Present Bias in Politics and Self–Committing Treaties *

Bård Harstad Anke Kessler

September 2024

Abstract

We study how international agreements can take advantage of domestic time-inconsistency problems in the context of environmental policies. For example, policymakers will prefer future policies to be sustainable, but find it tempting to raise consumption when being in office. We find the equilibrium number of signatory countries to be higher than when preferences are time consistent, especially when the political environment is unstable and polarized, and the international spillovers are limited. In contrast to the traditional literature, the model can also explain why countries sign conventions with mandates that do not vary with the coalition size.

Keywords: international treaties, time inconsistency, self-commitment, environmental policy

JEL classification: Q54, Q58, H87, F53,

*Stanford University and Simon Fraser University, respectively, with emails harstad@stanford.edu and akessler@sfu.ca. Max Wosnitza has been an excellent research assistant. Harstad's part of the research received funding from the European Research Council, ERC GA no. 101055353. Kessler acknowledges financial support from the Chair's Research Grant, Simon Fraser University. All errors are our own.

1 Introduction

Environmental policies are textbook examples of decision problems that suffer from time inconsistency or "present bias." Pro-environment action generally involves future gain at immediate expense: most policies take the form of investments, trading off costs today with benefits tomorrow or, worse, as distant as several generations into the future. Examples are emission reduction, conservation of natural habitat, protection of species, and conservation of natural resources. In this context, the policy preferences of governments typically fail to be dynamically consistent. In fact, optimal policies are necessarily time inconsistent if citizens have time-inconsistency problems, or – if they do not – if policymakers rotate being in office.[1] In such a situation, contemporary governments always hope that future governments will act sustainably, while at the same time preferring to defer costly action to the future themselves.

In this paper, we explore the consequences of time-inconsistent preferences for countries' incentives to sign international environmental agreements (IEAs) and to uphold the treaty over time when compliance is endogenous. We build a simple model of treaty formation and enforcement that captures the essential elements of an environmental policy decision and includes declining discount rates over time. We show that while time inconsistency leads to a political failure for domestic politics and inefficiencies, the desire to attempt to tie the hands of future policymakers is a weakness that international treaties can take advantage of. Thus, international cooperation is facilitated by domestic political failure.

Three results emerge from our analysis. First, we demonstrate that the weakness in domestic politics increases the scope for participation: the equilibrium number of signatories is larger than when preferences are time consistent and increases as the domestic bias toward the present worsens. Second, domestic policy failure can strengthen compliance if enforcement is not guaranteed, i.e., if the treaty needs to be sustained by the credible threat of punishment among its member countries. Intuitively, countries can be more motivated to comply with an agreement when preferences are time inconsistent because they suffer more from the business-as-usual equilibrium they expect when being outside of the agreement. But retaliations come in the future, so too much present-bias leads to defections. If the time-inconsistency problem stems from the rotation of political power, then the extent of political turnover is positively related to both effects. That is, the political turnover can be necessary to create the weakness that an IEA can exploit, and that can make treaties large and robust. Third, since one motivation for countries to participate is to lock in domestic policies rather than to strengthen the contribution of others, the theory can explain why countries sign "shallow" as opposed to "deep" agreements and, more importantly, can provide a rationale for treaties or "conventions" that specify mandates irrespective of the coalition size. Specifically, we show (a) there is always a "shallow but broad" agreement that strictly Pareto dominates a deep but narrow treaty for all countries, and (b) "conventions" with fixed mandates are attractive and can be sustained in equilibrium, unlike in the standard model.

These results bear empirical relevance. In a world of domestic present bias, international agreements have the added benefit of tying the hands of future home governments with regard to *domestic* policies, the

[1] It is well known that political turnover leads to time inconsistency (e.g., Persson and Svensson, 1989; Alesina and Tabellini, 1990; Tabellini, 1991). The fact that policymaker rotation leads to time-inconsistent preferences follows from Amador (2003), Chatterjee and Eyigungor (2016), and Harstad (2020).

incentives to join – and to abide by – international agreements are larger the more pronounced the domestic policy problem is. In our context of environmental policies, this means that the participation and compliance scope of IEAs widens further in cases where the environmental issue to be addressed with the policy has a significant local component. Many conservation treaties explicitly recognize domestic habitat protection as a secondary objective. Examples are all agreements that fall under the framework of the Convention on the Conservation of Migratory Species of Wild Animals (CMS) as well as the Convention for the Protection and Conservation of Sea Turtles (IAC) and the Ramsar Convention on Wetlands.[2] Interestingly, these kinds of agreements frequently have new signatory countries joining over time, even though the original text of the treaty (largely) remains unaltered. In other words, it is not the case that the agreement is (re)negotiated to internalize spillovers on the additional member countries. These facts cannot be explained by traditional theories where the only benefit from signing a treaty is that other members will abate more. In our model, in contrast, countries may want to join even if new members do not affect policy, simply because current governments perceive an additional gain from committing future domestic policymakers to the given (treaty) policy.

Literature. By combining time inconsistency and the formation of environmental agreements, we contribute to two strands of literature. First, we draw on a long tradition of political economy models studying time inconsistency and strategic commitments – going back to Kydland and Prescott (1977). Fischer (1980) explained that even when capital taxes should be low to motivate savings, policymakers would be tempted to raise the taxes after the investments are sunk. In this setting, international cooperation can be harmful because it eliminates the competition for capital among nations that could motivate low taxes despite the time-inconsistency problem; see Rogoff (1985), van der Ploeg (1988), and Kehoe (1989).

The idea that international treaties can alleviate domestic time-inconsistency problems has primarily been explored in the area of international trade. Staiger and Tabellini (1987), Matsuyama (1990), and Maggi and Rodruiguez (1998, 2007) all highlight how time-inconsistency challenges in domestic trade policy that arise for economic or political reasons are mitigated by binding agreements that are facilitated through international institutions such as the GATT/WTO. Staiger and Tabellini (1999) present evidence on the effectiveness of this strategy by showing that GATT rules helped the US government to make domestic trade policy commitments that it could not have made otherwise. Conconi and Perroni (2009) study the relationship between domestic and international policy credibility in a general repeated game framework, where deviations are followed by noncooperation of other domestic and international players. They also consider an application to environmental policy, where the reason why the domestic choice of emission tax fails to be time consistent is that once firms have already invested in green technology, lowering emission taxes will reduce the distributional burden without altering incentives.

