From gridlock to ratchet: Conditional cooperation on climate change

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Abstract

Climate treaties have progressed over time to pledge substantial reductions in global warming. This is surprising given that theories of climate politics emphasize collective action problems and domestic deadlock. I first describe the process of updating climate mitigation targets under the Paris Agreement. Then I develop a theoretical argument that explains targets based on how countries are situated in economic and political networks. Trade flows create competitive economic pressures that may undermine climate action, but this may ebb when partners also commit to act. I argue political networks support conditional cooperation, especially when institutional design promotes gradual commitments. I use spatial regression models to study how countries' climate targets are related to their partners' prior targets. I find that countries pledged stronger updated mitigation targets in the Glasgow Climate Pact when their closest political partners submitted strong targets in the Paris Agreement. This suggests the Paris Agreement could drive conditional cooperation on mitigation.

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1 Introduction

Governments have been negotiating climate treaties since the early 1990s, but global greenhouse gas emissions and temperatures have continued to rise. Climate scientists project that temperatures will increase roughly 4°C by 2100 if emissions follow their historical trends. Early climate treaties, such as the 1997 Kyoto Protocol, did little to alter global emissions trends and contemporary modeling suggested it would hardly influence global temperatures.[1] After nearly two decades of lacklustre multilateral climate negotiations, the 2015 Paris Agreement enshrined a new global goal of limiting temperature rise to between 1.5°C and 2°C of warming; nonetheless, governments continued to fall short of the challenge, as the sum of their pledged climate targets allows roughly 3°C of warming.[2] However, governments finally began to close this ambition gap at the 2021 Glasgow climate summit, where they submitted updated targets as part of the Paris Agreement's ratchet process. Recent modeling suggests the Glasgow targets would hold global warming to under 2°C by 2100 — in line with the Paris Agreement's goal (figure 1).[3] Climate treaties have committed to progressively stronger mitigation, bringing us closer to the 1.5°C goal.

That the ratchet process seems to be working is surprising for theories of international climate politics. The dominant perspective emphasizes how collective action problems, especially enforcement problems, have undermined international climate treaties.[4] Nothing about the Paris Agreement or the Glasgow Climate Pact suggests these problems have been overcome by adding enforcement powers;[5] yet, we observe more ambitious targets. Recent research argues that international collective action problems are not the principal reason why climate action has been weak and argues instead that powerful domestic interest groups — such as the fossil fuel industry and carbon-intensive industries — block policy.[6] However, this distributive conflict perspective is better at explaining stasis than simultaneous enhanced ambition. How has the observed progress in climate governance come about?

[1] Wigley 1998; Tørstad 2020.
[2] Rogelj et al. 2016.
[3] Meinshausen et al. 2022.
[4] Barrett 2003; Nordhaus 2015; Keohane and Victor 2016; Kennard and Schnakenberg 2023.
[5] Allan et al. 2023.
[6] Aklin and Mildenberger 2020; Colgan et al. 2021.

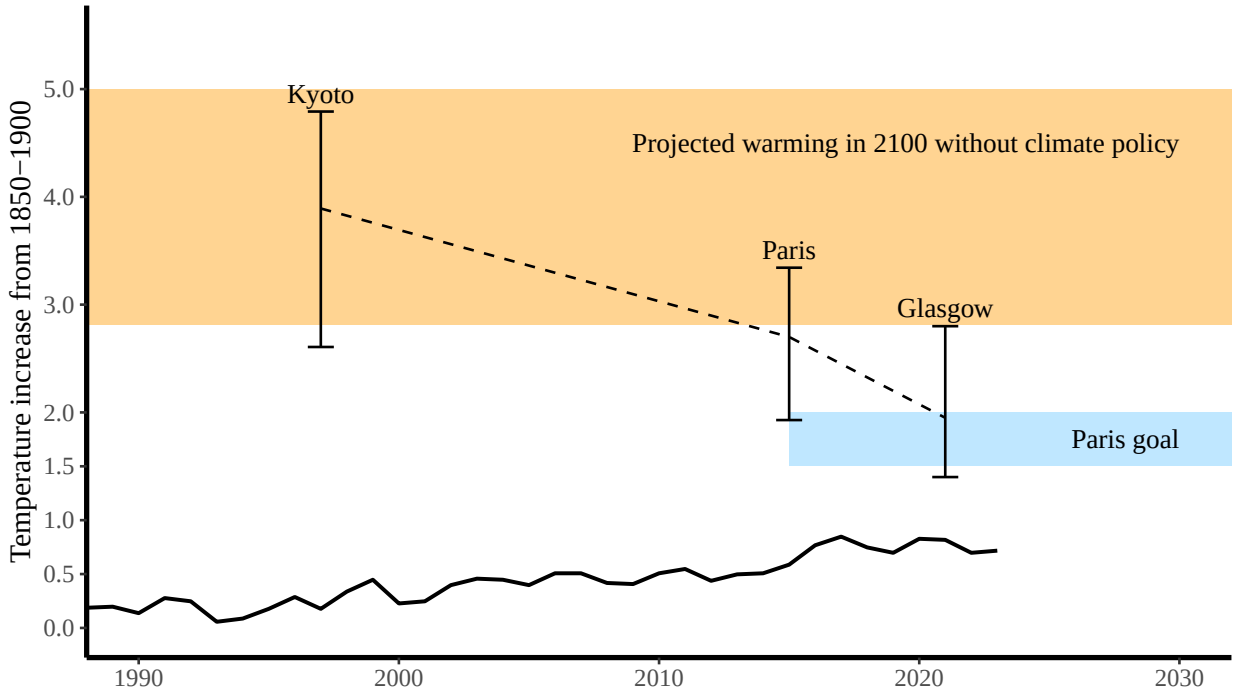

Figure 1: Progress in projected temperature change across climate treaties. Global temperature time series in black. Dashed lines pass through the median temperature projection for each treaty Author's calculations based on Wigley (1998), Rogelj et al. (2016), and Meinshausen et al. (2022).

I advance debates in international cooperation by studying iterated mitigation targets in climate treaties. I emphasize the conditional nature of cooperation as it has evolved over time. In principle, states could condition their mitigation actions on others' behavior in different ways. From an enforcement perspective, states might react negatively to increase their emissions opportunistically when their peers reduce their own.[7] In this situation, free riders gain a competitive advantage in global markets that contributors struggle to rectify due to anarchy. By contrast, the distributive conflict perspective downplays international dynamics and suggests that mitigation decisions primarily reflect domestic policy battles. For these scholars, climate policy is predominantly unconditional since governments are mostly attuned to domestic actors who are rarely concerned about international coordination.[8]

The Paris Agreement articulates a different logic. Here, governments recognize they are caught in a sub-optimal outcome and make periodic efforts to escape it through reciprocity. Climate governance has been marred by distrust and non-cooperation, so mitigation needs to be supported by

[7]Kennard and Schnakenberg 2023.
[8]Aklin and Mildenberger 2020.

gradual conditional commitments. The pledge and review process allows governments to observe their counterparts' behavior and tailor their actions to match.[9] I argue conditional cooperation is most likely to develop among states that are already closely connected politically and have extensive shared experience governing global problems. These political networks are formed by joint membership in international organizations (IOs), where states develop longstanding relationships that enable them to govern across issues.[10] Institutional design supports conditional cooperation when it sequences cooperation through iterated pledges that states can strengthen over time. In this context, prior climate action enables future cooperation.[11] If the ratchet process works, then it will drive an "upward spiral of increasing ambition."[12]

Enforcement, conditional cooperation, and distributive conflict, therefore, offer three contrasting perspectives for explaining climate politics. I derive empirical expectations about the Paris Agreement's ratchet process for each perspective and ground these in a common spatial modeling framework. The enforcement perspective expects countries to weaken their targets when their peers set strong targets. This emerges from concerns about economic competitiveness, where states can gain an advantage over their competitors, particularly within trade networks. Conditional cooperation expects countries to strengthen their targets when their peers set strong targets. States work through their pre-existing political networks to achieve conditional cooperation, where prior governance experience facilitates regulatory convergence and alleviates domestic opposition. Finally, distributive conflict does not expect countries to adjust their targets based on peers' behavior because the key domestic interest groups that dominate climate policy have fixed preferences for or against mitigation. From this perspective, climate policy decisions are not conditional.

I investigate these claims with spatial regression models predicting states' Glasgow climate targets as a function of their previous Paris targets and their trade- and IO-weighted peers' Paris targets. I find evidence of conditional cooperation, where governments are more willing to strengthen their targets when their political partners set strong targets. Additionally, I find no evidence that trade networks undermine cooperation. This suggests that the United Nations climate regime may be able to sustain progressively stronger climate action.

[9] Keohane and Oppenheimer 2016.
[10] Cao 2010; Copelovitch and Putnam 2014.
[11] Hale 2020.
[12] Sachs 2020.

This study contributes new analysis of the Paris Agreement's mitigation targets and ratchet mechanism.[13] I document progress in targets and explain how these diffuse within networks. This study also helps to bridge debates between the domestic and international politics of climate change by specifying expectations from different perspectives and studying these in a common empirical framework.[14] I find strong evidence for international drivers of climate policy, which have been neglected by the distributive turn in climate research. This also study makes a theoretical contribution by recasting how conditional cooperation should work — namely, through networks of peers — which helps situate climate change within broader debates on interdependence.[15]

2 Theories of international climate politics

Climate change mitigation has challenging public goods characteristics.[16] Mitigation is individually costly and generates climate stability benefits that mostly accrue globally, over time, and are not excludable from others who do not mitigate. Theory expects mitigation's individual costs outweigh its individual benefits for every state, and therefore no state will mitigate aggressively. This creates a collective action problem, where individually rational decisions lead to collectively inefficient outcomes because governments under-mitigate (or over-pollute) and, thereby, cause dangerous global warming. The obvious solution is to craft an agreement that binds states to reduce their emissions[17]. But, anarchy means there is no international authority to enforce agreements and states have incentives to free ride on others' contributions when agreements prescribe substantial adjustment costs.[18] This reasoning underpins the dominant perspective on climate politics, which argues mitigation is under-provided due to enforcement problems.

Recent research emphasizes domestic distributive conflict as an alternative explanation for the under-provision of climate mitigation.[19] Distributive conflicts pit interest groups that support climate action against those that oppose it. Decarbonization benefits groups that are vulnerable to the impacts of climate change and those that provide key inputs for the energy transition.

[13]Rowan 2019; Sælen 2020; Tørstad 2020; Rowan 2021.
[14]Dai 2010; Milkoreit 2019.
[15]Simmons et al. 2006; Cao 2010.
[16]Barrett 2003; Kennard and Schnakenberg 2023.
[17]Nordhaus 2015.
[18]Downs et al. 1996.
[19]Aklin and Mildenberger 2020; Colgan et al. 2021.

But, decarbonization threatens fossil fuel companies, their upstream and downstream partners, and the livelihoods of communities linked to these industries.[20] They mobilize against mitigation using misinformation, lobbying, and relocation threats.[21] Climate policy stalls out when political institutions empower incumbent polluting interests.[22] From this perspective, governments under-contribute to mitigation because anti-climate action groups have historically been stronger than pro-climate action groups in most countries' domestic politics.

This revisionist approach seeks to correct for the literature's apparent over-emphasis on enforcement problems.[23] To emphasize the significance of domestic politics, these studies often argue that international collective action is mostly irrelevant for explaining mitigation.[24] For example, Aklin and Mildenberger argue governments "can be insulated from the pressures of free riding" because they must satisfy domestic constituencies, such as fossil fuel companies and the broader public, who seem to "not care about reciprocal action."[25] Here, the Paris targets are "nationally determined" in the literal sense that they summarize unconditional national positions on climate rather than iterated pledges that respond to behavior in other countries. Despite usefully highlighting the role of fractious domestic politics, I argue this approach risks over-correcting and missing important international dynamics that have arisen with the Paris Agreement.

Ultimately, both enforcement and distributive conflict struggle to explain the Paris Agreement's ratchet process. Each perspective provides stronger explanations for policy stasis than reform. Climate treaties did not add enforcement powers nor did pro-climate groups win in every jurisdiction, so neither perspective provides reasons why most governments would strengthen their targets so quickly. Therefore, we need another perspective to explain why states simultaneously upgraded their targets.

