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Catalytic Institutions for the Global Commons: Tragedy or Tipping Point?

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Abstract

Scholars typically model the politics around global public goods or common pool resources as tragedies of the commons. Theories of international organization therefore aim to explain how institutions can promote cooperation by solving the free-rider problem. Various "logics of cooperation" are advanced in the literature, including regulatory agreements that proscribe behaviour, club arrangements that create excludable benefits, or polycentric structures that tackle the problem at multiple scales. Based on an analysis of the evolution of the climate mitigation regime, this article challenges both this diagnosis of the problem and the concomitant institutional remedies. The problem structure of global climate mitigation more closely resembles a tipping point game than a tragedy of the commons. In this context, the chief barrier to cooperation is not the threat of free-riding, but the lack of incentive to act in the first place. States and other actors seek to solve this problem by creating "catalytic institutions," which work to shift actors' preferences and strategies toward cooperative outcomes over time. While catalytic institutions can be seen in many areas of world politics, the 2015 Paris Agreement has fully embraced this logic of cooperation, raising the possibility that similar catalytic regimes may help drive cooperation in other areas of world politics characterized by tipping point structures.

1. Introduction

Theories of international organization seek to explain how, and under what conditions, international institutions help states cooperate. This article argues that this literature has missed both the problem structure of an important class of international cooperation dilemmas, and the way states and other actors use international institutions to overcome them. International relations (IR) theory has emphasized how the difficulty of making credible commitments and the incentive to free-ride undermine cooperation. But for many issues, a more fundamental obstacle is simply that the costs of cooperation for most actors outweigh the benefits. That is, there is not a sufficient incentive to act in the first place, and the actions of others provide little benefit on which to free-ride. Much IR theory would see little use for international institutions in such cases. Contra this expectation, states and other actors have built numerous institutions to address issues characterized by this problem structure. I refer to such institutions as *catalytic*, and argue that they can facilitate cooperation when issues have a "tipping point" problem structure. This framework shows how international institutions can help create and sustain cooperation not by solving the problems of free-riding and credible commitments, but by shifting the strategies and even preferences of states and other actors over time.

The article grounds its theoretical arguments in an analysis of the evolution of international efforts to mitigate climate change. In 1992, countries signed the United Nations Framework Convention on Climate Change (UNFCCC), pledging to prevent "dangerous" changes in the Earth's climate caused by emissions of carbon dioxide and other greenhouse gasses (GHGs). Despite significant diplomatic effort, countries made little progress toward this goal for two decades. States agreed only one treaty to limit emissions, the 1997 Kyoto

Protocol, which required modest cuts for wealthy countries but was rejected by the United States and soon outpaced by the rapid industrialization of emerging economies. Though the Kyoto Protocol was always intended as a first step, states failed to take a second step at the 2009 Copenhagen summit, leading some to question whether the international climate regime could ever succeed, or whether a different approach was needed.

Remarkably, the UNFCCC did not simply sink into stasis. Instead, over the following years, policy entrepreneurs radically changed the logic of international climate mitigation efforts. Kyoto, following the model of most other multilateral environmental agreements, took what this article will call a "regulatory" approach, in which states negotiated a set of shared reductions targets. States are bound to report on their emissions and, should they miss the agreed target, face sanctions (minimal, in this case). The 2015 Paris Agreement, instead, requires each country to put forward its own pledge, or "nationally determined contribution" (NDC). These pledges are then reviewed internationally and ratcheted up every five years. Paris also gives a central role to cities, businesses, provinces and regions, and other sub- and non-state actors, creating institutions to recognize and orchestrate their climate action alongside the national pledges.[1] Both these processes aim toward the ambitious long-term goal of ensuring no more GHGs are going into the atmosphere than are being absorbed—effectively decarbonizing the world economy—by the second half of the 21st century.

The evolution of the climate regime represents a rare case of multilateral innovation and adaptation in the face of gridlock, and how it came to pass merits significant research.[2] But the evolution of the climate regime and the logic of the Paris Agreement also highlight empirical anomalies for theories of international institutions and gaps in our understanding of the logic of international institutions. To wit, this article makes two theoretical arguments.

First, it aims to correct a persistent misdiagnosis in IR theory, which overemphasizes free-riding as the chief barrier to international cooperation. Whereas the IR literature, many economists, policymakers, and popular discourse have cast global commons issues—of which climate change is quintessential—as a "tragedy of the commons," the empirical record contradicts a number of the strong assumptions this analytic model requires. In the abstract, the tragedy of the commons represents a plausible interpretation of the problem structure of global climate change, but it fails to account for much of the observed political behaviour and outcomes over the past two decades. Instead, I argue that the dominant problem structure for climate change is better understood as a "tipping point," in which the incentive to act in the first place is

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[1] Hale, T. (2016). ""All Hands on Deck": The Paris Agreement and Nonstate Climate Action." Global Environmental Politics **16**(3): 12-22.

[2] Bäckstrand, K. and E. Lövbrand (2016). "The Road to Paris: Contending Climate Governance Discourses in the Post-Copenhagen Era." Journal of Environmental Policy & Planning: 1-19, Dimitrov, R. (2016). "The Paris Agreement on Cliamte Change: Behind Closed Doors." Global Environmental Politics **16**(3): 1-11, Falkner, R. (2016). "The Paris Agreement and the new logic of international climate politics." International Affairs **92**(5): 1107-1125, Hale, T. (2017). Climate Change: From Gridlock to Catalyst. Beyond Gridlock. T. Hale and D. Held. Cambridge, Polity Press.

the chief barrier to cooperation. Generalizing beyond climate, I also specify the conditions under which other global commons issues are better described by "tragedy of the commons" or "tipping point" structures.

Second, the article introduces the concept of catalytic institutions, demonstrating how international institutions in areas such as trade, human rights, and especially the recent Paris Agreement attempt to support cooperation not by solving the free-rider problem, but by shifting the preferences and strategies of states and other actors over time. I outline the theoretical logic of such institutions, and distinguish their workings from alternative institutional mechanisms, including regulatory multilateral agreements to govern the global commons, club arrangements, and polycentric structures. While distinguishing these ideal types boosts analytic clarity, actually existing regimes (including the climate regime) of course can possess differing combinations of them. Indeed, the article shows how the institutional logic of the climate regime has shifted over time, and posits how the "tipping point" problem structure may lead to further institutional shifts in the future.

The next section describes the evolution of the climate regime, noting how different ways of understanding the climate problem, and corresponding institutional strategies, have arisen over time. The third section analyses the problem structure of climate mitigation, asking whether the empirical record better supports a tragedy of the commons interpretation or a tipping point interpretation. The fourth section then elaborates the logic of catalytic institutions and shows how the Paris Agreement and other international institutions have been structured to shift state preferences and strategies over time. In conclusion, the article considers which other issues in world politics might be productively interpreted as tipping point problems, and therefore where else catalytic institutions may support cooperation, as well as how regimes may shift their logics of cooperation endogenously over time.

2. The evolution of the climate regime: four logics of cooperation

International regimes differ in the mechanisms and causal processes through which institutions help states cooperate, their "logic of cooperation." Each logic of cooperation assumes a certain problem structure, and a corresponding role for international institutions. Regimes may also combine multiple logics to different degrees, and may shift amongst them over time.

Four logics of cooperation can be seen in the evolution of international climate governance. The regime began as a standard *regulatory* regime, similar to those observed in many global commons issues, seeking to solve the collective action problem through a universal, proscriptive agreement. As this traditional approach faltered, the regime become more pluralistic and complex,[3] developing

[3] Falkner, R., H. Stephan and J. Vogler (2010). "International Climate Policy after Copenhagen: Towards a 'Building Blocks' Approach." Global Policy **1**(3): 252-262, Keohane, R. O. and D. G. Victor (2011). "The Regime Complex for Climate Change." Perspectives on Politics **9**(1), Zelli, F. (2011). "The fragmentation of the global climate governance architecture." Wiley

aspects of both governance *clubs* (or, following Green, "quasi-clubs")[4] and *polycentric* governance,[5] and with some observers calling for greater emphasis on these alternative approaches. Most recently, the regime has shifted to a *catalytic* logic of cooperation.

Below I trace this evolution and define each logic more precisely. While the purpose of this article is not to explain the changes in the regime, it is important to understand the regime's development in order to see how different conceptions of problem structure, and the concomitant institutional strategies, have been advanced by policymakers and scholars. To simplify the discussion, I focus on climate mitigation, not adaptation, finance, technology transfer, or other aspects of global climate governance.

The regulatory logic

The climate regime emerged from the historical high point of international environmental treaty-making, the 1992 Rio Earth Summit. Though the science of climate change and the appropriate policy responses were only beginning to be understood, the delegates meeting in Rio (and academics observing them) were clear-minded about the nature of the problem they confronted—a tragedy of the commons—and the approach for addressing it—a global treaty under which all should reduce emissions. International regimes can be defined as institutions around which actors' expectations converge. In this sense, there was an enormous amount of conceptual convergence in the basic logic of the international climate regime, a mental model that is difficult to shift.[6] As Ostrom later noted, "the applicability of the conventional theory is considered to be so obvious by many scholars that few questions have been raised about whether this is the best theoretical foundation for making real progress."[7]

As the name implies, the UNFCCC was not intended to "solve" climate change immediately, but rather to set out a framework for addressing the issue. This approach followed the "convention + protocol" template that characterized most contemporary environmental regimes, and, most proximately, the widely praised

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Interdisciplinary Reviews: Climate Change **2**(2): 255-270, Stewart, R. B., M. Oppenheimer and B. Rudyk (2013). "A new strategy for global climate protection." Climatic Change **120**: 1-12.

[4] Victor, D. G. (2011). Global Warming Gridlock: Creating More Effective Strategies for Protecting the Planet Cambridge, Cambridge University Press, Weischer, L., J. Morgan and M. Patel (2012). "Climate Clubs: Can Small Groups of Countries Make a Big Difference in Addressing Climate Change?" Review of European Community and International Environmental Law **21**(3): 177-192, Green, J. F. (2015). "The strength of weakness: pseudo-clubs in the climate regime." Climatic Change, Nordhaus, W. (2015). "Climate Clubs: Overcoming Free-riding in International Climate Policy." American Economic Review **105**(4): 1339-1370.

[5] Ostrom, E. (2009). A Polycentric Approach for Coping with Climate Change. Washington, DC, World Bank Policy Research Working Paper No. 5095, Cole, D. H. (2015). "Advantages of a polycentric approach to climate change policy." Nature Climate Change **5**, Dorsch, M. J. and C. Flachsland (2017). "A Polycentric Approach to Global Climate Governance." Global Environmental Politics **17**(2): 45-64.

