

Weathering Trade? The Impact of Climate Disasters on Environmental Provisions in
Preferential Trade Agreements.

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Abstract

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Abstract In Global Environmental Politics, States experience climate change to varying degrees, which defines their level of vulnerability. They also take action at different scales, with their level of capacity and responsibility often determining this outcome. Looking at their terms of trade, I ask the following questions; Is it possible that countries include more environmental provisions in Preferential Trade Agreements when they experience more climate disasters? Exactly what effect does extreme weather have on the environmental content of PTAs?

I investigate this inquiry using global data from 2000 to 2021, with disaster shocks for one and two years prior to signing, testing mechanisms using GDP, agricultural activity and carbon emissions.

The methodology gives way to a quantitative analysis featuring fixed effect OLS regressions, using an original dataset that combines selected environmental provisions in all Preferential Trade Agreements with the observed weather shocks of each signatory. I suggest three mechanisms, directing the dyadic format of the panel with the higher levels of GDP, Agriculture and CO2 of the pair as country A, and the lower as country B, making this dynamic interpretable in the final results.

The findings support a positive correlation, meaning that States impacted by weather shocks sign onto PTAs with more environmental provisions, particularly the ones with lower GDP, more agricultural and less carbon-intensive economies. Outcomes of the comparative multivariate regression models show statistically significant positive correlations between disaster frequency and the number of environmental provisions, reaching as high as +0.315 points.

Keywords *Preferential Trade Agreements, Environmental Provisions, Extreme Weather, Climate-induced Disasters.*

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1. INTRODUCTION

As the climate crisis unfolds, vulnerability has become a defining feature of international politics. The global threat of a changing climate poses highly variable impacts across states, who already present different levels of capacity and responsibility. Climate governance, as a framework for the collective management of that vulnerability, reflects and reproduces these asymmetries. How exactly is exposure to risk a catalyst of global cooperation and can state-level vulnerability be a driver of international climate action? Understanding how vulnerability translates into concrete governance choices motivates the following inquiry. To explore these questions empirically, I focus on a place where they intersect: climate disaster exposure and environmental commitments embedded in international trade agreements.

Policy responses to climate risk vary on a state level due to a variety of factors, from financial interests to political context. Yet, changes in our environment disrupt our socio-economic systems and generate substantial financial losses. States have mitigated much of this economic fallout through trade cooperation. Since the 1990s, they have increasingly embedded environmental provisions within trade agreements. If states are willing to include climate commitments in the terms of their trade, those commitments may be motivated by their exposure risk - weather shocks in this case. Understanding the nature and extent of this relationship will contribute to broader debates within the literature on extreme weather and political economy. Therefore, the central research question is: What effect does extreme weather have on the environmental content of Preferential Trade Agreements (PTAs)?

Two key concepts guide the analysis. The first, extreme weather, refers to locally occurring natural disasters from extreme rain, drought, heat waves, or similar meteorological phenomena that endanger human and natural life (IMF 2021). The frequency and intensity of these events are increasing due to anthropogenic climate change (IPCC, 2021). In this paper, I

will use climate shocks to refer to the abnormal national incidence of these events beyond national baseline levels and global trends. This isolates particularly unusual year-on-year variation in extreme weather.

The second concept, environmental provisions in trade agreements, encompasses a wide range of environment-related regulations. They exist within the terms that countries set through the signing of PTAs, including multilateral and bilateral agreements, to protect their respective interests and facilitate trade. Those terms are referred to as provisions, which are clauses within the texts that specify how products or services will be regulated, whether it involves measurable things like tariffs, or ‘non-trade’ issues such as labour standards. Amongst those provisions, some are categorized as ‘environmental’ by virtue of establishing norms, rules and protocols on resource management and climate-related issues, in areas like forest conservation, air pollution or early notification systems, without always being explicitly motivated by mitigation or adaptation efforts (Morin, Dür, & Lechner 2018). For example, in the COMESA Agreement, parties agree to “(e) take measures to control trans-boundary, air and water pollution arising from mining, fishing and agricultural activities.” (art. 124) (TREND Codebook p. 41). This illustrates what environmental provisions look like and how they can target resource management that affect industrial activities. In the research design, I select 41 variables that make up the environmental score index inclusive of ‘core’ environmental provisions on disasters and climate change, as well as natural resources management and cooperation or enforcement provisions.

The literature that examines the quantifiable effects of climate change on trade flows volumes and financial losses is prolific (Colgan, Green, and Hale 2021; Amodio et al. 2025; Conevska 2021; Dallmann 2019; Osberghaus 2019). Manufacturing and agricultural exports in particular are negatively affected by disaster severity and frequency (Osberghaus 2019; Dallmann 2019). More and more attention is devoted to the influence of climate change on

trade policy, with issue linkage in trade agreements being a growing topic area of research (Lechner and Spilker 2021; Morin, Dür, and Lechner 2018; Morin and Jinnah 2018). Fewer studies establish the direct impacts of vulnerability and exposure on different levels of government, through governance outcomes, policy support or voting behavior (Rowan 2023; Hazlett and Mildemberger 2020; Hai and Perlman 2022; Garside and Zhai 2022). Research on local, regional and national effects of extreme weather have documented numerous socio-economic and political impacts that stem from individuals experiencing a changing climate, potentially affecting larger institutions. For example, staff members of international organizations may make decisions influenced by their exposure to weather shocks, leading to different policy outcomes (Clark and Zucker 2023). Overall, a strong relationship between weather shocks and economic loss is widely established (Coveska 2021; Amodio et al. 2025), whereas links between disasters and behavioral or policy responses - such as voting, party support, or institutional change - tend to be weaker or less consistent (Rowan 2023; Hazlett and Mildemberger 2020; Hai and Perlman 2022; Clark and Zucker 2023). This tension reveals a crucial gap: although we know that disasters have economic consequences which individuals connect to climate change, it remains unclear whether such connections consistently translate into policy changes at the state level. This project directly addresses that puzzle by investigating whether climate-related disasters shape the environmental commitments embedded in Preferential Trade Agreements (PTAs), enlarging the level of analysis and bringing in economic impacts to test a potential effect at a global scale.

The existing contributions map out the areas where climate policy (governance) and weather shocks (vulnerability) interact, but a smaller part of this interaction where trade overlaps is largely understudied. The literature that aims to determine if extreme weather has any effect on the trade rules that states commit to is somewhat limited, leaving opportunities to test the effects of extreme weather at an international scale. I select trade agreements as a

foreign policy tool, informed by the fact that they are a reflection of cooperation on essential economic rules, but also prone to influence from various interest groups. Alternative frameworks in climate diplomacy include UNFCCC conference commitments such as NDCs, but leave out trade and collaborative dimensions for the most part (Clémentçon 2023). This makes PTAs a uniquely reflective environment where both risk exposure and economic interests intersect, but also an avenue for ‘regime shifting’ (Laurens and Morin 2019, p. 4). I test three mechanisms to observe whether dynamics in PTA dyads based on GDP, agriculture levels and carbon intensity make any difference in how states respond. In particular, agriculture is a climate-vulnerable industry that experiences considerable losses from weather variations and with well-documented influence on trade policy, which makes it a factor where I expect to see significant differences. This informs my argument that economic interests towards climate risk and policy may moderate the effect.

Based on existing work, I expect that the relationship between weather shocks and the environmental content of PTAs will be positive. This is reflected in H1: *Countries experiencing more extreme weather shocks will be more likely to include environmental provisions in their preferential trade agreements than countries not experiencing these shocks, all else being equal.* I further develop those expectations based on three mechanisms (GDP, Agriculture, CO2): in H2, I hypothesise that richer, more agricultural and less polluting countries will be more likely to include environmental provisions in their preferential trade agreements than poorer, less agricultural and more polluting countries experiencing these shocks, all else being equal.

I conduct a quantitative analysis with fixed-effect OLS regressions. As measure for the dependent variable, I select environmental provisions types and aggregate the raw count into an index score. The independent variable measures extreme weather shocks as the annual incidence of disaster relative to national period average as a percentage, which are lagged by

one and two years. I construct a global panel from 2000–2021, merging disaster data from EMDAT (IMF 2021) and PTA data from TREND (Morin, Dür and Lechner 2022), structured on a directed dyadic basis which documents variation across PTAs partners and reflects the relational nature of these agreements. This dyadic format is of major consideration in the interpretation because the outcomes are attached to a pair of countries rather than one, which makes the effects aggregated at this level. The PTA-related data reads on a dyadic level while country-level terms, like GDP and democracy scores, read individually for each state (Country A and Country B). Additional datasets on GDP, agriculture, carbon intensity and democracy index are sourced from the World Bank (2025; Global Carbon Budget 2024).

Overall, the relationship between weather shocks and environmental provision scores is positive in the most statistically significant results. The results also corroborate differences across mechanisms, as directionality in the dyads based on levels GDP, agriculture and carbon intensity considerably alter the dynamics of the pairs. In the models with covariates in the two year lag, disaster shocks are associated with environmental provisions at different degrees amongst the poorest, most agricultural, and least polluting countries in the dyad with statistical significance corresponding to $p < 0.001$. Overall, states with more to lose from climate change, the poorer ones, those that depend more on agriculture and are less carbon intensive are more likely to add environmental regulations to their trade agreements after experiencing weather shocks.

The project contributes to broader theoretical and policy frameworks: it speaks to debates on whether governments and international institutions respond to shocks, whether economic losses can drive collective climate action, and if global crises translate into enforceable trade rules. The results indicate that climate commitments and environmental regulations in PTAs can be driven by vulnerability. This suggests that similarly to some domestic policy responses, States may be translating disasters and economic consequences

into interest in establishing mitigation and adaptation in their terms of trade. Within PTAs, we see a larger number of environmental provisions and stronger commitments when they already include binding language and explicitly exclude protectionist motives. In other words, economic security is permeable to the effects of climate change and pushes States to take action. Because PTAs are one of the few potentially enforceable international agreements where states willingly commit to environmental norms, even marginal changes in their provisions carry important implications for climate governance. This means states are able to generate small positive change within the existing trade governance frameworks as they experience the effects of increased disaster frequency.