I argue conditional cooperation theory offers a promising alternative perspective for explaining climate mitigation. Its core contention is that actors are willing to contribute more private resources to collective projects when other actors contribute more of their own. Fischbacher and his colleagues show this with a public goods game where participants contribute conditional on other participants'

[20]Green et al. 2022; Cory et al. 2021; Gaikwad et al. 2022.
[21]Supran and Oreskes 2017; Brulle 2018; Bayer 2023.
[22]Mildenberger 2020.
[23]Colgan et al. 2021, p. 590.
[24]Urpelainen and Van de Graaf 2018.
[25]Aklin and Mildenberger 2020, p. 22.

aggregate contributions.[26] They show that roughly half of participants contribute more when others make larger contributions. By contrast, only one-third of participants free ride by never contributing and a large share of the remainder contribute unconditionally.

These ideas have affinity with institutionalist theory that shows international cooperation is possible under anarchy.[27] Cooperation is often built on reciprocity, where states make roughly equivalent reforms to address a problem. When interactions are iterated, states can condition their behavior on previous actions. Combining reciprocity with iteration allows gradual cooperation, as states build reputations for cooperativeness and the shadow of the future disciplines defection. Many institutions, such as those governing ozone-depleting substances, are designed to promote incremental cooperation, where states begin with limited concessions and strengthen these in negotiating rounds. In the ozone regime, a handful of states with self-interested reasons to restrict their pollution were willing to move first and they structured institutions to expand in membership and scope over time.[28] This can be particularly helpful in situations with high uncertainty, like climate change, because gradualism can use reciprocity to build trust among participants and incremental reforms allow states to adjust their behavior as they learn about policy consequences.[29]

The Paris Agreement's ratchet mechanism crystallizes this intuition. Here, states pledge initial targets and are tasked with updating them periodically. Conditional cooperation could support the ratchet process. Sælen models this and finds that when initial targets are already ambitious, they drive further ambition.[30] Milkoreit and Hale each articulate a similar logic, where initial leadership by a core ("k-group") of environmentally-inclined governments can jumpstart mitigation that becomes self-sustaining.[31] Dai anticipated some of the regime's eventual transformation at Paris and argues that pro-compliance domestic constituencies can pressure governments to act by benchmarking them against treaty goals and peers.[32] The ratchet process also harnesses temporal focal points to define key moments in the negotiation cycle when domestic and international peer pressure can be exerted before new targets are due.[33] Once climate action passes some minimum

[26] Fischbacher et al. 2001.
[27] Axelrod and Keohane 1985.
[28] Parson 2003.
[29] Abbott and Snidal 2004.
[30] Sælen 2020.
[31] Milkoreit 2019; Hale 2020.
[32] Dai 2010.
[33] Manulak 2022.

threshold, it can be stable and strengthen over time.

But this work has paid relatively little attention to how states are positioned differently in climate politics, which is one of the core insights from the distributive conflict perspective. Fischbacher and his colleagues assume undifferentiated actors with the same preferences and no pre-existing relationships.[34] This assumption simplifies the theory and experiments, but we know that states are differentiated in practice. Recent work by Hale starts with actor heterogeneity to develop a theory of "catalytic cooperation."[35] He shows that relaxing core assumptions in public goods models — to add co-benefits, preference heterogeneity, or increasing returns to mitigation — transforms the cost-benefit calculus to support action. Mitigation might still be under-provided relative to efficient levels, but states might have reasons to begin mitigation irrespective of others' contributions. However, even in this extension, mitigation is still under-theorized because the relationships between states are not addressed.

3 Peer networks in international climate politics

I argue for an alternative reason for mitigation that emphasizes how states are positioned in international peer networks. This argument incorporates, from the distributive conflict perspective, the idea that states are differentiated and do not all have the same interests. But, it also incorporates a much larger role for international collective action, where governments account for the behavior of other countries in their economic and political networks. This has affinities with policy diffusion research that emphasizes how pre-existing economic, political, and social networks influence state behavior.[36] Within these networks, states have closer ties to some peers, rather than being equally affected by all other states or solely affected by the hegemon. Networks also differ in the kinds of interactions between states, such as economic, social, or political connections, which can have positive or negative effects. I focus on economic peer networks that manifest through bilateral trade flows and political peer networks that manifest through joint membership in IOs.

Peers are especially important in climate politics given the nature of the cooperation problem. Mitigation costs reflect both a state's own mitigation choices and peers' choices. Climate reforms

[34]Fischbacher et al. 2001.
[35]Hale 2020.
[36]Simmons et al. 2006; Cao 2010.

generate a range of competitiveness concerns through their impacts on trade. To see this, consider a situation where a country enacts costly reforms, but its main trade partners do not. This is collective action's "sucker's payoff" because it generates a range of material costs for the reformer. First, imports of unregulated foreign goods outcompete more expensive regulated goods in the home market. Second, exports of regulated goods become uncompetitive in unregulated peers' markets. Third, exports of regulated goods also become uncompetitive in third markets relative to unregulated peers' exports. These concerns are acute in energy-intensive, trade-exposed (EITE) sectors — such as steel or chemicals — where carbon pollution is high and goods compete in global markets with thin margins.[37] Therefore, governments hesitate to regulate domestic firms to higher standards than their trade partners.

To counteract these advantages, governments may combine climate reforms with trade restrictions that adjust for uneven regulations, such as the European Union's carbon border adjustment mechanism that is set to begin in 2026. In practice, however, there may be more examples of unilateral reforms containing carveouts for trade-exposed domestic industries than ones that require peers to match costs. Canada's national carbon price rebates EITE firms, such as those in the oil industry which accounts for roughly 30% of national emissions, because Canada's largest trade partners — the USA, China, and Mexico — do not uphold an equivalent carbon price. The European Union, similarly, freely allocates emissions allowances to minimize competitiveness impacts.

If all governments enact equivalent reforms, then regulatory costs are roughly equal. Firms' total costs will increase, but they should increase roughly proportionately conditional on similar endowments, like access to clean electricity or economies of scale. This minimizes concerns about carbon leakage, undercuts relocation threats, and dampens domestic opposition to climate policy. To see this, consider how regulatory harmonization fractures the bloc of carbon majors and EITE firms that have jointly opposed mitigation. Carbon majors, such as coal mining and oil companies, will oppose climate policy no matter how it is implemented because it has existential stakes for them.[38] However, harmonized reforms establish an even playing field for EITE firms and they may even support the energy transition in the right regulatory environment.[39]

Synchronizing these reforms across jurisdictions is challenging because governments disagree

[37]Genovese 2019; Cullenward and Victor 2021.
[38]Colgan et al. 2021.
[39]Cullenward and Victor 2021.

on the desirable pace of reforms, struggle to credibly commit to maintaining them, and reneging has arbitrage opportunities. Current institutions do not align climate and trade policy, leaving these to evolve in a decentralized fashion. As a result, the carbon-intensive status quo should be sticky if trade ties place an upper limit on climate policy.

States can find pockets of assurance within their political networks. Matching contributions across countries requires coordinating on a common level of effort and assurances that reforms will not be undercut by peers. I argue these considerations are easier to overcome when states have pre-existing political relationships built through joint experience governing global problems. States have limited resources for checking other states' behavior, so they must prioritize. Trade partners are a natural reference point since they can impose the highest costs. But because states govern many global issues simultaneously, they also develop longstanding relationships with the peers with whom they interact frequently in IOs. Within these networks, states develop better information about their counterparts' preferences, including the level of contributions they usually make and the sincerity of those commitments. These peer groups become the starting point for coordinating policy. Costly mitigation policies require some assurance that others will reciprocate, and when peers have previously made contributions, even small ones, these signal some willingness to cooperate.[40] When embedded in a broader structure of joint governance experiences, this builds trust among peers that support collective action.[41]

Political networks also facilitate monitoring. Since governments that share many IO memberships interact more often, their diplomats have more incentives to check in on implementation and compliance in these peer countries. They can use these meetings to clarify concerns, learn about challenges, and apply pressure to lagging governments. These dense governance networks discipline reneging because its consequences may ripple through to many other issues.[42]

Joint memberships in IOs create durable political relationships, wherein governments can exchange mutual concessions and enact reciprocity. Copelovitch and Putnam find support for this in treaty design.[43] They find that states design agreements with less dispute resolution and fewer escape clauses when members have high levels of prior joint IO membership. States in these highly

[40]Kydd 2005.
[41]Kinne 2013.
[42]Davis 2009.
[43]Copelovitch and Putnam 2014.

institutionalized relationships rely less on formal mechanisms to enforce agreements them. Other studies document how states' pre-existing joint memberships in IOs create political ties that lead to policy convergence.[44] Institutional design can support these processes when institutions articulate clear goals that domestic groups can use to benchmark progress and when they create focal moments to concentrate efforts on upgrading cooperation.[45] Simultaneous climate action in peer countries sets a global benchmark that makes under-contributing more visible. Overall, political networks can support mutually reinforcing mitigation policies.

Survey experimental research also supports the idea that mitigation in other countries facilitates domestic action. Bechtel and Scheve find that respondents are more supportive of their government participating in climate agreements when a larger number of other countries join and when these countries represent a higher share of global emissions.[46] Bechtel, Scheve, and Lieshout also explain these multilateral agreements are perceived as more effective and fair.[47] Beiser-McGrath and Bernauer show similarly that respondents are more supportive of domestic mitigation when other countries have previously decreased their emissions.[48] Together, this research provides strong microfoundations for multilateral climate cooperation. However, while these studies buttress my argument about conditional cooperation, they generally rely on stylized examples of mitigation in other countries. My application moves from survey experiments to observed state behavior, as well as, from the mitigation contributions of "other countries" to the specific contributions of other relevant countries in economic and political networks.

4 Empirical expectations

The evidentiary basis for each of the three perspectives — enforcement, conditional cooperation, and domestic distributive conflict — is relatively thin. Few papers have made empirical interventions in this debate. The enforcement perspective can declare that cooperation should be weak when institutions cannot prevent non-compliance and reason from that to explain mitigation's apparent

[44]Cao 2010; Jones and Zeitz 2019.
[45]Dai 2010; Manulak 2022.
[46]Bechtel and Scheve 2013.
[47]Bechtel et al. 2022.
[48]Beiser-McGrath and Bernauer 2022.

under-provision.[49] The distributive conflict perspective notes that governments have enacted some reforms despite existing treaties being weak, and uses this to rebut collective action arguments.[50] However, this perspective generally fails to go a step further and consider whether climate policy could be stronger if other countries also contribute. Conditional cooperation mostly relies on anecdotes that governments have set conditional targets. Harrison's study of the 1997 Kyoto Protocol reports that Canadian negotiators were instructed to set a target 1% above Washington's target.[51] Dimitrov traces a similar dynamic at the 2009 Copenhagen negotiations, but it remains unclear how this generalizes.[52]

One challenge with evaluating these perspectives empirically is that states' under-contribution to mitigation seems over-determined because both enforcement and distributive conflict expect it. However, the Paris Agreement's ratchet mechanism provides an opportunity where each perspective generates contrasting predictions because it focuses on *changes* in targets. The ratchet tasks governments with submitting stronger targets and states can condition their behavior on others' targets. I use the ratchet process as an opportunity to re-formulate the arguments from the enforcement, conditional cooperation, and distributive conflict perspectives as empirical expectations about how interdependence shapes mitigation targets.

First, the enforcement perspective expects that mitigation in one country will be offset by opportunistic behavior in others. Kennard and Schnakenberg formalize this insight to show that as some countries mitigate — which we observe in the Paris targets, even if mitigation remains under-provided relative to ideal levels — other countries should increase their emissions to use more of the remaining global emissions budget.[53] Mitigation's public goods characteristics create incentives to undermine others' efforts by increasing home emissions when other countries mitigate, or making negative mitigation contributions. While collective action theory generally proceeds from the assumption that states are undifferentiated, the prior discussion of mitigation's competitiveness impacts through trade suggests opportunistic behavior should be acute in trade networks. Therefore, I reformulate the enforcement perspective from a network perspective to expect that countries will ratchet less when their peers in trade networks set strong targets.

