NBER WORKING PAPER SERIES

THE POLITICAL ECONOMY OF WEAK TREATIES

Marco Battaglini
Bård Harstad

Working Paper 22968
http://www.nber.org/papers/w22968

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
December 2016

For useful comments and discussions we thank Stephen Coate, Eleonora Patacchini, Torsten Persson and seminar participants at Cornell, Harvard, Rice, Stanford GSB, the 2016 EEA meeting and the 2016 Warwick political economy conference in Venice. We thank Angela Cools, Torje Hegna and Esteban Mendez Chacon for outstanding research assistance. Harstad received funding from the European Research Council (ERC) under the European Union's Horizon 2020 research and innovation programme (grant agreement No 683031). The views expressed herein are those of the authors and do not necessarily reflect the views of the National Bureau of Economic Research.

The Political Economy of Weak Treaties
Marco Battaglini and Bård Harstad
NBER Working Paper No. 22968
December 2016
JEL No. D72,F55,Q58

ABSTRACT

In recent decades, democratic countries have signed hundreds of international environmental agreements (IEAs). Most of these agreements, however, are weak: they generally do not include effective enforcement or monitoring mechanisms. This is a puzzle in standard economic models. To study this phenomenon, we propose a positive theory of IEAs in which the political incumbents negotiate them in the shadow of reelection concerns. We show that, in these environments, incumbents are prone to negotiate treaties that are simultaneously overambitious (larger than what they would be without electoral concerns) and weak (might not be implemented in full). The theory also provides a new perspective for understanding investments in green technologies, highlighting a channel through which countries are tempted to rely too much on technology instead of sanctions to make compliance credible. We present preliminary evidence consistent with these predictions.

Marco Battaglini
Department of Economics
Uris Hall
Cornell University
Ithaca, NY 14850
and EIEF
and also NBER
battaglini@cornell.edu

Bård Harstad
Department of Economics
University of Oslo
P.O. Box 1095
Blindern 0317
Oslo, Norway
bardh@econ.uio.no

1 Introduction

Over the past forty years, environmental issues have achieved increasing prominence in international politics. Both developed and developing countries have signed hundreds of international environmental agreements (IEAs). These agreements have targeted a wide range of goals, from forest preservation, to water management, to the regulation of transboundary pollution. This development has surprised economists. By reducing pollution, IEAs are designed to provide pure public goods; economic theory therefore suggests that countries should find it optimal to free ride. Why, then, do we see so much cooperation? In a survey on the "Economics of Climate Policy," Kolstad and Toman [2005] referred to the rise of IEAs as the "Paradox of International Agreements." A large literature has been devoted to highlighting and explaining this paradox.[1]

Two features of IEAs, which have so far attracted little attention, suggest that the paradox should be qualified. The first is the fact that IEAs are typically very weak agreements: they generally do not include effective enforcement or monitoring mechanisms. The lack of enforcement sets IEAs apart from other types of international agreements (such as trade or arms control agreements) that are much more specific in this respect.[2] The second striking feature of IEAs is that many of them, including some of the most prominent, are generally seen as ineffective.[3] These two facts suggest that the paradox may lie in the fact that so many countries are negotiating and signing weak agreements, rather than in the number of agreements itself. Negotiating treaties is an expensive and laborious process; signing treaties that are either not ratified (as was the case with the U.S. and the Kyoto agreement) or that are ratified and then reneged on (as was the case with Canada and the Kyoto agreement) is even more damaging. We may call this the "Paradox of Weak Agreements."

In this paper, we present a positive theory of international environmental agreements to study this issue. We argue that, in the presence of reelection concerns, governments are biased toward

[1] See, for example, Carraro and Siniscalco [1993], Barrett [1994], Dixit and Olson [2000], and Battaglini and Harstad [2016]. We review this literature more extensively at the end of this section.

[2] The lack of enforcement is only partially explained by the lack of third party enforcement in global politics; after all, the countries could sign treaties where noncompliance is met by trade sanctions (as in trade and arms control treaties). The Montreal protocol of 1997 regulating chlorine emissions damaging the ozone layer, for instance, did indeed permit trade sanctions to be imposed on violators.

[3] Finus and Tjotta [2003] and Ringquist and Kostadinova [2005] find that the Helsinki and Oslo Protocols have not generated emission reduction beyond the levels that would have been achieved without an agreement. Aakvik and Tjotta [2011] find no evidence for the effectiveness of the Helsinki and Oslo agreements in reducing sulphur emissions. Vollenweider [2013] finds no evidence of net environmental benefits for the Gothenburg Protocol of 1999.

signing weak agreements that leave the ultimate decision on compliance on the outcome of future elections. These agreements are characterized by enforcement mechanisms that are less effective than optimal, and that are indeed repudiated with positive probability. Interestingly, this is a general phenomenon that does not depend on the preferences of the incumbent government that negotiates the agreements: relatively "green" and "brown" governments alike are affected by it. It explains the underprovision of international cooperation by rationalizing weak agreements when strong agreements would be optimal. Even more surprisingly, it also explains how electoral concerns may induce governments to join agreements even when no agreement would be optimal. This explains the possibility of oversupply in ineffective agreements.

In our model, a political incumbent in the home country negotiates a treaty with a foreign country (or a group of foreign countries). The agreement is motivated by the fact that a country generates negative externalities on the other.[4] The treaty specifies what the home country ought to do to reduce the externalities, as well as the consequence if it does not. After the negotiation, an election decides whether the incumbent party continues to be in charge or is replaced. At this stage, voters discern which party is best given the country commitments made in the first period: the green party, which has more environmentally friendly preferences than the median voter; or the brown party, which has less environmentally friendly preferences than the median voter. At the last stage of the game, the elected party decides whether or not to comply with the treaty, facing the options negotiated at the first stage of the game. We have a *strong treaty* if, no matter which party is in power in the following periods, the agreement is enforced. We have a *weak treaty* if it includes sanctions that are not sufficiently high to guarantee its implementation (and so it may be repudiated if the brown party is elected). We use this simple model to study how electoral incentives shape the type of agreement that is signed (weak vs. strong), the size and scope of the agreement, and the incentives to invest in green technologies.

