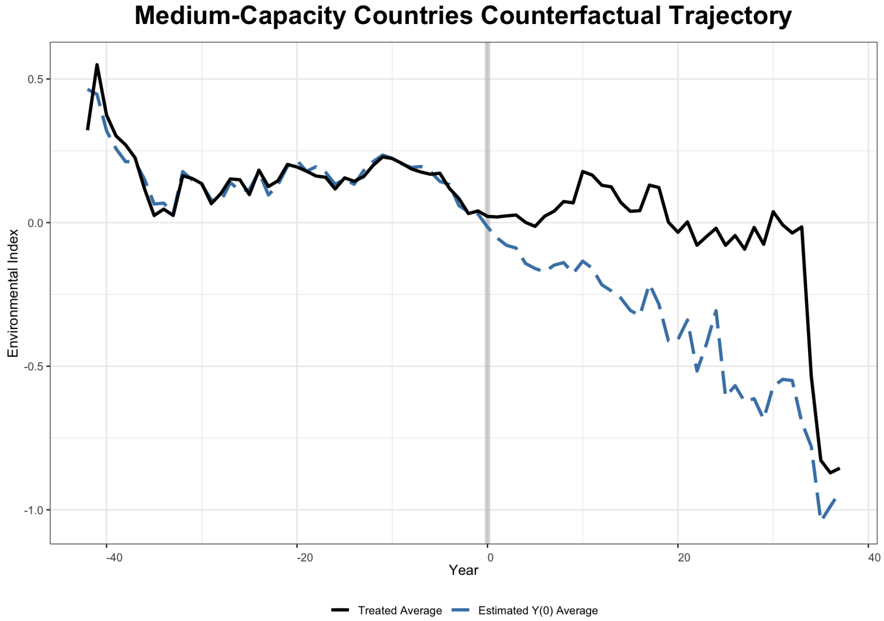
Figure 6: Generalized Synthetic Control Low-Capacity Countries Estimated Counterfactual Trajectory



Note: Estimates extending before and beyond 15 years after recognition are extrapolated and lack statistical significance, warranting cautious interpretation.

Figure 7 presents results for medium-capacity countries. Here, trajectories of the treated and counterfactual groups show moderate divergence in the post-recognition period, consistent with heterogeneity in estimated effects across capacity groups. Again, the statistical strength of observations wanes with extended years since recognition, as indicated in the figure note.

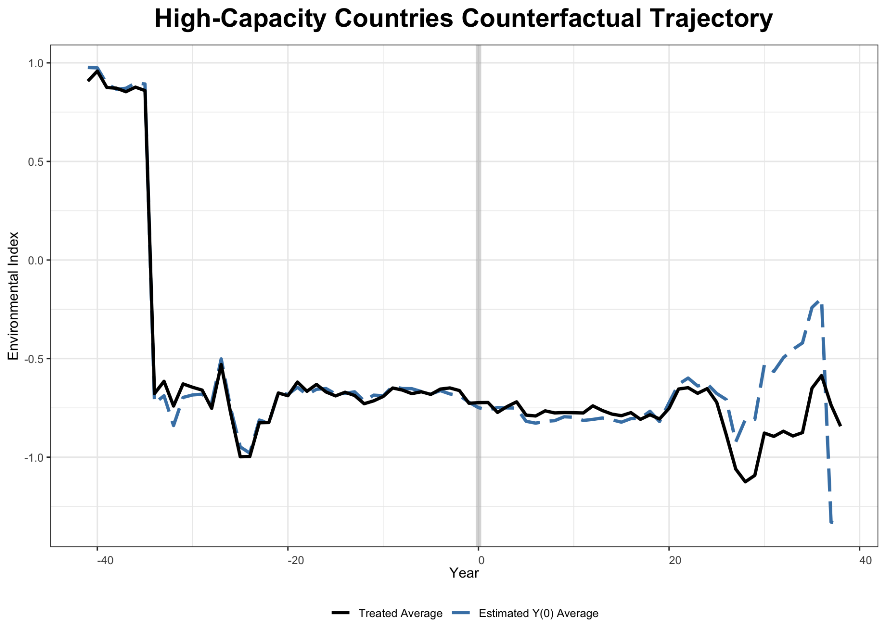
Figure 7: Generalized Synthetic Control Medium-Capacity Countries Estimated Counterfactual Trajectory



Note: Estimates extending before and beyond 15 years after recognition are extrapolated, warranting cautious interpretation.