[49] Nordhaus 2015.
[50] Aklin and Mildenberger 2020.
[51] Harrison 2007.
[52] Dimitrov 2010.
[53] Kennard and Schnakenberg 2023.

H1 *Enforcement, economic competition hypothesis.* States will weaken their mitigation contributions when their peers in trade networks set strong targets.

Conditional cooperation predicts the opposite response. The institutional design of the ratchet process allows states to observe their peers' contributions and set stronger targets over time if peers also mitigate. This effect should be stronger in political networks, where states build on their prior experience governing global problems to support climate action. Countries might strengthen their targets but still fall short of the 1.5°C goal collectively, with the implication that mitigation remains under-provided. Nonetheless, evidence of conditional cooperation could provide insight into the climate regime's ability to close its ambition gap over time.

H2 *Conditional cooperation, political reciprocity hypothesis.* States will strengthen their mitigation contributions when their peers in political networks set strong targets.

Finally, the distributive conflict perspective does not have a dynamic mechanism tied to the negotiations that affects states differently. From this perspective, climate policy reflects the relatively exogenous alternation between pro- and anti-climate action groups for control over domestic political institutions. These groups, as Aklin and Mildenberger have shown, care more about the impacts of climate reforms on their assets than whether reforms are coordinated multilaterally.[54] Therefore, the distributive conflict perspective expects that the climate targets of peer countries should not affect the ratchet.

H3 *Unconditional, distributive conflict hypothesis.* States' mitigation contributions will not be related to peers' targets.

5 Target-setting in the United Nations climate regime

I investigate conditional cooperation in United Nations (UN) climate treaties. Studying how cooperation unfolds over time requires a relatively stable institutional context where governments make iterated public commitments, which other governments can observe and use to tailor their own. The ideal empirical context would have all states make rounds of commitments. The Paris

[54] Aklin and Mildenberger 2020.

Agreement's pledge and review process approximates this by inviting all countries to submit climate mitigation commitments every five years that are hosted by the UN climate secretariat. I study the universe of climate mitigation targets under the Paris Agreement and its successor, the Glasgow Climate Pact.

Though not without its critics, the 2015 Paris Agreement was hailed as a breakthrough.[55] The Kyoto Protocol expired in 2012 and negotiations on its successor failed in 2009, leaving an institutional void. The Paris Agreement introduced three key innovations in mitigation target-setting. First, all states are expected to undertake climate action. Paris encourages states to "self-differentiate" and select a level of action that reflects their domestic political circumstances and development priorities. Second, states now pre-submit their mitigation pledges, which become a non-binding annex to the treaty. Prior multilateral negotiations over targets collapsed and Paris' new pledge system ensures that some deal will exist, though it may not be aligned with strong mitigation. These pledge documents are called nationally determined contributions (NDCs).

Third, to bridge the gap between the Paris Agreement's aspirational temperature goals and the weak first NDCs, states introduced a "ratchet mechanism", wherein all parties update their climate targets on a five-year cycle. The treaty text sets an expectation that targets will reflect each country's "highest possible ambition" and "progres[s] over time" to limit warming to "well below 2°C." The ratchet mechanism's first iteration took place at COP26 in Glasgow, which was postponed from November 2020 to November 2021 due to the coronavirus pandemic.

The Glasgow ratchet was successful. 160 countries, representing roughly 94% of global emissions, submitted new NDCs before the Glasgow conference. This is a slight drop-off since 190 countries representing 95% of emissions submitted NDCs in Paris. At the global level, one study estimates that, if fully implemented, the Glasgow pledges would lead to 1.9°C [1.4, 2.8 with 90% confidence intervals] of warming by 2100.[56] This suggests a real improvement on the 2015 Paris pledges, which if fully implemented were estimated to lead to warming of 2.1–3.2°C, and an even greater improvement over "business as usual" baselines that project roughly 4°C.[57]

These global numbers mask variation in the extent to which individual countries submitted stronger targets. The Paris Agreement entailed a compromise, wherein all countries submitted

[55]Allan et al. 2023.
[56]Meinshausen et al. 2022.
[57]Rogelj et al. 2016.

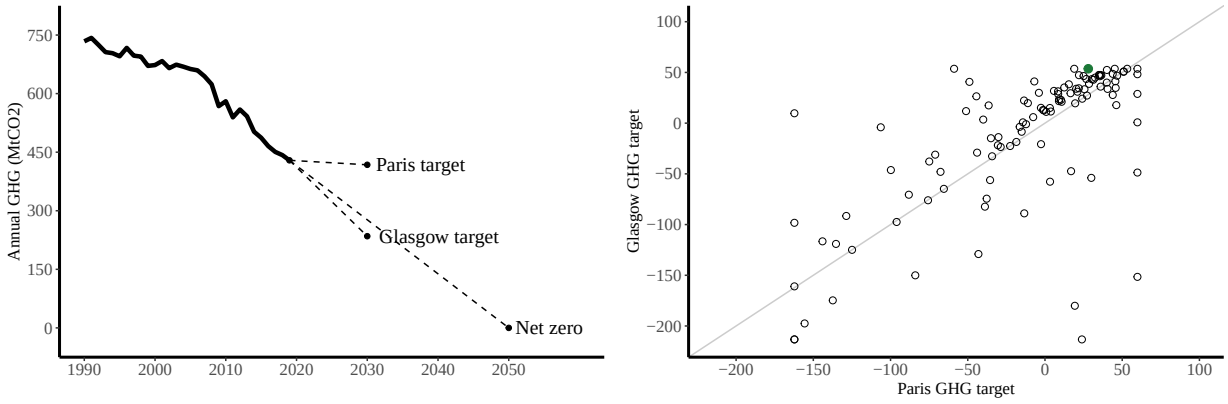

Figure 2: United Kingdom's 2021 target enhances its 2015 target (left panel). Most countries ratcheted and pledged further emissions cuts in 2021 (right panel; UK flagged in green). Values above zero indicate percentage emissions reductions from 2010 levels; values below zero indicate percentage emissions increases from 2010 levels. Values winsorized at the 5th and 95th percentile.

NDCs, but without requirements on content. Therefore, countries submitted targets indexed to a historical base year (e.g., Canada's 40% reduction from 2005 levels), a projected future emissions level (e.g., Mexico's 21.2% reduction from projected emissions levels under a no-policy baseline), some additional variable (e.g., China's pledge to reduce the GHG intensity of economic production by 60% from 2005 levels), among other idiosyncratic formats. This means some NDCs are ambiguous or lack necessary information about their reference emissions levels for quantification. The countries with enhanced NDCs in this study are the subset of countries that have quantifiable 2015 and 2021 NDCs.

The generic updated NDC replaces existing percentage goals with more ambitious ones. For example, in December 2020, the UK government updated its target to reduce GHG emissions by 68% from 1990 levels compared to 37% from 2005 levels (figure 2). 112 countries have quantifiable NDC targets in both rounds of target-setting. Overall, 73 countries submitted stronger targets in their updated NDCs, 9 held theirs constant, and 30 weakened them.

The degree to which these targets improve over their previous targets also varies. Figure 2 displays countries' Paris mitigation targets versus their Glasgow mitigation targets. Countries that submitted stronger updated targets lie above the reflection line, and the median ratcheting country improved their target by 14 percentage points. Countries that submitted weaker targets lie below the reflection line, and in this subset, the median country weakened their target by 40 percentage points. I discuss emissions trajectories for developing countries in more detail in the appendix.

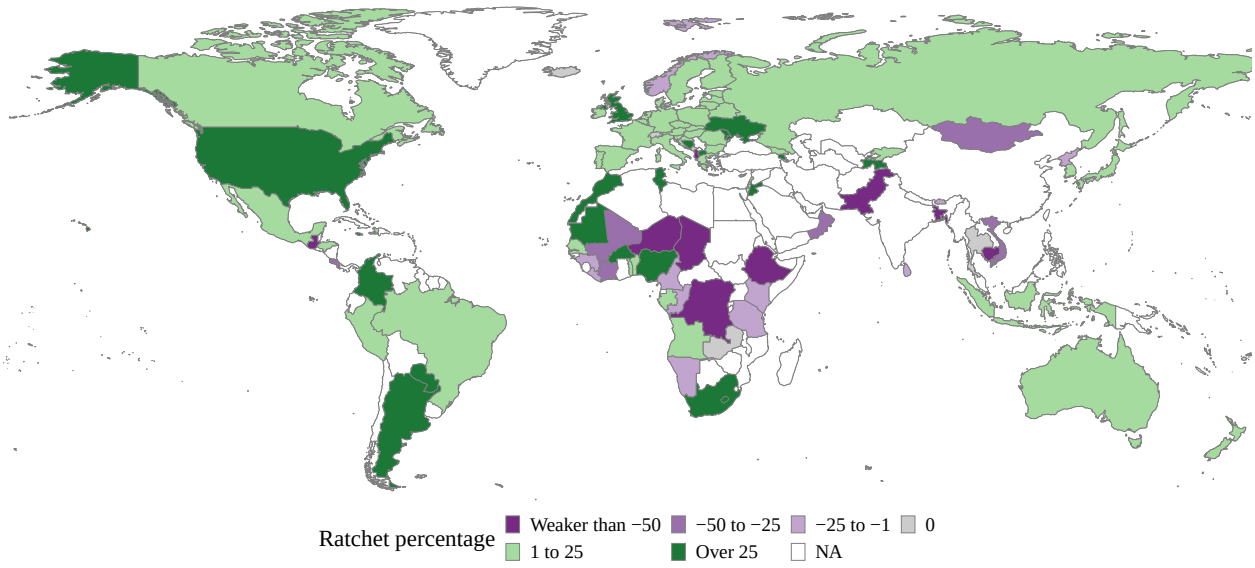

Figure 3: Mitigation enhancement of 2021 NDCs compared to 2015 NDCs in percentage terms. Most countries ratcheted and pledged further emissions cuts (green), while some countries held their pledges constant (light grey), and others weakened their mitigation targets in their updated NDCs (purple). Many countries submitted non-quantifiable NDCs or did not submit updated NDCs (white).

Figure 3 illustrates countries submitted enhanced NDCs. We can see that European and North American countries tended to improve their targets, while some developing countries in Africa and Asia weakened theirs. Nonetheless, regions are diverse, which highlights one of the advantages of the spatial modeling approach that I adopt below. Spatial modeling captures these connections through a defined connectivity matrix that links all countries based on the intensity of their interactions. Regional intercepts are also often used to adjust for differences across regions statistically and can account for further unobserved heterogeneity, but these assume that all states in a defined region are impacted equally. I prefer the spatial approach explained below, but discuss results with regional fixed effects in the supplementary information (section SI-3.1).

6 Research design

6.1 Outcome variable: Updated climate targets

This study's outcome variable is the stringency of states' updated 2021 climate mitigation targets. Climate targets are observed in 2015 and 2021, ahead of the Paris and Glasgow climate summits, respectively. This implies each country's 2021 target can be benchmarked against their most recent target from 2015. I convert each country's 2015 and 2021 NDC into absolute emissions levels and then into percentage changes from 2010, with higher values indicating larger emissions reductions — greater ambition or stringency. While measuring targets in percentages might seem to imply that all countries ought to mitigate equally, which would contravene the climate regime's norm of common but differentiated responsibilities, in practice this measure simply isolates the difference in mitigation between the first and second targets and accounts for persistent differences between countries which are absorbed in the first target's level. Country-specific, time-invariant traits that affect targets are absorbed in the 2015 target, like a lagged dependent variable.