Regarding the type of agreement, we first show that signing an IEA may or may not be optimal from a social point of view (depending on the preferences and the cost of the environmental policy); however, *if* the IEA is signed, it should always be strong. Nevertheless, when reelection incentives are sufficiently important, the equilibrium IEA is always *weak* and thus repudiated with positive

[4] Examples of these type of negotiations are the protocols signed under the Convention on Long-Range Transboundary Pollution (CLTAP), which attempt to reduce sulphur and other hazardous emissions with transboundary effects; or those signed under the United Nations Framework Convention on Climate Change (UNFCCC), which commit state parties to reduce greenhouse gas emissions.

probability, regardless of whether the first-period incumbent was green or brown. To understand the intuition behind the results, note that with no agreement or with a strong agreement, the incumbent is reelected with probability 1/2. In this case, the parties are equivalent for the voters because they would behave in the same way after the election: in the first case, because there would be no agreement to implement; in the second, because both of them would implement the agreement. When the treaty is weak, however, the agreement is enforced only if the green party is elected and therefore the median voter's preferences depend on whether they prefer to comply or face the sanction. The key insight of our analysis is that the median voter's preferences depend on the details of the agreements: the median voter prefers to comply ex post if the sanction is sufficiently hight, and to not comply if it is sufficiently low. Using this insight, we show that *both* the parties can design a weak agreement that gives them an advantage in the election. The green party designs a weak treaty in which the median voter wants implementation ex post and implementation is guaranteed *only* if the incumbent is reelected; the brown party designs a treaty in which the median voter does not want implementation and implementation can be avoided *only* if the incumbent is reelected.

Regarding the size of treaties, we show that electoral incentives induce a novel *overshooting effect* according to which the incumbent tends to make environmental commitments that, besides being weak as discussed above, are larger than what would be chosen without electoral incentives. This phenomenon, again, is remarkable because it characterizes both green and brown incumbents. As we will explain more extensively in Section 3, this phenomenon occurs because the incumbent, aware of the fact that he is signing a weak treaty, attempts to compensate with size for the fact that the treaty might not be fully complied with.

We also analyze investments in "green" technologies, such as abatement technology or renewable energy sources. The desire for a weak agreement may lead to either underinvestment or overinvestment in green technologies. By reducing the marginal cost of compliance, green technology makes the two parties similar ex post, making it easier for both to comply. This makes green technology similar to sanctions, and so it allows parties to use it to sustain a weak agreement. There is underinvestment when the parties limit the investments in efficient green technology in order to preserve a sufficient difference ex post between the two parties (i.e., to make sure that the brown party does not find it sufficiently easy to comply). We have overinvestment when an inefficient technology is used instead of sanctions: this may occur both when costly technology

is necessary to separate oneself from the challenger, and when doing so is preferred to a socially optimal strong treaty enforced by sanctions.

Our work is related to two literatures: the literature on environmental agreements, and the literature on the political economy of commitments. Traditionally, the first literature has studied the incentives of countries to join environmental agreements in the presence of free riding (Hoel [1992], Carraro and Siniscalco [1993], Barrett [1994], Dixit and Olson [2000], Battaglini and Harstad [2016]).[5] While some recent work has highlighted conditions under which large IEAs can be self-enforcing despite free riding problems, most of this literature has highlighted negative results, motivating the view that the rising number of IEAs is a paradoxical phenomenon. Two assumptions have characterized these analyses: first, that countries act as individual agents with no internal politics; and second, that once established, IEAs fully enforce their provisions. Some recent research has endogenized the government's preferences,[6] but we are not aware of any work modeling the decision of weak vs. strong agreements, explaining the popularity of weak agreements, or its implications for welfare. In this paper, we attempt to shift the focus of the literature from simply explaining participation in a self enforcing agreement to analyze the very nature of the agreement. This analysis not only rationalizes the stylized facts mentioned above, but also opens a number of new questions that have not been studied to date.[7]

There is naturally a large literature studying the relationship between international and national policies more generally. In economics, international cooperation has sometimes been viewed as collusion between incumbents, ruining beneficial tax competition (Rogoff [1985]; Kehoe [1989]), while elections allow voters to delegate strategically before policies are set or negotiated (Persson and Tabellini [1995] survey the early literature on such double-edged incentives). In political science, so-called two-level games have been analyzed in which nations negotiate before the treaty must be ratified domestically (Putnam [1988]; Evans et al. [1993]). Putnam also stressed that

[5] See Barrett [2003] for an extensive survey of this literature.

[6] Two lines of research have been pursued. First, researchers have studied how voters (or a generic principal) choose the characteristics of the negotiator when bargaining over environmental protection in order to gain a bargaining advantage (see, for instance, Segendorff [1998] Buchholz et al. [2005], Eckert [2003], and Harstad [2008 and 2010]). Second, researchers have studied how lobbying affects government preferences when bargaining for environmental protection with models a la Grossman and Helpman [1994] (see, for instance, Conconi [2003], Altamiano-Cabrera et al. [2007], Haffoudhi [2005], Dietz et al. [2012]).

[7] A related line of work has been pursued by Fearon [1998a] who has studied arms control agreements as two-step processes in which first a deal is negotiated in a war of attrition, and then it is implemented in a repeated "enforcement game." Rather than studying the strength of the resulting deals, Fearon focuses on the effect of the time horizon on the length of the negotiations. See also Fearon [1998b] for a general review of the literature on international relations.

domestic conflicts between different parties are necessary for international agreements and their ratifications to succeed, since one party, often the minority, can then collude with the foreign country to get a policy implemented which neither of these two would have been able to succeed with alone. We add to this that even when *all* domestic parties find the policy costly, the agreement may still be signed—and designed in an inefficient way in order to influence future elections.

Because we study how self-interested governments strategically use IEAs to affect future governments' behaviors and improve their electoral prospects, our work fits in a long tradition of political economy models studying the strategic role of commitment devices. Persson and Svensson [1989], Alesina and Tabellini [1990] and Aghion and Bolton [1990], for example, have highlighted how public debt can be used in this sense to limit expenditures of future governments; Milesi-Ferretti and Spolaore [1994] and Besley and Coate [1998] study how fiscal policy investments in public infrastructure can be used to affect the outcome of future elections; Biais and Perotti [2002] show how privatization can be used to manipulate the preferences of the median voter; and Maggi and Rodriguez-Clare [2007] examine how trade agreements can be used as commitment devices to limit demands from lobbyists.

Especially close to our work are Aghion and Bolton [1991], Milesi-Ferretti and Spolaore [1994], Besley and Coate [1998], Bias and Perotti [2002], and Robinson and Torvik [2005] who, as we do in our paper, study environments in which governments commit to distorted policies in order to affect which political party will win elections in the future.[8] The mechanism that we study in our paper, however, differs from the mechanism in these papers and therefore provides an original contribution to the larger political economy literature. While these papers focus on the strategic effect of choosing a policy that ties the hands of future governments, they all assume an exogenous level of commitment associated with the policies. In our work, the key step is in endogenizing the degree of commitment inherited by future governments, and in studying the larger question of when it may be optimal to choose a policy that leaves partial discretion to future governments (which, in our model, is achieved by designing weak agreements). By strategically leaving partial discretion to future governments, the incumbent can exploit the fact that the opponent will choose policies that are disliked by the median voter. As we show, this idea has important implications not only for the strength of the equilibrium agreement, but also for its impact on the size of the

[8] Antras and Padro i Miquel [2011] analyze how a foreign country may try to influence domestic elections when domestic policies generate international externalities. In our model, it is instead the domestic incumbent that uses the international treaty to influence policies at home.

agreement and the level of investment in green technologies. Of course, this idea applies to more general problems than the design of IEAs, though we leave these extensions for future research.