Second, we contribute to the body of research that focuses on the equilibrium size of IEAs. The typical finding in this literature is that fully enforceable international agreements are incentive compatible only if

[2] The guidelines in the CMS framework state (article V) that "where appropriate and feasible, each *agreement* should provide for but not be limited to: [...] f) maintenance of a network of suitable habitats appropriately disposed in relation to the migration routes; g) where it appears desirable, the provision of new habitats favourable to the migratory species or reintroduction of the migratory species into favourable habitats." See https://www.cms.int/en/convention-text. IAC and Ramsar can be found at https://www.fisheries.noaa.gov/national/endangered-species-conservation/inter-american-convention-protection-and-conservation-sea and https://www.ramsar.org/, respectively.

they involve a very small number of countries (Hoel, 1992; Carraro and Siniscalco, 1993; Barrett, 1994).[3] This prediction clashes with the observation that real-world coalitions are often quite large, leading to the "paradox of international environmental agreements" (Kolstad and Toman, 2005; see also Nordhaus, 2015). Among the explanations that have been proposed to explain this puzzle, our theory complements that of Battaglini and Harstad (2020), where incumbents sign weak treaties in order to influence the probability of winning the next election.[4] Marchiori et al. (2017) study how domestic lobby groups affect the size of stable IEAs, and show that the government's desire to improve its bargaining position with respect to strong anti-emission lobbies may increase its incentives to sign an IEA.

Our model differs from those above and our analysis contributes to both literatures by deriving the equilibrium coalition size as a function of the time-inconsistency problem. We believe our theory emphasizing political turnover can better explain why *democracies* are more likely to sign treaties than nondemocratic countries are (see Table I in Battaglini and Harstad, 2020). We study participation as well as compliance, deep agreements as well as shallow conventions, and we highlight when and how the treaty can exploit the domestic time-inconsistency problem.

Outline. Based on the simple model in Section 2, we present our three main results in Section 3. Section 4 explains how the results hinge on the (im)possibility to commit domestically. Section 5 concludes. All proofs are in the Appendix.

2 The Model

2.1. The Stage Game

Consider a set N of n countries contributing to a local public good or, equivalently, a local public bad. To fix ideas, we refer to emissions and abatements. Time is discrete and the horizon is infinite. Current emissions increase the pollution stock in the future. Denote by $G_{i,t}$ the stock of pollution in country i at time t and let $1 - q_G \in [0, 1]$ measure the fraction of G that "depreciates" every period.

The stock of pollution in i can also depend on the emissions of other countries $j \neq i$. Today's collective emissions together with the current stock of pollution determine tomorrow's pollution stock as follows:

$$G_{i,t+1} = q_G G_{i,t} + \gamma g_{i,t} + \epsilon \sum_{j \in N \setminus i} g_{j,t}. \tag{1}$$

Every unit of i's emission leads to $\gamma \geq 0$ units of local pollution and $\epsilon \geq 0$ units of pollution in every other country. For climate change, $\gamma = \epsilon$, but for regional problems, $\gamma > \epsilon$.

The benefit of emissions accrues through consumption of a dirty good (e.g., energy). The harm of emissions is that they accumulate in $G_{i,t}$. To help derive closed-form solutions, we assume a quadratic functional form

[3] See also Barrett (2005) and Aldy and Stavins (2009) for a survey and further references.

[4] In an extension of Battaglini and Harstad, Spycher (2022) considers the possibility of a "treaty as a trap," where a "brown" government negotiates an unpopular IEA that a possible green successor would ratify but they would not, thereby strategically increasing its reelection chances.

for the per-period benefit from emissions and constant marginal harm:

$$u_{i,t} := -\frac{b}{2}\left(g_{i,t}^{*}-g_{i,t}\right)^{2}-cG_{i,t}. \tag{2}$$

Here, b measures the benefit of being close to the bliss point $g_{i,t}^{*}$ and c is the cost of the public bad. Because we do not require $g_{i,t}$ to be positive, the model allows for an alternative interpretation where $-G_{i,t}$ is a local public good such as a natural resource, the preservation of a critical ecosystem, or the protection of a species that depends on country i's conservation efforts g_i as well as on the efforts of other countries that spill over into i, e.g., if the resource or the ecosystem crosses the border or the species is migratory. Country i's contribution or investment to the local public good is (the abatement level) $a_{i,t} \equiv g_{i,t}^{*} - g_{i,t}$.

2.2 Dynamics and Time Inconsistency

At each time t, country i is run by the party in power, $P_{i,t}$, and (2) represents the utility of $P_{i,t}$. The revenues from emitting, or the expenditures on abatement, change the budget. The remaining budget is allocated according to $P_{i,t}$'s preference. We suppose that each remaining dollar has the additional value Δ for the party in power, relative to the party not in power, which causes preferences between the current government and the opposition to diverge. Let p be the probability with which $P_{i,t}$ is in power in the future. With these assumptions, we have:

Lemma 1 *$P_{i,t}$'s objective is to maximize*

$$v_{i,t}^{P} \equiv u_{i,t}^{P} + \beta \sum_{\tau=t+1} \delta^{\tau-t} u_{i,\tau}^{P}, \quad \textit{where} \tag{3}$$

$$u_{i,t}^{P} \equiv -\frac{b}{2}\left(g_{i,t}^{*}-g_{i,t}\right)^{2} - c^{P}G_{i,t}, \qquad c^{P} \equiv c/\beta, \quad \textit{and} \tag{4}$$

$$\beta \equiv \frac{b-(1-p)\Delta}{b}. \tag{5}$$

It is straightforward to prove the lemma by combining the equations. Lemma 1 shows that $P_{i,t}$'s objective is to maximize a continuation value characterized by quasi-hyperbolic discounting. When $\beta \in (0,1)$, these preferences are time inconsistent: $P_{i,t}$ wishes that $P_{i,t+1}$ will emit less, or abate more, but this plan will not be followed. The smaller is β, the larger is the disagreement between the plan that seems optimal today vs. the plan that will actually be followed. We see that two factors determine the size of disagreement between current and future policymakers: β is small if the rotation of political power is frequent, i.e., for small values of p, and if the preferences are more polarized, in that the additional value of spending dollars when one is in power (Δ) is large. We may also interpret Δ as a measure of corruption. This way of rationalizing quasi-hyperbolic discounting in politics is in line with Amador (2003), Chatterjee and Eyigungor (2016), and Harstad (2020, 2023b).

There are other reasons why policy formation might suffer from time-inconsistency problems. First, there is ample evidence that individuals have time-inconsistent preferences (see the literature following Laibson, 1997). Since policymakers are individuals too, they are likely to have time-inconsistent preferences even in the absence of political rotation. Second, a government who is a benevolent planner or is concerned with reelection will exhibit time-inconsistent preferences if individual discount factors are heterogeneous (Gollier and Zeckhouser, 2005) or uncertain (Gollier and Weitzman, 2010). Finally, intergenerational altruism – where today's parents care for their children and their grandchildren – can generate quasi-hyperbolic discounting (Phelps and Pollak, 1968).