6.2 Explanatory variable: Peers' climate targets

My argument suggests two dimensions of spatial interdependence — trade ties create concerns about economic competitiveness and political ties help to coordinate collective action. Methodological work suggests these should specified in their own connectivity matrices.[58]

For the economic competition argument, competitiveness manifests through trade networks, where high levels of domestic regulation can disadvantage firms in less regulated global markets. I measure economic connectivity between countries using dyadic trade flows. I build an $n \times n$ matrix **Trade** that represents the row-standardized value of bilateral trade. This connects each country i to every other country $j \neq i$ by their dyadic trade relative to their total trade. I aggregate trade over 2016–2019 using data from UN Comtrade and the Centre d'études prospectives et d'informations internationales (CEPII).[59] I build separate matrices for total trade and trade in energy-intensive trade-exposed sectors, defined as aluminum, cement, chemicals, fertilizer, iron, polymers, and

[58]Neumayer and Plümper 2016.
[59]Gaulier and Zignago 2010.

steel.

Row-standardization adjusts the influence of each country's trading partners in proportion to the country's total trade exposure. Moreover, row-standardization implies that all countries are equally exposed to economic competition in trade networks, as their total trade ties sum to unity. Neumayer and Plümper note that this approach neutralizes level effects, which may be inappropriate if countries experience larger spatial stimulus when they are more open to trade.[60] However, all governments encounter competitiveness pressures once they are integrated into the global economy. Upon integration, the primary concern shifts to the degree of policy divergence from peers rather than total trade exposure. Row-standardization maintains the relative importance of each trade partner; for instance, a partner representing 40% of a country's trade will contribute equivalently to its spatial lag, regardless of a country's total trade volume. This method subtly alters the significance of trade partners across dyads because, for countries with the same total trade value, a partner's influence is magnified in countries that trade less. But this is an appropriate operationalization when governments are focused on regulatory harmonization with their most important trading partners.

Consider the United States. Concerns about decarbonization in key trade partners — particularly EITE industries in China, which represent 10–15% of U.S. trade — have led successive administrations to increase tariffs and enact industrial policies to enhance domestic competitiveness. Yet, the United States is among the countries with the lowest trade exposure, defined as imports plus exports as a share of GDP. This suggests that the spatial stimulus is substantial even in relatively closed countries. Nonetheless, I evaluate a non–row-standardized measure in the supplementary information and find similar results (section SI-2.3).

The political ties argument emphasizes that politically close countries can overcome collective action problems and enact reciprocal reforms. I build on existing literature that uses joint membership in IOs to measure political ties. I construct a second $n \times n$ matrix **IOs** that represents the row-standardized sum of common membership in IOs. This connects each country to every other country by their overlapping institutional memberships. I take IO membership from formal IOs and informal ones.[61]

[60] Neumayer and Plümper 2016.
[61] Pevehouse et al. 2020; Roger and Rowan 2023.

I multiply each of these connectivity matrices by an $n \times 1$ vector of lagged climate targets to create a continuous, country-level measure of the stringency of peers' climate targets in the 2015 Paris Agreement. These measures differentiate between countries whose partners set strong or weak prior targets. I re-base all mitigation targets as percentage changes from a common 2010 base year, which places all targets on the same scale, removes opportunistic reporting, and reflects governmental and public discussion of targets. Using a reference year in the past will attenuate percentage reductions for countries that began mitigating before the Paris Agreement was adopted. However, very few countries had made serious prior efforts, so this is not a major measurement concern. For example, Bayer and Aklin estimate that the European Union's emissions trading scheme, widely considered one of the strongest early climate policies, reduced members' emissions by roughly 0.5 percentage points per year from 2008–2016.[62]

6.3 Estimation

I estimate the effect of peers' mitigation targets on a country's own updated climate target using ordinary least squares (OLS) regression with a spatial regressor and a lagged measure of targets. Countries' 2021 Glasgow targets are the outcome variable and the 2015 Paris targets are included as a regressor, which isolates changes between the initial and the ratcheted target. This empirical strategy's strength is that the 2015 target acts as a lagged outcome variable, thereby absorbing time-invariant, country-level factors that affect climate targets.

The primary explanatory variables are spatial lags for the trade-weighted and IO-weighted climate policy of peers, whose effect is identified by controlling for previous targets. This estimation strategy assumes no confounding between the spatially lagged climate policy terms and the 2021 targets. Existing research has struggled to identify a consistent set of cross-national predictors of climate policy. Most candidate factors are relatively stable over time and the relatively short observation period between 2015 and 2021 implies they should be well accounted for with the lagged outcome variable. To address confounding, I include specifications that control for fossil fuel rents, industrial composition, total trade exposure, and renewable electricity generation.

[62]Bayer and Aklin 2020.

I estimate versions of the following spatial lag of x (SLX) model by OLS:

$$\text{GlasgowTarget}_{i,2021} = \alpha + \beta\text{ParisTarget}_{i,2015} + \theta\mathbf{W}\text{ParisTarget}_{j\neq i,2015} + \epsilon_i$$

where θ estimates the effect of weighted peers' prior climate targets. I swap two types of connectivity matrices $\mathbf{W}$ across specifications: for trade **Trade** and for IOs **IOs**. Each spatial lag varies by country i as it re-weights other countries' 2015 Paris mitigation target by their dyadic trade or joint membership in IOs. The main coefficient of interest is θ, where positive coefficients indicate conditional cooperation, negative coefficients indicate free riding, and coefficients indistinguishable from zero indicate no conditional dynamics. The SLX model does not introduce the same concern about simultaneity bias as spatial autoregression models because the outcome variable does not appear on both sides of the equation, so it can be estimated by OLS.[63] Similarly, SLX estimates spatial spillovers directly in θ, which can take values greater than $|1|$, unlike how spatial autoregression models require interpreting indirect effects through a combination of the model parameters and the connectivity matrix.[64]

Data for these variables are public. I hand code 2015 and 2021 mitigation targets from countries' NDCs. Total trade flows are from CEPII, which is derived from UN Comtrade, from which I take the sectoral trade data. Controls are from the World Bank. Missing covariates and trade data are multiply imputed. The mitigation targets have outliers at both extremes, so I winsorize these variables at the 5th and 95th percentiles. More details, summary statistics, and alternative specifications are in the appendix.

7 Results

Table 1 investigates the economic competitiveness argument. Higher values of the dependent variable indicate larger emissions cuts, or better targets. The key coefficient of interest is θ on the **Trade**ParisTarget term, which measures the Paris targets of each state's peers weighted by their dyadic trade ties. In model 1, the spatial term is positive and statistically significant at conventional thresholds, indicating that governments set stronger Glasgow targets when their trade partners set

[63] Vega and Elhorst 2015.
[64] Ward and Gleditsch 2018, pp. 99–101.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
TradeParis	1.01**	0.89*						
	(0.31)	(0.36)						
Trade$^{\text{EITE}}$Paris			0.72**	0.74**				
			(0.18)	(0.22)				
Trade$^{\text{Competition}}$Paris					0.82*	0.85*		
					(0.36)	(0.37)		
Trade$^{\text{Competition,EITE}}$Paris							0.67**	0.67**
							(0.22)	(0.24)
Paris target	0.71**	0.70**	0.66**	0.65**	0.77**	0.72**	0.74**	0.70**
	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)
(Intercept)	9.58	6.05	13.46*	27.92	24.16+	−5.08	18.17*	21.65
	(5.82)	(48.23)	(6.01)	(47.89)	(12.40)	(47.03)	(7.99)	(49.32)
Controls	No	Yes	No	Yes	No	Yes	No	Yes
Observations	112	112	112	112	112	112	112	112
R^2	0.50	0.51	0.52	0.53	0.48	0.51	0.50	0.52

Table 1: Outcome variable is emissions change in 2021 NDC as a percentage of 2010 emissions levels, re-scaled so that positive values are emissions cuts. OLS regression models with standard errors in parentheses. + p < 0.1, * p < 0.05, ** p < 0.01

strong Paris targets. Substantively, a one-unit change in trade-weighted peers' climate targets — where peers set targets 1 percentage point stronger on average — implies an additional 1.01 [0.40, 1.63] percentage point emissions reduction in Glasgow, controlling for the strength of a country's previous Paris target. This is evidence against the economic competitiveness hypothesis, which proposed that states would weaken their mitigation contributions when their trading partners set strong targets. Economic competitiveness as manifested by joint trade ties does not appear to hold climate policy back. Instead, strong climate policy by trade partners supports conditional cooperation.

This result is robust across a number of specifications. Model 1 is estimated without controls, so I add fossil fuel rents, industrial composition, trade exposure, and renewable electricity generation in even numbered models in table 1.

One concern may be that total trade flows mischaracterize how trade raises competitiveness concerns. Trade in EITE sectors may better capture the relevant ties because these goods will be the most sensitive to changes in relative prices induced by climate regulation. I create a new connectivity matrix **Trade**$^{\text{EITE}}$ that contains only dyadic trade in these sectors, re-measure the spatial lag, and then re-estimate the models. In models 3 and 4, I find the same positive, statistically

significant effect.

I also consider the role of trade competition with an alternative connectivity matrix that measures the similarity of dyadic exports to third states. If two countries share similar export profiles, where their most important export markets are similar, then they may be trade competitors even if these two countries have little bilateral trade. I construct $\mathbf{Trade}^{\text{Competition}}$ as the cosine similarity of each state's export flows, separately for total and EITE trade, and re-calculate the spatial lags. I then find positive, statistically significant coefficients for trade competition in models 5 through 8.

Overall, rather than trade ties undermining climate policy, I find that trade ties support conditional cooperation. In the Paris Agreement's ratchet process, governments were willing to set more ambitious climate targets when their most important trading partners set strong previous targets.

Table 2 investigates the political reciprocity hypothesis that expects states to set stronger climate targets when states they are more connected to politically set strong prior targets. The key coefficient is on the **IOs**Paris term, which measures the climate targets of states' political peers weighted by their sum of joint dyadic IO memberships. In models 1 and 2, I find a strong positive effect of political peers' climate targets on the ratchet process. Governments were more willing to strengthen their climate mitigation targets at the Glasgow climate summit when the states with whom they share common IO memberships set strong targets under the Paris Agreement. This is support for conditional cooperation. Prior action by politically relevant peers helps states overcome collective action problems and set more ambitious climate goals.

We now have evidence that trade and political ties each support conditional climate cooperation. On one hand, this is surprising given the existing literature that suggests trade competition hinders climate action. However, on the other hand, trade ties and political ties are correlated, with a Pearson correlation coefficient of $r = 0.69$. This implies that some of the effect of economic ties on cooperation may be confounded when political ties are omitted. In models 3–7 of table 2, I include both political and economic spatial weights. The coefficient for peers' IO-weighted climate policy is positive and statistically significant in all but one of these models, suggesting an independent effect of political connections. By contrast, the effect of trade ties is attenuated and never statistically significant. This implies that the IO-weighted term explains most of the

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
IOsParis	4.27**	4.25**	3.26*	3.34*	2.40	3.85**	3.41**
	(1.11)	(1.39)	(1.49)	(1.66)	(1.58)	(1.15)	(1.22)
TradeParis			0.41	0.43			
			(0.41)	(0.43)			
Trade$^{\text{EITE}}$Paris					0.43		
					(0.26)		
Trade$^{\text{Competition}}$Paris						0.48	
						(0.36)	
Trade$^{\text{Competition, EITE}}$Paris							0.39
							(0.24)
Paris target	0.70**	0.70**	0.69**	0.69**	0.66**	0.70**	0.69**
	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)
(Intercept)	127.68**	135.59+	101.77*	121.79	79.99+	130.13**	113.06**
	(33.93)	(73.27)	(42.46)	(74.55)	(44.26)	(33.86)	(34.84)
Controls	No	Yes	No	Yes	No	No	No
Observations	112	112	112	112	112	112	112
R^2	0.52	0.52	0.53	0.53	0.53	0.53	0.53

Table 2: Outcome variable is emissions change in 2021 NDC as a percentage of 2010 emissions levels, re-scaled so that positive values are emissions cuts. OLS regression models with standard errors in parentheses. + p < 0.1, * p < 0.05, ** p < 0.01

same variation in the ratchet that the trade-weighted term explains, but that joint IO membership also explains some additional variation in targets beyond what trade ties can also explain. Trade connections do not necessarily enable countries to cooperate conditionally on climate mitigation, as this effect is better attributed to joint political ties. Nonetheless, there remains no evidence that trade ties hinder climate cooperation, as expected by economic competition because the coefficient is not negative.