The paper is organized as follows. Section 2 derives the main results of the model in a basic version in which treaty and abatement decisions are zero-one variables. Section 3 extends this basic model in three directions: Section 3.1 allows for investments in green technology and relates their choice to the strength of the treaty and the choice of sanctions; Section 3.2 allows the countries to choose the depth and scope of the negotiation; and finally Section 3.3 shows how our results on polarization are strengthened once we allow for uncertainty and stochastic compliance costs. Section 4 discusses our theory in light of recent historical experiences with IEAs and presents a first attempt to test it with a large panel of countries over environmental treaties signed in the past 40 years. Section 5 concludes. All proofs are presented in the Appendices.

2 A Political-Economy Model of Treaties

2.1 Setup

We begin our analysis by considering a simple model with two periods and two countries, a home country H and a foreign country F. The home country's pollution generates an externality $e \geq 0$ on the foreign country. Country H, however, can abate pollution and eliminate the externality by incurring a cost. The net costs incurred by the citizens are heterogeneous: the cost suffered by citizen i is denoted c_i; the cost suffered by the median voter is c_m. We assume that the net cost of abating is positive for all citizens, so everyone in H prefers to emit as long as there is no treaty.

The two countries can negotiate a treaty in which H is required to abate. To motivate compliance, the treaty also specifies some consequence or sanction that F imposes on H if H does not abate.[9] The cost of the sanction to H is $s \geq 0$ and F's cost of imposing the sanction is gs. If $g > 0$, F dislikes imposing the sanction (as, for example, when s is imposed by restricting trade with F). If $g < 0$, F benefits from imposing the sanction, perhaps because it takes the form of a monetary transfer.[10] We assume that $g \geq -1$, so that there is a deadweight loss $(1+g)\,s \geq 0$

[9] In Section 3, we extend the model to allow the countries to negotiate on the possibility of investment in green technologies (that reduce the cost of compliance), and on the size of the abatement project (that allow abatement to be incomplete). In that section, we show that the theory generalizes to environments in which "sanctions" are exogenous (as in the case in which they comprise only a reputational cost) or even nonexistent.

[10] Naturally, if the sanction is just a monetary transfer, then we should expect $g = -1$.

when the sanction is imposed.

Policies are chosen in the home country by one of two political parties: a green party, G, facing the net compliance cost $c_G < c_m$; or by a brown party, B, with cost $c_B > c_m$.

The timing of the game is as follows. First, in period one, F and H's incumbent governments $i \in \{B, G\}$ negotiate s. Second, an election determines whether the incumbent remains in power or it is replaced. Third, in the second period, the winner of the election decides whether to comply or face the sanction s.

We will now explain each step in turn.

1. We make two important assumptions on the negotiations in period one. First, we assume that the two parties can use side transfers when negotiating the treaty. This implies that the equilibrium level of s will simply be the s that maximizes the two negotiators' sum of expected payoffs. An advantage of this assumption is that, with side transfers, it is irrelevant whether there is also a symmetric problem where F emits, harming H. As long as F and H can negotiate using side transfers, the two problems can be separated and thus can be considered independently. Second, we assume that H and F are fully committed to imposing the sanction if H does not comply. The fact that countries can commit to a system of sanctions is demonstrated, for example, by the Montreal protocol.[11] Countries may also be able to commit for reputational reasons, although we do not formalize the reasons for this commitment here.[12]

2. After the treaty has been negotiated, there is an election. The outcome of the election is determined by the median voter, m, who votes for the candidate delivering the highest expected payoff. Specifically, m reelects the first-period incumbent $i \in \{B, G\}$ if $u_m^i - u_m^{-i} > \delta$, where u_m^i (resp. u_m^{-i}) is m's expected payoff if electing i (resp. $-i$), while δ is some relative popularity shock in favor of the challenger $-i \in \{B, G\} \setminus i$. The popularity shock can refer to the importance of other policies not modeled here. We assume δ to be uniformly distributed on $[-z/\sigma, (1-z)/\sigma]$, implying both that the density of the shock is σ, and that the incumbent wins with probability $z \geq \frac{1}{2}$ if $u_m^i = u_m^{-i}$. The incumbency advantage is therefore measured by $z - \frac{1}{2} \geq 0$. We start by assuming that the support of the shock is sufficiently large so that reelection probabilities are interior in $(0, 1)$. It turns out that this property is guaranteed if the density of the shock is so

[11] See Article 4 of the Protocol and, for a more extensive discussion, Barrett [2003].

[12] In Section 3, we show that the results also extend to environments in which there is no commitment power when we allow for green investments.

small that:

$$\sigma < \min\left\{\frac{1-z}{c_B - c_m}, \frac{1-z}{c_m - c_G}\right\}. \tag{1}$$

3. At the third stage of the game, the newly elected policymaker $j \in \{B, G\}$ decides whether to comply with the treaty. By comparing the two costs, the second-period incumbent finds it optimal to comply if and only if the sanction s is larger than the cost to j, c_j. If $s > \overline{s} \equiv c_B > c_G$, both of the parties will comply with the treaty, so we have what we call a *strong treaty*. If instead $s < \underline{s} \equiv c_G < c_B$, none of the parties will comply with the treaty, so we have an *ineffective treaty*. If $s \in [\underline{s}, \overline{s}]$, the treaty will be complied with if the second-period incumbent is G, but not if B is in power. Since this treaty may or may not be complied with, we name it a *weak treaty*.[13]

Modulo the transfers that can be exchanged at the bargaining stage, the payoffs are in line with the discussion above. If H complies, F receives $e > 0$ while $i \in \{B, m, G\}$ pays the compliance cost $c_i > 0$. If H does not comply, F imposes the sanction at cost gs, where $s > 0$ measures the cost for every individual in H. In addition, the second-period incumbent $j \in \{B, G\}$ enjoys the office rent $R \geq 0$ as the benefit of staying in office. (A similar office rent for the first period is sunk and would not influence the analysis.) In the proofs of the following results, we allow the office rent to be conditioned on the identity of the second-period incumbent j. Here, we simplify by abstracting from these contingencies.

2.2 The Equilibrium Treaty

It is useful to start by describing three relevant benchmarks. The first benchmark is the *optimal* solution, which we define as the allocation that maximizes the sum of payoffs for F and the median voter in H. It is easy to see that if $e > c_m$, it is optimal for H to commit to abatement; if $e < c_m$, it is optimal for H not to abate. This outcome can be implemented if H and F sign a strong treaty if $e > c_m$ and no treaty otherwise. A weak treaty is always dominated.