2. LITERATURE

2.1 EXTREME WEATHER

Climate disaster frequency follows a steady upward trend over time, while the number of people affected displays greater volatility. Although the two indicators align in certain periods (e.g., 2006–2014 and 2017–2021), they do not systematically move together, suggesting that impact severity does not directly follow disaster frequency. Importantly, both measures are simple counts and do not capture shocks, which require deviation from baseline conditions. A closer view shows that yearly global disaster counts vary within a relatively narrow range, indicating that while there is short-term variation, disaster frequency follows a stable upward trajectory. This pattern is important for the empirical strategy, as fixed effects account for this common time trend, effectively centering the data around deviations from it.

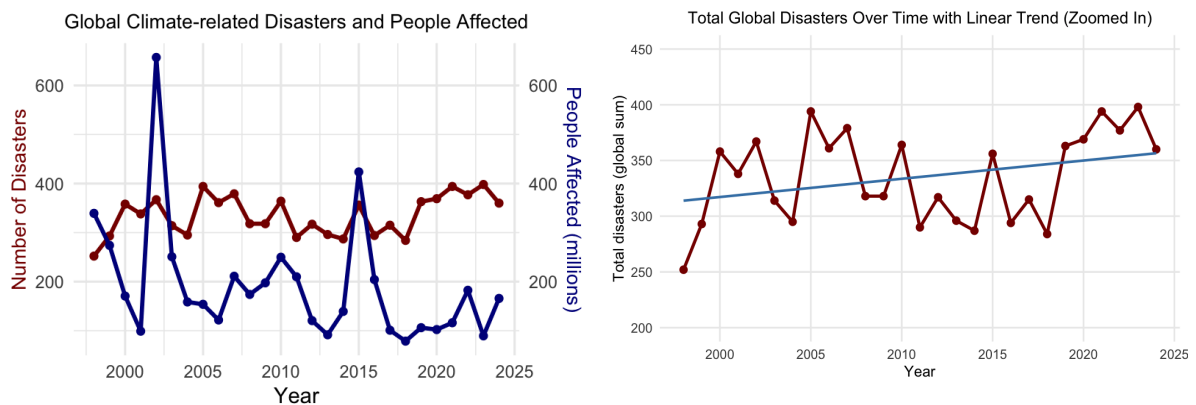


Figure 1. Climate-related Disasters and People Affected Over Time.

With increased disasters, an increasingly large empirical literature examines whether exposure to extreme weather translates into climate action. Across cases including the UK, the US, Germany, and China, findings range from null to moderate and vary across disaster types, political contexts, and levels of governance (Rowan 2023; Ettinger et al. 2023; Hai and Perlman 2022; Arias and Blair 2024; Hazlett and Mildemberger 2020; Garside and Zhai 2022; Cao and Su 2025). Disaster characteristics are central to this variation, as different hazards produce distinct effects and are often studied in context-specific ways, such as wildfires in

California or floods in Germany (Hazlett and Mildenerger 2020; Garside and Zhai 2022). Three factors inform these findings: limited responsiveness, political mediation, and localized effects.

First, the literature consistently finds limited and short-lived responsiveness to weather shocks. Despite expectations that disaster frequency would increase climate policy traction, existing work identifies weak effects and a persistent “gap in policy responsiveness” with “no systematic evidence that climate impacts enable climate mitigation policy” (Rowan 2023, p. 703). Even highly visible disasters tend to produce minimal behavioural change (Rowan 2023, p. 684). Media dynamics may further constrain these effects: hurricanes received more coverage than wildfires in the US between 2016 and 2021 but were less frequently linked to climate change, while coverage became increasingly politicized and normalized over time (Molder and Calice 2023, pp. 375, 380). Although extreme weather can function as a “teachable moment,” evidence that communication strategies significantly amplify climate action remains limited (Ettinger et al. 2023, p. 828).

Second, effects are mediated through extreme event attribution, which varies systematically by ideology, shaping whether individuals connect disasters to climate change and support policy responses (Ettinger et al. 2023; Hai and Perlman 2022; Reny, Reeves and Christenson 2026). In the US, attributing disasters to climate change has “been shown to evoke negative reactions from politically conservative audiences” (Ettinger et al. 2023, p. 830; Rüttenauer 2024), and Republican respondents are less supportive of co-partisan representatives who make such attributions (Hai and Perlman 2022, p. 3). However, attribution effects can emerge under certain conditions: in the UK, exposure to floods and heatwaves increases attribution to climate change, including among right-leaning individuals (Rüttenauer 2024, p. 1046).

Third, effects are localized and contingent on intensity. In California, support for climate ballot measures increases by 5–6 percentage points within 5 km of wildfires, declining to zero beyond 15 km, with strong partisan asymmetry (Hazlett and Mildenerger 2020, p. 1359). In Germany, floods generate “small localised increases in vote shares for Green parties (0.4 - 1.6 percentage points)”, with stronger effects in less affected areas, suggesting persuasion rather than mobilisation (Garside and Zhai 2022, p. 6). Stronger and more persistent effects appear only under high-intensity shocks: exposure to Hurricane Ian increased support for climate action for up to six months, likely due to severity and increased attribution, with persistence partly explained by recency bias and disaster relief (Arias and Blair 2024, pp. 1593-1601). By contrast, no association is found between extreme weather and climate concern at different regional levels in the case of China (Cao and Su 2025, pp. 1, 9). Beyond individual behaviour at these levels of government, some evidence points to institutional pathways, where exposure among policymakers shapes outcomes, as in the case of IMF bureaucrats influencing climate policy (Clark and Zucker 2023, p. 1300). Overall, extreme weather effects are best understood as context-dependent, politically filtered, and rarely durable, with outcomes ranging from null to moderate.

2.2 ENVIRONMENTAL PROVISIONS IN PTAs

Substantive contributions have emerged to explain why and how states pursue climate commitments and trade interests through policy, and whether environmental provisions are used as a mechanism to do so. While PTAs aim to increase trade flows (Rodrik 2018; Conevska 2021, p. 1), they also include environmental rules that can directly affect trade or operate as broader regulatory commitments (Lechner 2016, p. 842).

The evolution of environmental provisions in preferential trade agreements is an important trend to observe, with the yearly average number of provisions showing a clear upward trajectory from 2000 to 2021, with greater variation emerging after 2010. This

sustained increase is accounted for in the empirical strategy through fixed effects, which control for the underlying time trend.

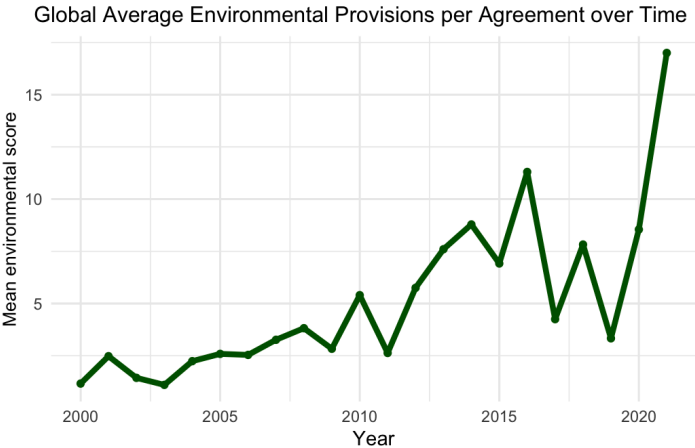


Figure 2. Environmental Provisions Over Time.

Two main factors explain their expansion: strategic protection and norm diffusion. Early scholarship interprets environmental provisions as protectionist tools compensating for domestic regulatory costs, while later work emphasizes the diffusion of environmental norms across agreements (Lechner 2016; Lechner and Spilker 2021, p. 1059). At the same time, scholars question whether such provisions are substantive or merely “window dressing covering protectionist interests” (Morin, Dür and Lechner 2018, p. 128).

Empirically, differences across development levels are more limited than often assumed. While developed countries historically promoted environmental provisions, variation in content across North–North, North–South, and South–South agreements remains relatively small and stable (Lechner and Spilker 2021, p. 1059). This reflects the fact that PTAs are costly and strategic instruments, where “negotiating PTAs is a rare and costly endeavor” and provisions reflect deliberate cost–benefit calculations, even as bargaining asymmetries and pre-existing domestic policies shape outcomes (Lechner and Spilker 2021, pp. 1058-1060). Negotiation periods can reach an average length of 2.5 years, with great degrees of variability ranging from days, months to years (Lechner and Wüthrich 2018).