In supplementary information, I address further considerations in measurement and estimation. One consideration with measuring the strength of peers' climate policy by their Paris mitigation targets is that, while the targets provide an indication of mitigation's direction and pace, targets may be disconnected from enacted policies. As a robustness test, I rebuild the spatial weights swapping measures of climate targets for the number of climate laws a country has passed. I find that IO-weighted measures remain positive and statistically significant, though trade-weighted measures are not statistically significant (section SI-2.2). Second, I build alternative spatial weights that do not row–standardize and therefore allow the effect of the spatial stimulus to vary based on levels

of trade exposure or IO memberships. I find that the trade term is robust across specifications. However, the IO term is more influenced by this measurement choice, such that it may be the case that IO-weighted peers' climate targets have the strongest influence on countries with fewer total IO memberships and this influence wanes for countries at the highest percentiles of IO membership (section SI-2.3). Third, I analyze specifications with regional fixed effects that could capture additional confounding between peers' targets and the ratchet (section SI-3.1). In these models, the trade terms are attenuated, but the IO term is stable across specifications. In both cases, the statistical significance falls below conventional thresholds. Fourth, since many countries did not submit targets and therefore may be missing non-randomly from the data, I use multiple imputation to add missing 2015 and 2021 targets and re-run the model. I find the same results (section SI-2.1). Finally, sensitivity analysis suggests that even an omitted confounder as strongly correlated with IO-weighted peers' climate targets and the Glasgow targets as the Paris targets would not drive the estimates to zero or its p-value above 0.05 (section SI-3.3).

8 Conclusion

Research on international climate politics has been divided between an enforcement and a distributive conflict perspective. Scholars from the enforcement perspective have called for the flawed UN process to be jettisoned and replaced with a binding regime.[65] Similarly, the distributive perspective casts doubt on the viability of the UN process because it cannot resolve domestic zero-sum battles.[66] Both perspectives doom the non-binding, consensus-driven, universal membership Paris Agreement to irrelevance.

However, the empirical record suggests that states have bought into the Paris framework and are making progress through its ratchet mechanism. While not every state has committed to strong targets, a crucial subset has and they are pulling others with them. In this paper, I document extensive ratcheting in national targets and find that political networks support increasingly ambitious targets. Specifically, when states met in Glasgow to deliver their verdict on the Paris Agreement, they were more likely to commit to stronger targets when their political peers had ambitious targets. This is

[65] Nordhaus 2015.
[66] Aklin and Mildenberger 2020; Colgan et al. 2021.

in keeping with the institutional design of the Paris Agreement,[67] an agreement many observers claimed would fail.

What does this imply about climate cooperation? First, there are strong elements of positive reciprocity in target-setting. Governments are more willing to act when others have as well. Second, we see progress on targets because some states have been willing to lead through unilateral action. Without at least some states setting strong Paris targets, we would likely not have observed a strong ratchet. Third, it is important to remember that global mitigation remains under-provided, as the Glasgow targets still hold the possibility of breaching the 1.5°C threshold. That countries are strengthening their targets over time does not imply they have committed to sufficient targets. Finally, it remains important to examine compliance. It may be easier to generate compliance with existing targets than to generate strong targets in the first place. While the NDCs are not binding under international law, they often have been treated as such by domestic courts and activists who can put pressure on governments to comply. By creating an institution that blends international and domestic logics of climate policy, the Paris architects seem to have created a resilient institution that motivates greater action.

[67] Allan et al. 2023.

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Supporting information for:
"From gridlock to ratchet:
Conditional cooperation on climate change"

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SI-1 Full regression tables and summary statistics

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
TradeParis	1.01**	0.89*						
	(0.31)	(0.36)						
Trade$^{\text{EITE}}$Paris			0.72**	0.74**				
			(0.18)	(0.22)				
Trade$^{\text{Competition}}$Paris					0.82*	0.85*		
					(0.36)	(0.37)		
Trade$^{\text{Competition, EITE}}$Paris							0.67**	0.67**
							(0.22)	(0.24)
Trade openness		2.39		0.74		6.74		0.98
		(9.92)		(9.60)		(9.52)		(9.88)
Industry		−0.62		−0.65		−0.67		−0.81
		(0.71)		(0.69)		(0.71)		(0.70)
Renewable electricity		0.78		−0.10		2.22+		1.60
		(1.20)		(1.24)		(1.12)		(1.11)
Fossil rents		3.72		−2.11		5.07		2.27
		(8.86)		(8.93)		(8.87)		(8.83)
Paris target	0.71**	0.70**	0.66**	0.65**	0.77**	0.72**	0.74**	0.70**
	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)
(Intercept)	9.58	6.05	13.46*	27.92	24.16+	−5.08	18.17*	21.65
	(5.82)	(48.23)	(6.01)	(47.89)	(12.40)	(47.03)	(7.99)	(49.32)
Controls	No	Yes	No	Yes	No	Yes	No	Yes
Observations	112	112	112	112	112	112	112	112
R^2	0.50	0.51	0.52	0.53	0.48	0.51	0.50	0.52

Table SI-1: Full regression results from models in table 1. Outcome variable is emissions change in 2021 NDC as a percentage of 2010 emissions levels, re-scaled so that positive values are emissions cuts. OLS regression models with standard errors in parentheses. + p < 0.1, * p < 0.05, ** p < 0.01

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
IOsParis	4.27**	4.25**	3.26*	3.34*	2.40	3.85**	3.41**
	(1.11)	(1.39)	(1.49)	(1.66)	(1.58)	(1.15)	(1.22)
TradeParis			0.41	0.43			
			(0.41)	(0.43)			
Trade$^{\text{EITE}}$Paris					0.43		
					(0.26)		
Trade$^{\text{Competition}}$Paris						0.48	
						(0.36)	
Trade$^{\text{Competition, EITE}}$Paris							0.39
							(0.24)
Trade exposure		0.51		−1.30			
		(9.78)		(9.94)			
Industry		−0.56		−0.55			
		(0.70)		(0.70)			
Renewable electricity		0.06		−0.08			
		(1.25)		(1.26)			
Fossil rents		5.54		4.72			
		(8.71)		(8.75)			
Paris target	0.70**	0.70**	0.69**	0.69**	0.66**	0.70**	0.69**
	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)
(Intercept)	127.68**	135.59+	101.77*	121.79	79.99+	130.13**	113.06**
	(33.93)	(73.27)	(42.46)	(74.55)	(44.26)	(33.86)	(34.84)
Controls	No	Yes	No	Yes	No	No	No
Observations	112	112	112	112	112	112	112
R^2	0.52	0.52	0.53	0.53	0.53	0.53	0.53

Table SI-2: Full regression results from models in table 2. Outcome variable is emissions change in 2021 NDC as a percentage of 2010 emissions levels, re-scaled so that positive values are emissions cuts. OLS regression models with standard errors in parentheses. + p < 0.1, * p < 0.05, ** p < 0.01

Variable	N	Mean	Std. Dev.	Min.	Median	Max
Glasgow target	112	-11.7	69.1	-213.2	16.3	53.6
Paris target	112	-13.3	59.7	-162.2	3.5	59.9
IOsParis	112	-30.5	4.3	-35.8	-31.8	-23.6
TradeParis	112	-11.7	15.6	-47.0	-10.9	11.5
Trade$^{\text{EITE}}$Paris	112	-22.8	26.8	-72.6	-22.9	16.8
Trade$^{\text{Competition}}$Paris	112	-31.5	13.1	-55.8	-31.5	-9.0
Trade$^{\text{Competition, EITE}}$Paris	112	-30.0	21.7	-71.6	-25.6	0.8

Table SI-3: Summary statistics for observations in the main models (no missing target data)

	Glasgow	Paris	**IO**Paris	**Trade**Paris	**Trade**$^{\text{EITE}}$Paris
Glasgow target	1.000	0.675	0.421	0.390	0.495
Paris target	0.675	1.000	0.259	0.264	0.378
IOParis	0.421	0.259	1.000	0.688	0.738
TradeParis	0.390	0.264	0.688	1.000	0.844
Trade$^{\text{EITE}}$Paris	0.495	0.378	0.738	0.844	1.000

Table SI-4: Correlation matrix

SI-2 Measurement

SI-2.1 Climate targets

M1 Some countries did not submit NDCs with mitigation targets, leading them to have missing values in the dataset. Since these targets are unlikely to be missing at random, in table SI-5, I multiply impute these missing values and re-estimate the relationship. I find the same results.

M2 Since some countries did not submit NDCs with mitigation targets, this means that their values as trade partners in constructing the spatial weights are also missing. In the main results presented in text, I use the imputed values to generate the spatial weights (see previous item). I now use only the observed (non-imputed) values to generate the spatial weights, where missing trade partners' values stay missing and contribute nothing to measuring peers' trade-weight climate policy. I re-estimate the models and find the same effects as before.

M3, M4 Some countries set very weak mitigation targets in their NDCs, which would allow emissions to rise 5 or more times by 2030 and still be in compliance with their targets. These outlying values can have high leverage on the coefficients, so I winsorize targets at the 5th and 95th percentiles in the main models. Now, I consider the stability of the coefficients by dropping observations. First, I removed three observations based on their extreme values of their Paris target (Paraguay) or their Glasgow target (Cote d'Ivoire, Gambia); in re-running the models, I find the same result (M3). Second, I drop 7 countries based on their Cook's distance (the prior three, plus Cambodia, Mali, Niger, and Pakistan); in re-running the models, I find the same result, which suggests that outlying observations are not driving the results (M4).

M5 Countries choose to index their mitigation targets to measures of GHG emissions including land-use, land-use change, and forestry (LULUCF) or excluding these emissions. LULUCF emissions can be highly idiosyncratic year-on-year, as they can be influenced by deforestation shocks, such as wildfires and land clearing. Countries often prefer to use LULUCF accounting because forestry can act as a carbon sink and provide low-cost carbon dioxide removals that aid national inventories. But they are also more difficult to measure than emissions from other sources, such as electricity generation or transportation, and therefore many analyses exclude them. As a robustness test, I swap all countries' mitigation targets to be based on measures that exclude LULUCF emissions; in re-running the models, I find the same result.

	(1)	(2)	(3)	(4)	(5)
IOsParis	5.67**		2.57*	2.09*	3.17**
	(1.25)		(1.21)	(1.01)	(1.11)
TradeParis	0.06		0.17	0.13	0.01
	(0.30)		(0.33)	(0.28)	(0.30)
IOsParis (don't impute partner's target)		7.99**			
		(2.42)			
TradeParis (don't impute partner's target)		0.24			
		(0.54)			
Paris target		0.72**	0.81**	0.76**	
		(0.08)	(0.07)	(0.06)	
Paris target (impute)	0.58**				
	(0.06)				
Paris target (emissions excluding LULUCF)					0.81**
					(0.06)
(Intercept)	151.69**	99.48**	81.64*	70.13*	99.07**
	(36.88)	(31.91)	(34.46)	(28.77)	(31.60)
Observations	192	112	109	105	106
R^2	0.45	0.53	0.66	0.67	0.77

Table SI-5: Regressions with different measurement considerations. Outcome variable is emissions change in 2021 NDC as a percentage of 2010 emissions levels, re-scaled so that positive values are emissions cuts. OLS regression models with standard errors in parentheses. + p < 0.1, * p < 0.05, ** p < 0.01

SI-2.2 Climate laws

One consideration with measuring the strength of peers' climate policy by their Paris mitigation targets is that, while the targets provide an indication of countries' directions and paces on mitigation, targets may be disconnected from enacted policies. As a robustness test, I rebuild the spatial weights swapping measures of climate targets for the number of climate laws a country has passed, using the Grantham Institute's climate laws database. I use two measures: (1) a straight count of national climate laws, and (2) a count of national climate laws passed between 2016 and 2019. In moving from targets to laws, some comparability across countries is lost. While targets can be standardized across countries, the impact of individual laws is more varied. Some laws enact economy-wide mitigation requirements, but others are more targeted on individual sectors. As such, laws provide a proxy for policymaking effort, but remain several steps removed from the underlying concept.