Figure 8 displays trajectories for high-capacity countries, where post-recognition divergence between treated and synthetic averages is less pronounced compared to other groups. The results indicate that strong state capacity may mediate or mitigate the average effect of constitutional environmental rights recognition on observed environmental performance.

Figure 8: Generalized Synthetic Control High-Capacity Countries Estimated Counterfactual Trajectory

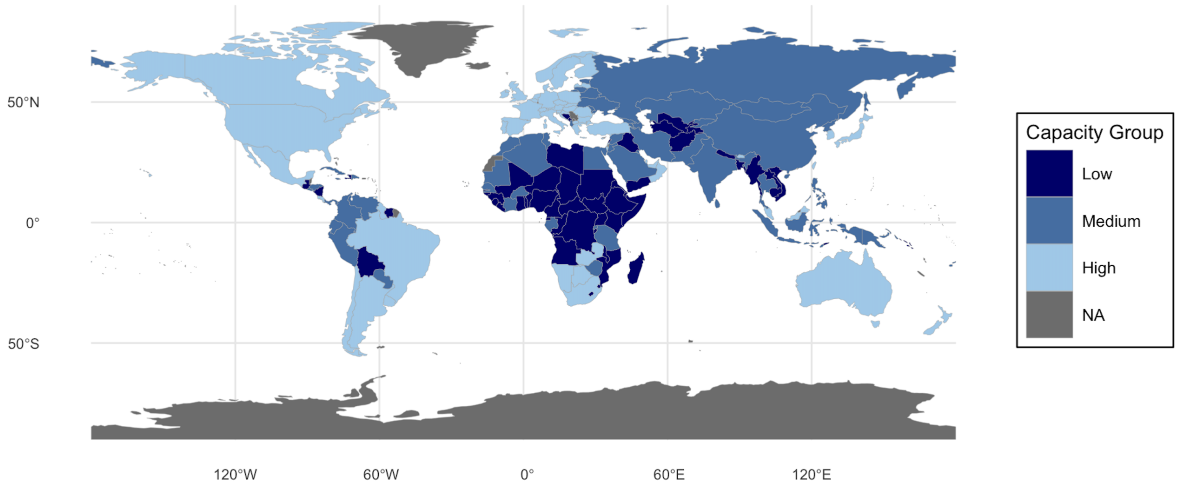


Note: Estimates extending before and beyond 15 years after recognition are extrapolated and lack statistical significance, warranting cautious interpretation.

F State Capacity Designations

Figure 9 visualizes the global distribution of countries according to their assigned state capacity group. Countries are divided into low, medium, and high capacity groups based on their mean level of state capacity over the period 1970-2015, revealing substantial heterogeneity in administrative strength across regions.

Figure 9: Global Distribution of State Capacity Groups



Note: Countries are stratified into capacity terciles based upon their mean state capacity across 1970-2015. Countries without assigned capacity groups due to non-existence at the time or missing standard codes are excluded from the analysis and are thus not represented in the visualization.

G Significant Treatment Effects by Capacity Group

The table below lists all countries for which the estimated treatment effect of constitutional environmental rights recognition on environmental performance was statistically significant at the 5% level, disaggregated by capacity group. This highlights the specific cases driving significant results within the heterogeneous effects analysis and provides further transparency by showing the distribution of significant effects across low, medium, and high capacity settings.

Table 7: Countries with Significant Treatment Effects by Capacity Group

Country	**Capacity Group**
Montenegro	Low
Congo - Brazzaville	Low
Kenya	Low
Ethiopia	Low
Comoros	Low
Sudan	Low
South Sudan	Low
Iraq	Low
Turkmenistan	Low
Timor-Leste	Low
Moldova	Medium
Russia	Medium
Ukraine	Medium
Belarus	Medium
Armenia	Medium
Georgia	Medium
Azerbaijan	Medium
Mauritania	Medium
Gabon	Medium
Rwanda	Medium
Zimbabwe	Medium
Kyrgyzstan	Medium
Mongolia	Medium
Fiji	Medium
France	High
Slovakia	High
North Macedonia	High
Croatia	High
Slovenia	High
Turkey	High

Note: All treatment effects are considered statistically significant at the 5% level ($p < 0.05$).