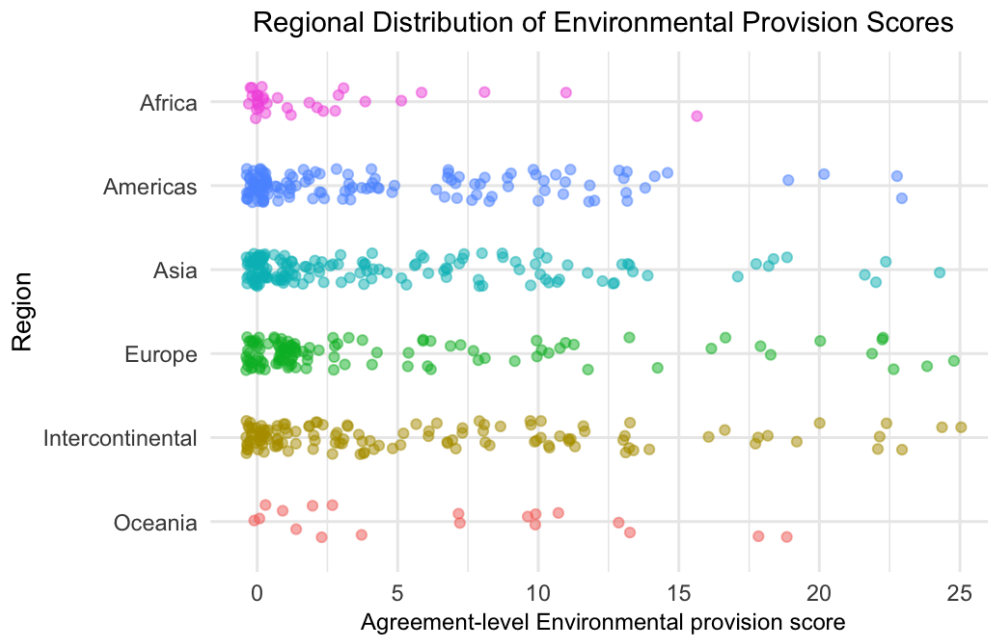


Figure 3. Regional Distribution of Environmental Provision Scores.

Regional variation in the sample further contextualizes these observations. Africa and Oceania have relatively fewer intra-regional agreements, explained by structural geography and differences in regional integration. While most regions show clustering at low environmental scores (0–2), intercontinental agreements are more evenly distributed, suggesting modest variation but a consistently low level of environmental provisions across contexts.

Effectiveness of PTAs with environmental provisions depends primarily on legal design and enforcement. Binding language and institutional support are critical for implementation (Morin and Jinnah 2018, pp. 11-12). EU agreements tend to include more but weaker provisions, while US agreements include fewer but stricter commitments (Lechner 2016, p. 848). Nonetheless, issue linkage through trade incentives can strengthen climate commitments and improve compliance (Morin and Jinnah 2018), and PTAs can incorporate mitigation and adaptation targets effectively (Leal-Arcas 2013, p. 34). Structural factors such as democracy, import competition, and pre-existing environmental regulation increase the likelihood of including environmental provisions (Morin, Dür and Lechner 2018, pp.

124-133). Overall, environmental provisions are negotiation instruments shaped by strategic interests, regulatory norms, and enforcement design, rather than purely climate-driven commitments.

2.3 CLIMATE RISK AND TRADE POLICY

The relationship between climate and trade policy operates through risk distribution, interdependence, and adaptive policy responses. A central framework distinguishes between climate-vulnerable and climate-forcing assets, which face opposing incentives regarding climate policy (Colgan, Green and Hale 2021, p. 587). Vulnerable actors benefit from mitigation, while carbon-intensive actors resist it, generating distributional conflict. Both ultimately face unavoidable costs through losses, insurance burdens, or stranded assets (Conevska 2021, p. 4), with effects across time and space reflecting broader ethical tensions described as a “perfect moral storm” (Gardiner 2006, p. 398).

In an interdependent global economy, climate risks generate cross-border spillovers. Disruptions in major markets, such as China’s energy and financial systems, can affect global stability, with risk varying across sectors and over time and amplified by both extreme weather and policy uncertainty (Dong et al. 2024, p. 1). Disaster frequency also affects participation in global value chains and increases the importance of risk-reduction mechanisms within PTAs (Permani and Xu 2022).

Trade policy serves as a key instrument for managing these risks. Carbon pricing reduces the competitive advantage of polluting production (Rabe 2018), while carbon clubs coordinate costs across jurisdictions (Nordhaus 2015). The EU’s Carbon Border Adjustment Mechanism extends these dynamics to imports of carbon-intensive goods (Smith, Overland and Szulecki 2024).

Sectoral exposure further shapes responses. Climate impacts are nonlinear across industries such as agriculture and energy (Dell, Jones and Olken 2014, p. 790), creating

uneven political pressures. In agriculture, weather shocks to domestic production are strongly associated with tariff reductions in PTAs, with rates falling by around 40% when shocks occur during negotiations (Amodio et al. 2025, pp. 698, 700). With regards to energy, increases in demand can generate positive feedback loops as production generates greenhouse gas emissions, while consumption patterns, appliances and infrastructure change to adapt to the effects of climate change (Dell, Jones and Olken 2014, p. 764).

Although direct evidence remains limited, trade agreements can mitigate the impacts of climate-related disruptions. Deep PTAs can reduce trade costs when disasters threaten export capacity, facilitating recovery and stabilizing trade flows, in contrast with shallow trade cooperation which limit the range of products traded (Conevska 2021, pp. 1-2). PTAs can reduce risk exposure and prevent unpredictable losses through specific terms and policies that states negotiate in their best interests. Overall, climate influences trade policy through distributional conflicts, spillovers across interdependent markets, and policy adaptation, with PTAs functioning as tools to manage climate-related uncertainty.

3. ARGUMENT

With the documented effects of extreme weather, the nature of environmental provisions in PTAs and the reality of climate risks and trade policy in mind, I suggest three mechanisms that map out an argument as to why states may interpret disaster shocks to produce different outcomes. The following mechanisms rely on the assumption that interest groups and the public have at least some degree of influence over PTA negotiation and exist as policy advocates in the broader institutional design. Luckily, this position is well developed in the existing literature.

First, some scholars argue that those advocates can be desirable: institutions may be open to lobbying because ‘[insulating] policy makers from private groups’ can weaken compliance and ultimately determine the success of an agreement (Betz 2019, p, 1251). Empirical evidence from the DESTA database shows that governments do respond to the politicization of trade negotiations in the public debate, which limits liberalization, and conversely that liberalization increases when private sector mobilization is diverse (i.e. when more than just the major interest groups are active) (Antoine, Atikcan and Chalmers 2023). Interest groups routinely attempt to sway public opinion as well and represent a mutually reinforcing relationship between public perception and private interests (Dür 2019). In Europe and the US, survey experiment data on attitudes on the Transatlantic Trade and Investment Partnership and the Paris agreement show that interest groups affect individual sentiment by the arguments they convey rather than their source cues (Dür 2019, p. 515). Complex interplays of ideas and vested interests (worldview and identity politics) can explain why individuals react in certain ways (Mukand and Rodrik 2018). On another dimension, the drivers of interests, public support and groups’ organization may vary greatly across time and space, making variation observable (Dür 2019). The idea that public and private interests can shape PTA outcomes remains a globally established mechanism. The case of agricultural

lobbying is most notable (Amodio et. al 2022). This confirms that both public perception and private interests do affect PTA negotiations, and that the relationship between industry, interest groups and public opinion is in fact intertwined.

The potential explanation I test to explain how disasters may drive environmental provisions at different degrees is that national industrial interests and economic conditions translate those effects into these trade policy outcomes. From the climate-to-trade nexus, I suggest three disaster-to-PTA mechanisms that are directed by GDP, agriculture and carbon intensity dynamics in the dyad.

First, I look at wealth and resources balance across dyads to observe any variation in PTA outcomes. GDP indicates which country of the dyad has the most economic resources. It creates a clear dynamic of a wealthier state singing with a less wealthy partner. This means one partner is richer than the other, which may bring to light some differences in how gross domestic product directs countries across pairs to sign onto environmental provisions when they experience disaster shocks.

I categorize the agricultural industry as a climate-vulnerable interest that may increase salience for trade negotiations, because they experience sudden and immediate costs from changing climate. The idea that economies with industries that are more vulnerable to climate change will adopt more environmental provisions when they experience weather shocks is based on the fact that those interests are directly reliant on natural resources affected by disaster - which in turn influence trade negotiations when frequency is higher. Agricultural industries are a particularly active lobbying group across global trade negotiations, which reinforces the effect (Permani and Xu 2022, p. 3021).

The opposing force, climate forcing interests, would include groups that benefit from fossil fuel extraction and fewer environmental regulations, like oil and gas lobbies and conventional auto-manufacturers. To some extent, the carbon cost of a dollar of GDP works

as an indicator of the share of fossil-fuel based activity in the national economy to assess the reliance of the domestic market on climate-forcing sectors. It can serve as a robustness test against climate-vulnerable agriculture.

4. HYPOTHESES

Informed by the literature and empirical evidence, I expect that an increase in the frequency of climate-related disasters will increase the number of environmental provisions in PTAs overall. I present the following hypothesis:

- *H1: Countries experiencing more extreme weather shocks will be more likely to include environmental provisions in their preferential trade agreements than countries not experiencing these shocks, all else being equal.*

A very strong relationship seems unlikely, given how ambiguously such effects have been established in the extreme weather literature. At the same time, certain studies did find null effects of disasters on policy responses in both domestic contexts (Cao and Su 2025) and globally (Nohrstedt et al. 2021), so this outcome is a reasonable possibility given the variability of the existing empirical work and the lack of testing at a global scale.

With regards to the mechanisms framing the argument, I expect the poorest, most carbon-intensive and least agricultural partners to exhibit weaker associations between their disaster shocks and PTA outcomes. In other words, higher GDP, larger share of agricultural industry and less carbon-intensive economies might present a positive association, superior to those of their counterparts. Amongst those three mechanisms, I would expect agriculture to be a strong predictor of the effect size due to both the vulnerable nature of the industry but also the active representation of interests in trade negotiations.

- *H2.A: Richer countries experiencing more extreme weather shocks will be more likely to include environmental provisions in their preferential trade agreements than poorer countries experiencing these shocks, all else being equal.*
- *H2.B: Countries with greater reliance on agriculture experiencing more extreme weather shocks will be more likely to include environmental*

provisions in their preferential trade agreements than less agricultural countries experiencing these shocks, all else being equal.

- *H2.C: Countries with less reliance on carbon-intensive activities experiencing more extreme weather shocks will be more likely to include environmental provisions in their preferential trade agreements than more polluting countries experiencing these shocks, all else being equal.*

H1 speaks to a general effect, while H2.A,B,C are specific to variations across mechanism dynamics.