[6] Poulson has shown the importance of such mental anchoring for international economic treatymaking Poulsen, L. N. S. (2015). Bounded Rationality and Economic Diplomacy: The Politics of Investment Treaties in Developing Countries. Cambridge, Cambridge University Press.

[7] Ostrom 2014, p. 9.

ozone regime.[8] Countries agree a framework convention to identify a problem and create a negotiating process through which member states then work to agree a series of protocols that collectively bind them to specific commitments. Through a series of negotiation rounds, countries agree what commitments each will take on, reaching a mutually agreeable "burden-sharing" of effort to protect the global commons. International institutions then help monitor compliance and sanction defection. Poorer countries are typically given a longer window to come into compliance, as well as financial and technical support to aid implementation. I term this strategy a "regulatory" logic since is seeks collective agreement to proscribe what each country is allowed to do and aims to detect and punish non-compliance.

Interestingly, however, the 1992 framework convention also included provisions, akin to the Paris Agreement, that we might call a "pledge and review" system. Article 4(b) requires all UNFCCC members to, "Formulate, implement, publish and regularly update national and, where appropriate, regional programmes containing measures to mitigate climate … and measures to facilitate adequate adaptation to climate change." Article 12 further requires countries to report on these activities to the Conference of Parties (COP).[9] However, this rudimentary pledge and review system was only articulated in vague terms. The 'real' work of the regime in facilitating cooperation was always thought to come in subsequent protocols, specifically envisioned in Article 17 of the framework convention.

Following this plan, countries agreed at the first COP in 1995 to devise a protocol to the convention by 1997. The resulting Kyoto Protocol, significantly modelled on the 1989 Montreal Protocol for ozone, required rich countries to reduce emissions by, on average, five percent below 1990 levels. It also created an emissions trading system and other flexibility measures to allow rich countries to reduce emissions in poorer countries and claim the reductions against their own targets. Though admittedly a modest treaty, it was always intended as a first step.

However, a second step never came. Though countries gave themselves a deadline of 2009 to agree a successor to Kyoto, a summit in Copenhagen that year failed to meet this objective. Fundamental disputes between rich and poor countries, and particularly between the United States and China, over who had responsibility to act prevented an agreement. Instead, the most substantive outcome was, harking back to the original Article 4 of the framework convention, a series of voluntary pledges from 60 countries. The regulatory path on which countries had embarked in 1995 seemed to lead right back to the place they had begun in 1992, a vague pledge and review system.

Growing pluralism: the club logic and the polycentric logic

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[8] The ozone model was highly salient in the minds of the architects of the UNFCCC, since many of the negotiators and experts involved had also played a role in the design of the ozone regime.
[9] For developed countries, the requirement to act and report on national measures to address climate was more specific.

At this critical juncture several paths emerged. Perhaps most likely would have been a gradual stagnation of the regime into a system of uncoordinated voluntary pledges like those that emerged from Copenhagen. Alternatively, states might have turned to other institutions. Indeed, around the Copenhagen summit, alternative conceptions of global climate governance gained prominence, with observers questioning the feasibility and/or desirability of the unified multilateral regime and the regulatory approach represented by the Kyoto Protocol. Noting the growing range of institutions and actors engaged in climate governance, scholars began to speak of a "building blocks" regime[10] and a regime complex for climate change.[11] Scholars also turned attention to the emerging groundswell of transnational climate governance, noting how sub- and non-state actors were increasingly involving themselves in the governance of climate change both within and across state borders.[12]

As the regime became more pluralist, two logics of cooperation were articulated as alternatives to the faltering regulatory approach: clubs and polycentrism.

Proposals for "climate clubs" followed a well-researched category of solutions to collective action problems: create excludable benefits to give actors an incentive to cooperate.[13] Noting the cumbersome process of seeking to negotiate amongst 190-odd nation states, only a few dozen of whom really "mattered" in terms of emissions, observers suggested that limited membership institutions would stand a better chance of achieving cooperation.

But while this theory seems to offer an attractive alternative to the unwieldy UNFCCC process, in practice climate clubs have struggled to identify excludable benefits because the atmosphere is inherently non-excludable. Instead, scholars have suggested technology clubs (in which countries pool resources to develop decarbonisation technologies, to which they retain the intellectual property), though few examples of these have emerged. In addition, a number of academic papers have sought to apply the logic of the trade regime, positing that carbon tariffs could create a club dynamic by penalizing laggards with higher export duties. In this arrangement, the excludable benefit is to avoid being penalized by trade partners. Again, such ideas have struggled in practice. The most serious

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[10] Falkner et al 2010.
[11] Keohane and Victor 2011.
[12] Betsill, M. and H. Bulkeley (2006). "Cities and the Multilevel Governance of Climate Change." Global Governance **12**, Abbott, K. W. (2010). "The Transnational Regime Complex for Climate Change." Transnational Climate Governance Workshop, Trisolini, K. (2010). "All Hands on Deck: Local Governments and the Potential for Bidirectional Climate Change Regulation." Stanford Law Review **62**(3): 669-746, Hale, T. (2011). "A Climate Coalition of the Willing." The Washington Quarterly(Winter), Bulkeley, H., L. B. Andonova, M. Betsill, D. Compagnon, T. Hale, M. Hoffmann, P. Newell, M. Paterson, C. Roger and S. D. VanDeveer (2014). Transnational Climate Change Governance. Cambridge, Cambridge University Press.
[13] Victor, D. G. (2011). Global Warming Gridlock: Creating More Effective Strategies for Protecting the Planet Cambridge, Cambridge University Press, Weischer, L., J. Morgan and M. Patel (2012). "Climate Clubs: Can Small Groups of Countries Make a Big Difference in Addressing Climate Change?" Review of European Community and International Environmental Law **21**(3): 177-192, Green, J. F. (2015). "The strength of weakness: pseudo-clubs in the climate regime." Climatic Change, Nordhaus, W. (2015). "Climate Clubs: Overcoming Free-riding in International Climate Policy." American Economic Review **105**(4): 1339-1370.

attempt to impose a carbon tariff of this nature was the EU's modest proposal to require airlines using European airspace to pay a small carbon tax. Though the proposal was not particularly costly, it was vigorously opposed by the United States, China, and India, and eventually scrapped by European member states that did not want to pay the costs of friction with significant trading partners.[14]

Despite these difficulties in creating excludable benefits, many "pseudo clubs" have emerged in the climate regime, in which mitigation or aspects thereof are discussed in smaller fora.[15] As Green notes, these pseudo clubs convey political benefits through reduced transaction costs, building linkages through low entry costs, and harmonization, even if they have not yet proven efficacious for deep emissions reductions. In other words, they have largely served as informal coordination mechanisms, aligning actors already disposed to certain policies, as opposed to changing the incentives actors face through the creation of excludable benefits.

Alongside proposals for climate clubs, there has been growing interest in the role of non-state actors in global climate governance, and the broader implications of an increasingly pluralistic regime. Since the early 1990s, transnational networks of cities, businesses, and other sub- and non-state actors have engaged in climate governance. Though initially few in number, these institutions expanded and multiplied rapidly in the late 1990s in the first decade of the 21st century, and especially in the lead-up to the Paris climate summit.[16] Governments and international organizations have increasingly sought to 'orchestrate' these transnational activities, and the Paris Agreement and subsequent decisions have made them more central to the UNFCCC itself.[17] In addition, there has been a rapid expansion and diffusion of "unilateral" climate change governance by actors at all scales, as actors not connected to formal transnational networks seek to experiment with different approaches.[18]

Indeed, there has been such a proliferation and pluralisation of climate governance, that observers increasingly speak of a "polycentric" climate regime, in which governance and action occur in myriad ways through many different coalitions that range in scale from global to local. Though this decentralized approach to the climate challenge was suggested even before the formation of the UNFCCC, it has now become a reality.[19]

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[14] Torney, D. (2015). European Climate Leadership in Question: Policies toward China and India. Cambridge, MIT Press.
[15] Green, J. F. (2015). "The strength of weakness: pseudo-clubs in the climate regime." Climatic Change.
[16] Bulkeley, H., L. B. Andonova, M. Betsill, D. Compagnon, T. Hale, M. Hoffmann, P. Newell, M. Paterson, C. Roger and S. D. VanDeveer (2014). Transnational Climate Change Governance. Cambridge, Cambridge University Press.
[17] Hale, T. and C. Roger (2014). "Orchestration and Transnational Climate Governance." Review of International Organizations **9**(1): 59-82.
[18] Hoffmann, M. (2011). Climate Governance at the Crossroads: Experimenting with a Global Response after Kyoto. Oxford, Oxford University Press.
[19] Gerlach, L. and S. Rayner (1988). Managing Global Climate Change: A View from the Social and Decision Sciences. Oak Ridge, Oak Ridge National Laboratory. **ORNL/6390**.

For Ostrom and others, this trend constitutes an entirely different, polycentric logic of cooperation. Polycentrism argues that "climate change" encompasses many interlocking sub-issues that manifest differently across contexts. It may still be a tragedy of the commons at the global scale, but many actors' will engage with specific aspects of the problem at different scales, such as a city focused on transport, a farming community focused on preserving their crops from drought, or a consortium of corporations seeking to preserve the sustainability of their supply chains. In many of these realms, which range from the micro-level to regional or transnational institutions, collective action can emerge and be sustained where existing social and political structures facilitate cooperation. In the polycentric logic, we should therefore focus not on global deal-making, but on fostering and supporting mitigation at all levels, wherever conditions are ripe. Moreover, Ostrom expects information to flow amongst these different governance efforts, and calls for "methods for assessing the benefits and costs of particular strategies adopted in one type of ecosystem and comparing these with results obtained in other ecosystems."[20]

But while the pluralisation of the climate regime is now a fact, some observers doubt that it will enhance cooperation as much as Ostrom and others hope. Sabel and Victor, for example, question whether information transmission institutions are sufficient to allow bottom up solutions to diffuse.[21] However, the more central limitation is that polycentric structures, though able to drive cooperation at multiple scales for those actors who wish to address the problem, offer few solutions to compel recalcitrant actors outside their communities. So while much of the world may be willing to act on climate change, or at least sub-aspects of it, in their own realm, there is no guarantee that enough actors will follow this approach to resolve the global commons problem. Similarly, the polycentric approach does not offer a theory of change over time. This is a significant gap, because even though the current proliferation of actors and institutions addressing climate is far larger than traditional approaches would suggest, it is not yet sufficient to solve the problem.