As a second benchmark, suppose the first-period incumbent $i \in \{B, G\}$ takes as exogenous the probability that the green party G wins, p_i.[14] In this situation, i and F prefer that the second-period incumbent complies if $e > c_i$, but not if $e < c_i$. In the former case, i and F sign a

[13] Note that we assume that G complies when indifferent, while B does not comply when indifferent (i.e., when $s = c_j$). Assuming these tie-breaking rules is without loss of generality in the following analysis.

[14] If, for example, the incumbent were a strong dictator, then we may have $p_i = 1$. Moreover, in the probabilistic voting model of democracy described above, we have $p_i = z$ (if $i = G$) or $p_i = 1 - z$ (if $i = B$) when $\sigma \to 0$, since the popularity shock will then dictate the electoral outcome.

strong treaty. In the latter case, no treaty will be signed. Again, a weak treaty is never strictly optimal. If neither of the two inequalities holds, the sum of payoffs for i and F is the same whether or not H abates. A weak treaty is therefore dominated.

Finally, consider the case in which the reelection probability is endogenous but politicians do not have electoral ambitions, so $R = 0$. Once again, i prefers that the second-period incumbent complies if and only if $e > c_i$ and is indifferent on the identity of the second period policy-maker. Also in this case, a weak treaty is dominated.

We can summarize these considerations with the following result:

Proposition 0. *In each of the benchmark cases described above, a weak treaty is dominated:*

(i) The optimal outcome is implemented by a strong treaty if $e > c_m$, and by no treaty if $e < c_m$.

(ii) If the first-period incumbent $i \in \{B, G\}$ takes p_i as given or if $R = 0$, then H and F sign a strong treaty if $e > c_i$, and no treaty if $e < c_i$.

Of course, these benchmarks are for illustration only, since the probability of staying in power is endogenous in the model presented above and politicians do care about being in office. The next result shows that the endogeneity of the reelection probability changes the outcome dramatically if the office rent is sufficiently large. To shorten notation, say $z_i = 1$ if $i = G$, and $z_i = 1 - z$ otherwise.

Proposition 1. *Let the first-period incumbent be $i \in \{B, G\}$:*

(i) Suppose $R > R_i^*$ where R_i^* is defined by:

$$R_i^*(e) = \begin{cases} \frac{(1+g)c_{-i} - (z_i - \sigma(c_m - c_{-i}))(e - c_i + (1+g)c_{-i})}{\sigma|c_m - c_{-i}|} & \text{if } e \leq c_i\,, \\ \frac{(1 - z_i + \sigma(c_m - c_{-i}))(e - c_i + (1+g)c_{-i})}{\sigma|c_m - c_{-i}|} & \text{if } e > c_i. \end{cases}$$

H and F always sign a treaty, and the treaty is always weak. In particular, a brown first-period incumbent signs a treaty with sanction $s = \underline{s}$, while a green first-period incumbent signs a treaty with sanction $s = \overline{s}$.

(ii) If $R < R_i^*$, H and F sign a strong treaty when $e > c_i$, and no treaty when $e < c_i$.

Figure 1 illustrates the type of treaty as a function of R and e. While Proposition 1 is proven in the Appendix, it is instructive to outline the explanation for why it holds. At the election stage, the median voter anticipates that $u_m^G = u_m^B$ if the treaty is strong or ineffective, since then any

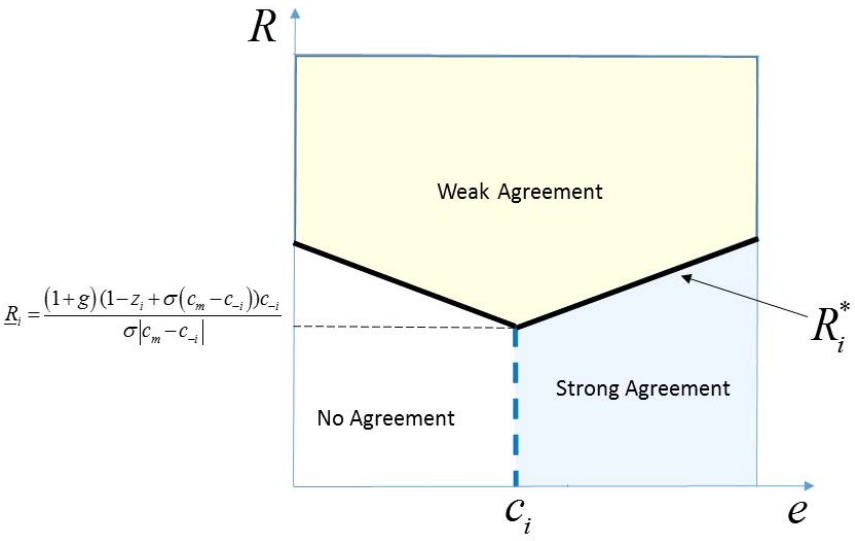

Figure 1: Equilibrium characterization in the basic model.

second-period incumbent will take the same action regarding abatement. If the treaty is weak, however:

$$u_m^G - u_m^B = s - c_m \text{ for } s \in [\underline{s}, \overline{s}]\,.$$

Thus, $u_m^G - u_m^B > 0$ when $s \in (c_m, \overline{s}]$, and $u_m^G - u_m^B < 0$ if $s \in [\underline{s}, c_m)$, implying that the ex post benefit of the treaty for the median voter depends on s. Since a green incumbent is reelected if and only if $u_m^G - u_m^B > \delta$, it follows that G is reelection with probability:

$$p_G(s) = \begin{cases} z & \text{if } s < \underline{s} \\ z + \sigma(s - c_m) & \text{if } s \in [\underline{s}, \overline{s}] \\ z & \text{if } s > \overline{s} \end{cases}. \tag{2}$$

Note that $p_G(s)$ is increasing in s for $s \in [\underline{s}, \overline{s}]$ and $p_G(\overline{s}) = z + \sigma(c_B - c_m) > z$, so the probability that G wins is maximized when $s = \overline{s}$ (see the top left quadrant of Figure 2). For such a large sanction, the median voter agrees with G that it is best to comply, and he rationally expects that party B will not comply. When the office rent is sufficiently large, the electoral gain is sufficiently important to compensate the incumbent for the possibility that the agreement is repudiated by the brown party if elected. In this case, the optimal s is equal to $\overline{s}$ (as in the bottom left panel of

Figure 2). Intuitively, the green party wants to have the highest penalty consistent with a weak agreement in which B alone would not comply; this is the best way to reduce the appeal of the brown party for the electorate, and thus maximize the reelection probability.

The case with a B incumbent is surprisingly similar. In this case, the probability that G wins is given by (2) if just z is replaced by $1-z$. Thus, the probability that B is reelected, $1-p_B(s)$, is declining in s and maximized at $s=\underline{s}$ where we have: $1-p_B(\underline{s}) = z+\sigma\left(c_m-c_G\right) > z$, as shown in the top right quadrant of Figure 2. With such a small sanction, the median voter agrees ex post with B that the cost of complying is too large, so it is better to get out of the agreement. Once again, if the office rent is sufficiently large, the preference for reelection trumps any other concern, and a weak treaty is signed, as shown in the bottom right quadrant of Figure 2.