5. DATA

The data needed to identify the effect of extreme weather on the environmental content of trade policy requires a sample of countries large enough to include variations in how they experience weather shocks and sign trade agreements with environmental content over time. The post-1990/2000s period has a rising incidence of extreme weather events globally, as anthropogenic climate change has become more prevalent. At the same time, with the end of the Cold War and deadlock in the WTO, countries have concluded a large number of bilateral, multilateral, and regional PTAs. While both extreme weather and the number of PTAs have risen over time, as we saw above, their spatial and temporal distributions have been uneven, providing variation as leverage for the quantitative analysis. One drawback previously mentioned is the fact that disaster frequency could occur at any point in the year they are coded. This makes the temporal effect potentially displaced. Specific dates would be ideal to observe a precise effect in relation to the date of signing. Another dimension that would add value to this analysis are details on the negotiation process and documentation on which states were pushing for environmental policy, but is hardly accessible (Rodrik 2018).

There is publicly available data on global disaster frequency and the content of PTAs over the past twenty-five years, which was combined into a country-year panel format. There are some challenges with this real-world data. One main consideration is that Trade Agreements are inherently relational. This means specific provisions cannot be attributed to a single member and both partner's data will be on the same row. Clearly, looking at outcomes on a dyadic level means the shocks could occur in either country A and B. Either country could experience shocks in the years prior to signing, but the format will make it impossible to discern which of them was impacted and to what extent. This problem is magnified in multilateral PTAs with many dyads (some having as much as 325). However, this also presents the opportunity to observe whether dyads with severe weather shocks commit to

different norms than other dyads within the same multilateral agreement. This is an asset of this data format as it permits the observation of variations across signatories of the same agreement (in the case that there are enough dyads to observe variation). A dyadic level is appropriate but associates the data to the pair without appropriating it to the individual partners because it aggregates environmental provisions while shocks remain individual. On the other hand, an agreement unit would aggregate all the PTA-level variation into one and have the variation of shocks read across all signatories rather than pairs. In other words, a dyadic level allows for more detailed variation within the agreement in the event that not all provisions are reciprocal. In addition to this, the dyadic level provides opportunity for testing ordered dynamics and gives meaning to each country in the pair. This is what I suggest in the mechanism section, outlining three dynamics based on GDP, Agriculture, and CO2.

The EM-DAT dataset is widely used in existing works on the effects of extreme weather (Rowan 2023, p. 692; Conevska 2021, p. 3; Osberghaus 2019). However, it is also subject to limitations, including missing data and possible human errors at collection and time of input (Jones, Kharb, and Tubeuf 2023). One important characteristic of this database is also that it records emergency events of a certain scale and dismisses the ones that do not meet this threshold. Specifically, disasters need to meet the following criteria: “Killed ten or more people, Affected a hundred or more people, Led to declaration of a state of emergency, or Led to call for international assistance” (IMF 2021). A clear implication is that the sample is reduced to the disasters that meet this threshold and excludes those that do not. The international dimension and disaster severity with national significance are standards that are relevant for this project, but it is somewhat arbitrary and undercounts disasters across countries. An important consideration is that countries may declare a state of emergency or call for assistance in different situations based on their capability and preparedness levels. This relates to the idea that an additional flood in Bangladesh has different implications than

in Canada. This measurement bias makes the data imperfect, but it is consistent and predictable.

6. RESEARCH DESIGN

6.1 OUTCOME VARIABLE

The outcome variable consists of environmental provisions included in PTAs, which is operationalized as an index variable that sums the number of selected provisions signed by each dyad. The environmental provision score is a simple addition of 41 binary (0/1) variables relating natural resources management, cooperation and enforcement, and environmental disasters and climate change at its core. The table listing each provision variable pertaining to the environmental score index is located in the appendix. Generally, provisions that have to do with existing agreements, general principles, institutional design beyond facilitating cooperation and implementation, or ultra-specific topics that have little to do with areas affected by climate disasters and trade are excluded (ex: CBDR, polluter pays, sovereignty, jurisdictions, dispute settlement). These clauses are inherent or essential to the operational nature of the agreement or the framework under which it falls, rather than establishing specific climate-motivated commitments.

6.2 INDEPENDENT VARIABLE

The independent variable in this case consists of climate disasters, but particularly times when states experience abnormal frequency. This is operationalized as disaster shocks as a percentage point difference. The reason for opting for shocks rather than counts is that the raw frequency alone tells us little about what a single disaster means for a particular country, since it exists without a proper context. For example, a single disaster increase is more impactful for a state that is used to experiencing three a year than another that experiences twenty. A simple count will not reflect the impact that each disaster had on the signatories relative to their baseline, which is why operationalizing the variable as shocks is essential.

Some considerations here are that disaster frequencies follow trends over time, but can also be determined by geography (biomes, plate tectonics, distance to the equator...) and a greater total land mass might also increase their likelihood of experiencing higher frequencies. A small country in a particularly climate-vulnerable region can present a significantly higher disaster count than a very large country in a least vulnerable climate, or the opposite.

In particular, the operationalization of weather shocks requires further attention. Climate disasters as raw counts give little indication of what a yearly value means relative to the time period, which is why extreme weather is operationalized as shocks. Disaster shocks are measured as the percentage deviation from a country's time period (2000–2021) average.

This looks like: $DisasterShock_{i,t} = \frac{Disasters_{i,t} - Disasters_{i,t=[2000;2021]}}{Disasters_{i,t=[2000;2021]}}$. Effectively, this 'normalizes' the data and anchors the shocks as proportions relative to a substantive baseline of a country's historical disasters. Therefore, a one-unit increase in the regression coefficient corresponds to a +100% deviation from the historical average.

There are one-year and two-year lags for this weather shock variable, meaning it uses disaster frequency one and two years prior to the year of signing of a PTA. This is because while the exact date of signing of PTAs exists in the data, disasters are coded in a single year regardless of the exact date of occurrence. We might inadvertently analyse the relationship between a PTA signed in January and a disaster occurring in September with the data as it is. To address this challenge, the one and two year lags allow us to look at recent events without clashes between disaster frequency and PTA-signing dates, while still having options to compare the effect across time. Ideally, relating the exact date of the disaster occurrence of the previous six to 18 months prior to the date of signing would ensure consistency across time. This would require access to specific disaster frequency recordings and additional time and skill that would make this a sound opinion for future research. Additionally, signing PTAs

is a lengthy process as well, which adds to this co-occurrence effect. It is unknown when a particular provision was added into the agreement or which negotiator suggested it, so the data aggregates the outcomes without knowing at what point in time and from which party the content originates. This also allows for examining the durability of the effects over different time periods.

6.3 DYADIC UNIT

The dyadic basis of this dataset and variables is explained by the fact that partners can agree to different terms amongst signatories of a PTA. While some provisions apply to all parties explicitly, there can be variations across memberships when there are more than two partners. It would not be precise to aggregate PTA data at an agreement level and apply that data to all signatories, because variations in multilateral PTAs would be overlooked. While this may have caused issues by shaping the panel with pairs which distributes the effect across two countries with no directionality, it has been exploited to instead give meaning to the dynamic between Country A and Country B. To do so, I have presented three different mechanisms that effectively re-order the data according to who in the dyad has the highest GDP, largest agricultural sector, or most polluting economy.

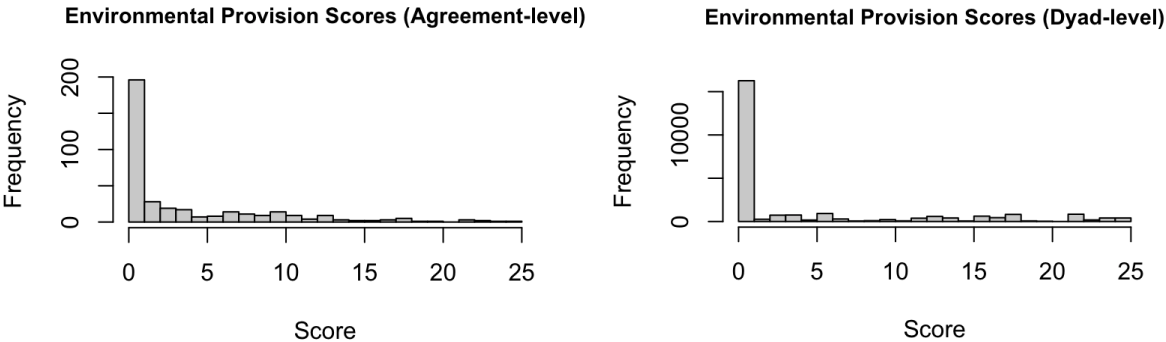


Figure 4. Environmental Provisions Scores at the Agreement and Dyad level.

To assess the impact of the unit of analysis, PTA-level data are compared at both the agreement and dyadic levels. Clustering by agreement aggregates all entries to a single row, whereas the dyadic specification preserves relationality, giving greater weight to larger

multilateral agreements. Both distributions show strong clustering at zero, and while dyadic observations are more numerous, the overall shape remains similar across units. The dyadic unit of analysis offers more detailed variation and displays limited differences in distribution relative to an Agreement-unit.

6.4 ADDITIONAL VARIABLES

An additional variable that has been integrated into the quantitative analysis is the people affected by disaster frequency. This has been coded as a shock from the country-period baseline with one and two-year lags similarly to disaster variation. It is also operationalized as a deviation from a country's time period (2000–2021) average, which

looks like: $PeopleShock_{i,t} = \frac{PeopleAffected_{i,t} - PeopleAffected_{i,t=[2000;2021]}}{PeopleAffected_{i,t=[2000;2021]}}$. This tests whether the consequences of disaster variations may reinforce the effect of a particularly disastrous year, based on how people were affected and not only based on the occurrence of a weather shock.