The catalytic logic

Given the growing prominence of these alternative governance logics in both scholarly thought and the policy realm, it seemed very plausible after Copenhagen that the regime would become increasingly fragmented, with a stagnating multilateral process increasingly eclipsed by clubs, transnational governance, and polycentric arrangements. Instead, surprisingly, the multilateral regime did not stagnate, but, partially in response to these trends, shifted its core logic to a catalytic model.

Though it builds on existing institutions in the UNFCCC process and in the regime more broadly (including those with regulatory, club and polycentric logics), the Paris Agreement changed the climate regime's primary approach to

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[20] Ostrom, E. (2009). A Polycentric Approach for Coping with Climate Change. Washington, DC, World Bank Policy Research Working Paper No. 5095.
[21] Sabel, C. F. and D. G. Victor (2015). "Governing global problems under uncertainty: making bottom-up climate policy work." Climatic Change.

mitigation in three ways. First, it made the objective of preventing dangerous changes in the Earth's climate specific, declaring that world must be "net zero"—no more GHGs can go into the atmosphere than are being absorbed—by the second half of the 20th century. Second, it abandoned the idea of negotiated commitments. Instead, it made the vague pledge and review system envisioned in the original UNFCCC treaty, and then defaulted to after Copenhagen, into a "pledge and review and ratchet" system. While the first round of pledges—which, for the first time, include effectively all countries—did not put the world on track to decarbonize quickly enough to reach the 2C target, if implemented they will likely bring the world from 4-5C of warming in the 21st century to somewhere around 3C.[22] Crucially, Paris also added a requirement that countries issue new national pledges every five years. Finally, Paris opened the doors of the regime to a wide array of sub- and non-state actors, who were encouraged to take their own climate actions alongside nation states, and created a system to stimulate, track, and otherwise orchestrate such actions. Some studies estimate that this groundswell of bottom up climate action could reduce emissions by as much as the national pledges.[23] While the details of the Paris system remain under negotiation at the time of writing, the basic logic of the regime has fundamentally changed from the traditional regulatory approach.

Anticipating Paris

Before proceeding to analyse the assumptions around problem structure and the role of institutions that undergird these various approaches to climate governance, it is important to note that throughout the development of the climate regime, there have been sceptical voices that have questioned the conventional wisdom of the predominant regulatory approach, as well as the deeper framing of the problem.[24] A full review is not possible here, but it is worth noting how many of these critiques anticipate the design of the Paris Agreement in various ways. For example, following the US's decision to "unsign" the Kyoto Protocol, Thomas Schelling wrote in *Foreign Affairs* that a regulatory approach was unworkable, and that a regime based on iterative, flexible commitments would be superior.[25] David Victor and others also called for a regime based on flexible commitments.[26] As early as 1988, Gerlach and Rayner, drawing on early IR regime theory, proposed a polycentric system including both state and non-state actors experimenting with a range of voluntary solutions and sharing information about success and failure through loose networks.[27] Following the adoption of the Kyoto Protocol, Laird echoed the call for flexibility, arguing against a "regulatory" approach that used quantified targets and more of a "catalytic" approach to stimulate experimentation (the present article employs

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[22] UNFCCC 2015.
[23] UNEP 2016
[24] Several critiques are gathered in Rayner, S. and M. Caine, Eds. (2015). The Hartwell Approach to Climate Policy. London, Earthscan.
[25] Schelling, T. C. (2002). "What Makes Greenhouse Sense?" Foreign Affairs **81**(3): 2-9.
[26] Victor, D. G. (2011). Global Warming Gridlock: Creating More Effective Strategies for Protecting the Planet Cambridge, Cambridge University Press.
[27] Gerlach, L. and S. Rayner (1988). Managing Global Climate Change: A View from the Social and Decision Sciences. Oak Ridge, Oak Ridge National Laboratory. **ORNL/6390**.

these terms but uses them differently).[28] Urpelainen built on this theme by articulating a "dynamic model" of climate mitigation that envisioned ambitious long-term targets that could be achieved by small short-term steps that had the potential to scale over time into larger medium- and longer-term steps.[29] And Levin et al. proposed focusing on "sticky" interventions that would generate increasing returns over time.[30]

3. The problem structure of climate change: tragedy of the commons or tipping point?

What kind of problem is climate change? Problem structure refers to how the characteristics of an issue in world politics—e.g. the number of actors involved, the severity of enforcement problems, the extent of distributional conflicts, the informational environment, dominant norms, etc.— shape political outcomes, including the design of institutions and their effectiveness.[31] Scholars sometimes summarize an issue's problem structure as a certain kind of "game," e.g. a cooperation game like the Prisoner's Dilemma or a coordination game like Chicken.

Each logic of cooperation articulated above sees international institutions working in a different way. But regulatory, club, and even polycentric approaches largely share a common view of global climate mitigation's underlying problem structure: a tragedy of the commons.[32] Indeed, seeing climate change as a global tragedy of the commons seems so obvious that it has rarely been questioned in the literature.[33] This conventional wisdom seems very plausible. After all, the nature of the atmosphere is inherently rival (one actors' emissions mean there is less absorptive capacity for others) and non-excludable (emissions anywhere affect the climate everywhere), making the climate a textbook common pool resource, and therefore prone to collectively detrimental overexploitation.[34]

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[28] Laird, F. (2000). "Just say no to greenhouse gas emissions targets." Issues in Science and Technology(Winter): 45-52.
[29] Urpelainen, J. (2013). "A model of dynamic climate governance: dream big, win small." International Environmental Agreements **13**: 107-125.
[30] Levin, K., B. Cahsore, S. Bernstein and G. Auld (2012). "Overcoming the tragedy of super wicked problems:
constraining our future selves to ameliorate global
climate change." Policy Sci **45**(123-152).
[31] Koremenos, B., C. Lipson and D. Snidal (2001). "The Rational Design of International Institutions." International Organization **55**(4): 761-799, Mitchell, R. B. (2006). "Problem Structure, Institutional Design, and the Relative Effectiveness of International Environmental Agreements." Global Environmental Politics **6**(3): 72-89.
[32] The polycentric approach argues that climate includes multiple, overlapping problem structures at various scales, and that non-global ones may be more salient for some actors. But it does not disagree with the regulatory logic regarding the global problem structure of climate mitigation, even as it disputes the primacy of this frame and recommends focusing on other aspects of the problem.
[33] Note the exceptions cited above.
[34] Stavins, R. N. (2010). "The Problem of the Commons: Still Unsettled after 100 Years." NBER Working Paper **Working Paper 16403**.

But while it is incontrovertible that climate change can be analysed as a tragedy of the commons, it does not necessarily follow that this model accurately describes the politics of climate mitigation. Indeed, to assume this problem structure for climate politics is an analytic choice, and a significant one. Especially for an issue as complex as climate change, many different analytic choices are possible, depending on which aspect of the problem we want to answer—including the role of international institutions. And while assuming a certain problem structure can aid analysis, a model is only useful if its assumptions are theoretically plausible and empirically substantiated. But many aspects of international climate politics and the resulting regime stand at odds with the assumptions of the tragedy of the commons:

1. The types of actors that matter
2. The preferences of states and other actors and the determinants of those preferences
3. The value of free-riding
4. The effect of actors' behaviour on others' preferences and strategies
5. The function of international institutions

I review these empirical anomalies below. For each, I compare the tragedy of the commons problem structure to a proposed alternative problem structure: the tipping point.[35] Such "cascade" or "threshold" models have been used in political science in reference to norm diffusion, protests and revolutions, racial segregation, environmental treaties that require a minimum critical mass, and other realms.[36] Here I suggest that they can also describe many aspects of climate mitigation's problem structure.

Before turning to the anomalies, it is useful to differentiate the key features of the tragedy of the commons from the tipping point with greater precision.

A tragedy of the commons has a familiar and intuitive problem structure.[37] The relevant actors are typically assumed to be nation states, though this is assumption is not definitional. These states have symmetric preferences such that each stands to lose from climate change, but also wishes to minimize the cost of mitigation. States may choose to contribute a certain amount of mitigation, and the sum of all mitigation actions determines the amount of climate change that is prevented, providing a benefit that accrues to all states. Because no state's contribution is by itself sufficient to gain a mitigation benefit that outweighs its cost of acting, collective action is required.

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[35] To make the argument clear, I compare the empirical record against expectations that follow from an ideal type tragedy of the commons, though some of the authors that have used this idea of course deploy more nuanced versions of the concept.

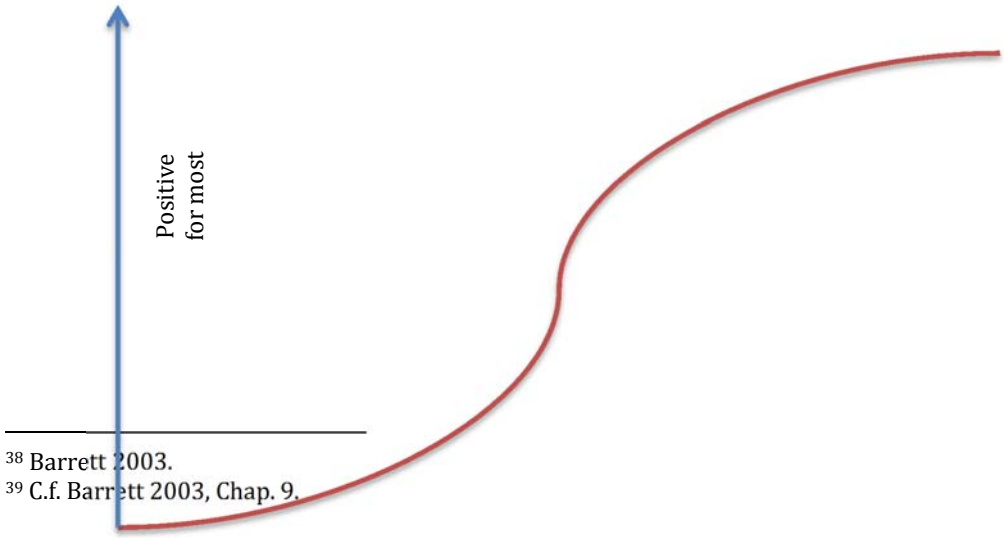
[36] Schelling, T. C. (1971). "Dynamic Models of Segregation." The Journal of Mathematical Sociology **1**(2): 143-186, Granovetter, M. (1978). "Threshold Models of Collective Behavior." The American Journal of Sociology **83**(6): 1978, Finnemore, M. and K. Sikkink (1998). "International Norm Dynamics and Political Change." International Organization **52**(4): 887-917, Barrett, S. (2003). Environment and Statecraft. Oxford, Oxford University Press.