In either case, both incumbents maximize the reelection probability by signing some kind of weak treaty. The weak treaty separates the incumbent from the challenger, while a strong or an ineffective treaty makes the two parties equivalent from the voter's point of view.

Observe that $R_i^*(e)$ is a positive threshold, decreasing for $e \leq c_i$, increasing for $e > c_i$, reaching a minimum at $e = c_i$:

$$\underline{R}_i = R_i^*(c_i) = \frac{\left(1-z_i+\sigma\left(c_m-c_{-i}\right)\right)(1+g)c_{-i}}{\sigma\left|c_m-c_{-i}\right|}$$

as illustrated in Figure 1. Three factors therefore determine the region where weak agreements prevail. The first is the variance in the popularity shock. If σ is small, the popularity shock is likely to dictate the outcome of the election. Thus $R_i^*(e)$ increases when σ falls, and a weak treaty is less likely for any given R. A weak treaty is signed only when σ is large and the voters are substantially influenced by the payoffs they can expect. If σ is so large that (1) is violated, then an incumbent can be reelected with probability one by strategically signing a weak treaty. Since this situation seems empirically unrealistic, we rule it out by assuming that (1) holds.[15]

A second factor affecting the type of agreement is the deadweight cost of a sanction, g. As g decreases, R_i^* shifts downward uniformly, making the region in which weak agreements prevail larger. The presence of a distortionary sanction makes it more likely that a strong treaty is signed, since only then can we guarantee that no sanction will be imposed.

The third factor is the ideological bias of the opposition party with respect to the median

[15] Specific historical examples in which σ appears sufficiently high justify the assumption that electoral incentives matter for the incumbent when negotiating an IEA. These are discussed in Section 4.1.

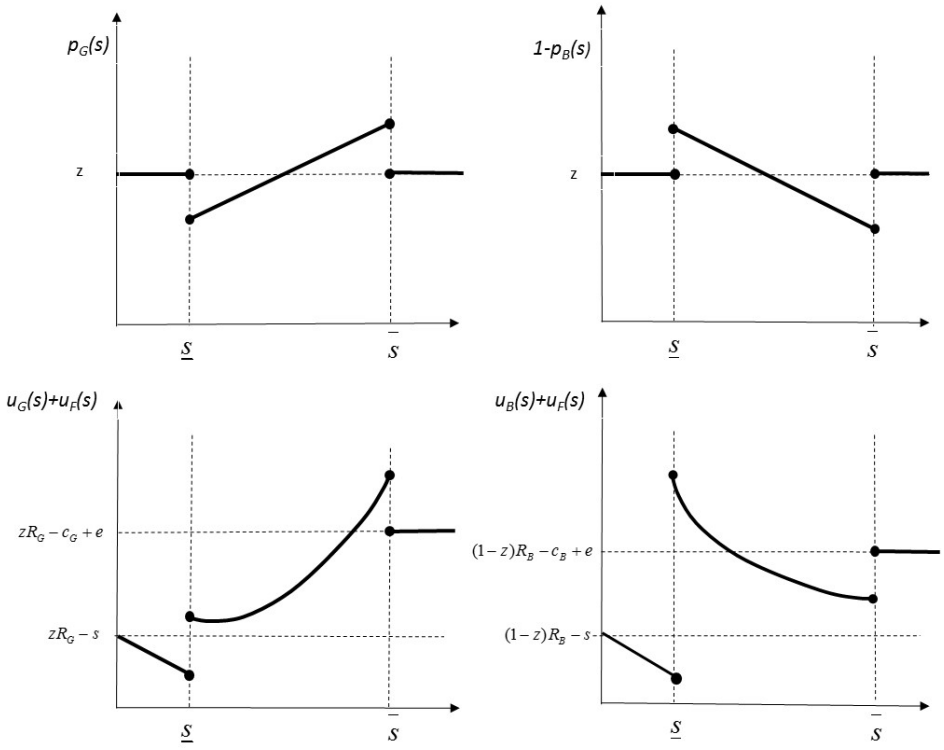

Figure 2: Reelection probabilities and parties' expected payoffs when G is the incumbent (left) or B is the incumbent (right).

voter, as measured by $|c_{-i} - c_m|$ when i is the incumbent. As this bias increases, the minimal point of R_i^* at c_i shifts downward, and R_i^* becomes flatter both on the right and the left of c_i, so R_i^* shifts down for any e. Intuitively, the larger the discrepancy between the opposition and the median voter, the more the incumbent can take advantage of it with a weak agreement.

The free-riding theories of IEAs discussed in the Introduction predict that there is insufficient participation in IEAs; Proposition 1 shows that instead two phenomena may occur. When $e < c_m$, it is optimal with no agreement: however, both parties will sign a weak agreement in equilibrium if just R is large. Therefore, there can be an oversupply of IEAs. When $e > c_m$, on the contrary, it is optimal with a strong agreement. In equilibrium, however, there will be a weak agreement if R is large. The problem here is not a lack of participation, but the *quality* of the IEA. Both of these predictions appear to be consistent with the historical experience with IEAs, as discussed in the Introduction and, more extensively, in Section 4.

3 Negotiating Depth, Risks, and Technology

Environmental policies generally include many components outside of sanctions. In fact, large portions of negotiations focus on aspects that we have deliberately ignored in the previous section, including the size and scope of the treaty, the magnitude of the emission cuts, policy measures on green technologies, and the number of industrial sectors that are to be regulated.

This observation raises two sets of questions. First, does the fact that we rarely see sanctions mean that agreements are, in the terminology of the previous section, "ineffective" rather than "weak," or can we have weak agreements (with all their strategic implications) even without sanctions? Second, what is the implication of the logic outlined in the previous section for the depth and nature of environmental treaties?

To address these issues and, more generally, study the robustness of the model, in this section we enrich the basic framework in three directions. In Section 3.1, we allow governments to negotiate on green technologies that reduce the marginal cost of compliance (for instance, investments in renewable energy). In Section 3.2, we allow for nonbinary emission and compliance levels, and we let the depth of the IEA be endogenous. In these cases, weak agreements naturally emerge even when the cost of failing to comply with an agreement is exogenous and very small (even zero). In Section 3.3, we let the compliance cost be stochastic and show that the parties may prefer very different kinds of weak treaties, even when the two parties' preferences converge. All of these extensions highlight new implications of the theory.