Additionally, GDP, agriculture and carbon intensity were chosen as mechanisms indicators. GDP accounts for the wealth generated by a state's economy, measured as gross domestic product per capita, and although imperfect, this indicator is valuable in understanding the level of development of a signatory (World Bank 2025). Agriculture as a percentage of GDP includes forestry and fishing activities to effectively measure the share of economic activity dependent on these particular resources (World Bank 2024). On the other hand, carbon intensity is measured as CO₂ emissions (kg) per dollar of GDP, indicating the dependency of a country on carbon intensive industries (Global Carbon Budget 2024). In relation to signing PTAs, carbon intensity is an important consideration since we might assume countries that rely on polluting activities have less interest in mitigation. In addition to this, a carbon intensive economy with low wealth compared to another intensive carbon economy with very high wealth suggests they may not be exploiting the same resources,

having developed the same infrastructure or relying on the same activities, which makes the distinction important for nuance.

In models with additional control variables (Table 2), I include a set of country-level variables and a set of PTA-level variables. The GDP, agriculture and CO2 data is included as controls at the country-level, along with a democracy index which indicates quality of the democratic institutions as a contextual cue to understanding public engagement and governance across PTA signatories (World Bank 2024). In the same table, two additional variables are read at the dyadic-level, similarly to the provision score. From PTA data, ‘not for protectionist purposes’ speaks to the institutional design by describing whether states specifically acknowledge whether their domestic interests are a driver of their provisions, and ‘binding obligations’ indicates whether the agreement includes wording that strengthens their commitments. The exact definitions of each of these variables as per the corresponding codebook are presented in the appendix. Because of the dyad-year fixed effects, the variation in all of those confounding variables are accounted for in the models.

6.5 ESTIMATION

To answer the question ‘What effect does extreme weather have on the environmental content of PTAs?’ I effectively test the relationship between weather shocks and environmental commitments. The models are estimated using two-way fixed-effects (FE) ordinary least squares (OLS) regressions with dyad and year fixed effects and standard errors clustered at the dyad level.

Regarding fixed effects, its widespread use in existing weather research consolidates its appropriateness in model specification (Bergé, Butts, & McDermott 2026). In fact, country and time fixed effects can be quite essential to properly accounting for local and temporal variation (Obserghaus 2019, p. 8; Dell, Jones and Olken 2014). This is the case in much of

the research investigating international trade (Permani and Xu 2022, p. 3004; Conveska 2021, p. 7) as well as policy outcomes (Rowan 2023).

I include models organized across three distinct tables. Tables 1-3 compare coefficients across the three models based on GDP, Agriculture and CO2 mechanisms. Table 1 establishes the simplest version of the FEOLS by looking at disaster shocks in country A and B in with one and two year lags across all three mechanisms, using total disaster frequency operationalized as shocks. In Table 2, covariates are added to the models from Table 1, including GDP, Agriculture, CO2, democracy, protectionism and binding language. In Table 3, I replace disaster frequency with the people affected to test whether the severity of events has comparable effects.

To analyse the central relationship, I construct the following statistical model:

$$EnvProvisions_{AB,t} = \mu_{AB} + \tau_t + \beta_1 DisasterShock_{A,t-1} + \beta_2 DisasterShock_{B,t-1} + \epsilon_{AB,t}$$

Where $EnvProvisions_{AB,t}$ is the environmental-provisions score of the agreement signed between countries A and B in year t; β_1 and β_2 are the slope coefficients associated with disaster shocks in each partner country; $DisasterShock_{A,t-1}$ and $DisasterShock_{B,t-1}$ denote the disaster shock experienced by each partner country in the previous year (t-1); μ_{AB} represents dyad fixed effects capturing time-invariant characteristics of the country pair; τ_t represents year fixed effects capturing global temporal trends in environmental provisions; and $\epsilon_{AB,t}$ is the error term. The same specification is also estimated using a two-year lag of the disaster shocks ($DisasterShock_{A,t-2}$ and $DisasterShock_{B,t-2}$). This baseline model with one and two year lags corresponds to the results reported in Table 1.

I further develop this baseline model into a version with covariates. These results correspond to table 2 and account for dyad-year fixed effects. The additional variables integrated are binding language and protectionist motives, which are PTA-dependent and

therefore dyadic, while GDP, agriculture, carbon intensity and democracy scores are country-specific. This effectively preserves the structure of the 'baseline' model and adds GDP, agriculture, CO2, and democracy scores for each partner of the dyad while binding language and excluding protectionist motives are relational from the PTA data.

Another variation of these models examines the relationship between people affected by disasters and PTA outcomes. This corresponds to the results from table 3. This furthers the analysis by assessing whether the relationship between disaster shocks and environmental provisions varies depending on the scale of human impact, comparing results across all three mechanisms. The specification integrates people affected as shocks in country A and B with one and two year lags ($PeopleShock_{i,t}$), preserving dyad-year fixed effects. Through this specification, the model evaluates whether disasters that affect abnormally more people influence environmental provisions outcomes.

7. ANALYSIS

This section reports and contextualizes the results of the two-way fixed-effects OLS regressions. The different model specifications yield results that warrant contextualization across ordering mechanisms. Country A corresponds in each specification to the highest level of GDP, agriculture, or carbon intensity according to the ordering rule applied, while country B represents the lower-GDP, less agricultural, or less carbon-intensive member of the dyad in each specification. The various models are arranged from more parsimonious to more comprehensive and organized in three main comparative tables.

In Table 1, I find that disaster shocks increase the likelihood that states will add environmental provisions to their future trade agreements. This effect is most statistically significant and particularly strong when shocks affect poorer, more agricultural, and less carbon-intensive states, and materializes most two years after the shock, all with $p < 0.001$. This validates the positive hypothesis (H1), with stronger effects for the poorest (0.315), most agricultural (0.225), and least polluting (0.253) country in the dyad. The effects for richer (0.097), less agricultural (0.118), and more polluting (0.112) partners are significantly smaller but still suggest a positive relationship. In Table 2, I find that disaster shocks and environmental provisions are positively associated for the poorest (0.424), most agricultural (0.320), and least polluting (0.298) countries in the dyads with a two year lag (with $p < 0.001$). This effect is stronger here than in the first table. The effects for richer (-0.027), less agricultural (-0.003), and more polluting (0.031) partners are considerably smaller or negative, but not as statistically significant ($p > 0.1$) which prevents us from rejecting the null hypothesis on this side of the dyad. Table 3 suggests that the most meaningful association between people affected by disasters and environmental scores are visible in the one year lag for the poorest (0.105), most agricultural (0.095) and least polluting (0.051) partners, which

further confirm this mechanism-driven positive relationship, with strong statistical significance with $p < 0.01-0.001$.

7.1 BASELINE MODELS

Table 1. Disaster Shocks and Environmental Provisions with Mechanisms

	GDP ordered	Agri ordered	CO2 ordered
Disaster shock (A, t-1)	0.101*	0.141*	-0.084+
	(0.049)	(0.057)	(0.049)
Disaster shock (B, t-1)	0.104+	0.075	0.246***
	(0.062)	(0.052)	(0.055)
Disaster shock (A, t-2)	0.097**	0.225***	0.112**
	(0.032)	(0.038)	(0.035)
Disaster shock (B, t-2)	0.315***	0.118**	0.253***
	(0.050)	(0.040)	(0.040)
Num.Obs.	11788	11788	11788
Std.Errors	by: dyad_id	by: dyad_id	by: dyad_id
FE: dyad_id	X	X	X
FE: Year	X	X	X

+ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

The findings of Table 1 highlight some key differences amongst mechanism orders in the most parsimonious model. Regarding GDP, there is little difference between the two partners' coefficients in the one year lag (0.101 and 0.104). With a two year lag, there is a significant difference, with the highest GDP country of the dyad having a coefficient of 0.097, while the lower-GDP member of the dyad has a coefficient of 0.315. Given that the shock variable is measured as a proportional deviation from historical average, a 100% increase in disaster frequency (or doubling from the country's period average) is therefore associated with a 0.315 point increase in the number of environmental provisions included in a PTA for the lower-GDP member of the dyad in the two year lag. This coefficient is

statistically significant with $p < 0.001$, the highest confidence interval of this model specification.

Regarding directionality based on agriculture as a percentage of GDP, Country A (highest level of agriculture) consistently shows a larger positive coefficient in each year lag. In the one year lag, the coefficient for country A is 0.141, while country B shows 0.075 points. These results correspond to a statistical significance of $p < 0.05$ and $p > 0.1$ respectively. In the two year lag, country A shows 0.225 and country B 0.118. There is a considerable difference between country A and B with the most agricultural partner experiencing close to double the intensity of the least agricultural partner. These coefficients are more statistically significant than the one year lag with $p < 0.001$ and $p < 0.01$ respectively. There are also significant differences between results across the two year lags, with the coefficients being more pronounced two years prior to signing rather than one year prior, for both countries but even more so for country A (most agricultural).

Regarding directionality based on carbon intensity, the most polluting economy (country A) in the one year lag displays the only negative association in the table, with -0.084, and is statistically significant with $p < 0.1$. This means that the most polluting country of the dyad is associated with lower environmental provisions when experiencing a one-unit increase in disaster shock (equivalent to a 100% deviation from its historical average). By contrast, for the least polluting country (B), the estimated coefficient is 0.246 in the same year, with $p < 0.001$. Here, the effect is negative for the most polluting country and positive for the least one, with a significant difference in relative values (-0.084 and 0.246). On the other hand, a 100% increase in disaster frequency two years prior to signing (t-2) is associated with a 0.112 increase in environmental provisions for the most polluting country and a 0.253 increase for the least polluting country, with these results being statistically significant with $p < 0.01$ and $p < 0.001$ respectively. The effect has become positive for

country A with a two year lag, and it is only slightly higher for country B. The least polluting country in the two year lag experiences over double the scale of the effect that the most polluting partner reports (0.112 for country A and 0.253 for country B).