The following analysis holds whenever decision-makers maximize (3), regardless of the rationale for the quasi-hyperbolic discounting. The key property we will exploit is that a policymaker at time t would prefer to commit to abate or invest more at some future date $t + \tau$, but the policymaker actually in office at that time will be tempted to contribute less. Put differently, for any $\beta < 1$, the next government will abate too little from the perspective of the current policymaker.[5]

2.3. The First Best

For simplicity, let the first best (FB) maximize the sum of payoffs. When preferences are not time consistent, it is common to let the FB refer to the outcome as if decisions could be committed to beforehand. Thus, we will call a vector of $a_{i,t}$'s the FB allocation if it maximizes the welfare function for the first generation at time $t = 0$. As is easily seen, for each country i and time $t > 0$ we must have:

$$a_{i,t} = a^{FB} \equiv \delta(\gamma + (n-1)\epsilon)C/\beta b, \tag{6}$$

where $C \equiv c/(1 - \delta q_G)$ is the present-discounted harm of a unit of pollution that will slowly depreciate over time. Note that the FB requires that the $a_{i,t}$'s be identical across the countries and over time even though the bliss points $g^*_{i,t}$ vary in both dimensions.

2.4. Business as Usual

Suppose the $P_{i,t}$s simultaneously and noncooperatively set $a_{i,t}$ every period, taking foreign countries' strategies as given. In the environmental literature, this scenario is referred to as "business as usual" (BAU). Because there is a large number of subgame-perfect equilibria (SPEs) in dynamic games, it is common to restrict attention to Markov-perfect equilibria (MPE) where players' strategies depend only on current stocks; they are not history-dependent. It is straightforward to show that there is a unique MPE of this game:[6]

$$a_{i,t} = a^{bau} = g^*_{i,t} - g^{bau}_{i,t} = \gamma\delta C/b. \tag{7}$$

As in the FB, each country reduces consumption relative to the bliss level by the same amount. Compared to the FB, countries abate too little both because they do not take into account the externality $\epsilon > 0$, and because $\beta < 1$. Thus, even if $\epsilon = 0$, $P_{i,t+1}$ will abate too little (from the viewpoint of $P_{i,t}$) because $P_{i,t+1}$ will emphasize the personal expense of abatement (or the benefit from emitting) more than what earlier decision-makers found to be optimal.

[5]A similar logic applies if a "green" government with preferences that favor environmentally beneficial policies is in power today, and worried about the possibility of a less environmentally friendly "brown" government tomorrow.

[6]The MPE here is unique because the constant marginal harm from emissions implies that country i's best response to the strategies of other countries (assuming those do not depend on stocks) is independent of G_t. Thus, Markov-perfect strategies do not condition on the stock of pollution. The outcomes in the unique MPE of the infinite horizon game are also identical to the limit of the unique SPE in any finite horizon game for $T \to \infty$.

Specifically, if $P_{i,t}$ could commit to the future abatement level, it would prefer:

$$a_{i,\tau} = g^*_{i,\tau} - g_{i,\tau} = \gamma\delta C/\beta b > a^{bau}_{i,\tau}, \tag{8}$$

for every $\tau > t$, but $P_{i,\tau}$, in power at time τ, will prefer only $a^{bau}_{i,\tau}$.

3 Results on Participation and Compliance

3.1. Deep and Binding Agreements

We start by considering the standard two-stage participation game (see, for example, Barrett, 2005). At the beginning of the game, at $t = 0$, each of the n countries simultaneously decides whether to participate in a coalition M that negotiates an agreement. While the length of the treaty could be part of the negotiations, we simplify and shorten the exposition by restricting attention to treaties that are signed for the remaining duration of the game, i.e., that are infinite.[7] Next, signatory countries $i \in M$ negotiate abatement levels $a_{i,t}$, for every $t > 0$, while every $P_{i,t}$, $i \notin M$, contributes noncooperatively and without commitment.

The agreement is binding and compliance is supposed not to be an issue. An example of this kind of agreement would be the Kyoto Protocol where emission reduction targets were negotiated but legally binding. Note that the symmetry in payoffs implies all countries in a treaty collectively agree on what the optimal abatement levels are. They also have the same benefits and costs of abating relative to the default (BAU) outcome.[8] Hence, every bargaining outcome that is efficient and symmetric (as long as the underlying game is symmetric) leads to:

$$a_{i,t} = a(m) = (\gamma + (m-1)\epsilon)\delta C/\beta b, i \in M, t > 0. \tag{9}$$

The treaty is referred to as "deep" because the contributions internalize all spillovers on coalition members. Recalling that the unique BAU contributions are independent of stocks, every $P_{i,t}$, $i \notin M$, emits according to (7) regardless of how many countries join the coalition and how high their contributions might be.

We can now analyze the initial participation stage of the game at the beginning of the game. For M^* to be an equilibrium coalition, no nonsignatory country should wish to join (external stability) and no signatory country should wish to leave (internal stability). The cost of participation in the treaty is that members must abate more than the level that would maximize their individual objectives; the benefit is that other participants will internalize the harm on one additional member. Yet, all countries outside the coalition benefit from this internalization as well – the agreement itself is a public good. The latter effect implies strong incentives to free-ride. We find:

Proposition 1 *If $\beta = 1$, m is an equilibrium coalition size if and only if $m \leq 3$.*

[7] Our results are unchanged if we allow for arbitrary agreement duration. For a treatment of endogenous duration T, see Battaglini and Harstad (2016), where countries can invest in technology as well as abate, making the game with an endogenous T more interesting.

[8] We can easily extend the model to allow for lower weights on the payoffs of others, as in Finus and Maus (2008) and Harstad (2023a), without changing the results qualitatively.

(i) When $\beta < 1$, m can be larger, and m is an equilibrium coalition size if and only if:

$$m \leq 2 + \sqrt{1 + \frac{1-\beta^2}{(\epsilon/\gamma)^2}}.$$

(ii) The FB, with $m = n$, can be supported in equilibrium if and only if:

$$\beta \leq \sqrt{1 - (\epsilon/\gamma)^2[(n-2)^2 - 1]}.$$

The benchmark result that $m \leq 3$ when discounting is exponential is a long-standing result in environmental economics, and it gives rise to the "paradox of IEAs" mentioned in the Introduction: the number of signatory countries to IEAs predicted by theory is smaller than what we observe in practice.[9] Intuitively, the individual net cost of joining a treaty relative to BAU rises in the number of treaty countries because of the required internalization of spillovers to others in a deep agreement that prescribes the optimal contributions for the coalition. This effect puts strict limits on the size of voluntary coalitions.

Proposition 1 shows that when policymakers' plans exhibit present bias, the coalition can be larger. In fact, the smaller β is, the larger m can be. The intuition for this finding is simple. Time-inconsistent domestic policymakers have a desire to commit to larger contributions. An international treaty is one vehicle to achieve this commitment. From the perspective of other signatories, the agreement exploits a weakness (failure) in domestic politics.