3.1 Green Technologies and Compliance

Assume that the home country can invest in an abatement technology $y \in [0, Y]$ at a cost qy as part of the negotiation. With investment y, the abatement cost is reduced to $c_i - y$ for all types $i = G, B, m$.[16]

Exogenous sanctions (or no sanctions at all). As a start, assume s is fixed at some exogenous nonnegative value and, to focus on the most interesting cases, let $s < c_G$ and $Y + s > c_B$. The first condition ensures that with no green investment, we have an ineffective agreement with no compliance; the second ensures that with a sufficiently large investment, we have a strong

[16] It is natural to assume that, as y increases, the marginal benefit of the investment decreases. In this case, the green investment reduces the abatement cost to $c_i - \phi(y)$ for some concave function ϕ. We assume above a linear ϕ only for simplicity; the results of this sections can be extended to allow for decreasing marginal returns of investments.

agreement with full compliance. Signing an environmental agreement and complying is optimal for F and the median voter in H if and only if $e > c_m - \max\{0, (1-q)Y\}$, so $y = Y$ is optimal if and only if $q < 1$. If this condition holds, the first-best treaty is strong, i.e. it is never optimal to leave any uncertainty about compliance.

By reducing the cost of compliance, the green technology has two effects: first, obviously, a *direct* effect on welfare as it makes the agreement cheaper when implemented; but, secondly, a *strategic* effect determining when the agreement is implemented. A very high level of investment in green technology makes compliance optimal for both B and G; similarly, a very low investment green technology makes compliance suboptimal for both G and B. Incumbents may prefer to make compliance dependent on the winner, since they can boost their reelection probabilities, as described in Section 2. They can achieve this goal if:

$$s + y - c_B \leq 0 \leq s + y - c_G. \tag{3}$$

The first inequality guarantees that B will not fulfill the agreement, and the second inequality guarantees that G will. By choosing $y = \overline{y} \equiv c_B - s$**,** a green incumbent achieves two goals: he ensures that compliance will be achieved if G is reelected; and he ensures that this damages the reelection probability of B. To see the second point, note that $c_m < c_B$, so when $y = \overline{y}$, we have $s + y - c_m > 0$, implying that the median voter prefers compliance ex post, and that the probability that G is reelected is maximized at $p_G^* \equiv z + \sigma(c_B - c_m)$.

Similarly, a B-incumbent can improve his electoral prospects by choosing $y = \underline{y} \equiv c_G - s$. This level of investment guarantees that only party G complies ex post, and that the median voter is more likely to prefer B, who does not comply. In fact, this level of technology minimizes the probability that G is reelected and the probability becomes $p_B^* \equiv 1 - z - \sigma(c_m - c_G)$.

The following result characterizes the equilibrium with fixed exogenous s when the green technology is efficient (i.e. $q < 1$):[17]

Proposition 2. *Let the first-period incumbent be $i \in \{B, G\}$ and $q < 1$. There exist thresholds R_i^* such that:*

(i) If $R > R_i^*$, the treaty is always weak, and only G will comply. If $i = B$, investments are $\underline{y} = c_G - s$, while if $i = G$, investments are $\overline{y} = c_B - s$.

[17] We focus on the case of an efficient technology here for simplicity, since the main point is to show that weak agreements can emerge even if s is exogenous or zero. The full characterization of the equilibria with endogenous s and y (and allowing for inefficient technologies) is presented in Proposition 3.

(ii) If $R < R_i^*$, the treaty is never weak. If $e > c_i - Y(1-q)$, a strong treaty with $y = Y$ is signed; otherwise no treaty is signed and $y = 0$.

The intuition for this result is similar to the intuition of Proposition 1. Politicians behave in the same way under a strong agreement and under no agreement, but they act differently once elected if the agreement is weak. If it is important to win office, there is a level of investment such that the green party will comply, the brown will not, and the median voter will prefer to stick with the incumbent regardless of the incumbent's preferences. If the investment level is large, the median voter prefers compliance and party G; if the investment level is low, the median voter is more likely to prefer party B. If the office rent is sufficiently large, the electoral concerns outweigh other concerns, and a weak treaty is always signed, and $y \in \left\{\underline{y}, \overline{y}\right\}$.

There are three interesting implications of this proposition. First, now we have a weak agreement even if the countries have no commitment power to impose sanctions (i.e. $s = 0$). This occurs because the green investment is chosen by design to change the parties' preferences and make the treaty time consistent if G is elected.

Second, we can have a novel *crowding-out* effect of sanctions. Consider an increase in the exogenous cost of sanctions s that makes it more onerous for H to not comply.[18] If $R > R_i^*$, an increase in s does not translate into an increase in compliance when green investments are endogenous. To see this, note that if G is the incumbent, he chooses $y = \overline{y}$ such that $s + \overline{y} - c_B = 0$: an increase in s will just reduce y with no effect on compliance. Similarly, if B is the incumbent, he chooses $y = \underline{y}$ such that $s + \underline{y} - c_G = 0$: once more, an increase in s will just reduce y with no effect on compliance. In both cases, an increase in s has no impact whatsoever on the strength of the agreement.[19]

Third, we have underinvestment in green technologies when a weak treaty is signed. This occurs because the incumbent does not want to make compliance a dominant strategy for everyone, so he restricts technological investment despite its efficiency. This result, however, crucially depends

[18] An example of this change is the recent design of the Paris Accord of 2015 that does not explicitly include monetary sanctions or enforcement agencies, but relies on the fact that the countries will not want to suffer "reputational costs" by missing the targets. The implementation of the accord is supposed to strengthen these costs by instituting a "name and shame" mechanism that exposes noncompliant countries, and the policy thus corresponds to an increase in s in our model.

[19] An increase in s can influence the type of the treaty only if R is close to the thresholds R_i^* in Proposition 2. In this case, it becomes more costly to stick with a weak treaty when the sanctions are larger. If $e > c_i - \max\{(1-q)\overline{y}, Y(1-q)\}$, a larger s makes it more likely that we move to a setting with a strong treaty. However, if $e < c_i - \max\{(1-q)\overline{y}, Y(1-q)\}$, a larger s makes it more likely that we move to a setting with no treaty.

on the fact that we have assumed green technologies are efficient. We will return to this aspect below, where we allow for investments in inefficient technologies and allow for both s and y to be endogenous.

Endogenous sanctions and green investments. In the previous section, we assumed s to be exogenous. As a result, we could not study the equilibrium choice between sanctions and technology and its full implications for underinvestment or overinvestment. The next result characterizes the decision to adopt green technology in a political equilibrium in which both sanctions and green investments are endogenous.

Proposition 3. *Let the first-period incumbent be $i \in \{B, G\}$. The equilibrium choice of IEAs is characterized by a threshold $R_i^* > 0$ such that:*

(i) If $R > R_i^*$, F and H sign a a weak agreement with the probability of compliance p_i^*. Also, $y = 0$ and $s = c_{-i}$ if $q \geq q_i^* \equiv 1 + g - gp_i^*$; and $s = 0$ and $y = c_{-i}$ if $q < q_i^*$.