[37] Hardin, G. (1968). "The Tragedy of the Commons." Science **162**(1243), Barrett, S. (2003). Environment and Statecraft. Oxford, Oxford University Press.

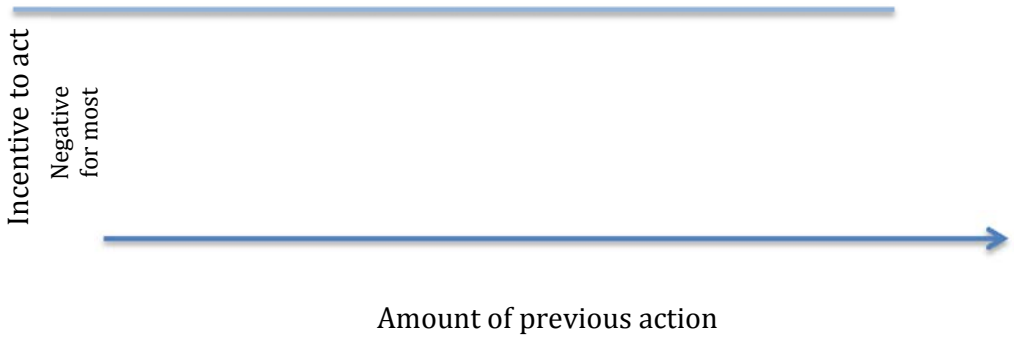
In this set up, all states will be worse off as the climate changes, but because no actor can solve the problem on its own, no actor has an incentive to act unless it knows others will act as well. But, at the same time, if an actor knows other will address the issue, it has no incentive to join them, because it can more easily free-ride on their efforts. Absent a credible commitment for all to act, no action is taken, and everyone ends up worse off. In this sense, the tragedy of the commons can be thought of as a large scale "prisoners' dilemma."[38]

By shifting just a few characteristics of the tragedy of the commons game, we can model climate change as a quite different game, the tipping point.[39] The key differences are that some actors will be more willing to act than others, and that the actions of early movers can have an impact on the strategies and preferences of other actors. Like in the tragedy of the commons, the actors are often assumed to be nation states, but this is not required. Whatever the actors, their preferences vary substantially, with some willing to mitigate no matter what, and others highly reluctant to do so. That is, for some, the value of mitigation may actually be positive. Also critical, the game unfolds over time, with actors observing previous action before deciding how much mitigation action to take. Most importantly, any actions taken previously do not just increase the mitigation benefits for all, they also lower the cost of acting through various mechanisms, including technological change and the accumulation of network benefits. Even more fundamentally, past actions affect actors' preferences (how they value the cost of mitigation and the benefit of collective reductions) as new constituencies for action are created and expanded, and as social norms solidify around a new status quo. In other words, the incentive to act is a function of the amount of previous action, with the relationship perhaps following an S-curve as in figure one (though any increasing function is possible). If these effects are sufficiently large, mitigation action by early-movers can "tip" other actors into mitigation over time. Indeed, if a sufficient number of actors "tip," and the effects of early action on costs and preferences in later rounds are high, even quite recalcitrant actors may end up mitigating. In this problem structure, early action sets off a chain reaction that can make cooperation self-reinforcing.

Figure 1: A tipping point model



[38] Barrett 2003.
[39] C.f. Barrett 2003, Chap. 9.



3.1 Which actors are relevant to climate change?

The tragedy of the commons approach has traditionally focused attention on nation states and the negotiations between them. After all, only sovereign governments can make treaties, which both the regulatory approach and the club approach see as needed to sustain cooperation. For the regulatory approach this is doubly so, as only nation states would be able to agree a kind of universal treaty needed to ensure a global solution to a global problem. From an analytic perspective, scholars of course understand that states are not the only actors, nor are they unitary actors, but often stress the value of studying governments "as if" they were in order to generate parsimonious theories of political outcomes.[40]

How well does this analytic choice advance our understanding of the climate regime? There are theoretical reasons to doubt it. State-centric approaches make most analytic sense when a) powerful domestic political actors share relatively homogenous preferences over an issue, and b) the decisions and behaviour of national governments are the primary determinants of outcomes. For an issue like nuclear proliferation, both assumptions are typically tenable. For regulation of international trade, the first assumption is too stringent, as competing domestic interest groups win or lose from the distributional impacts of economic openness. But for an issue like climate change, in which essentially every sphere and every scale of human activity is involved in the problem, neither condition can be assumed. Cities, states and provinces, private businesses, investors, and other actors can hold not just different preferences on climate change, but can substantially affect the problem through their own actions.

The polycentric approach, of course, explicitly recognizes the role of other actors, operating at multiple scales, in climate governance. This shift in thinking is also well understood in the policy realm. The World Bank estimates that 70 percent of GHG emissions come from cities, and C40, a leading transnational network of megacities, estimates that 40% of the Paris Agreement's aspiration 1.5C target could be met by cities acting individually and in collaboration with each other.

[40] Barrett 2003, p. 54.

According to the UN Environment Programme, transnational climate governance initiatives have the potential to reduce GHGs emissions by the same order of magnitude as nation states (UNEP 2017). The rise of transnational climate governance, and the study thereof, has profoundly reshaped our understanding of who matters for climate politics. The state-centric assumptions of the regulatory logic seem untenable, as statecraft shifts to "webcraft"[41] strategies.

While the tragedy of the commons problem structure does not require a state-centric approach, the empirical expectations that follow from it run into complications in a more pluralistic climate governance landscape. After all, if cooperation is difficult for 190-odd countries, would it not be even more difficult for a wider, more diverse, more numerous array of actors? The tragedy of the commons model predicts an even higher likelihood of inaction under such conditions, since actors' individual contributions diminish relative to the whole, and monitoring and enforcement become more costly and difficult. In other words, under a tragedy of the commons logic, the expectation is that increasing the number of actors will yield less, not more, collective action.[42]

However, if we instead see the climate problem through a tipping point lens, there are three theoretical reasons to expect proliferating the number of actors to enhance cooperation. First, even if we assume, conservatively, that preferences over climate change are distributed normally across both state and non-state actors, simply raising the number of actors increases the likelihood that at least a few actors will hold very pro-action preferences, because we become more likely to reach the "tails" of the distribution of preferences. Under a collective bargaining framework, this would do little to increase cooperation, because pro-climate actors would be, on average, balanced out by anti-climate actors on the opposite side of the distribution. But under a tipping point problem structure, having a continuous chain of actors along the full preference spectrum—and especially at the pro-action extreme—is critical. This preference structure increases the likelihood of at least one or more actors having a strong enough preference to take action on climate change even when it is costly to do so, becoming first-movers who can then influence subsequent decisions by actors with slightly less pro-climate views.

Second, there are reasons to expect preferences to be distributed differently across nation states as opposed to other kinds of actors. I turn to the issue of preference formation in the following sub-section, but note for now that numerous studies have identified climate champions among cities, regional governments, and private-sector organizations in low-emissions sectors.[43] In

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[41] Slaughter, A.-M. (2017). The Chessboard and the Web: Strategies of Connection in a Dangerous World. New Haven, Yale University Press.

[42] A possible exception is under the very restrictive assumption that enough of the "new" actors are sufficiently large and pro-climate to, on their own, create a coalition that can provide the public good without the cooperation of laggards (who are then able to free-ride). While this is unlikely to be the case, it does highlight the way that new actors can expand the number of possible coalitions beyond those available in a world with just 190-odd countries.

[43] Bulkeley, H. and M. Betsill (2003). Cities and Climate Change: Urban Sustainability and Global Environmental Governance. London, Routledge, Betsill, M. and H. Bulkeley (2006). "Cities and the Multilevel Governance of Climate Change." Global Governance **12**, Andonova, L. B., M. M. Betsill

practice, the sub- and non-state actors that have become involved in international climate governance have been strongly pro-climate.

Third, there are theoretical reasons to expect many nation states to be more susceptible to capture by fossil-fuel interests than cities or other types of actors. For example, many countries' national institutions are malaportioned, meaning that rural interests (which tend to have higher emissions and be more adverse to climate action) are over-represented in national politics compared to urban institutions.[44] At the same time, while publics around the world tend to be supportive of climate action, powerful interest groups stand to loose significantly from the shift away from fossil fuels. In classic Olsonian fashion, the concentration of interests against climate action and the diffuseness of interests for climate action creates, in many countries, a natural barrier against strong climate policy in national politics. At the subnational level, or in different economic sectors, such problems are mitigated. While certain fossil fuel producing regions of a country may indeed be very adverse to climate action, such areas are often geographically concentrated, while other regions may have no anti-climate interest groups to contend with. Again, this increases both the number of "pro-climate" actors in the system and likelihood of first-movers emerging.

3.2 Actor preferences and their determinants

Under the standard tragedy of the commons set up, we assume, for analytic ease, that all actors have similar preferences. Each would be better off acting and avoiding future climate change, but acting is costly. Therefore the temptation to free-ride (to enjoy the benefits of mitigating climate change without paying the cost), leads to a perverse outcome in which no one acts.

How helpful is it to posit a common set of preferences for all actors relevant to climate mitigation? Though prima facie innocuous, this assumption is extremely consequential. It assumes a model in which, on average, a) governments are primarily concerned with economic welfare, b) emissions abatement requires such substantial and costly investment that it diminishes economic welfare (e.g. by requiring an increase in taxes or a drop in other spending), and, c) if a deal is made, aggregate emissions reductions avoid enough future economic harm such that the benefits of collective action to each actor outweigh the cost. Moreover, the model assumes, implicitly, that it is useful to model actors' preferences as constant, not subject to change over time.

Though plausible as a first approximation, this basic political economy model of climate policy fails to explain the behaviour of many significant actors. Most obviously, over the past two decades, a number of countries, cities, business, and others have taken aggressive and costly action on climate change even without

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and H. Bulkeley (2009). "Transnational Climate Governance." Global Environmental Politics **9**(2): 52-73, Roger, C., T. Hale and A. Liliana (2017). "The Comparative Politics of Transnational Climate Governance." International Interactions **43**(1): 1-25.

[44] Broz, J. L. and D. Maliniak (2010). "**Malapportionment, Gasoline Taxes, and Climate Change**." APSA 2010 Annual Meeting Paper.

any guarantee that others will follow suit. To cite just a few examples at the time of writing, Germany has embarked on an ambitious energy transition; the United Kingdom has passed a domestic law requiring it to reduce its emissions by 80% by 2050; 177 sub-national jurisdictions around the world, led by the state of California have committed to either an 80% reduction in emissions by 2050 or remaining below two tons of carbon per capita; 240 of the world's largest corporations have agreed to bring their emissions in line with a 2C scenario, and 100 have committed to source 100% of their energy from renewables. How can we explain this variation in actors' responses? Are they merely "suckers"? For a tragedy of the commons model, these outcomes seem to fall off the equilibrium, given the lack of a global deal.