Interestingly, the effect of a smaller β on equilibrium coalition size m^* is especially large when ϵ is small relative to γ. Then, the primary importance of the IEA is not to motivate the internalization of *international* externalities but rather to address *domestic* policy problems. If ϵ/γ is small, m is large because rather than being costly, the treaty permits the country to tie the hands of future policymakers.

3.2 Deep and Self-Enforcing Agreements

So far, we assumed that the parties are able to fully commit to the pledges for the duration of the agreement. However, one essential feature of international agreements is that enforcement through sufficiently severe sanctions for noncompliance is difficult and often impossible. The question then arises of whether the countries will comply with the promises they have made. In this section, we search for conditions under which the contributions are *self-enforcing* in the sense that member countries are incentivized to comply with their pledges because other treaty members might cease to cooperate otherwise. Allowing for history-dependent strategies requires us to relax the MPE equilibrium refinement. Instead of characterizing all subgame-perfect equilibria in this dynamic game, however, we will check when the negotiated emission cuts, characterized above, can be supported by SPEs.

Specifically, we assume that coalition members employ trigger strategies in that they all revert to BAU

[9]It should be noted, though, that counting signatories of existing treaties may oversimplify the issue. In the case of the Kyoto Protocol, for example, while some countries – notably the United States – never ratified the agreement, others like Canada ratified but later withdrew. In addition, East European signatory countries enjoyed very lax commitment and non-Annex I (developing) countries ratified without a legally binding emissions limitation target.

(i.e., the noncooperative MPE) with probability $q \in [0,1]$ if any one of the signatories abated less than its promised level in the previous period. (Thus, with probability $1-q$, the commitments are sticky and unresponsive to a country's defection.) Formally, we will say a treaty with coalition size M and pledges $a(m)$ is self-enforcing if the following constitutes an SPE: Every country $i \in M$ sets $a(m)$ in every period $t \geq 1$ unless one country $i \in M$ sets $a_{i,t} \neq a(m)$ in some period $t \geq 1$, in which case, with probability $q \in [0,1]$, everyone in M reverts to a^{bau} in $t+1$ and forever after. Every country $i \notin M$ sets a^{bau} at time $t=0$ and all future periods, independent of the history of the game.

Proposition 2 *Deep agreements are self-enforcing if and only if:*

$$(1-q)(m-1)\frac{\epsilon}{\gamma} \leq \left[\frac{\delta(1+\beta)-1}{2\delta}\right]\left[\frac{1+(m-1)\epsilon/\gamma}{\beta}-1\right], \text{so}$$

(i) $\beta > 1/\delta - 1$ is necessary, and

(ii) when $\beta = 1$, a reduction in β increases the right-hand side (and relaxes the compliance constraint if $q < 1$) if and only if:

$$(m-1)\frac{\epsilon}{\gamma} \leq \frac{2\delta-1}{(1-\delta)}.$$

To understand this result, consider first a very strong present bias, i.e., small values of β. This will require larger optimal treaty commitments (that overcome the bias) and enforcement will be impossible.[10] For larger values of β, the intuition developed in the full-commitment case applies to self-enforcing treaties as well: a domestic time-inconsistency problem makes international agreements more valuable, which also makes countries more eager to ensure that the agreement survives over time. Put differently, $\beta < 1$ reduces the temptation to defect because it increases the value of the treaty, especially for small ratios ϵ/γ. As the proposition shows, the capacity of a self-enforcing deep agreement to be sustainable by larger coalitions is no longer monotone but rather is hump-shaped in β. The interaction between Proposition 1 (participation) and Proposition 2 (compliance) is illustrated in Figure 1, which is drawn for specific parameter values $q = 1/2$, $\delta = 9/10$, and $\epsilon/\gamma = 1/10$. The maximum coalition size m as a function of β (from Proposition 1) is the decreasing curve in the figure, while the compliance constraint (from Proposition 2) is given by the hump-shaped curve. If β decreases from 1, both constraints are relaxed and the coalition can be larger.

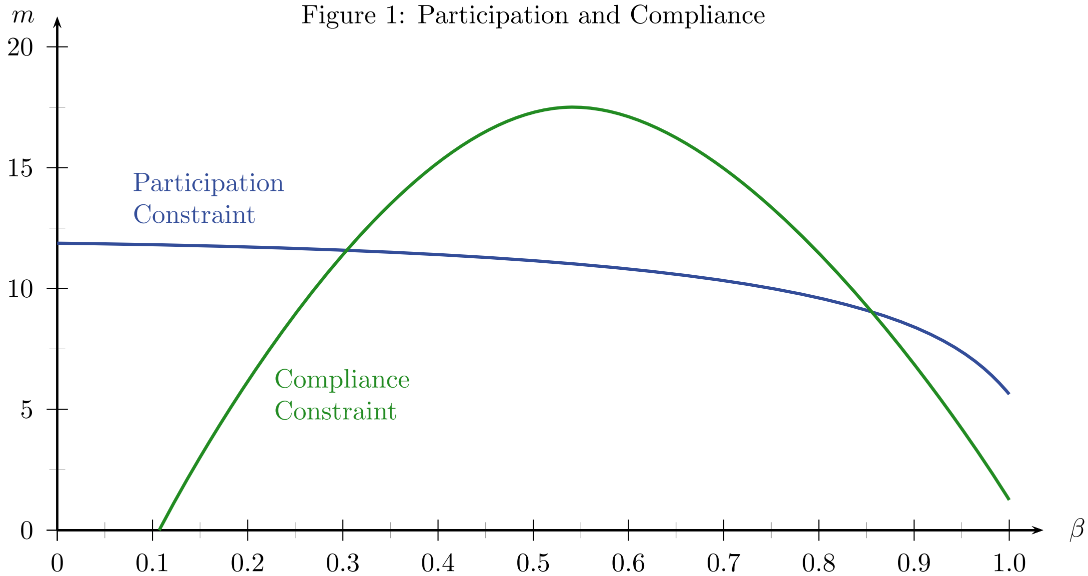
3.3. Shallow Agreements and Conventions

In the traditional theory for environmental coalitions (and in Section 3.1), the benefit of participating is that other coalition members will contribute more. Many treaties, however, mandate a particular contribution level, regardless of the number of members.

For instance, some agreements that preserve habitat or protect migratory species (a) are initially negotiated by a (smaller) set of countries which subsequently grows as additional members join and ratify the agreement

[10] The same is true for large coalitions m with extensive spillovers that will have to be internalized.