In table SI-6, I show six models using these different measures of peers' climate policy. I find that IO-weighted measures remain positive and statistically significant. Trade-weighted measures are not statistically significant.

	(1)	(2)	(3)	(4)	(5)	(6)
TradeLaws (count)	3.63+				−0.12	
	(1.93)				(2.25)	
TradeLaws (post-Paris)		5.14				−0.88
		(4.41)				(4.49)
IOLaws (count)			25.95**		26.22**	
			(7.25)		(8.80)	
IOLaws (post-Paris)				72.83**		74.28**
				(18.78)		(20.26)
Paris target	0.76**	0.77**	0.70**	0.69**	0.70**	0.69**
	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)
(Intercept)	−62.63+	−28.98	−284.81**	−243.29**	−285.67**	−243.37**
	(32.89)	(24.27)	(79.39)	(62.55)	(81.34)	(62.83)
Observations	112	112	112	112	112	112
R^2	0.47	0.46	0.51	0.52	0.51	0.52

Table SI-6: Regressions with climate laws as measure of peers' climate policy. Outcome variable is emissions change in 2021 NDC as a percentage of 2010 emissions levels, re-scaled so that positive values are emissions cuts. OLS regression models with standard errors in parentheses. + p < 0.1, * p < 0.05, ** p < 0.01

SI-2.3 Spatial matrices

Trade flows. The models in the main text use row-standardized spatial matrices for dyadic trade ties and joint IO memberships. Concretely, the row-standardized measure divides the value of dyadic trade by a country's total trade: $(Imports_{i \leftarrow j} + Exports_{i \rightarrow j})/(Imports_i + Exports_i)$. This means that a country's trade to each of its partners is converted to a share of that country's total trade, and each country's total trade shares add to 1. This also implies that each country is equally exposed to international trade, since all countries' total trade exposures are the same. However, we know that countries are differentially integrated into global trade, with some countries trading high volumes and others trading lower volumes relative to the size of their economy. When governments set climate targets, if they take into account their trade partners' climate targets *and* they respond differently when they are more integrated into the global economy, then the row-standardized spatial matrix will misrepresent the data generating process.

I now investigate an alternative construction of the spatial weight for trade, where trade ties are normalized by dividing dyadic trade by a country's economic size rather than standardizing across countries as dyadic trade shares. Concretely, cells of the connectivity matrix are GDP-normalized by taking dyadic trade and dividing dyadic imports and exports by GDP: $(Imports_{i \leftarrow j} + Exports_{i \rightarrow j})/GDP_i$. With this measure, countries that trade large volumes relative to the size of their economy are more exposed to international trade and receive a larger spatial stimulus from their trade partners' climate targets. The Pearson correlation coefficient between the row-standardized and the GDP-normalized spatial weight for countries in the analysis is $r = 0.84$. I also multiply the GDP-normalized spatial weight by 1000 to bring it onto a similar scale as the row-standardized measure. I construct an analogous measure for EITE trade only.

In table SI-7, models 1 and 2 reproduce the results from the main text (table 1, models 1 and 2), which use a row-standardized spatial matrix for trade ties. In models 3 and 4, I use the GDP-normalized spatial matrix instead, and I recover the same positive and statistically significant coefficient. Models 5 and 6 find the same results with EITE trade. An interaction model can help adjudicate which of the row-standardized or GDP-normalized measures better characterizes climate target-setting. Interacting the row-standardized spatial weight with trade openness allows the effect of trade partners' climate targets to vary based on a country's level of trade openness

because trade openness sums national imports and exports as a share of GDP. This is analogous to the GDP-normalized measure, but explicitly models whether the effect of trade partners' targets depends on levels of trade openness. In models 7 and 8, I interact the row-standardized spatial weight with a country's log-transformed trade openness, which was a control variable in model 2. I find that the coefficient on the interaction term is not statistically significant and the main effects are also no longer significant. That the interaction is not significant suggests that the effects of trade partners' climate targets does not differ by levels of trade openness. This lends support for relying on the row-standardized measure, where all states receive equivalent impulses from their trade partners, regardless of their levels of trade.

Figure SI-1 examines common support between trade openness and the row-standardized spatial weight for trade and finds common support across terciles of trade openness, with the exception of low trade openness and high values of the spatial weight. In the right panel, I show the fitted values and 95% confidence intervals across the range of the spatial weight for trade for a relatively closed country (where trade is roughly 54% of GDP; the 25th percentile of trade openness) and a relatively open country (where trade is roughly 103% of GDP; the 75th percentile). Here, there is no difference in the effect of the spatial weight at low and high values of trade openness.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
TradeParis (row-standardized)	1.01**	0.89*					4.94+	5.12+
	(0.31)	(0.36)					(2.81)	(2.85)
TradeParis (normalized by GDP)			1.16**	1.06**				
			(0.33)	(0.37)				
Trade$^{\text{EITE}}$Paris (normalized by GDP)					6.32**	5.61*		
					(2.06)	(2.29)		
TradeParis (row-standardized):Trade openness							−0.90	−0.96
							(0.64)	(0.65)
Trade openness		2.39		9.16		8.52	−9.17	−8.95
		(9.92)		(9.25)		(9.37)	(12.12)	(12.44)
Paris target	0.71**	0.70**	0.73**	0.71**	0.71**	0.69**	0.72**	0.71**
	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)
(Intercept)	9.58	6.05	7.49	−24.11	5.93	−22.78	52.39	60.20
	(5.82)	(48.23)	(5.35)	(43.58)	(5.33)	(44.38)	(55.54)	(60.10)
Controls	No	Yes	No	Yes	No	Yes	No	Yes
Observations	112	112	112	112	112	112	112	112
R^2	0.50	0.51	0.51	0.52	0.50	0.51	0.51	0.52

Table SI-7: Regressions with dyadic trade flows normalized by GDP levels. Outcome variable is emissions change in 2021 NDC as a percentage of 2010 emissions levels, re-scaled so that positive values are emissions cuts. OLS regression models with standard errors in parentheses. + p < 0.1, * p < 0.05, ** p < 0.01

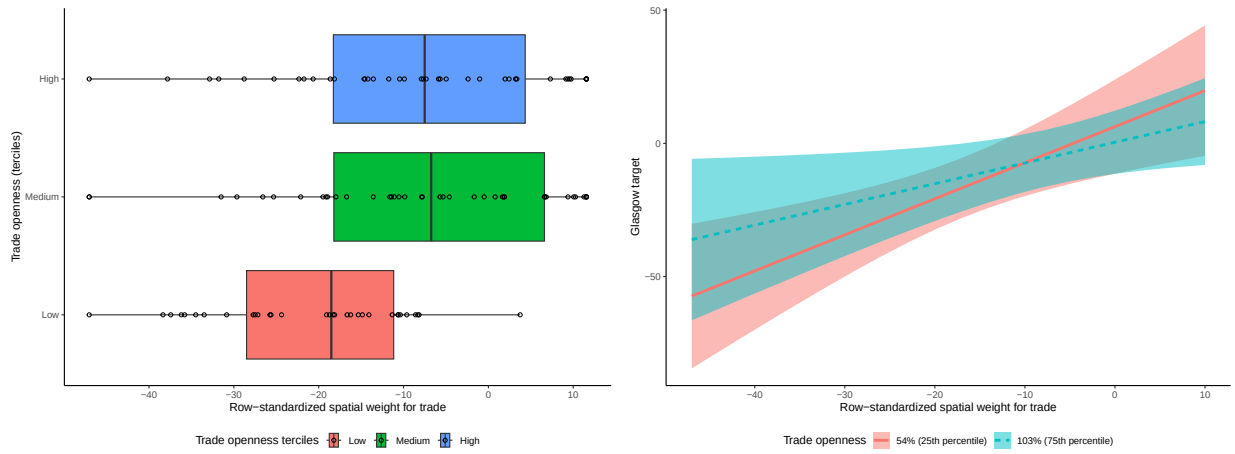

Figure SI-1: Multiplicative interaction model for row-standardized spatial weight for trade and trade openness (trade as a share of GDP). The left panel investigates common support for the spatial weight across terciles of trade openness. The right panel shows fitted values from M7.

IO memberships. The same consideration could arise with the spatial matrix for joint IO memberships, which is row-standardized in the main text. I now create a non–row-standardized matrix of joint IO ties and use this to re-create the IO-weighted measure of peers' climate targets. With this measure, states receive a larger spatial stimulus when they have more total IO memberships. The Pearson correlation coefficient between the row-standardized and the non–row-standardized spatial weight for countries in the analysis is only $r = 0.22$. I also divide the spatial weight by 1000 to place it on a similar scale as the prior measure.

Table SI-2 begins by reproducing the baseline models from table 2. Then in models 3 and 4, I use the non–row-standardized measure of IO ties. The coefficient on IO ties is not statistically significant in either model. I investigate this further by interacting the row-standardized spatial weight and the count of IO memberships in models 5 and 6. Once again, this allows the effect of IO-weighted peers' climate targets to vary at different levels of countries' total IO membership. We see a positive main effect for the spatial weight and a negative interaction effect in both models.

In figure SI-2, I investigate common support and show fitted values for model 5. First, the data lack common support, as there are no countries in the lowest tercile of IO membership whose IO-weighted peers have stronger climate targets than about -29%. Therefore, we should be attentive to not make inferences outside the range of common support. Second, the fitted values show that countries set stronger targets when their IO-weighted peers set stronger targets, but that the marginal effect of these peers' targets wanes as states have more IO memberships. The interaction effect is negative, implying that IO-weighted peers' climate targets have diminishing effects on the ratchet process as countries gain more total IO memberships. The fitted values in figure SI-2 suggest that the effect of IO ties flattens out at high counts of IO memberships rather than reversing and turning sharply negative. The effect is still positive at the 75th percentile of total IO membership and reaches zero around the 93rd percentile of membership. Combined with the positive main effect of the IO-weighted targets and the positive effect for countries in the lower tercile, there remains some empirical support for the ratchet process diffusing through shared IO memberships, though the effect appears to be diluted when states have many IO memberships.

	(1)	(2)	(3)	(4)	(5)	(6)
IOsParis (row-standardized)	4.27**	4.25**			12.33**	11.72*
	(1.11)	(1.39)			(4.39)	(4.61)
IOsParis (non–row-standardized)			0.03	−0.03		
			(0.13)	(0.15)		
IOsParis (row-standardized):IO memberships					−0.08*	−0.08*
					(0.04)	(0.04)
IO memberships					−2.34+	−2.25+
					(1.19)	(1.23)
Paris target	0.70**	0.70**	0.78**	0.73**	0.73**	0.72**
	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)
(Intercept)	127.68**	135.59+	5.99	−56.47	359.19*	324.37+
	(33.93)	(73.27)	(31.59)	(72.14)	(137.76)	(169.93)
Controls	No	Yes	No	Yes	No	Yes
Observations	112	112	112	112	112	112
R2	0.52	0.52	0.46	0.48	0.54	0.54

Table SI-8: Regressions with alternative spatial weights for joint IO memberships. Outcome variable is emissions change in 2021 NDC as a percentage of 2010 emissions levels, re-scaled so that positive values are emissions cuts. OLS regression models with standard errors in parentheses. + p < 0.1, * p < 0.05, ** p < 0.01

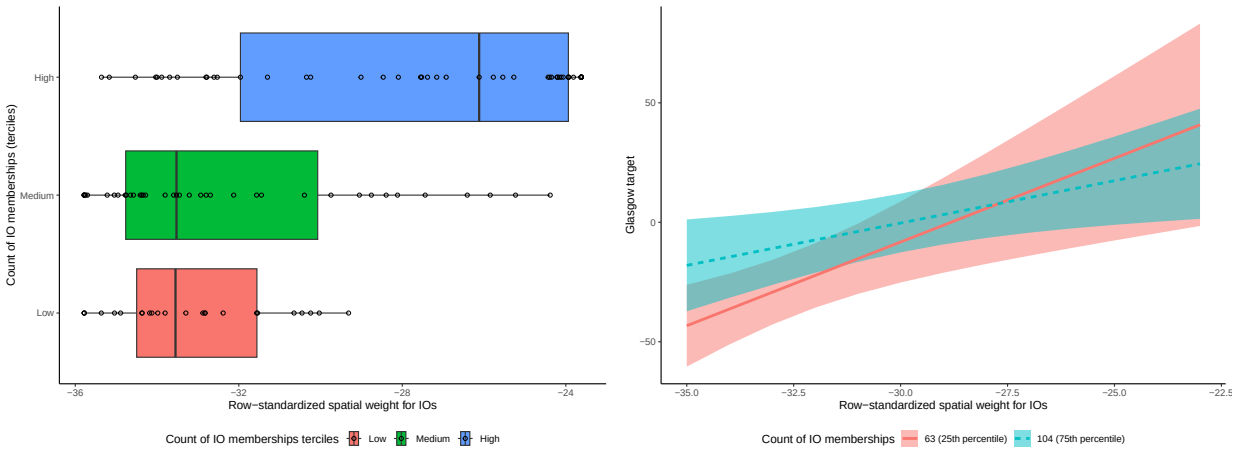

Figure SI-2: Multiplicative interaction model for row-standardized spatial weight of IO peers' climate targets and states' counts of IO memberships. The left panel investigates common support for the spatial weight across terciles of trade openness. The right panel shows fitted values from M5.