Overall, the results from table 1 highlight disparate effects across years, with the effects generally intensifying in the two year lag, but also across partners (A/B) and mechanisms (GDP, Agriculture, CO₂). The highest coefficient is reported for the poorer partner in the two year lag (0.315), followed by the least polluting (0.253) and most agricultural country (0.225). These results are echoed by the smallest coefficients being attributed to the richest (0.097), most polluting (0.112) and less agricultural (0.118) countries. Coefficients with a two year lag are more statistically significant than a one year lag overall, with p meeting a consistent minimum of 0.01 across all three mechanisms.

These results show that poorer, more agricultural and less carbon intensive countries experience consistently stronger positive outcomes in environmental provisions than their richer, less agricultural and more carbon intensive counterparts. Conceptually, these results have implications in various assumptions found in trade and climate cooperation. With regards to PTA negotiation, we might assume that more powerful countries will get their way in the form of provisions that better serve their interests. In the case of economic power, we see that poorer countries experience stronger associations between weather shocks and environmental provisions. This suggests that it was either in the interests of the richer partner to sign onto less of those provisions, or that the poorest country was willing to sign onto more provisions. In any case, those results are surprising in the sense that environmental provisions have been regarded as costly - yet countries with the least capacity sign onto more of them when they experience climate shocks. This suggests it either might be in their ultimate interests, suggesting overlap with more vulnerable industries like agriculture, or that they were pressured to do so. Another consideration is that GDP and carbon intensity are strongly

correlated historically. This means that richer, more polluting countries share interests in signing onto the least number of potentially costly environmental provisions - which explains why they fail to react as strongly to climate shock.

7.2 MODELS WITH COVARIATES

In Table 2, we can see considerable differences in the results of the models that include covariates, which integrate democracy index scores, GDP, agriculture, carbon intensity and excluding protectionist motives or using binding language in PTA. The full table with all of these additional variables as controls is located in the annex.

Table 2. Covariates and Environmental Provisions with Mechanisms

	GDP Ordered	Agriculture Ordered	CO2 Ordered
Disaster shock (A, t-1)	0.131** (0.041)	0.308*** (0.046)	0.044 (0.048)
Disaster shock (B, t-1)	0.406*** (0.056)	0.173*** (0.043)	0.393*** (0.044)
Disaster shock (A, t-2)	-0.027 (0.037)	0.320*** (0.043)	0.031 (0.038)
Disaster shock (B, t-2)	0.424*** (0.042)	-0.003 (0.037)	0.298*** (0.036)
Not Protectionist	3.676*** (0.116)	3.845*** (0.116)	3.849*** (0.114)
Explicitly Binding	10.118*** (0.174)	10.181*** (0.175)	10.175*** (0.174)
Num.Obs.	8817	8810	8915
Std.Errors	by: dyad_id	by: dyad_id	by: dyad_id
FE: dyad_id	X	X	X
FE: Year	X	X	X

+ p < 0.1, * p < 0.05, ** p < 0.01, *** p < 0.001

First, the richest country presents a coefficient of 0.131 points in the one year lag, while the poorest in the dyad measures at 0.406 points. This is a strong difference between partners but also a departure from the model in table 1, especially for country B. Both coefficients are highly statistically significant with $p < 0.01$ and $p < 0.001$ respectively. In the

two year lag, country A displays a negative coefficient of -0.027 points, but the coefficient is not statistically significant at conventional levels, while country B shows a strong positive coefficient of 0.424 provision points with $p < 0.001$. These differences indicate substantial heterogeneity across lags and ordering mechanisms but the significance levels limit the interpretation of the effect for country A. These coefficients for the poorest country are the highest of the table in terms of disaster shocks. A strong statistical significance is observed ($p < 0.001$) in both lags for country B, with the coefficients ranging from 0.406 to 0.424 points, supporting a strong positive association and providing strong evidence against the null hypothesis.

With regards to the second mechanism, the most agricultural country in the one year lag displays the highest coefficient of this first row with 0.308 points, while the least agricultural country shows a coefficient of 0.173 with the same lag. With a two year lag on disaster shocks, the most agricultural country reports a positive coefficient of 0.320 with $p < 0.001$, while the least agricultural partner of the dyad corresponds to a slight negative value of -0.003 points with no conventional statistical significance. Here, the most agricultural country presents consistently significant results across the two lags, with the effect increasing by 0.012 points from one to two years prior to signing (0.320-0.308). On the other hand, the results for country B are limited in terms of statistical significance with a two year lag ($p > 0.1$) which fails to dismiss the null hypothesis.

In the last specification, the most polluting country (A) in the one year lag has a coefficient of 0.044, with no conventional statistical significance, while the least polluting country (B) displays 0.393 points with $p < 0.001$. There is a considerable difference amongst levels of carbon intensity here, but the coefficient from country A presents insufficient statistical evidence to reject the null hypothesis, amounting to the conclusion that weather shocks have no effect on environmental provisions for the most polluting countries. Two

years before signing, country A has a coefficient of 0.031, while country B presents 0.298 points. This is again a significant difference, but the p value of the results of country A does not correspond to conventional levels of statistical significance, while country B corresponds to $p < 0.001$. Again, we fail to reject the null hypothesis for the most polluting country but have significance at $p < 0.001$ for country B, which makes this positive coefficient meaningful. The effect is positively consistent for the least polluting country across one and two year lags in this model, ranging from 0.393 to 0.298 points associated with a 100% increase in disaster shocks in this model.

Finally, across all three mechanisms, PTAs with explicitly binding language and excluding protectionist motives are associated with strong positive coefficients. Indeed, agreements with binding language correspond with over 10 points of positive association in the outcome of environmental provisions (10.118, 10.181 and 10.175 index points). On the other hand, dyads that specifically acknowledge the purpose of their provisions is not to defend protectionist interest are associated with over 3 points in the provision outcome, ranging from 3.676 to 3.849 across the three models.

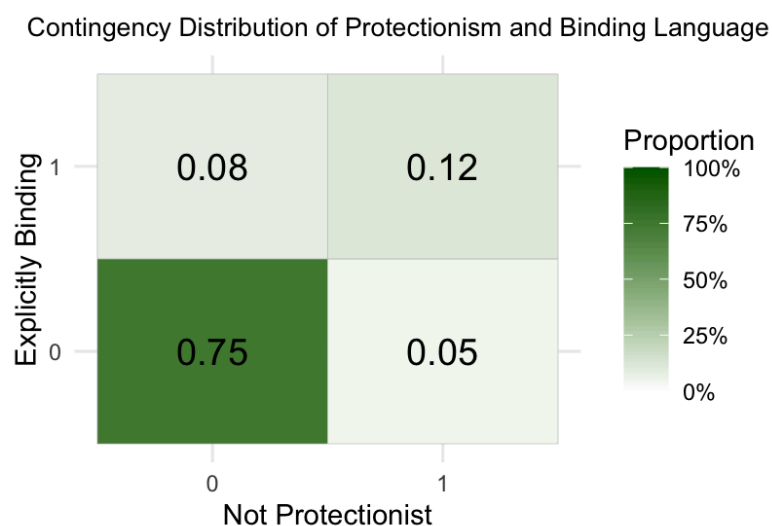


Figure 5. Cross-tabulation of Anti-Protectionist and Binding Language provisions.

One interesting point to observe is the association between binding language and anti-protectionism amongst PTAs with environmental provisions. In table 2, we can see that across all three mechanisms, binding language in an agreement is associated with over 10 points while excluding protectionism is associated with 3.6 to 3.8 environmental provision points. This cross-tabulation observes the nature of the distribution across those two variables in the overall sample. We can see that the very vast majority (75%) of dyads actually contain neither. This means they are not explicitly binding and could potentially be motivated by protectionist interests. On the other hand, 8% are explicitly binding, 5% proclaim they are not protectionist, and 12% are both. This means 20% of the dyadic entries is at least one of the two, which are both associated with positive outcomes on environmental provisions.

The results of these models with covariates differ from the results of Table 1 in absolute values, but the relative meaning of each coefficient across the three mechanisms reflects the observations drawn from the previous models. Indeed, the association between disaster shocks and provision scores is increased for partners with lower GDP, higher agriculture and lower carbon intensity. The effect intensifies across all these observations in comparison to the models in table 1 and is consistent in statistical significance with $p < 0.001$. There are many changes to be observed between the two model iterations. In particular, the most agricultural country in the one year lag presented a coefficient of 0.141 points in Table 1, but jumped to 0.308 points in Table 2, with the corresponding p value also improving from $p < 0.05$ to $p < 0.001$. Another meaningful change is observed for the partner with the lower GDP in the one year lag, going from 0.104 with $p < 0.1$ in table 1 to 0.406 with $p < 0.001$ in table 2. The only negative coefficient in table 1 corresponds to the most polluting country in the one year lag (-0.084 with $p < 0.1$), changes to a positive association in table 2 (0.044) with no conventional statistical significance ($p > 0.1$), but two negative coefficients (both with $p >$

0.1 as well) appear for the richest country in the one year lag (-0.027) and the least agricultural in the two year lag (-0.003) instead. These examples are rather significant differences which suggests the additional covariates have improved the explanatory power of the models. With the two year lag in this table, coefficients corresponding to the richest, least agricultural and most polluting partners are negative or minimized in comparison to table 1, but reflect no indicators of conventional significance ($p > 0.1$). The significant difference across results in the one and two year lags suggest the association is accrued with weather events that are further into the past, aligning with the negotiation timelines of PTAs of about 2-3 years (Lechner and Wüthrich 2018).