Figure 1: Participation and Compliance



over time, and (b) specify pledges or duties of signatory countries that do not expand (significantly) as the number of signatories grows. An example is the *Ramsar Convention on Wetlands*, the oldest of the modern global environmental agreements, which came into force in 1975 with 23 signatory countries, and has since grown to 172 contracting parties. Under this convention, new countries can join only if they designate at least one wetland on their own territory as a "Ramsar" site to be included in the convention's list of protected wetlands.[11] Another example is the *Inter-American Convention for the Protection and Conservation of Sea Turtles*, which came into effect in 2001 with 11 signatory countries and currently has 16 members. Under the accord, signatory countries commit to protect or restore habitat and to take action to prevent the capture of turtles or commerce with their eggs.[12]

The traditional IEA literature on treaty size and coalition formation cannot explain these agreements, because the only benefit from joining a treaty in a coalition formation game is that all members of the coalition will take the spillovers on the new signatory country into account, and everyone has to increase their pledges as a result. In the absence of this effect, e.g., if individual pledges do not increase with the number of signatories, no country would wish to join a treaty. With time-inconsistent preferences, however, it is easy to see why countries would unilaterally join, even without the benefit from elevated commitments of existing treaty members, especially if the treaty obligations pertain to an environmental action that also has a significant local component (such as protection of habitat under national jurisdiction).

Thus, consider the following game. At $t = 0$, a neutral party or "arbitrator" proposes an agreement that specifies a given increase $\alpha > 0$ in the abatement level, relative to BAU, that every member country must commit to forever after joining the convention. Countries can sign at any time $t = 0, 1, \ldots$ and must set $a_\tau = (1+\alpha)a^{bau}$ at every future time $\tau > t$. If m^* countries join in an MPE of the game, we will call the resulting agreement a^* among m^* countries a *convention*, to distinguish it from the traditional IEA

[11] Article 2.1 of the Convention. Although the convention offers support and resources, a key commitment of the contracting parties is to manage their own Ramsar sites. With over 2,400 Ramsar sites, the convention established the world's largest network of protected areas, covering more than 2.5 million square kilometers. See https://www.ramsar.org/ for details.

[12] See http://www.iacseaturtle.org/.

coalition-formation framework.

The benefit from joining the convention is independent of t since we assumed that upon signing in t, pledges apply only to $\tau > t$, i.e., the government in power at t has the same benefit (cost) of joining as the government in power at any other time does. Next, because policies under the agreement do not depend on how many countries join and because all countries have identical objective functions (up to constants) with respect to abatement levels, symmetry implies that either all countries join, or none. Lastly, for the same reason as before, every nonsignatory country will set $a_{i,t} = a^{bau} \forall t$, but this will have no effect on the benefit (cost) of the convention because a country's harm from a given set of free-riders is independent of whether it is a signatory or not.

Proposition 3 *Suppose that a convention mandates a fixed contribution level* $a_{i,t} = (1+\alpha)a^{bau}$.

(i) If $\beta = 1$, $m^* = 0$ *for every* $\alpha > 0$.

(ii) When $\beta < 1$, *an MPE exists in which* $m^* = n$ *for any*

$$\alpha \leq \alpha^* \equiv 2(1-\beta)/\beta \tag{10}$$

and $m^* = 0$ *otherwise.*

(iii) The FB can be implemented if:

$$\beta \leq \frac{1}{1+(n-1)\epsilon/2\gamma}. \tag{11}$$

The first part of the result confirms that if policymakers discount the future exponentially, there is no benefit from joining any convention that commits them to a unilateral increase in abatement. The second part formalizes the intuition that if governments' preferences exhibit present bias, signing a convention is beneficial because it helps bind future policymakers. A country's net benefit from the convention is strictly positive and maximized for $\alpha = (1-\beta/\beta)$, the value that would equate $(1+\alpha)a^{bau}$ to the current policymaker's most preferred policy (8). An arbitrator can leverage this fact and propose even higher α as long as the net benefit does not go to zero, which happens at α^*. Clearly, the MPE with any convention $\alpha > 0$ Pareto dominates the MPE under BAU, and higher values of α raise joint welfare as long as $(1+\alpha)a^{bau} < a^{FB}$. Thus, a benevolent arbitrator would propose $\alpha = \alpha^*$ unless the FB can be achieved with a lower commitment. Third, if (11) holds, the local time-inconsistency policy is sufficiently pronounced (β and/or ϵ/γ sufficiently low), so that the FB can be implemented by mandating a^{FB}.

Finally, note that any convention with $\alpha \leq \alpha^*$ is self-enforcing by construction: withdrawing from a convention results in a lower continuation utility, independent of what other signatory countries do.

Proposition 3 points to an additional insight when countries are heterogeneous. Suppose countries differ in the degree to which domestic politics suffers from time-inconsistency β, for example, because the political system differs and equilibrium political turnover (incumbency advantage) is higher in some countries than others. Clearly, the benefit of joining a given convention is elevated for governments who face a more pronounced time-inconsistency problem, ceteris paribus. In equilibrium, signatory countries will be those with the lowest β. This is consistent with the fact that democracies are more likely to commit to international environmental treaties relative to autocracies, both in the cross-section and as they undergo a transition to a more democratic system.[13]

4 Role of Commitment

The additional benefit from participating, emphasized above, is that it is possible to tie the hands of *future* policymakers. This benefit is isolated when an agreement signed at time t is effective only from time $t+1$. If the agreement instead had an immediate effect, it would be costly for the current policymaker as well. The equilibrium coalition size of such an agreement would be smaller. Thus, to motivate many countries to participate, it is helpful to let the increase in abatement levels be effective from a future date rather than from this period on.

To highlight the role of commitment, suppose that $P_{i,t}$ at time t can fully commit to future policies a_τ for every $\tau > t$, even without an international agreement. In this case, $P_{i,t}$ would want to prescribe abatement in line with (8) for every future date. With this possibility, the value of signing the treaty is diminished and we are, in essence, back to the case where β equals 1. We know from the above results that the incentive to participate is smaller in this case:

Corollary *Suppose $P_{i,t}$ can commit to future policies without the treaty.*

(i) A deep agreement can be of size m if and only if $m \leq 3$.

(ii) For a convention with mandate $\alpha > 0$, in every equilibrium, $m = 0$.

Part (i) follows trivially from Proposition 1 since countries no longer derive the additional benefit of self-commitment. Part (ii) reiterates our earlier claim that in the absence of a domestic time-inconsistent policy problem, no one would participate in a convention when the other signatories face the same mandate regardless of the number of members. The contrast to Propositions 1 and 3 highlights that domestic time-inconsistency problems can be key to explain the large coalitions we observe in reality. That is, the results suggest that it must be difficult to tie the hands of future domestic policymakers in isolation, so that joining an international treaty becomes necessary.