SI-3 Estimation

SI-3.1 Unobserved regional heterogeneity

Figure 3 suggests that ratcheting behavior may cluster geographically — where some world regions have ratcheted more on average, while others have ratcheted less. The spatial terms already account for regional variation to the extent that countries trade more with their geographic neighbors and share more international organizational memberships with their neighbors through regional IOs. Nonetheless, there may be further unobserved heterogeneity across regions and I now include a set of regional fixed effects to account for this. I take the World Bank's regional classifications and add these to the main regression models; East Asia and the Pacific is the reference category.

I report these results in table SI-9, where even numbered models control for trade openness, industry's share of GDP, renewable electricity generation, and fossil fuel rents. In models 1 and 2, we see that the **Trade**Paris term is no longer statistically significant when controlling for regional heterogeneity. The **IOs**Paris term remains statistically significant in models 3 and 4. Finally, in models 5 and 6, with the spatial terms for trade and IOs, neither spatial term is statistically significant at conventional thresholds. The p-values for **Trade**Paris are very large, while those for **IOs**Paris are 0.025, 0.044, 0.054, and 0.066 across models 3–6, respectively. Nonetheless, the coefficients on **IOs**Paris are very stable across models, which suggests that omitting the regional intercepts does not bias the estimates. The standard errors are larger in models 5 and 6, which make the estimates less precise. The only remaining variation in models 5 and 6 for the **IOs**Paris term to explain is within-region IO ties beyond what can be accounted for with existing trade ties *and* the lagged Paris climate target in a single cross-section. Introducing these additional region terms adds little to the model fit, as shown by the small increase in the R^2 statistic between table 2 and table SI-9. This is intuitive given that the lagged climate target already accounts for most of the underlying variation in levels across observations. As a result, these models may be over-specified, which can be inefficient and inflate standard errors.

	(1)	(2)	(3)	(4)	(5)	(6)
TradeParis (row-standardized)	0.41	0.34			−0.08	−0.14
	(0.36)	(0.39)			(0.44)	(0.47)
IOsParis (row-standardized)			4.71*	5.03*	5.00+	5.52+
			(2.07)	(2.47)	(2.56)	(2.97)
Europe and Central Asia	33.99*	35.91*	15.62	15.53	15.24	14.80
	(16.37)	(17.61)	(18.60)	(20.53)	(18.79)	(20.77)
Latin America and Caribbean	44.57*	46.00*	54.94**	57.39**	55.97**	59.53**
	(18.59)	(19.88)	(18.38)	(19.61)	(19.25)	(20.94)
Middle East and North Africa	33.45	36.08	37.34+	36.56	37.70+	37.11
	(22.63)	(24.05)	(22.25)	(23.58)	(22.43)	(23.76)
North America	44.05	44.03	32.21	33.13	32.31	33.98
	(36.92)	(38.66)	(36.75)	(38.29)	(36.92)	(38.57)
South Asia	−8.66	−6.98	−3.20	0.66	−3.65	0.31
	(25.93)	(26.72)	(25.48)	(26.53)	(25.71)	(26.68)
Sub-Saharan Africa	−0.12	1.71	13.73	14.62	14.23	15.81
	(16.60)	(17.85)	(17.67)	(18.69)	(17.95)	(19.20)
Paris target	0.71**	0.70**	0.70**	0.69**	0.70**	0.70**
	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)
(Intercept)	−18.91	−20.65	121.55+	126.65	129.16+	135.44
	(14.97)	(54.37)	(65.93)	(94.81)	(77.32)	(99.64)
Controls	No	Yes	No	Yes	No	Yes
Observations	112	112	112	112	112	112
R^2	0.56	0.56	0.58	0.58	0.58	0.58

Table SI-9: Alternative specification of main models with regional intercepts added; reference region is "East Asia and the Pacific". Outcome variable is emissions change in 2021 NDC as a percentage of 2010 emissions levels, re-scaled so that positive values are emissions cuts. OLS regression models with standard errors in parentheses. + p < 0.1, * p < 0.05, ** p < 0.01

SI-3.2 Independence of trade and IO pathways

The models in text present an independent relationship between trade-weighted peers' and IO-weighted peers' climate targets — where each has an additive effect on the ratchet that can be estimated after partialling out the other's influence. However, it could also be the case that the targets of trade-weighted and IO-weighted peers interact — either through a complementary process where strong pre-existing IO ties support trade ties or a substitution process where strong IO ties can make up for weak trade ties, and vice versa. I model this as a multiplicative interaction effect in table SI-10. Models 1 and 2 reproduce the main results from 2. Models 3 and 4 add the interaction, and the interaction term is not statistically significant.

Figure SI-3 investigates common support across the interaction. Since the spatial terms for trade and IOs are positively correlated, there are no cases with high levels of IO-weighted peers' climate targets but low values of trade-weighted peers' climate targets, which restricts which inferences can be drawn from this data. In plotting the fitted values, we see that IO-weighted peers with strong climate targets can substitute for trade-weighted peers with weak targets, while the effect of IO-weighted peers on climate targets is attenuated when countries' trade partners have strong targets. Similarly, when a country's IO-weighted peers have relatively weak targets their trade-weighted peers' targets can support the ratchet when the latter are strong; but when IO-weighted peers have strong targets, trade-weighted peers' targets do not effect the ratchet. The interactions suggest that trade and IO relationships can substitute for each other when one is low, but the coefficients remain imprecisely estimated and their relationship lacks common support across the full range of the interaction.

	(1)	(2)	(3)	(4)
IOsParis (row-standardized)	3.26*	3.34*	2.55+	2.62
	(1.49)	(1.66)	(1.51)	(1.69)
TradeParis (row-standardized)	0.41	0.43	−4.84+	−4.64+
	(0.41)	(0.43)	(2.70)	(2.78)
TradeParis (row-standardized):**IO**Paris (row-standardized)			−0.17+	−0.16+
			(0.08)	(0.09)
Paris target	0.69**	0.69**	0.73**	0.72**
	(0.08)	(0.08)	(0.08)	(0.08)
(Intercept)	101.77*	121.79	86.10*	103.84
	(42.46)	(74.55)	(42.65)	(74.35)
Controls	No	Yes	No	Yes
Observations	112	112	112	112
R^2	0.53	0.53	0.54	0.54

Table SI-10: Regressions with alternative spatial weights for joint IO memberships. Outcome variable is emissions change in 2021 NDC as a percentage of 2010 emissions levels, re-scaled so that positive values are emissions cuts. OLS regression models with standard errors in parentheses. + p < 0.1, * p < 0.05, ** p < 0.01

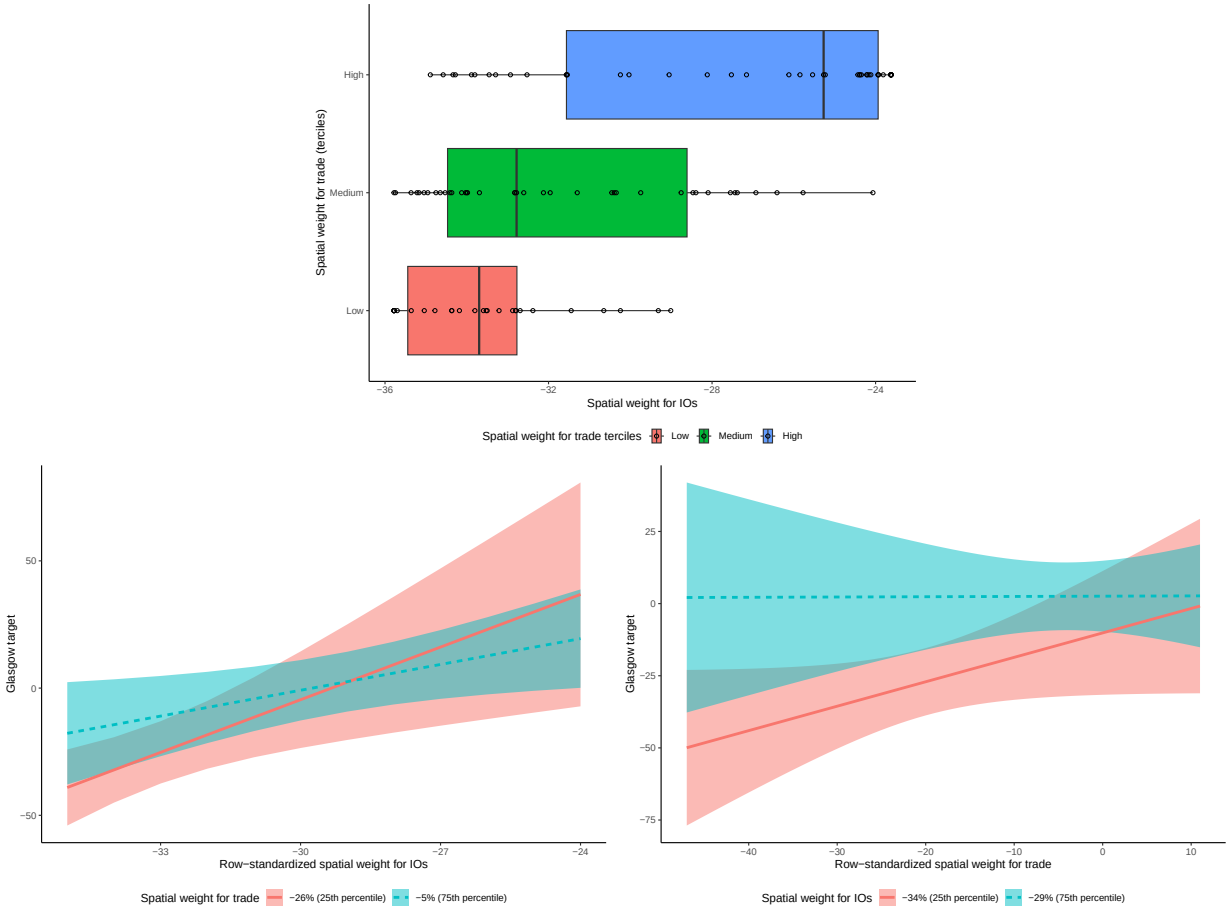

Figure SI-3: Models with a multiplicative interaction between trade-weighted peers' climate targets and IO-weighted peers' climate targets. Top panel investigates common support across levels of the interacted variables. Bottom-left panel shows fitted values across levels of IO-weighted peers' climate targets for a country whose trade-weighted peers have weak targets (red) and strong ones (blue); bottom-right panel is vice versa.

SI-3.3 Sensitivity analysis

The research design relies on no confounding to estimate the average treatment effect of peers' targets on the ratcheted targets. I have argued that the strongest source of confounding in this design are states' previous climate targets, where the Glasgow targets strongly reflect each state's pre-existing Paris target. Controlling for other observed covariates helps strengthen the argument of no confounding, but we can also assess the credibility of this assumption more rigorously using sensitivity analysis. Sensitivity analysis is a tool for understanding how strong an unobserved confounder would need to be to substantially change an observed estimate. It can be used to place bounds on an estimate that quantify how much unobserved confounding there would need to be to reduce an estimated effect size to zero.