7.3 MODELS WITH PEOPLE AFFECTED

Table 3. People Affected by Disasters and Environmental Provisions with Mechanisms

	GDP-Ordered	Agriculture-Ordered	CO2-Ordered
People affected (A, t-1)	-0.009 (0.019)	0.095*** (0.023)	0.025 (0.021)
People affected (B, t-1)	0.105*** (0.025)	-0.008 (0.018)	0.051** (0.016)
People affected (A, t-2)	0.003 (0.003)	-0.009* (0.004)	-0.003 (0.002)
People affected (B, t-2)	-0.007* (0.003)	0.000 (0.002)	-0.005* (0.002)
Num.Obs.	10203	10203	10203
Std.Errors	by: dyad_id	by: dyad_id	by: dyad_id
FE: dyad_id	X	X	X
FE: Year	X	X	X

+ p < 0.1, * p < 0.05, ** p < 0.01, *** p < 0.001

Table 3 tests the association between climate vulnerability and environmental provisions with the people affected by disasters rather than the disaster variation itself. This

effectively re-operationalises the independent variable and tests robustness to look at the impacts of disasters rather than occurrence.

In comparison with the results from Tables 1 and 2, the regression coefficients related to the people affected and the interaction with disaster frequency are either very slightly positive or very slightly negative, and generally very close to 0, with rare statistical significance ($p > 0.001$). Interpreting these results is difficult since they are somewhat null but also vary considerably across the three models. The most statistically significant coefficients show a positive association of 0.105 points for the poorest country in the one year lag, and a coefficient of 0.095 for the most agricultural country in the one year lag, both with $p < 0.001$. This indicates positive associations in line with the results from the two previous tables. With $p < 0.01$, the only coefficient that corresponds to this level of statistical significance is the least polluting country in the one year lag with 0.051 points. There are three coefficients with a statistical significance of $p < 0.05$, all in the two year lag, the poorest country (-0.007), the most agricultural (-0.009) and the least polluting (-0.005). There are three other negative coefficients in this table, one for the richest country with a one year lag (-0.009), another corresponding to the least agricultural in the one year lag (-0.008) and the last for the most polluting in the two year lag (-0.003). The only positive associations are for the poorest country in the one year lag and the richest in the two year lag, the most agricultural in the one year lag, and both partners in the CO₂ mechanisms in the one year lag, with the coefficient for the least carbon intensive partner double the value of the most polluting partner.

In the figure “Global climate-related disaster and people affected” (page 7), we can see that the global trend for people affected often diverges from the disaster frequency. This might suggest that very specific events cause more people to be affected and shift that distribution accordingly, making it challenging to establish a clear relationship. It is also

likely, with regards to disaster types, that the people affected are too small or the disaster frequency too low to have observable effects - this is answered by the fact that the total disaster shocks have fairly small positive effects overall. Overall, as we experience more disasters, we may also become more resilient to their impact as a general response to exposure. It is unclear which progresses faster, but we might assume that it is limited by factors such as states' capacity to invest in emergency preparedness and the highly unpredictable scale of impact of extreme weather events.

8. CONCLUSION

8.1 SYNTHESIS

Overall, the results that inform a clear answer to the research question and a contribution to the literature at large come from the models in tables 1 and 2. In fact, disaster shocks are overall positively associated with environmental provisions across the three mechanisms, from 0.075 to 0.315 points, but negatively associated for the most carbon intensive economy in the one year lag (-0.084) from table 1. The partner with the comparatively lower GDP scores slightly higher across both years, while the most agricultural country has a significantly stronger positive association and the least agricultural country. The most carbon intensive country has a negative association in the one year lag and the least polluting country has consistently strong positive associations throughout the two year lags. This means that overall, the less wealthy, less polluting and more agricultural countries that experience weather shocks respond most positively in terms of PTA outcomes. From table 2, we notice some changes in the disaster shock coefficients across the three mechanisms, with two small negative associations observed in highest GDP in the two year lag (-0.027) and the least agricultural country in the two year lag (-0.003), while the rest of the coefficients range between 0.031 for the most carbon intensive country in the two year lag and 0.424 for the lower GDP country in the two year lag. Overall, this also corroborates that countries with

lower GDP, higher agriculture and lower carbon emissions in each dyad experience stronger positive associations between their disaster shocks and PTA outcomes, with the effect generally intensifying in the two year lag.

These results are generally consistent with H1, as the most statistically significant coefficients suggest a positive relationship overall. With regards to H2.A, it is surprising that poorer countries experience stronger positive effects than richer countries, who I expected to be more capable to absorb the potential cost of these provisions. In terms of agriculture and carbon intensity, H2.B and H2.C, the most agricultural and least polluting countries in the dyads consistently outperform the least agricultural and most polluting partners which supports these hypotheses. Overall, there are varying degrees of confidence at which we can reject the null hypothesis. This degree is higher when observing the effect for the poorest, most agricultural and least polluting countries, while the effects may not be as sustained in the case of their partners.

8.2 IMPLICATIONS

The literature demonstrates that individuals are capable of making connections between extreme weather and policy choices, sometimes informed by political beliefs, identity, distance or media exposure. At the state level, it shows that certain outcomes like increased trade flows or tariff cuts can be facilitated by extreme weather, and that interest groups in the domestic context affect trade negotiations. The gap this project looks to fill is exactly how States govern their trade with partners when they experience the worsening effects of climate change internally - and how they may do so.

The main hypothesis I presented to answer the question “What effect does extreme weather have on the environmental content of PTAs?” proposed a positive relationship between climate shocks and provision scores. The results of the quantitative analysis employing FEOLS regressions have shown that is the case, but varying under certain

conditions. In fact, through three distinct mechanisms, I have tested whether dynamics in GDP, Agriculture and Carbon intensity in pairs of countries that sign PTAs with environmental provisions affect the extent of their weather shocks. In the most simple models, the country with the lowest GDP, the highest level of agriculture and the least carbon intensive economy consistently scores higher than its counterpart in environmental outcomes when they experience weather shocks. The effect is generally more pronounced two years prior to signing than only one. This suggests that countries with more wealth, smaller agricultural sectors and more polluting activities have more limited interests in the way disaster risk might inform or direct their environmental provisions. In this way, we might understand that countries that experience the same level of shock produce different outcomes based on the characteristics of their economy - whether they have climate-vulnerable or climate-forcing assets, and how much wealth they generate. The potential cost associated with environmental provisions may be a deterrent, but economic powers that generate much wealth based on polluting activities are less vulnerable to climate change. In fact, the countries with a lower GDP on a dyadic level sign onto more environmental provisions than richer countries when they experience weather shocks, so either they are not willing to pay, or their revenue relies on polluting activities in the first place. The fact that countries with larger agricultural sectors see more positive outcomes in the environmental provisions of their PTAs when they experience weather shocks confirms the idea that risk exposure and vulnerability can be drivers of change if financial interests align, despite the potential costs associated with these commitments.

For future research, an excellent improvement would be using the exact date of each disaster occurrence and the day of signing for each PTA to set lags to 6 month, 1 year, or 18 months lags, and observe more precise temporal variations. A potential consideration with

regards to bureaucrats' exposure to weather shocks would be to document the distance from the place of occurrence of each climate disaster to the capital or the place of PTA negotiation.

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APPENDIX

Table 4. Additional Variable Definitions.

Definitions of ‘Not Protectionist’ and ‘Binding Language’ variables (TREND codebook):

2.01 Not for protectionist purposes

§ Includes prohibition to adopt environmental measures that are discriminatory or unnecessary.

§ Only includes environmental measures that specifically have a negative or adverse effect on trade. The sole acknowledgment that environmental measures *may* impact trade in an unspecified manner is excluded.

§ As opposed to the exceptions in section 8. Norms in 2.04 are not exceptions. If the sentence prohibiting protectionist, discriminatory or unnecessary measures is immediately followed by a sentence allowing trade restrictions for environmental purposes, then it is considered as an exception and should not be coded in 2.04.

§ For greater certainty, excludes GATT Art. XX chapeau and similar wordings. It should be a norm’s main obligation, rather than a complement to another environmental norm.

3.01.01 Binding obligations

§ Includes shall, should, must, have to, etc.
Ex: US-Chile, art. 19.2: “(a) A Party shall not fail to effectively enforce its environmental laws, through a sustained or recurring course of action or inaction, in a manner affecting trade between the Parties [...]”

Table 5. Variables of the Environmental Provisions Index.

New name	TREND code	Description
prov_notif	X7.03.03	Early notification or exchange of information in case of natural disasters, environmental catastrophes, or accidents
prov_envprot	X8.01.03	Protection of the environment (general right to adopt measures for environmental protection)
prov_emergency	X9.04	Emergency assistance in case of natural disaster
prov_transwat	X10.01.04	Management of transboundary waterways
prov_water	X10.01.08	Water efficiency
prov_forests	X10.05.01	Conservation of forests

prov_emred	X10.15.02.01	Reduction of greenhouse gas emissions; includes mitigation, low-carbon technologies, and climate-related clean technologies
prov_adaptation	X10.15.02.02	Climate change adaptation; includes reducing adverse impacts and vulnerability to climate change
prov_ozone	X10.16	Protection of the ozone layer and regulation of CFCs
prov_air	X10.17	Air pollution
prov_soil	X10.19	Soil erosion
prov_disasters	X10.22.03	Other norms related to disasters
prov_envstrength	X2.02.02	Commitment to enhance or strengthen levels of environmental protection
prov_monitor	X3.04	Commitment to monitor the state of the environment
prov_capacity	X3.06	Commitment to invest in environmental research and science
prov_natstandards	X3.07	Establishment or support of national standard-setting bodies
prov_infoexchange	X7.03.01	General obligation to exchange environmental information
prov_harmonization	X7.04.01	Harmonization of environmental measures
prov_techassist	X9.01.01	Technical assistance, training, or capacity building provided to another party
prov_fundtech	X9.03.01	Funding for capacity building, training, technical assistance, and technology transfer
prov_fundingcoop	X9.03.02	Funding of cooperation activities
prov_coral	X10.01.02	Protection of coral reefs
prov_seas	X10.01.03	Protection of seas and oceans
prov_rivers	X10.01.05	Management of rivers, basins, and lakes
prov_coasts	X10.01.06	Protection of coastal areas

prov_aquifers	X10.01.07	Protection or management of aquifers and groundwater
prov_otherwater	X10.01.10	Other water-related environmental norms
prov_fisheries	X10.04.01	Conservation of fishery resources
prov_fishpollution	X10.04.04	Prevention of pollution from fishing activities
prov_foresttrade	X10.05.02	Sustainable trade in forestry products
prov_invasives	X10.10	Regulation of invasive, alien, or exotic species
prov_protectedareas	X10.13	Protected areas, parks, and natural reserves
prov_climateother	X10.15.02.05	Other climate change-related norms
prov_desertification	X10.20	Desertification, land degradation, salinisation, and acidification
prov_domwaste	X10.23	Domestic waste management
prov_haztrade	X10.24.01	Restrictions on hazardous waste trade (export, import, transport)
prov_pesticides	X10.25	Regulation of pesticides, fertilizers, toxic products, and chemicals (for environmental purposes)
prov_scenery	X10.30	Scenery preservation
prov_otherenv	X10.31	Other specific environmental issues
prov_publiccomm	X11.02.01	Communication on actions undertaken under the agreement

Table 6. Full Covariates Table.