It is important to keep in mind that these types of self-commitment strategies might not be renegotiation proof. Agreements between multiple parties can be supported and be renegotiation proof if the parties use trigger strategies that either punish the defector more than they punish the other parties or give the defector no bargaining power in the renegotiation game (Mailath and Samuelson, 2006). For domestic self-commitment strategies, in contrast, if $P_{i,t}$ defects, then $P_{i,t+1}$ has an incentive to start over by trying to

[13] See Battaglini and Harstad (2020, Table I). There is a large literature on international relations connecting political regimes and international cooperation. See for example Neumeyer (2002) for a cross-country analysis of IEAs. Mansfield and Pevehouse (2008) show that the likelihood of joining international environmental organizations is particularly high during the process of democratization, and speculate that a desire to commit (to reforms and future policies) can explain their finding. It is straightforward to allow for heterogeneity when the abatement mandate is fixed, because then participation depends only on domestic parameter values. If, instead, the abatement level is decided on collectively, as in Section 3.1, then heterogeneity can influence the level of ambition and generate additional time-inconsistency problems (Bowen et al., 2019).

commit once again (Asheim, 1997). When $P_{i,t+1}$, in effect, renegotiates i's own strategy, without the need to persuade anyone else, $P_{i,t+1}$ will itself capture the entire surplus of skipping the punishment. When the punishment is skipped, defection is costless, and the compliance constraint will not be satisfied. An agreement with multiple parties weakens the renegotiation constraint and facilitates the possibility to commit.

5 Concluding Remarks

This paper sheds light on how international treaties can benefit from domestic time-inconsistency domestic policy problems. In our framework, present bias arises because policymakers rotate being in office, and derive an additional benefit from being in power because they can direct funds to their preferred projects; the latter creates a divergence of preferences between the current government in power and the opposition (polarization). One can imagine other empirically relevant reasons for time-inconsistent policy formation, however. The main premise we rely on is that each government would like future governments to act sustainably but, once in office, is tempted to postpone costly actions. We show that the larger is the domestic time-inconsistency problem, the larger is the incentive to tie the hands of future policymakers, and the larger is the equilibrium coalition size of IEAs. Further, the motivation to comply with an agreement, rather than to defect, can be stronger if domestic policy preferences exhibit a present bias. The positive effect of present bias on participation and compliance is more pronounced when the international spillovers are limited relative to the domestic policy issue. Lastly, and in contrast to traditional theories, the above logic can also explain why countries sign treaties (conventions) even when doing so does not alter the contribution levels of other members.

Our argument was based on a simple model that abstracted from elections, heterogeneity, and asymmetric information, and other relevant factors. The appropriate equilibrium refinement is, ultimately, an empirical question. We do not expect the key insight to qualitatively change with those considerations, however. Given that environmental policies are prone to suffer from time-inconsistent political choice, it is important to learn more about the extent to which policymakers adopt strategies that can implement consistent policies, with and without international treaties. Theoretical and empirical research along these lines is necessary to deepen our understanding of how international agreements should be designed so that they do not simply account for domestic political failures, but rather take advantage of them to facilitate participation and compliance.

Appendix

Proof of Proposition 1.

For every $i \in M$, it is easy to check that the payoff, relative to BAU, is a function of the $a_{j,\tau}$'s that is independent of the bliss points, i.e., the $g_{i,\tau}^*$'s. Thus, when the bargaining solution predicts an efficient and symmetric outcome when the bargaining set is symmetric (as does the Nash Bargaining Solution, for example), then, at every future time $\tau > t$, $a_{i,\tau}$ is:

$$a(m) = \delta(\gamma + (m-1)\epsilon)C/\beta b,$$

which takes into account the externality on $m-1$ other coalition members. With this, $P_{i,t}$'s continuation value after signing is:

$$\begin{aligned} v_{i,t}^{in}(m) = \sum_{\tau=t+1}^{\infty} \delta^{\tau-t} \Bigg[& -\frac{\beta b}{2} a(m)^2 - \delta\gamma C\left(g_{i,\tau}^* - a(m)\right) \\ & - \delta\epsilon C \sum_{j \in M \setminus i} g_{j,\tau}^* + \delta\epsilon C(m-1)a(m) + \delta\epsilon C(n-m)a^{bau} \Bigg]. \end{aligned}$$

Conversely, the continuation value if $P_{i,t}$ had chosen to free ride instead would have been:

$$\begin{aligned} v_{i,t}^{out}(m-1) = \sum_{\tau=t+1}^{\infty} \delta^{\tau-t} \Bigg[& -\frac{\beta b}{2}\left(a^{bau}\right)^2 - \delta\gamma C\left(g_{i,\tau}^* - a^{bau}\right) \\ & - \delta\epsilon C \sum_{j \in M \setminus i} g_{j,\tau}^* + \delta\epsilon C(m-1)a(m-1) + \delta\epsilon C(n-m)a^{bau} \Bigg]. \end{aligned}$$

For internal stability, $v_{i,t}^{in}(m) \geq v_{i,t}^{out}(m-1)$, implying:

$$\begin{aligned} -\frac{\beta b}{2}\left(\frac{\delta C(\gamma + (m-1)\epsilon)}{\beta b}\right)^2 + \frac{\beta b}{2}\left(\frac{\delta C\gamma}{b}\right)^2 + \delta\gamma C\left(\frac{\delta C(\gamma + (m-1)\epsilon)}{\beta b}\right) + \frac{(\delta C\epsilon)^2}{\beta b}(m-1) \geq 0 \Leftrightarrow \\ -\frac{1}{2}\left[(\gamma + (m-1)\epsilon)^2 - (\beta\gamma)^2\right] + \gamma[\gamma + (m-1)\epsilon - \beta\gamma] + (m-1)\epsilon^2 \geq 0 \Leftrightarrow \\ \frac{1}{2}\left[\Upsilon^2 - (\beta\gamma)^2\right] - \gamma(\Upsilon - \beta\gamma) - \Upsilon\epsilon + \gamma\epsilon \leq 0 \Leftrightarrow \\ \frac{1}{2}\Upsilon^2 - (\gamma + \epsilon)\Upsilon - \frac{1}{2}\left[(\beta\gamma)^2 - 2\beta\gamma^2 - 2\gamma\epsilon\right] \leq 0, \end{aligned}$$

if we define $\Upsilon := \gamma + (m-1)\epsilon$. Thus, $P_{i,t}$ is indifferent between joining the treaty and not joining if

$$\begin{aligned}
\Upsilon &= \gamma + \epsilon + \sqrt{(\gamma+\epsilon)^2 + (\beta\gamma)^2 - 2\beta\gamma^2 - 2\gamma\epsilon} \Leftrightarrow \\
\gamma + (m-1)\epsilon &= \gamma + \epsilon + \sqrt{(\gamma+\epsilon)^2 + (\beta\gamma)^2 - 2\beta\gamma^2 - 2\gamma\epsilon} \Leftrightarrow \\
m &= 2 + \frac{1}{\epsilon}\sqrt{(\gamma+\epsilon)^2 - (\beta\gamma)^2 - 2\gamma\epsilon} = 2 + \sqrt{\left(\frac{\gamma}{\epsilon}+1\right)^2 - \left(\frac{\beta\gamma}{\epsilon}\right)^2 - 2\frac{\gamma}{\epsilon}} \Leftrightarrow \\
m &= \widehat{m} \equiv 2 + \sqrt{1 + \left(\frac{\gamma}{\epsilon}\right)^2 (1-\beta^2)} = 2 + \sqrt{1 + \frac{1-\beta^2}{(\epsilon/\gamma)^2}}.
\end{aligned}$$

For coalition sizes $m \leq m^*$, a member benefits from participating, while, if $m > m^*$, a member would strictly benefit from not participating. □

Proof of Proposition 2.