The empirical literature, however, emphasizes a number of factors that shape actors' preferences over climate policy above and beyond the basic political economy model. First, mitigation actions may not be perceived primarily as climate policy per se. Many so-called "co-benefits" may come along with specific mitigation actions, including reducing local air pollution and improving human health, increasing energy security and reliability, developing new industrial sectors, preserving forests, etc. In some cases, these co-benefits temper the cost of mitigation actions; in other cases, the other benefits are governments' primary focus, and mitigation is an ancillary result. Even if it is true that, on average, most mitigation actions are costly, some will not be, and these "win-win" actions can allow early movers to take significant steps.[45]

Second, the economic costs and benefits vary substantially across actors, and may not be the primary motivation for governments, CEOs, mayors, or other decision-makers. While there have not been many comparative political studies of national climate policy formation, the existing literature shows enormous variation.[46] Comparative studies of non-state actors also show how a wide range of motivations shape preferences. On average, decision makers certainly prefer to avoid expending money with little immediate return, but many actors face pro-climate stakeholders, including citizens and voters, customers, and investors. For the mayor of a progressive city, the CEO of a company with a 'green' brand, or the leader of a country whose voters value the environment, there may be strong incentives to reduce emissions even absent global collective action. Alternatively, for many countries, sub-national jurisdictions, or companies heavily dominated by fossil-fuel dependent actors, even low-cost climate policies may be anathema, no matter how big the potential mitigation gains. Even a very favourable "global deal" may not be enough to motivate such actors, since the future benefits from avoided climate change will never be

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[45] Dubash, N. K., M. Hagemann, N. Hohne and P. Upadhyaya (2013). "Developments in national climate change mitigation legislation and strategy." Climate Policy **13**(6): 649-664, Lachapelle, E. and M. Paterson ibid."Drivers of national climate policy." (5): 547-571, Green, F. (2015). "Nationally self-interested climate change mitigation: a unified conceptual framework." Center for Climate Change Economics and Policy **Working Paper No. 224**.

[46] Dubash, N. K., M. Hagemann, N. Hohne and P. Upadhyaya (2013). "Developments in national climate change mitigation legislation and strategy." Climate Policy **13**(6): 649-664, Lachapelle, E. and M. Paterson ibid."Drivers of national climate policy." (5): 547-571.

enough to outweigh their short-term reliance on hydrocarbons. Similarly, polycentric approaches will struggle to compel action from such laggards.

Third, consider variation in the "benefit" (reduced harm) that avoided climate change provides. Because the climate changes slowly, and with significant variation and uncertainty around localized impacts, the benefits of slowing global warming accrue gradually and unevenly, with the bulk going to people in the future. It is common in the literature to model this innate feature of the climate problem by assigning a discount rate to the future benefits of mitigation; as in all economic models, a benefit in the future is worth less than a cost now, even if they have the same nominal value. Again, this simplifying assumption can obscure more than it clarifies. The physical impact of climate change varies substantially across different geographic regions and time periods. For small island states, arid countries near the equator, and coastal cities, the impacts are already severe and will become existential. For more temperate and inland areas, the changes will likely be slower and more moderate, potentially even bringing some benefits in the medium term to certain areas. Differential levels of economic development and state capacity will also mean that some actors will be able to adapt to climate disruptions much more effectively than others. This natural heterogeneity is magnified by how different politicians, local leaders, and corporate entities value the future. Some, like pension funds, may have long horizons that increase the value of climate mitigation. But many actors, focused on quarterly reports or electoral cycles, likely attach very little value to future avoided mitigation.

For these reasons, there is huge variation in the costs and the benefits of mitigation, and therefore in the willingness across actors to act. As we have observed, for a non-trivial set of actors, action on climate change is not a cost but a benefit.[47] This is true for both state and especially, as argued above, non-state actors. The symmetrical preference assumption is therefore both empirically weak and theoretically consequential. Under a tragedy of the commons structure, these differential preferences are just "noise." A tipping point lens, instead, focuses attention on exactly these differences in the willingness to act across actors.

3.3 Free-riders versus first-movers

Perhaps the most consequential mechanism the tragedy of the commons structure generates is that climate action taken by others provides a benefit on which an actor can free-ride. This benefit can include both the "free" future reduction in climate change that others' actions produce (from which the free-rider cannot be excluded) and avoiding the cost of mitigating, which may give the free-rider a competitive advantage in the present. Because every actor can free-ride in these ways, absent a collective agreement, no action is taken under the tragedy of the commons framework. Free-riding is frequently cited in both academic and policy literature as the primary blockage to climate action, with

[47] Green, F. (2015). "Nationally self-interested climate change mitigation: a unified conceptual framework." Center for Climate Change Economics and Policy **Working Paper No. 224**.

perhaps the most significant example being the US Congress's 1997 resolution not to endorse a climate deal that did not also require cuts for emerging economies.

But how much benefit does reduced climate change in the future, or competitive advantage in the present, actually provide would-be free-riders? Consider future benefits first. Unlike with fisheries, forests, pastures, or many other commons, the benefits of avoiding climate change are hypothetical; they are damage mitigated in the future, not fish, lumber, or grazing gathered in the present. As argued above, the actual benefit this provides upon which actors in the present might free-ride is highly variable across actors, and in many cases quite small. In other words, the "political discount rate" that many actors attach to climate change may be so large that the benefits of avoiding climate change in the future are unlikely to ever be enough to motivate action by most. This means that even if collective agreements to reduce emissions can be reached, they will be of little value to many actors, and will therefore struggle to stimulate cooperative behaviour.

Second, what about free-riding by avoiding the costs of mitigation that others have to pay? This argument is frequently made to justify or explain inaction, most prominently in the US domestic context. But political justifications should not be accepted uncritically as analytic assumptions, even if the policymakers involved believe them to be true. Following the arguments above, an actors' ability to benefit from others' mitigation, or to be hurt by others' free-riding, will vary substantially across countries, sub-national jurisdictions, and sectors. Specifically, carbon-dependent actors will have the most to gain by free-riding, to or lose from others' free-riding. But even for these cases with much to lose, it is by no means clear that mitigation action has led to substantial competitive loses for those companies, countries, or sub-national jurisdictions that embrace it, or competitive gains for those who have not.[48] For a large national economy, the array of factors that determine competitiveness is so vast, it would be extremely difficult to discern the impact of mitigation actions.

That said, it is certainly true that many actors have believed that climate action put them at a competitive disadvantage, or advocated that position for rhetorical reasons. However, the relevant question here is not whether actors identified free-riding as significant, but whether the *relative* benefit (cost) of free-riding (others' free-riding) was consequential compared to the *absolute* cost of acting or not-acting. Put another way, what led to industry opposition to the Kyoto Protocol in the United States? Was it that they feared a loss of competitive advantage? Or simply that the cost of the regulation would have cut at their bottom line, and appeals to a level playing field were more rhetorically effective than special pleading? A concern for competitive position would be consistent with the tragedy of the commons framework, while a concern simply with the cost of taking action would fit better with the tipping point framework. There is

[48] Aldy, J. E. and W. A. Pizer (2014). "The Competitiveness Impacts of Climate Change Mitigation Policies." Journal of the Association of Environmental and Resource Economists **2**(4): 565-595, Dechezleprêtre, A. and M. Sato (2017). "The Impacts of Environmental Regulations on Competitiveness." Review of Environmental Economics and Policy **11**(2): 183–206.

not space to resolve this empirical question in the present study, but it seems at least plausible that the fear of competitive disadvantage may have been less important than the fear of regulation per se. Certainly we cannot automatically assume that competitive considerations were the primary determinant.

In sum, it is by no means clear that the problem of free-riding, either on the benefits of avoided climate change in the future or on avoided costs in the present, is a central barrier to cooperation for many actors in the climate realm. Indeed, a tipping point frame encourages us to consider that, for some actors, there may be a positive value to unilateral action, and a cost to being left behind. For example, actors with industrial policy goals can derive first-mover advantages in intellectual property rights and market position. Politicians with pro-climate constituencies can derive political benefits from being seen as a leader precisely because the rest of the world has not yet caught up. Conversely, actors that cling to fossil fuels rests may find themselves saddled with inefficient infrastructure that creates competitive disadvantages, "stranded" economic assets that to not provide a return on investment, little market share in new industries, or they may be the recipients of social opprobrium. In other words, unilateral action in a tragedy of the commons structure can lead to a "sucker" pay-off. But in a tipping point structure, there may actually be positive incentives for at least some actors to do so, as well as costs for late-movers who risk being left behind.

3.4 Effect of prior action on subsequent preferences and strategies

Perhaps the greatest difference between the tragedy of the commons and the tipping point is the way the two lenses understand the strategic effect of prior action on later action. In the tragedy of the commons model, action by others usually dissuades an actor from mitigating. If others contribute a lot, the actor can free-ride on their efforts. If others do not do enough, the actor can scarcely hope to slow climate change without them. Only when one's own action is pivotal—that is, able to trigger action from others—does it make sense to act. International coordination is therefore critical to sustain cooperation.

In the tipping point model, in contrast, prior action affects actors' preferences and strategies over time. Levin et al., van der Ven et al. , and Urpelainen argue that, given the difficult politics of climate mitigation, early action should focus on interventions with these kind of increasing returns and potential to scale.[49] Several mechanisms can be identified. First, many tipping point models note how prior action provides demonstration effects, for example showing that more people than expected hold anti-regime preferences and are willing to risk their lives for them. In the climate context, such information can be similarly

[49] Levin, K., B. Cahsore, S. Bernstein and G. Auld (2012). "Overcoming the tragedy of super wicked problems:
constraining our future selves to ameliorate global
climate change." Policy Sci **45**(123-152), Urpelainen, J. (2013). "A model of dynamic climate governance: dream big, win small." International Environmental Agreements **13**: 107-125, van der Ven, H., S. Bernstein and M. Hoffmann (2017). "Valuing the Contributions of Nonstate and Subnational Actors to Climate Governance." Global Environmental Politics **17**(1): 1-20.

consequential, showing that mitigation action is for many actors desirable (i.e., revealing that they hold pro-climate preferences) and that the costs are worth paying. This changes the information available to actors in the future, allowing them to reassess their beliefs about whether others will act (affecting strategies) and what the costs and benefits of actions might be (affecting preferences).