	GDP Ordered	Agriculture Ordered	CO2 Ordered
Disaster shock (A, t-1)	0.131** (0.041)	0.308*** (0.046)	0.044 (0.048)
Disaster shock (B, t-1)	0.406*** (0.056)	0.173*** (0.043)	0.393*** (0.044)
Disaster shock (A, t-2)	-0.027 (0.037)	0.320*** (0.043)	0.031 (0.038)
Disaster shock (B, t-2)	0.424*** (0.042)	-0.003 (0.037)	0.298*** (0.036)
GDP per capita (A)		-0.000*** (0.000)	-0.000*** (0.000)
GDP per capita (B)		-0.000*** (0.000)	-0.000*** (0.000)
Agriculture as % of GDP (A)	-0.045 (0.062)		-0.111* (0.044)
Agriculture as % of GDP (B)	-0.095 (0.059)		-0.184*** (0.041)
Democracy Score (A)	0.096 (0.238)	0.286 (0.241)	0.680*** (0.199)
Democracy Score (B)	0.201 (0.265)	0.527** (0.200)	0.113 (0.219)
Not Protectionist	3.676*** (0.116)	3.845*** (0.116)	3.849*** (0.114)
Explicitly Binding	10.118*** (0.174)	10.181*** (0.175)	10.175*** (0.174)
Num.Obs.	8817	8810	8915
Std.Errors	by: dyad_id	by: dyad_id	by: dyad_id
FE: dyad_id	X	X	X
FE: Year	X	X	X

+ p < 0.1, * p < 0.05, ** p < 0.01, *** p < 0.001

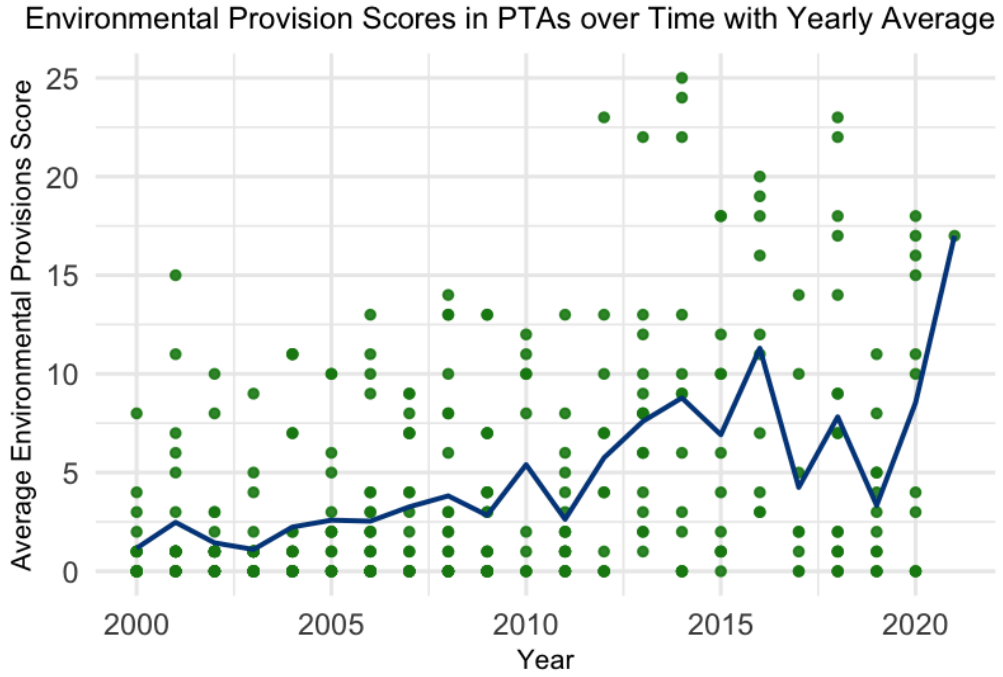


Figure 6. Scatterplot of Environmental Provision Scores Over Time.

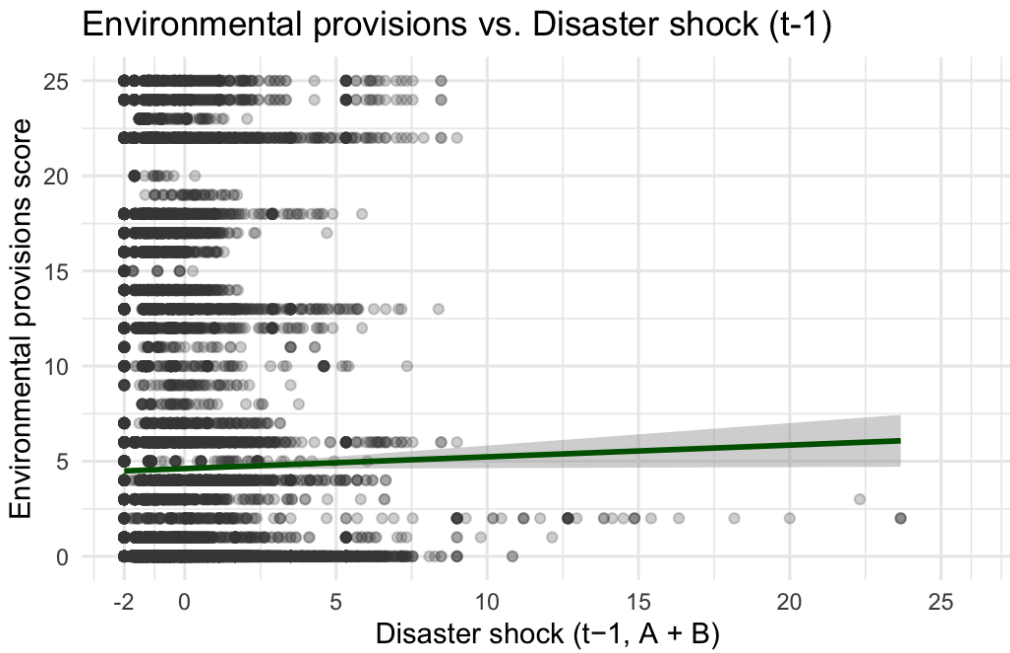


Figure 7. Simple Regression Visualization: One year lag (t-1).

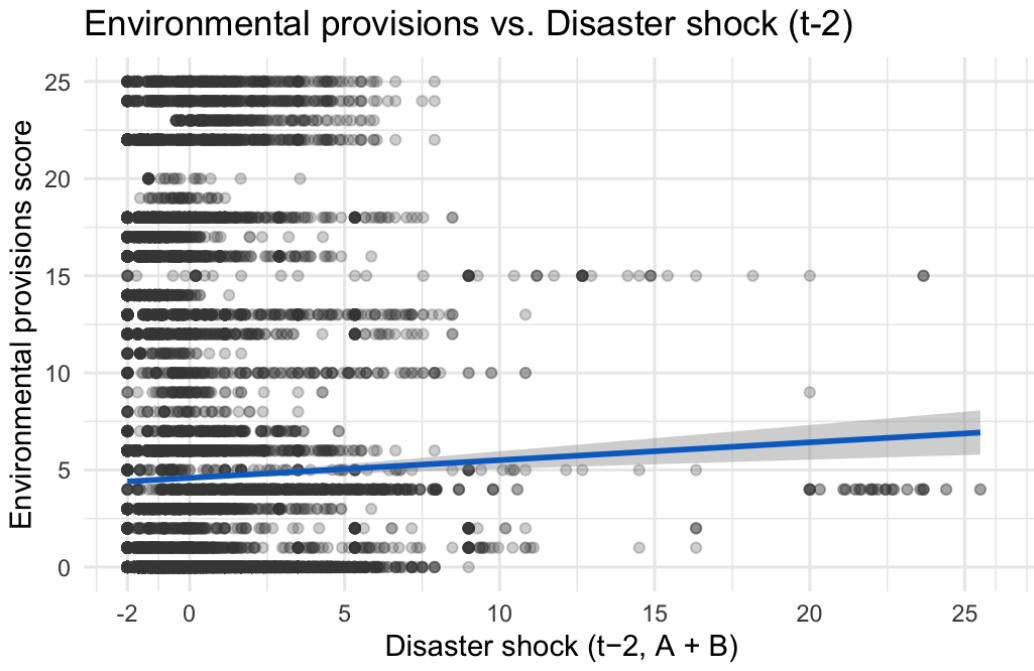


Figure 8. Simple Regression Visualization: two year lag (t-2).