By defecting on some pledged a, i will in this period, and forever after, change to $a^{bau} = \delta\gamma C/b$. Holding fixed the other $a_{j,t}$'s, this benefit is:

$$\left(1 + \frac{\delta\beta}{1-\delta}\right)\frac{b}{2}\left(a^2 - \left(a^{bau}\right)^2\right) - \frac{\delta}{1-\delta}\gamma C\left(a - a^{bau}\right).$$

If defection leads all other treaty members, one period later, to change their abatements to a^{bau}, with probability q, the cost of defecting is:

$$q\,(m-1)\,\frac{\delta^2}{1-\delta}\epsilon C\left(a - a^{bau}\right).$$

Combined, defecting is unattractive if:

$$\begin{aligned}
\left(1 + \frac{\delta\beta}{1-\delta}\right)\frac{b}{2}\left(a^2 - \left(a^{bau}\right)^2\right) &\leq \frac{\delta}{1-\delta}\gamma C\left(a - a^{bau}\right) + q\,(m-1)\,\frac{\delta^2}{1-\delta}\epsilon C\left(a - a^{bau}\right) \Leftrightarrow \\
\left(1 + \frac{\delta\beta}{1-\delta}\right)\frac{b}{2}\left(a + a^{bau}\right) &\leq \frac{\delta}{1-\delta}\gamma C + q\,(m-1)\,\frac{\delta^2}{1-\delta}\epsilon C \Leftrightarrow \\
(1 - \delta + \delta\beta)(ab + \delta\gamma C) &\leq 2\delta\gamma C + 2q\,(m-1)\,\delta^2\epsilon C \Leftrightarrow \\
[1 - \delta(1-\beta)]\,ab &\leq [1 + \delta(1-\beta)]\,\delta\gamma C + 2q\,(m-1)\,\delta^2\epsilon C.
\end{aligned}$$

Replacing a with $a(m) = \delta C(\gamma + (m-1)\epsilon)/\beta b$, the above inequality becomes:

$$\begin{aligned}
[1 - \delta(1-\beta)]\,\delta C(\gamma + (m-1)\epsilon)/\beta &\leq [1 + \delta(1-\beta)]\,\delta\gamma C + 2q\,(m-1)\,\delta^2\epsilon C \quad \Leftrightarrow \\
[1 - \beta - \delta(1+\beta)(1-\beta)]\,\gamma &\leq [2\delta q\beta - 1 + \delta(1-\beta)]\,(m-1)\,\epsilon \quad \Leftrightarrow \\
[1 - \delta(1+\beta)]\,(1-\beta)\,\gamma &\leq [2\delta(q-1)\beta - 1 + \delta(1+\beta)]\,(m-1)\,\epsilon \Leftrightarrow \\
2\delta\beta\,(1-q)\,(m-1)\,\epsilon/\gamma &\leq [\delta(1+\beta) - 1]\,[1 - \beta + (m-1)\,\epsilon/\gamma] \Leftrightarrow \\
2\delta\,(1-q)\,(m-1)\,\epsilon/\gamma &\leq [\delta(1+\beta) - 1]\left[\frac{1 + (m-1)\,\epsilon/\gamma}{\beta} - 1\right]. \qquad (12)
\end{aligned}$$

If $\beta = 1$, the inequality boils down to $1 \leq 2\delta q$. If, instead, $q = 1$, the inequality implies $\delta(1+\beta) \geq 1$. More generally, the inequality always fails if $\delta(1+\beta) < 1$. If $\delta(1+\beta) > 1$, the inequality is more likely to hold when the r.h.s. is large. The derivative of the r.h.s. with respect to β is negative if and only if:

$$\delta \left[\frac{1+(m-1)\epsilon/\gamma}{\beta} - 1 \right] + [\delta(1+\beta) - 1] \left[\frac{1+(m-1)\epsilon/\gamma}{-\beta^2} \right] < 0,$$

which holds at $\beta = 1$ if and only if:

$$\begin{aligned} \delta(m-1)\epsilon/\gamma &< (2\delta - 1)[1+(m-1)\epsilon/\gamma] \Leftrightarrow \\ (1-\delta)(m-1)\epsilon/\gamma &< 2\delta - 1. \end{aligned}$$

Thus, under this condition, a reduction in β from $\beta = 1$ makes the compliance constraint more likely to hold. □

Proof of Proposition 3.

Consider a proposed increase $\alpha > 0$ over a^{bau}, so that if $P_{i,t}$ signs the convention then country i commits to $a = (1+\alpha)a^{bau}$ for every period $\tau > t$. We can write i's net benefit from signing a convention with $m-1$ other signatories, relative to opting out, as:

$$\begin{aligned} \upsilon(\alpha) &= \sum_{\tau=t+1}^{\infty} \delta^{\tau - t} \left[-\frac{\beta b}{2} \left((1+\alpha)a^{bau}\right)^2 + \frac{\beta b}{2} \left(a^{bau}\right)^2 + \delta\gamma C \alpha a^{bau} \right] \\ &= \frac{\delta}{1-\delta} \alpha a^{bau} \left[-\beta b \left(1 + \frac{1}{2}\alpha\right) a^{bau} + \delta\gamma C \right], \end{aligned}$$

which is independent of m (as expected). For any $\alpha > 0$, $\upsilon(\alpha) \geq 0$ if and only if

$$\beta b \left(1 + \frac{1}{2}\alpha\right) a^{bau} = \beta b \left(1 + \frac{1}{2}\alpha\right) \delta\gamma C/b \leq \delta\gamma C \Leftrightarrow \alpha \leq \alpha^* \equiv 2\frac{1-\beta}{\beta}.$$

Hence, $\beta = 1$ implies $\upsilon(\alpha) < 0$ for any $\alpha > 0$. For $\beta < 1$, $\upsilon(\alpha) > 0$ for $\alpha \in (0, \alpha^*)$ and in the unique MPE, every $P_{i,t}$ will sign such a convention. At $\alpha = \alpha^*$, $P_{i,t}$ is indifferent between joining and not joining, so there is an MPE in which everyone participates. An arbitrator who seeks to maximize payoffs or aggregate abatement levels would thus want to set $\alpha = \alpha^*$, unless a^{FB} is implementable. For

$$(1+\alpha^*)a^{bau} \geq a^{FB} \quad \Leftrightarrow \quad \beta \leq \frac{1}{1+(n-1)\epsilon/2\gamma},$$

the FB abatement levels can be implemented. □

References

Aldy, Joseph E., and Robert N. Stavins. 2009. *Post Kyoto International Climate Policy: Summary for Policymakers*. New York: Cambridge University Press.