Second, and likely more powerfully, climate action can affect the material costs of future action by changing technology and the economic systems around it. As technologies are developed and deployed, their costs descend down a "learning curve," becoming cheaper as more R&D is conducted and as production and distribution systems "learn by doing" to reach economies of scale. Renewable energy technologies fit this pattern well.[50] Importantly, this technological improvement is not simply a product of engineering. As more of the economy decarbonizes, new business models and regulations are devised that can then diffuse to more jurisdictions. These effects give regulation in one jurisdiction a strategic impact that can affect other jurisdictions' propensity to act.[51]

Moreover, many new technologies and business model demonstrate network effects; like telephones or email, the more people have them, the more useful they are. Consider electric cars or solar rooftops. For the first movers, such products are very inconvenient because there are too few charging stations, maintenance technicians, or electric cables and pricing systems that allow homeowners to send power back to the grid. As market penetration increases, however, the enabling environment shifts and later adopters are well supported. Indeed, once network effects are strong enough, they may help to lock in new technologies as default options.

Third, beyond changing the material cost-benefit analysis for actors, early action can affect the political processes of preference formation for states and other actors.[52] As new technologies emerge and grow, their producers and consumers develop a distributional interest in their continuance and expansion. At first these new interest groups are unlikely to be able to overcome established incumbents in political contestation. But in economic sectors or geographic regions where incumbents are relatively weak, the new entrants may thrive and, as action spreads, eventually acquire the size and clout to become politically competitive with incumbents in more and more jurisdictions and industries. This materialist interest-group mechanism may also be complemented by normative and ideational shifts. As pro-climate action spreads and becomes mainstream in an increasing number of political and economic spheres, social norms may increasingly frown on political jurisdictions or companies that continue to pollute.[53]

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[50] BNEF 2017

[51] Hale, T. and J. Urpelainen (2015). "When and how can unilateral policies promote the international diffusion of environmental policies and clean technology?" Journal of Theoretical Politics **27**(2): 177 - 205.

[52] Urpelainen, J. (2013). "A model of dynamic climate governance: dream big, win small." International Environmental Agreements **13**: 107-125, van der Ven, H., S. Bernstein and M. Hoffmann (2017). "Valuing the Contributions of Nonstate and Subnational Actors to Climate Governance." Global Environmental Politics **17**(1): 1-20.

[53] Green, F. (2016). "Anti-fossil fuel norms." Forthcoming.

Through these mechanisms, early actions can increase the ratio of benefits to costs for subsequent actions, as well as the processes through which actors assess the value of mitigation action. Like the broader tipping point model, the relevance and intensity of these mechanisms is likely to follow an S-curve, operating weakly at first, but then increasing in force as a critical mass of actors takes action. In later periods, these mechanisms do not simply make it easier mitigation relatively easy; they can make it costly for recalcitrant actors not to mitigate.

3.5 The function of international institutions in a tragedy of the commons

As discussed in section two, the tragedy of the commons can be addressed, in theory, via several logics of cooperation. Under the regulatory approach, a collective agreement gives each actor the ability to credibly commit to mitigate a sufficient amount such that the collective benefits are, for each actor, more than the cost of mitigation. Institutions facilitate this outcome by determining, through negotiation, the appropriate contribution of each actor; providing transparency about each actor's contribution so others can observe (and punish) defection; and creating penalties for defection (either punitive sanctions, or simply the withdrawal of collective benefits in the future). In these ways, institutions allow actors to bind their future selves, and therefore unlock reciprocal benefits from other actors. In the club model, institutions play a similar role, though here the benefits of cooperation can be excluded, making cooperation more likely to be self-sustaining, and possible for a subset of actors. In polycentric approaches, individual actors develop diverse institutions that serve their own purposes, addressing pieces of the large mitigation challenge and creating a pluralist patchwork of different solutions at multiple scales.

What, then, can an agreement like Paris do? If we believe that climate contains more features of a tragedy of the commons than of a tipping point, we likely interpret Paris as a relatively modest achievement. For example, Keohane and Oppenheimer argue that Paris uses "discretion and vagueness" (p. 10) to make countries comfortable with making commitments; they can set the target they like, and there is no penalty for failing to deliver. Future commitments will therefore be determined through domestic politics, and the competing pressures governments face at home and abroad. In a similar vein, Victor notes that "flexibility offers a way to get started and build confidence that, in time, will beget more confidence and a willingness to do more," but that "eventually a much more integrated global treaty will be needed to make major cuts in the greenhouse gases." That is, Paris may be akin to the GATT, an iterative set of commitments that will eventually need a more effective collective agreement like the WTO. Bang et al. are even more blunt, noting that "Paris does little to restructure states' incentives so as to avoid free riding," though they hope actors will become more pro-climate over time.

For these observers, Paris is a positive but ultimately modest step. But if we instead view climate mitigation as a tipping point problem, a different interpretation of the Paris architecture emerges.

4. Catalytic institutions

If climate mitigation possesses more features of a tipping point than a tragedy of the commons, then the regulatory, club, and polycentric approaches discussed in section two will likely all be suboptimal. The regulatory approach will struggle because the costs of mitigation are too high in the present compared to the distant future benefits for the majority of actors. The club approach will struggle to identify excludable benefits. And the polycentric approach will do little to stimulate action from laggards. How, then, can catalytic institutions help?

When an issue area possess characteristics of a tipping point structure, catalytic institutions help states and other actors cooperate by shifting actors' propensity to act cooperatively over time. They do this by recognizing and stimulating action by an initial set of early movers, and by strengthening the impact of these leaders' actions on both the preferences and the strategic choices of laggards. Catalytic institutions can be found across a range of international regimes, and scholars have identified various mechanisms through which they can shape actors' behaviour, including goal-setting, review processes, norm diffusion, benchmarking, and experimentation. While such governance tools do not of course require a tipping point problem structure to operate, they are particularly effective in this context.

Building on and linking together this work, this section identifies several specific mechanisms through which catalytic institutions work:

1. Goal-setting and benchmarking
2. Flexible, iterated commitments
3. Transmission of information and resources from leaders to laggards
4. Constituency building

Below I lay out the causal logic of each mechanism, illustrating with examples from both the new architecture of the climate regime and other international institutions. Many such institutions include catalytic institutions alongside institutions that follow other logics of cooperation as well. What makes the Paris Agreement distinctive is its reliance on many complementary catalytic elements, putting the catalytic logic of cooperation at the center of the broader regime.

4.1 Goal-setting and benchmarking

Goal-setting is a regular feature of global governance.[54] Countries often declare their collective intent to eradicate a disease, uphold human rights, or provide other global public goods, most prominently in the Millennium Development Goals and Sustainable Development Goals. Sometimes goal-setting leads to deeper institutionalization over time, as in the human rights regime. In the climate realm, countries have declared their intent to limit temperature change

[54] Kanie, N. and F. Biermann, Eds. (2017). Governing through Goals: Sustainable Development Goals as Governance Innovation. Cambridge, MIT Press.

to below 2C, while aspiring to reach 1.5C. As the Paris Agreement affirms, this requires effectively decarbonizing the economy in the middle of the 21st century.

As many observers have noted, absent concrete plans, commitments, and accounting, goal-setting can be symbolic, cheap talk, or even intentionally dissembling. Indeed, we often expect an inverse correlation between ambitious commitments and binding obligations.[55] Nonetheless, scholars have identified various conditions under which, and mechanisms through which, goal setting can affect political behaviour. First, a goal provides a focal point around which actors can converge. This mechanism is unlikely to sway actors who do not wish to cooperate, but in coordination games it can enhance efficiency and enable benchmarking (Urpelainen 2013). Second, international goals can enhance the leverage of pro-cooperation constituencies in domestic politics, intra-firm deliberations, or other spheres of political contestation. To the extent states or other actors are sensitive about reputational critiques, explicit goal-setting raises the costs of non-compliance, and gives pro-compliance groups a "hook" for their arguments.[56] Third, international goals can bolster processes of norm diffusion by codifying and legitimating certain policy preferences and giving them the imprimatur of international consensus.[57]

None of these mechanisms is likely to motivate sufficient mitigation action in the short-term amongst a large number of actors. But in a tipping point context, and paired with other catalytic institutions, these causal mechanisms become be particularly efficacious. For example, the long-term goal in Paris—net zero emissions by the beginning of the second half of the century—provides a much clearer focal point for action than earlier targets. It allows successive NDCs to be benchmarked (see below) against a common standard through the review processes, and clarifies to pro-climate actors what mitigation action is required of them. Furthermore, as Young notes, goal-setting can have a significant effect on actors guided by a logic of appropriateness.[58] Given the above arguments about preference heterogeneity on climate change, we make expect this to be the case. Indeed, we see evidence of both these effects in the way the intergovernmental goals of the Paris Agreement have been voluntarily adopted by significant non- and sub-state actors. The flagship transnational governance commitment for business is the Science Based Target program, a protocol through which a company tracks its emissions and creates a company-specific plan to put itself on pathway compatible with 2C or below. Similarly, following Paris, one of the largest transnational city networks decided that each of its cities must present a 1.5C-compatible emissions pathway by 2020. In these ways, the Paris goal is more than just an abstract aspiration, like the promise in the 1992 framework convention to avoid "dangerous" climate change. It is a specific focal

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[55] Downs, G., D. M. Rocke and P. N. Barsoom (1996). "Is the Good News about Compliance Good News about Cooperation?" International Organization **50**(2): 379-406.
[56] Thomas, D. C. (2001). The Helsinki Effect: International Norms, Human Rights, and the Demise of Communism. Princeton, Princeton University Press.
[57] Young, O. R. (2017). Conceptualization: Goal Setting as a Strategy for Earth System Governance. Governing through Goals: Sustainable Development Goals as Governance Innovation. N. Kanie and F. Biermann. Governing through Goals: Sustainable Development Goals as Governance Innovation, MIT Press.
[58] Ibid.

point and normative standard that helps define and elicit ambitious action from pro-climate actors, exactly what is needed to stimulate the tipping point dynamics.

Complementing goal-setting, rating systems—which grade states against some standard and compare their compliance to others—are now common tools of multilateral institutions (like the World Bank "Doing Business" indicators), NGO advocacy (like the Transparency International corruption index), and bilateral diplomacy (like the US human trafficking scorecard).[59] When combined with a long-term goal, as in the Paris Agreement, such tools can increase the reputational benefits for leaders and, commensurately, the costs for laggards. To the extent actors are motivated by their reputations, such rankings can have a catalytic effect.

While some advocates proposed creating a grading system for NDCs in the Paris Agreement as part of the enhanced transparency framework, countries balked at exposing their "national determined" contributions to the collective judgement of their peers or others (suggesting the power of such ranking systems). Still, the Paris transparency framework creates the conditions under which third parties can compare and rank national ambition. The non-profit Climate Action Tracker, for example, has rated countries' NDCs, and the rankings are widely cited in media reports and diplomatic discourse.