Cinelli and Hazlett (2020) present a "robustness value" that quantifies how much of the residual variance in both the treatment and the outcome would need to be explained by a confounder to bring the estimated effect to zero.[68] The robustness value for table 2, model 3 is 0.19, implying that unobserved confounders would need to explain more than 19% of the unexplained variance in both the Glasgow targets and the climate policy of IO-weighted peers to reduce θ to zero.

I analyze the influence of a confounding variable as strong as each state's Paris target to consider the sensitivity of the main finding. The Paris targets are highly correlated with the Glasgow targets ($r = 0.68$) and also correlated with IO peers' climate policy ($r = 0.26$). It is difficult to imagine another confounder that would be more associated with the Glasgow targets than these lagged targets.

The sensitivity analysis finds that even a confounder as strong as the Paris targets that explained all of the residual variation in the Glasgow targets and that was as strongly associated with IO partners' targets would not be strong enough to reduce the effect of IO partners' climate targets to zero. The bound on $R^2_{D\sim Z|\mathbf{X}} = 0.0122$ is below the robustness value and below the partial R^2 of the treatment with the outcome $R^2_{Y\sim D|\mathbf{X}} = 0.0426$. The bound on $R^2_{Y\sim Z|\mathbf{X},D} = 0.71$ is above the robustness value; however, the bounds on each $R^2_{D\sim Z|\mathbf{X}}$ and $R^2_{Y\sim Z|\mathbf{X},D}$ would need to be greater than the robustness value to drive the estimate to zero. Note, as well, that the bound of $R^2_{D\sim Z|\mathbf{X}}$ is below

[68] Sensitivity analysis conducted in R using "sensemakr". Cinelli, Carlos and Chad Hazlett (2020). "Making sense of sensitivity: Extending omitted variable bias." *Journal of the Royal Statistical Society Series B — Statistical Methodology* 82.1, pp. 39-67.

the robustness value for the $\alpha = 0.05$ significance level ($R^2_{D\sim Z|\mathbf{X}} = 0.0122$; $RV_{q=1,\alpha=0.05} = 0.019$, which implies that this hypothetical confounder would also keep p-value below 0.05.

Outcome: *Glasgow target*						
Treatment	Estimate	Std. error	t-statistic	$R^2_{Y\sim D|\mathbf{X}}$	$RV_{q=1}$	$RV_{q=1,\alpha=0.05}$
IOParis	3.264	1.489	2.191	4.3%	19%	1.9%
df = 108	Bound: (1 × *Paris target*): $R^2_{Y\sim Z|\mathbf{X},D} = 71\%$, $R^2_{D\sim Z|\mathbf{X}} = 1.2\%$					

Table SI-11: Sensitivity analysis for table 2, model 3.

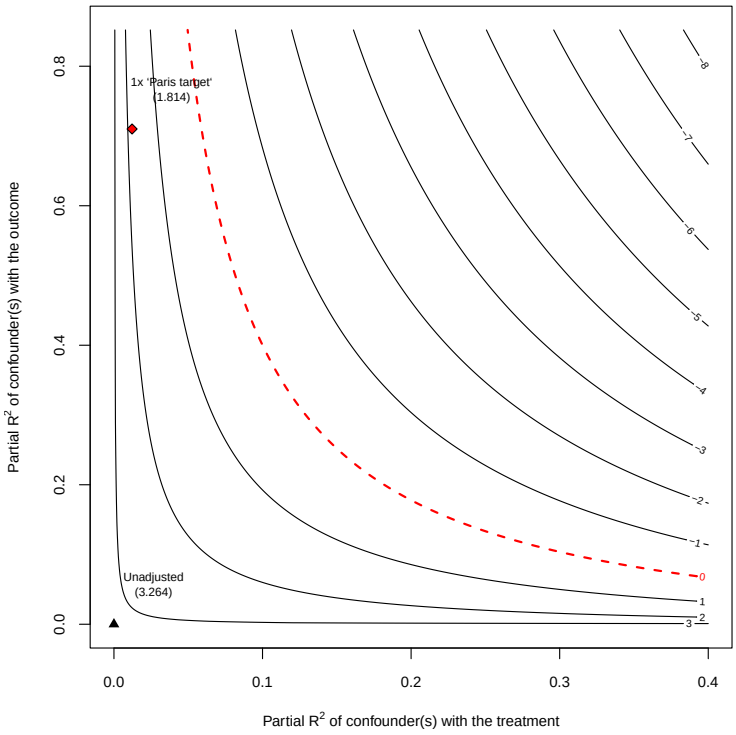

Figure SI-4: Sensitivity analysis reveals that unobserved confounding would need to explain 21–24% of the unexplained variance in both the Glasgow targets and the trade-weighted climate policy of peers to reduce the estimate for θ to zero. The bounds for a confounder as strongly correlated with these variables as the Paris targets measure would not be sufficient to confound the results.

SI-3.4 Randomization inference

There is some concern that p-values may be incorrect in small samples, especially when the main variables are not normally distributed, so I conduct randomization inference and find normally distributed estimates of θ, and calculate $p = 0.003$, smaller than the analytical $p = 0.0306$ in table 2, model 3.

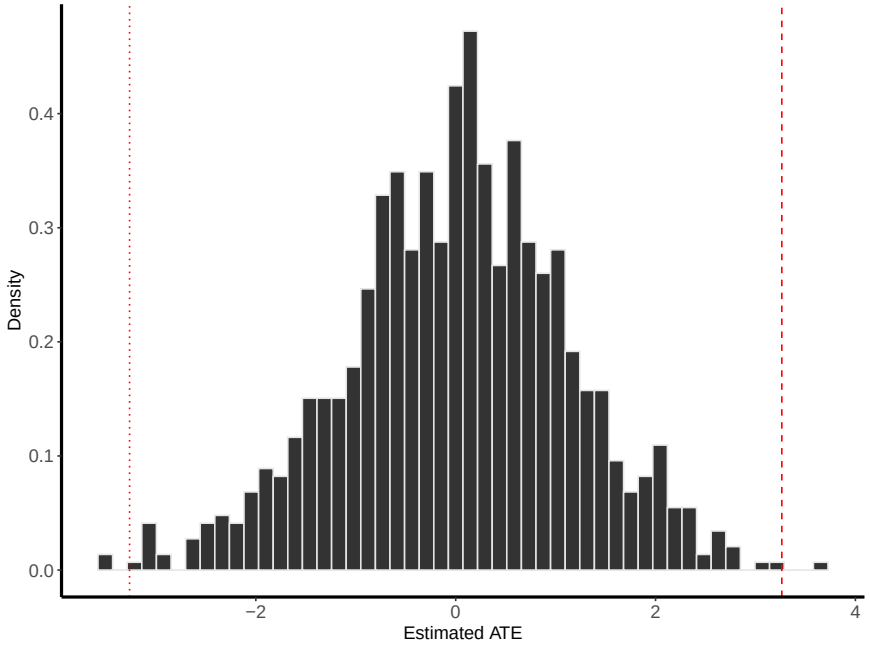

Figure SI-5: Randomization inference. Estimates of the average treatment effect in 1,000 permutations of **IO**Paris for table 2, model 3. Vertical lines indicate model ATE, $\theta = 3.26$ and the two-sided cutoff, -3.26. In 1,000 permutations, only 3 estimates were larger than $|\theta = 3.26|$, implying $p = 3/1000 = 0.003$.

SI-4 Who leads target-setting?

Table SI-12 presents results for the timing of climate target submissions. The outcome variable is a categorical indicator that measures when countries submitted their updated NDCs relative to the submissions of the EU and the US. The updated NDCs were "due" in March 2020, but very few states submitted these on time—even before the 2020 coronavirus pandemic completely halted daily activities. The slow progress in submitting NDCs on time was concerning for observers, and the UN climate secretariat eventually changed the updated NDC deadline to the end of December 2020; however, most countries missed even this second deadline. In 2020, the US was led by the Trump Administration that was in the process of formally withdrawing from the Paris Agreement. The combination of the pandemic and the American government's hostility to the Paris process led to only 6 NDCs being submitted by April 1, and only 33 NDCs throughout 2020, excluding EU states. In September 2020, the European Commission announced a new EU climate mitigation goal, and deposited its updated NDC in December. This seemed to signal a restart in multilateral climate politics, ahead of Joe Biden's presidential victory in November 2020. American participation in international climate treaties has hardly been assured historically, despite the Biden Administration's stated intentions and swift actions to rejoin the Paris Agreement.

As table SI-12 shows, the most likely countries to submit updated NDCs following the EU's announcement were countries with the most trade ties to the European Union. The EU was the first major emitter to submit their updated NDC, even if theirs was submitted after the initial due date. The Biden Administration finally presented its updated climate target at a widely-publicized virtual climate summit on Earth Day in April 2021, and pressured other countries to submit updated targets. However, as table SI-12 shows, while countries did submit new targets (as demonstrated by the positive coefficient on the intercept term), these countries were not necessarily more linked to the US by trade. One possible explanation for the lack of US pull on NDCs is the persistent domestic credibility problem in American climate policy. The Biden Administration hoped to have a major piece of domestic legislation finished by COP26 in Glasgow in November 2021, but opposition from key veto players in the Democratic Party stymied progress. If governments set climate policy conditional on the behavior of their closest trading partners, then trade ties to the EU seem to be the strongest determinant of updated NDCs.

	(1)					
	Early submission Before Sep. 2020		Post-EU, pre-US Oct. 2020–Mar. 2021		Post-US After Apr. 2021	
Term	Estimate	Std. error	Estimate	Std. error	Estimate	Std. error
(Intercept)	-0.471	0.503	-2.952*	1.000	1.004*	0.383
EU trade exposure	-0.391	1.771	4.589*	2.157	-0.474	1.320
US trade exposure	4.106	2.282	1.913	4.921	0.516	2.062

Table SI-12: Timing of updated NDC submission reflects national-level trade exposures to EU and US. Multinomial logistic regression with "Never submitted updated NDC" as the omitted reference category. $N = 161$ countries, excluding US, EU member states, and states that formally coordinate their climate policy with the EU. $*$ indicates $p < 0.05$

SI-5 Emissions growth scenarios in developing countries

Did countries that weakened their targets simply set more realistic reference levels? One consideration may be that countries that weakened their targets did so because they had unrealistic GHG emissions projections in their first NDCs and were able to update with more accurate projections in their second NDCs. This is only a consideration for countries that set baseline scenario targets that articulate their emissions reductions relative to a future "business as usual" scenario. If the first NDC's emissions projection was overly modest, then holding the target absolute emissions level fixed and updating the projection to be more realistic would imply a weakened target.

We can compare countries' GHG emissions growth rates that would be consistent with meeting their BAU reference level in both of their NDCs relative to their emissions growth rates up to the Paris Agreement. Looking only at non-high income countries, the average annual emissions growth from 2000–2015 was 2.35 percentage points (pp) per year. Within this set of countries, for countries that submitted stronger Glasgow targets, their Glasgow targets projected +1.69 pp, while their Paris targets projected +3.51 pp. Relative to developing countries' average pre-Paris growth rate, ratcheting countries projected higher BAU emissions growth in their Paris targets and then amended this to project lower BAU emissions growth in their Glasgow targets. Some of their enhanced ambition, therefore, could reflect revisions to emissions growth estimates that are more in keeping with historical averages.

For developing countries that submitted weaker Glasgow targets, their Glasgow targets projected +4.24 pp annual growth, while their Paris targets projected +2.09 pp. Relative to developing countries' average pre-Paris growth rate, these countries projected BAU emissions growth near the historical average in their Paris targets, but then revised their estimates to project much stronger BAU growth in their Glasgow targets than historical averages. Some of their observed reduced ambition, therefore, could reflect keeping percentage targets constant while updating BAU forecasts to project more future growth. Yet, this future growth is nearly double historical norms, which seems unrealistic. These targets are inflated revised growth forecasts that mask low levels of mitigation effort, rather than simply more realistic revised growth forecasts.