Alesina, Alberto, and Guido Tabellini. 1990. "A Positive Theory of Fiscal Deficits and Government Debt in a Democracy." *Review of Economic Studies* 57: 403–14.

Amador, Manuel. 2003. "A Political Economy Model of Sovereign Debt Repayment." *mimeo*, Stanford Graduate School of Business.

Asheim, Geir B. 1997. "Individual and Collective Time-Consistency." *The Review of Economic Studies* 64(3): 427–43.

Barrett, Scott. 1994, "Self-Enforcing International Environmental Agreements." *Oxford Economic Papers* 46: 878–94.

Barrett, Scott. 2005. "The Theory of International Environmental Agreements." In *Handbook of Environmental Economics (Vol 3)*, edited by K. G. Mäler and J. R. Vincent, 1457–1516. Elsevier.

Battaglini, Marco, and Bård Harstad. 2016."Participation and Duration of Environmental Agreements." *Journal of Political Economy* 124(1): 160–204.

Battaglini, Marco, and Bård Harstad. 2020. "The Political Economy of Weak Treaties." *Journal of Political Economy* 128(2): 544–90.

Bisin, Alberto, Alessandro Lizzeri, and Leeat Yariv. 2015. "Government Policy with Time Inconsistent Voters." *American Economic Review* 105(6): 1711–37.

Carraro, Carlo, and Domenico Siniscalco. 1993. "Strategies for the International Protection of the Environment." *Journal of Public Economics* 52(3): 309–28.

Chatterjee, Satyajit, and Burcu Eyigungor. 2016. "Continuous Markov Equilibria with Quasi-Geometric Discounting." *Journal of Economic Theory* 163: 467–94.

Coconi, Paula, and Carlo Perroni. 2009. "Do Credible Domestic Institutions Promote Credible International Agreements?" *Journal of International Economics* 79: 160–70.

DellaVigna, Stefano, and Ulrike Malmendier. 2006. "Paying Not to Go to the Gym." *American Economic Review* 96(3): 694–719.

Finus, Muchael, and Stefan Maus. 2008. "Modesty May Pay." *Journal of Public Economic Theory* 10: 801–26.

Fischer, Stanley. 1980. "Dynamic Inconsistency, Cooperation, and the Benevolent Dissembling of Government." *Journal of Economic Dynamics and Control* 2: 93–103.

Gollier, Christian, and Martin L. Weitzman. 2010. "How Should the Distant Future Be Discounted When Discount Rates Are Uncertain?" *Economics Letters* 107(3): 350–53.

Gollier, Christian, and Richard Zeckhauser. 2005. "Aggregation of Heterogeneous Time Preferences." *Journal of Political Economy* 113(4): 878-96.

Harstad, Bård. 2023a. "Pledge-and-Review Bargaining: From Kyoto to Paris." *The Economic Journal* 133 (651): 1181–1216.

Harstad, Bård. 2023b. "The Conservation Multiplier." *Journal of Political Economy* 131(7): 1731–71.

Harstad, Bård. 2020. "Technology and Time Inconsistency." *Journal of Political Economy* 128(7): 2653–89.

Hoel, Michael. 1992. "International Environment Conventions: The Case of Uniform Reductions of Emissions." *Environmental and Resource Economics* 2: 141–59.

Kehoe, Patrick J. 1989. "Policy Cooperation among Benevolent Governments May Be Undesirable." *Review of Economic Studies* 56: 289–96.

Kydland, Finn E., and Edward C. Prescott. 1977. "Rules Rather than Discretion: The Inconsistency of Optimal Plans." *Journal of Political Economy* 85(3): 473–91.

Laffont, Jean-Jacques, and Jean Tirole. 1996. "Pollution Permits and Compliance Strategies." *Journal of Public Economics* 62: 85–125.

Laibson, David. 1997. "Golden Eggs and Hyperbolic Discounting." *Quarterly Journal of Economics* 112(2): 443–78.

Maggi, Giovanni, and Andres Rodriguez-Clare. 1998. "The Value of Trade Agreements in the Presence of Political Pressures." *Journal of Political Economy* 106(3): 574–601.

Maggi, Giovanni, and Andres Rodriguez-Clare. 2007. "A Political-Economy Theory of Trade Agreements." *American Economic Review* 97(4): 1374–1406.

Mailath, George J., and Larry Samuelson. 2006. *Repeated Games and Reputations: Long Run Relationships*, Oxford: Oxford University Press.

Mansfield, Edward D., and John C. Pevehouse. 2008. "Democratization and the Varieties of International Organizations." *Journal of Conflict Resolution* 52(2): 269–94.

Matsuyama, Kiminori. 1990, "Perfect Equilibria in a Trade Liberalization Game." *American Economic Review* 80(3): 480–92.

Neumayer, Eric. 2002. "Do Democracies Exhibit Stronger International Environmental Commitment? A Cross-Country Analysis." *Journal of Peace Research* 39(2): 139–64.

Persson, Torsten, and Lars Svensson. 1989. "Why a Stubborn Conservative Would Run a Deficit: Policy with Time Inconsistency Preferences." *Quarterly Journal of Economics* 104(2): 325–45.

Phelps, Edmund S., and Robert A. Pollak. 1968. "On Second-Best National Saving and Game-Equilibrium Growth." *Review of Economic Studies* 35: 165–99.

Ploeg, Frederick van der. 1988. "International Policy Coordination in Interdependent Monetary Economies." *Journal of International Economics* 25(1–2): 1–23.

Rogoff, Kenneth. 1985."Can International Monetary Cooperation be Counterproductive." *Journal of International Economics* 18: 199–217.

Spycher, Sarah. 2022. "Elections and Environmental Agreements." *mimeo* Department of Economics and Oeschger Centre for Climate Change Research, University of Bern.

Staiger, Robert, and Guido Tabellini. 1999. "Do GATT Rules Help Governments Make Domestic Commitments?" *Economics and Politics* 11(2): 109–44.

Tabellini, Guido. 1991. "The Politics of Intergenerational Redistribution." *Journal of Political Economy* 99(2): 335–57.

Weitzman, Martin L. (2001). "Gamma Discounting." *American Economic Review* 91(1): 260—71.