Moreover, while it does not benchmark countries against each other, the Paris review system does create a regular "global stocktake" to gauge collective progress toward the long-term goal every five years. Coming before each cycle of new NDCs, the global stocktake seeks to determine how adequate countries' efforts are and what will be required for the next round of pledges. This form of benchmarking helps to define the type and scale of actions that will be required from countries and others in the future. To the extent actors want to continue to be considered leaders (or at least to not be seen as laggards), they will update their actions accordingly.

4.2 Flexible and iterated commitments

Like aspirational goals, voluntary, flexible commitments are often seen as weak tools of global governance. They do not give actors incentives to do what they would otherwise not, but rather codify "business as usual." Still, even outside a tipping point context, they may be helpful for promoting at least modest cooperation by helping to build trust.[60] While the NDCs countries delivered at Paris were not sufficient to achieve the Agreement's goals, they represent the single largest commitment to mitigation ever made, perhaps enough to lower global temperature rise by 1-2C if implemented. Critically, for the first time, all major emitters made a commitment.

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[59] Kelley, J. G. (2017). Scorecard Diplomacy: Grading States to Influence their Reputation and Behavior. Cambridge, Cambridge University Press.
[60] Keohane, R. O. and M. Oppenheimer (2016). Paris: Beyond the Climate Dead End through Pledge and Review? Discussion Paper 2016-85. Harvard Project on Climate Agreements, Belfer Center for Science and International Affairs, Harvard Kennedy School.

The flexible nature of the Paris commitments also helped open the doors to explicitly recognizing the voluntary commitments of cities, businesses, and other sub/non-state actors in the intergovernmental process. In a Kyoto style regime, national governments commit to legally binding targets. If reductions commitments are instead delivered by voluntary sub- or non-state actor commitments, governments may be accused of complying with the letter if not the spirit of their international legal obligations. Indeed, traditionally many progressive countries and NGOs in the UNFCCC process aimed to limit engagement with transnational climate governance, claiming it might divert responsibility from national governments. In the flexible Paris arrangement, these concerns are mitigated. To the extent sub- and non-state action overlaps with NDCs, it is helping governments deliver their commitments; to the extent they do not, they are helping close the mitigation gap.

Of course, in a tipping point context, flexible and iterated commitments go beyond mere codification to generate additional causal mechanisms that facilitate deeper cooperation over time. First, by lowering the cost of cooperation to what actors are willing to do, flexible commitments can help create the initial moves required to initiate a tipping point dynamic. If the bar for cooperation is too high (e.g. a binding commitment of the kind required for a regulatory solution) these "small steps" might never occur.[61] Moreover, by explicitly allowing variation in these initial moves, flexible commitments allow the most pro-mitigation actors to put forward ambitious commitments, instead of limiting themselves to a least common denominator negotiated outcome.

Second, iteration of commitments is a sine qua non for catalytic institutions. Though the Paris NDCs are not in themselves sufficient, countries are required to put forward new NDCs in 2020 and regularly thereafter, though there is of course no obligation that subsequent pledges be sufficient to address the problem. But even though flexible commitments capture only what actors are willing to do, in a tipping point context, what actors are willing to do increases over time. Iteration of commitment making is, of course, a common feature of international institutions. The global trade regime has developed through progressive trade rounds, and the "convention and protocol" approach to global commons issues like the ozone regime typically involves a series of increasingly stringent negotiated agreements. While these agreements follow the club or regulatory logics of cooperation, the regime from which they emerge has elements of a tipping point structure in the sense that past cooperation can alter future preferences and strategies. In trade, for example, the expansion of multinational companies enabled by early trade rounds re-shaped the domestic politics of economic openness in major economies by creating powerful new

[61] Victor, D. G. (2011). Global Warming Gridlock: Creating More Effective Strategies for Protecting the Planet Cambridge, Cambridge University Press, Urpelainen, J. (2013). "A model of dynamic climate governance: dream big, win small." International Environmental Agreements **13**: 107-125.

constituencies.[62] Paris replicates this logic but with individual (for both parties and non-party actors), as opposed to negotiated, commitments, which allows it to capture "updates" in countries' preferences more quickly and easily than with successive negotiated protocols.

Third, in a tipping point context, the flexibility of commitments makes cooperation more resilient in the face of backsliding. In a tragedy of the commons framework, or under a regulatory or club arrangement, one actor's cooperation is conditional on other actors' cooperation. Defection or free-riding is therefore toxic to cooperation. With flexible arrangements, such as those in polycentric or catalytic arrangements, this is not the case. Since countries commit to doing what they would do anyway, other countries' failure to deliver on their commitments does not create an incentive to shirk. This dynamic has been observed in countries' (and other actors') reactions to the Trump Administration's announced withdrawal from the Paris Agreement. Every major emitter has since reiterated its commitment to Paris, and the G7 and G20 issued exceptional "G6" and "G19" statements outlining further steps to implement the agreement. US sub-national and private-sector groups have also committed to delivering the US pledge through their own actions.

Finally, flexible commitments can help drive the policy innovation and experimentation that can change the cost/benefit ratio to mitigation in the future. Because countries are free to develop their own mitigation plans, reflecting their own conditions and interests, the NDCs contain a very diverse array of policies and measures. As the difficult work of implementing these plans progresses, countries will gain useful experience of what works and what does not. For a technically complex issue like mitigation, such knowledge can be highly consequential. For example, the positive and negative experiences first mover jurisdictions have had with emissions trading, feed-in-tariffs, or other common policy instruments has profoundly shaped policy design in places now adopting such schemes.[63] Coupled with mechanisms for knowledge diffusion, this information can reduce the cost of mitigating in the future.

4.3 Transmission of information and resources from leaders to laggards

As noted in section three, a definitional feature of a tipping point problem structure is that action in the past changes the cost-benefit ratio and preference formation process for actions in the future. Catalytic institutions aim to support the causal mechanisms through which this effect occurs by creating processes to direct information, technology, and other resources from leaders to laggards.

One important way through which catalytic institutions generate and diffuse information is via review processes. Allowing actors to make flexible

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[62] Milner, H. (1987). "Resisting the Protectionist Temptation: Industry and the Making of Trade Policy in France and the United States During the 1970s." International Organization **41**(4): 639-665.

[63] Schroeder, M. (2008). "The construction of China's climate politics: transnational NGOs and the spiral model of international relations." Cambridge Review of International Affairs **21**(4): 505-525.

commitments and expanding the realm of governance to non-state actors may help experimentation, but innovations that do not diffuse will not be catalytic. Here, review and other information-exchange institutions can help.[64] Such processes are common features of many international regimes, and are often oriented toward compliance, gathering information about countries' behaviour in order to make sure they are implementing commitments. But review processes can also have a learning effect on states and other actors. Through review processes, states and outside experts gather information about state behaviour vis-à-vis an international obligation, generating and transmitting knowledge about how best to approach the problem. Peer-to-peer transgovernmental networks have been shown to employ particularly influential versions of this type of review (Slaughter 2004).[65] In the environmental realm, the technical committees of the Montreal Protocol's provided an expert-oriented version of implementation review that was seen as particularly effectual.[66]

The Paris Agreement includes various review processes, including review of individual countries' implementation of NDCs (Art. 13), review of aggregate progress toward the long-term goal in a global stock-take (Art. 14), and a "non-punitive" enforcement review designed to troubleshoot barriers to NDC implementation. At the time of writing, these mechanisms remain under negotiation, so it is difficult to know how catalytic they will ultimately be.[67] Moreover, like in a regulatory or club arrangement, the review mechanisms can provide reassurance by showing what other actors are doing. This demonstration of actions supports demonstration effects, showing actors that that others are acting, and so acting must not be too costly.

Beyond information, catalytic institutions seek to transmit epistemic and material resources from leaders to laggards in various ways. Technology transfer and financial aid from rich countries to poorer ones is a common feature of multilateral environmental agreements, including the UNFCCC. In the climate realm, emissions trading (in which countries and other actors in the global North can pay for, and receive emissions credits for, reductions in the global South) is another vehicle through which material and technology resources can be exchanged. Interestingly, none of these common features of multilateral environmental agreements, and of the UNFCCC process, were central to the Paris Agreement. Rich countries were not prepared to offer greater intellectual property or funding to poor countries than they had already pledged, and emissions trading system remained too controversial to define explicitly, though a place-holder was left for them to be potentially created in the future. The Paris

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[64] Sabel, C. F. and D. G. Victor (2015). "Governing global problems under uncertainty: making bottom-up climate policy work." Climatic Change, Abbott, K. W. (2017). "Orchestrating experimentation in non-state environmental commitments." Environmental Politics **26**(4): 738-763.
[65] Slaughter, A.-M. (2004). A New World Order. Princeton, Princeton University Press.
[66] Victor, D. G., K. Raustiala and E. B. Skolnikoff (1998). The Implementation and Effectiveness of International Environmental Commitments. Cambridge, MIT Press.
[67] The experience of previous mechanisms along these lines in the UNFCCC such as the technical examination process, the technology mechanisms, and the review under the Kyoto Protocol have not been shown to be particularly efficacious for learning.

Agreement therefore did not create strong intergovernmental institutions to catalyse material and technological flows above and beyond information.