(ii) If $R < R_i^*$, then $y = s = 0$ and no agreement is signed if $e < c_i - \max\{0, (1-q)Y\}$; while otherwise F and H sign a strong agreement with $y = Y$ if $q < 1$ and $y = 0$ if $q > 1$.

The proof and the definition of R_i^* is in the Appendix. When R is sufficiently small (i.e. $R < R_i^*$), electoral incentives are not sufficiently strong to lead to a weak agreement. In this case we either have no agreement or a strong agreement, as in Proposition 1. The possibility of green investments affects this decision only because it affects the cost of compliance. If $q > 1$, the investment is inefficient, the minimal investment $y = 0$ is chosen, and the final cost of compliance remains c_i. In this case, we have the strong agreement if and only if $e > c_i$. If $q < 1$, the investment is efficient, the maximal investment $y = Y$ is chosen and the cost of compliance is $c_i - (1-q)Y$. In this case, we have a strong agreement if and only if $e > c_i - (1-q)Y$.

The results change when electoral incentives are sufficiently strong to make a weak agreement optimal (i.e. $R \geq R_i^*$). In this case, two scenarios are possible, depending on whether $g < 0$, as when the sanction benefits F (e.g., H makes a transfer to F), or $g > 0$, so that the sanction hurts both H and F (e.g., when sanctions include trade restrictions). In the first case, inefficient technologies are never adopted; however, we may have underinvestment since an efficient technology is not adopted if $q \in (q_i^*, 1)$. In the second case, an efficient technology is always adopted; but now we may have overinvestment since an inefficient level of investment is chosen when $q \in (1, q_i^*)$.

Interestingly, the brown party is the party that is more prone to invest in green technologies. To see this, note that $q_G^* < q_B^*$, so if the green party invests, then the brown party also finds it optimal to invest, but when $q \in (q_G^*, q_B^*]$, then only the brown party will invest.

The intuition behind these findings is as follows. Similarly to the analysis of the previous section, when R is large, the G-incumbent's objective function is increasing in $s+y$ in the region in which the agreement is weak, and the opposite is true for B.[20] In equilibrium we have a corner solution: either we have $s+y=c_B$, if G is the incumbent, and $s+y=c_G$, if B is the incumbent. This makes s and y *strategic substitutes* in weak agreements: an increase (resp., decrease) in y must be compensated by a reduction (resp., increase) in s. So either we have sanctions or investments. The condition determining when we have investment in technology can be written as $q-1 \leq E(g;i)$, where $E(g;i)$ is the expected deadweight cost of the sanction when the incumbent is party i:[21] we have investment when the net cost of the technology (i.e., $q-1$) is lower than the expected cost of the sanction. The brown party signs a treaty that has a higher expected marginal cost of sanctions since, by design, he maximizes the probability of being reelected and therefore of reneging on the agreement. This higher marginal cost of sanctions induces the brown party to rely less on them and more on technology as a way to induce compliance by the green party.

3.2 The Depth of the Treaty

Assume that the level of abatement expenditure is a continuous variable $x \in [0, \infty)$. As before, different stakeholders in the home country disagree on the net benefit of such a policy. Thus, suppose the perceived net cost is $c_j x$ for $j \in \{B, G, m\}$, where $c_G < c_m < c_B$, as before. To the foreign country, the benefit of these abatement expenditures is represented by the increasing and concave function $e(x)$. The concavity assumption captures the fact that, as the size of the abatement expenditure increases, less and less efficient abatement opportunities are employed, inducing decreasing marginal returns to the expenditures, as measured by x. The optimal level for F and the median voter in H is clearly to set x such that $e'(x) = c_m$. We interpret x^* as the

[20] The incumbents' objective functions are qualitatively similar to the objective functions illustrated in Figure 2, with the only difference being that the horizontal axis is $s+y$.

[21] When G is the incumbent, $q < q_G^*$ can be written as $q-1 < g(1-z-\sigma(c_B-c_m))$: the deadweight cost of the sanction is g and the probability of paying is $1-p_i^* = 1-z-\sigma(c_B-c_m)$. A similar interpretation can be given to the condition $q < q_G^*$ when B is the incumbent.

equilibrium size of the agreement.

When both size and the level of sanctions are negotiated, a treaty is defined by the associated target level of abatement x^* and sanction $s_{x^*} : [0, x^*] \to \mathbb{R}_+$ specifying a penalty $s_{x^*}(x) \geq 0$ for each abatement level $x < x^*$.[22] Just as before, the sanction can be either beneficial or costly for F: the cost of imposing s is gs for F, so the total cost *per sanction unit* is $1 + g \geq 0$.

Given the treaty, as represented by the target x^* and the function $s_{x^*}(x)$, the second-period policymaker $j \in \{B, G\}$ prefers an abatement level that minimizes the total costs:

$$x^j_{s^*} = \arg\min_x c_j x + s_{x^*}(x). \tag{4}$$

Note that in equilibrium H and F always prefer to sign a treaty in which at least the green party fully complies with the treaty, so $x^G_{s^*} = x^*$.[23] In general, however, $x^B_{s^*} \leq x^*$ so we can write $x^B_{s^*} = x^G_{s^*} - \Delta_{s^*}$ for some $\Delta_{s^*} \geq 0$. We can therefore have only two type of treaties. We have a *strong treaty* when $\Delta_{s^*} = 0$. In this case compliance is complete and the parties look equally good to the voters. For a strong treaty, it is necessary that the sanction is so large that any deviation is unattractive for every party.

We have a *weak treaty*, instead, when $\Delta_{s^*} > 0$. In this case, abatement is contingent on the identity of the winner of the election. This is similar to what we found in the previous section. Now, however, instead of solely the dichotomy a weak vs. strong treaty, we have different degrees of weaknesses: the larger the value of Δ_{s^*}, the weaker the treaty.

For a weak treaty, where the two parties make different choices, we must have $s_{x^*}\left(x^B_{s^*}\right) - s_{x^*}\left(x^G_{s^*}\right) \in [c_G \Delta_{s^*}, c_B \Delta_{s^*}]$, or $S_{s^*} \in [c_G, c_B]$, where S_{s^*} is the average sanction per "unit of deviation":

$$S_{s^*} \equiv \frac{s_{x^*}\left(x^B_{s^*}\right) - s_{x^*}\left(x^G_{s^*}\right)}{\Delta_{s^*}}.$$

The average sanction S_{s^*} relates to the median voter's attitude toward B: if $S_{s^*} \in [c_G, c_m]$ the median voter likes the fact that B does not fully comply and prefers B to G; if $S_{s^*} \in [c_m, c_B]$ the median voter wants full compliance and prefers G to B.

The next result provides a complete characterization of the equilibrium treaty with endogenous size and sanctions. We use starred superscripts to denote the equilibrium, and subscripts to denote

[22] It can be easily shown that weak agreements emerge in the case in which emissions are endogenous but the sanction s is exogenous. We omit a detailed discussion of this case here for brevity.