However, one "transmission belt" that Paris did embrace and orchestrate were transnational initiatives and sub- and non-state actor networks. Information diffusion is a major function of transnational climate governance initiatives, as cities, companies, and other actors experiment and seek common ways to advance their agendas.[68] In addition to providing knowledge, many sub-national actor networks are also vehicles for the human and financial resources sub-national or private sector actors need to implement ambitious mitigation actions. As Abbott notes, there is potential for the UNFCCC and other actors to play a more active role in enhancing the catalytic effect of these transnational elements of the regime.[69]

More broadly, the Paris structure has helped actors see how their mitigation action can have positive effects on others' propensity to act. Because the regime is explicitly designed to follow a tipping point dynamic, as opposed to other logics of cooperation, then actors are more likely to understand that their actions can have catalytic effects on other actors.[70] This belief would give them additional motivation for acting above and beyond what they would have done otherwise, because they know their action can influence others. This is often mentioned in the abstract. But a catalytic regime helps make this link clearer. For example, the We Mean Business coalition has explicltly designed the target list of corporations it wants to join its climate initiatives on their ability to tip their economic sector into climate action.[71]

4.4 Constituency building through orchestrating sub- and non-state actors

In various realms of world politics, international institutions and states have sought to empower and build constituencies for cooperation amongst sub- and non-state actors. These "orchestration" strategies seek to bring new resources and actors to global public good provision.[72] International organizations and states may not have sufficient authority and capacity to directly influence a problem, but can use their convening power and resources to recruit "governance intermediaries" like corporations and sub-national jurisdictions. Orchestration has been deployed in issues as diverse as global health provision, gender equality, commercial standards, and policing.[73]

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[68] Roger, C., T. Hale and A. Liliana (2017). "The Comparative Politics of Transnational Climate Governance." International Interactions **43**(1): 1-25.
[69] Abbott, K. W. (2017). "Orchestrating experimentation in non-state environmental commitments." Environmental Politics **26**(4): 738-763.
[70] Hale and Urpelainen 2014 term this "strategic regulation."
[71] Author interview with Nigel Topping, CEO WMB.
[72] Abbott, K. W. and D. Snidal (2009). "Strengthening International Regulation through Transnational Governance: Overcoming the Orchestration Deficit." Vanderbilt Journal of Transnational Law **42**: 501-578, Hale, T. and C. Roger (2014). "Orchestration and Transnational Climate Governance." Review of International Organizations **9**(1): 59-82.
[73] Abbott, K. W. and T. Hale (2014). "Orchestrating global solutions networks: a guide for organizational entrepreneurs." **Innovations** **9**(1-2): 195-212.

As noted above, the climate regime is unique in the extent to which it has aimed to catalyse non-state action, as key policy entrepreneurs engaged in "webcraft" strategies to complement the intergovernmental diplomacy.[74] While sub- and non-state and transnational governance of climate change had been building over the course of the regime, in the lead up to Paris the UN Secretary-General, the UNFCCC Secretariat, and the Peruvian and French hosts of COP20 and COP21, respectively, took a much more purposeful approach, mobilizing dozens of initiatives that ultimately came to include over 10,000 actors.[75] The Paris Agreement and COP22 in Marrakech then codified this engagement, creating two "Climate Champions" to orchestrate further sub- and non-state action, an annual segment of the COP for sub- and non-state actors to report on progress and make new announcements, a tracking system to monitor implementation, and explicit links between sub- and non-state climate action and national policy options in the technical examination process.

In a tipping point context, these orchestration efforts can have a particularly significant impact.[76] First, as noted above, because sub- and non-state actors have significant scope to affect climate mitigation, and because a significant number of them are likely to hold strong pro-climate preferences, mobilizing them has a large direct effect on emissions that helps stimulate enough initial action to help tip others.

Second, the Paris system does not just celebrate and encourage sub- and non-state climate action,[77] it creates structures to review and extract lessons from it, including the NAZCA platform, the climate action events at COPs, and an annual Yearbook of Climate Action. These review and tracking tools serves as a soft accountability mechanism, but also seek to draw out the epistemic benefits of sub- and non-state actors' innovations and experimentation. Moreover, it explicitly links these tools to the technical examination process that is meant to provide countries with concrete policy options to enhance their own climate action. In this way it seeks to ensure that the experiences of leaders are transmitted to other actors.

Third, orchestration may also have broader political effects than just mobilizing action or providing epistemic benefits. By reaching into the 'black box' of domestic politics and increasing the prominence and leverage of pro-cooperation constituencies, it may influence the process of national preference formation. Scholars have identified such a dynamic in international human rights tribunals or review processes, for example, which provide an international platform and legal leverage to civil society groups working at the domestic

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[74] Hale, T. and C. Roger (2014). "Orchestration and Transnational Climate Governance." Review of International Organizations **9**(1): 59-82, Hale, T. (2016). ""All Hands on Deck": The Paris Agreement and Nonstate Climate Action." Global Environmental Politics **16**(3): 12-22, Slaughter, A.-M. (2017). The Chessboard and the Web: Strategies of Connection in a Dangerous World. New Haven, Yale University Press.
[75] GGCA 2016.
[76] Van der ven et al. 2017
[77] Van der ven et al. term these "orchestration platforms."

level.[78] In the climate context, there are various ways in which more action by cities, states and provinces, businesses, and other actors in a country can increase national-level action.[79] For example, as more sub- and non-state actors gain expertise and experience in various mitigation approaches, they increase the capacity of the country as a whole to take on more ambitious policies, since they have already been tried domestically. China, for example, relied extensively on transnational linkages to gain expertise in carbon-trading, piloted through sub-national jurisdictions, before launching a national scale carbon market. In other places the effect of sub- and non-state action on national policy may take the form of political contestation, as "orchestrated" actors put political pressure on their domestic peers and the country as a whole to follow suit.[80] The United States provides a dramatic example of how such mobilization can interact with national policies. In the lead up to Paris, the Obama Administration actively sought to mobilize and highlight climate action by American cities and businesses in the international realm as a way to build domestic political support for its policies and provide "political cover" against the charge that the Paris conference would hurt American businesses. After the election of President Trump, this mobilization took on an opposite but equally important effect. Actors in the United States and around the UNFCCC process aimed to showcase and boost US sub- and non-state climate action in order to mitigate the Trump Administration's attempts to undo his predecessor's policies.

5. Conclusion: where and when can catalytic institutions work?

The article has advanced two theoretical arguments regarding international cooperation. First, it has argued that climate change, and perhaps other global commons issues, evince more elements of a tipping point problem structure than of a tragedy of the commons. The stringent assumptions of the tragedy of the commons framework face so many empirical anomalies as to put in doubt the value of that analytic model for climate change. The argument is not that global climate mitigation has no resemblance to a tragedy of the commons, but rather that choosing this, and only this, analytic model delivers a weak understanding of global climate politics.

Second, the article has agued that, under tipping point conditions, catalytic institutions like those in the emerging climate regime can help drive international cooperation. Such institutions seek to initiate and stimulate early action and to maximize the positive effect of previous action on the strategies and preferences of actors in later rounds. While regimes in areas ranging from trade to human rights include various elements of catalytic institutions, the Paris Agreement and associated shifts in the realm of climate governance have created an entire catalytic regime.

The extraordinary shift in the climate regime, after many years of gridlock, raises two questions of scope. Could such a catalytic approach work in other issue

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[78] Alter, K. J. (2014). The New Terrain of International Law: Courts, Politics, Rights. Princeton, Princeton University Press.
[79] Van der ven et al. 2017
[80] Urpelainen 2013

areas? And, given that the climate regime has shifted its logic of cooperation once, is the likely to evolve into something else in the future?

The theoretical arguments above suggest that the use of catalytic institutions could be increased in many areas where international cooperation dilemmas exhibit characteristics of a tipping point structure. To wit, where:

1. The costs and benefits of free-riding are low
2. There is high variation in actors' preferences, with at least some willing to act unilaterally
3. Many different actors can affect the problem
4. Prior action alters the costs, benefits, and preference formation processes around subsequent actions.

Clearly, many areas of world politics do not fit this description. For example, the cost/benefit of free-riding on the nuclear non-proliferation is high; if one country agrees to take in a number of refugees, it does not lower the cost for other countries to take in additional refugees. Still, many areas of world politics, and especially the realms of development, environment, and social welfare, satisfy these conditions. For example, of the 17 Sustainable Development Goals, areas like health, gender equality, water and sanitation, food security, energy, urbanization, and responsible consumption and production all are relatively insulated from free-riding concerns and affected by a wide range of actors with highly variable preferences. These tend to be, like climate change, classic "intermestic" issues that have domestic political dimensions but also spill across borders. Moreover, in each area certain actions can affect the preferences and strategies around later actions. For example, the more actors develop and create systems to deliver new medicines, crop varieties, or construction materials, the easier it is for others to follow suit. Similarly, increasing action to confront gender inequality builds activist constituencies and social norms that can then increase pressure on laggards, driving a norm-cascade.[81] Further catalytic institutions in these areas could be envisioned to accelerate cooperation, and the goal-setting and tracking functions of the Sustainable Development Goal process already take some steps in this direction.

In addition to variation across issue areas, it is interesting to consider how the problem structure of a single issue area may vary over time. While some features of an issue are innate (e.g., the scientific reality that GHGs emissions anywhere affect the climate everywhere), many are subject to change, such as the kind and number of actors' whose behaviour matters, the balance of power and interests between them, and the rules of the game they follow. Such factors are not just changeable, but potentially endogenous to the regime itself. Indeed, the entire purpose of a catalytic regime is to shift actors' preferences over time in favor of cooperation. In other words, if the Paris Agreement succeeds, it will do so by (eventually) altering parts of the problem structure of climate mitigation itself.

[81] Finnemore, M. and K. Sikkink (1998). "International Norm Dynamics and Political Change." International Organization **52**(4): 887-917.

Various outcomes are possible in the medium- to long-term. Most optimistically, the result could be a harmonious world in which every actor of consequence "tips" and pro-climate preferences diffuse globally. Under such conditions, the problem structure would change into a coordination game, and we would expect actors to create institutions to provide focal points and facilitate implementation.[82]

Alternatively, we may see some particularly recalcitrant actors, such as states whose political economies depend heavily on fossil fuels, fail to shift toward the Paris goals, even as the majority of other actors do. This could lead to a problem structure not dissimilar to that of nuclear proliferation or state support for transnational terrorist groups, where action by a few "rouges" imposes externalities on others. In this more conflictive scenario, a large bulk of states could have an incentive to develop more coercive club institutions to exclude and penalize the recalcitrant emitters, for example through carbon tariffs or other economic penalties. Such a move would not be dissimilar to the transition from the GATT to the WTO in 1994. As rich countries become increasingly open to each other through the GATT process, they developed an interest in bringing the rest of the world into the global trading system. They were then able to use their vast market share to compel smaller nations to join a more legalized trade regime.[83]

Of course, it may also be the case that the Paris Agreement will fail to catalyse sufficient action to force a critical mass of actors to raise their mitigation ambition. In other words, the tipping point may not tip. Under this scenario, the climate regime will look much as it did after Copenhagen, characterized by a weak multilateral process and increasing pluralism. As the polycentric logic suggests, this will involve many different approaches across different actors reflecting their individual preferences and strategies, but may not add up to a global solution.

In sum, given the tipping point nature of climate mitigation, and the emergence of a catalytic regime, we can expect the climate regime to continue to evolve, though the theory does not *a priori* predict the extent to which this process will unfold. The broader theoretical implication is that scholars should see problem structure as at least partially malleable and dynamic, and treat institutional design accordingly.

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[82] Barrett 2003 Chap. 9

[83] Steinberg, R. (2002). "In the Shadow of Law or Power? Consensus-Based Bargaining and Outcomes in the GATT/WTO." International Organization **56**(2): 339-374.

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