[23] To see this, suppose that $x^G_{s^*} < x^*$. Then no matter who is elected, a positive sanction will be paid. By reducing x^* to $x^G_{s^*}$, incumbent s can reduce the expected sanction by $s(x^*) - s\left(x^G_{s^*}\right)$ without changing the probability of winning since it increases the utility provided by both parties by the same amount.

the identity of the first-period incumbent negotiating the treaty.[24] To guarantee interior solutions when x is continuous, condition (1) for the binary case should be strengthened to the condition $\sigma < \overline{\sigma}$, where the threshold $\overline{\sigma}$ is derived in the Appendix.

Proposition 4. *Let the first-period incumbent $i \in \{B, G\}$ negotiate the treaty, summarized as $(x_i^*, \Delta_i^*, S_i^*)$ and suppose $\sigma < \overline{\sigma}$. In equilibrium, a green second-period incumbent complies in full by abating x_i^*, a brown second-period incumbent abates $x_i^* - \Delta_i^* \in [0, x_i^*]$, and the sanction satisfies $S_i^* = c_{-i}$ when $\Delta_i^* > 0$. We have two possible cases, which depends on the following thresholds:*

$$\widehat{R}_G \equiv \frac{(1-z)(1+g)c_B}{\sigma(c_B - c_m)} \text{ and } \widehat{R}_B \equiv \frac{z(1+g)c_G}{\sigma(c_m - c_G)}.$$

(i) If $R < \widehat{R}_i$, the treaty is strong in that $\Delta_i^* = 0$, and the size is x_i^{**}, defined as $e'(x_i^{**}) \equiv c_i$.

(ii) If $R > \widehat{R}_i$, the size x_i^* is larger than if $R \leq \widehat{R}_i$, but the treaty is weak and $x_i^* - \Delta_i^* < x_i^{**} < x_i^*$.

Similarly to the analysis of Section 2, the first-period incumbent is motivated to negotiate a weak treaty by the prospect of sufficiently large office rents. In the previous analysis, a weak agreement differed from a strong agreement only because it was associated with a positive probability of noncompliance; now we can instead distinguish two new phenomena.

The first phenomenon is the fact that the weakness of the agreement manifests itself as *partial* compliance, i.e. $\Delta_i^* \in (0, x_i^*)$, for any $R > \widehat{R}_i$. This effect is explained by an intuition analogous to the intuition behind the weakness in the previous section. When $\Delta_i^* = 0$, the parties will behave identically in office, so the incumbent is reelected simply with probability z. By choosing a weak treaty with $\Delta_i^* > 0$, the incumbent can improve his reelection probability by negotiating an appropriate sanction. The green party will choose a sanction sufficiently high so that the median voter but not the brown party want to comply; the brown party will choose a sanction sufficiently small so that the green party but not the median voter want to comply.

The second phenomenon is the *overshooting effect*. For $R > \widehat{R}_i$ the politically motivated incumbent i signs a treaty that is larger than the treaty that the same incumbent would have signed in the absence of electoral incentives, i.e. $x_i^* > x_i^{**}$. This effect can be explained as follows. By an appropriate choice of the penalty S_i^*, the incumbent can decouple the issue of the size of the treaty (i.e. x_i^*) from the issue of its strength (i.e. Δ_i^*). Once the agreement is signed,

[24] Thus, $x_i^* = x_s^G$ is the equilibrium size of the treaty, $\Delta_i^* = \Delta_{s^*}$ is the equilibrium abatement gap and $S_i^* = S_{s^*}$ is the equilibrium average sanction when i is the first-period incumbent.

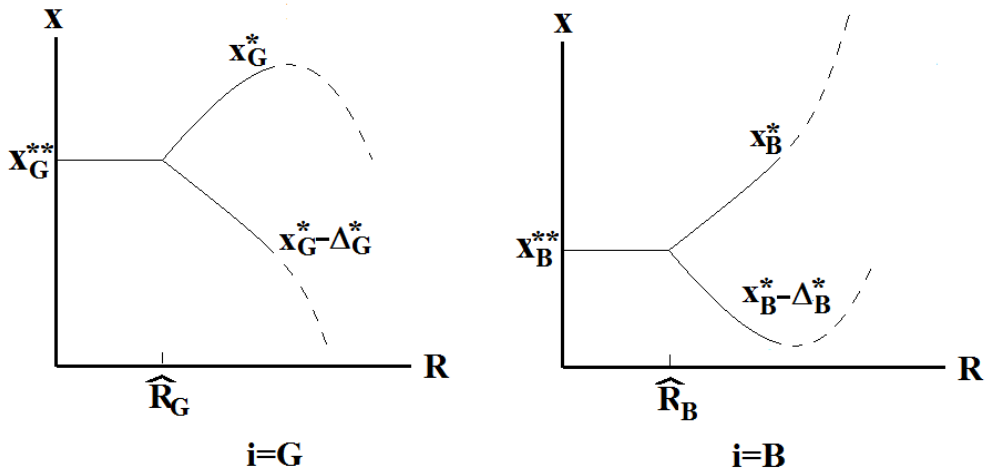

Figure 3: If the office rent is large, then the treaty size is larger but it is also weaker.

what matters for the electoral competition is not x_i^*, but Δ_i^* and S_i^*: that is, the difference in ex post behavior between the parties and its consequence. This implies that once S_i^* and Δ_i^* are chosen, the incumbent can choose the "second best" size that maximizes his expected utility. In a strong agreement, the optimal size is x_i^{**}, the level at which the marginal benefit equals the marginal cost: $e'(x_i^{**}) = c_i$. With a weak treaty and electoral uncertainty, the incumbent knows that with probability $1 - p_i$ the brown party will not fully comply. Given this uncertainty, it is optimal that the size is such that the *expected* marginal externality for F equals the marginal cost for the first-period incumbent:

$$Ee' = p_i e'(x_i^*) + (1 - p_i) e'(x_i^* - \Delta_i^*) = c_i \tag{5}$$

Since party B will not fully comply, the size must be larger so that the *expected* compliance stays at the right level. This implies that G must abate more than the first-best level, and the size of the treaty is thus also larger than the first-best size. Formally, (5) implies that, when $\Delta_i^* > 0$, we have $e'(x_i^*) < c_i$, so $x_i^* > x_i^{**}$, as illustrated in Figure 3.

The following result shows how the two effects described above evolve when we change the size of electoral incentives.

Proposition 5. *Let the first-period incumbent $i \in \{B, G\}$ negotiate the treaty, here summarized as $(x_i^*, \Delta_i^*, S_i^*)$:*

(i) For $R > \widehat{R}_i$, as R increases, then $\Delta_i^* > 0$ increases, the size x_B^* increases monotonically and $x_B^* - \Delta_B^* \to e'^{-1}(c_B)$, while $x_G^* - \Delta_G^*$ declines monotonically and $x_G^* \to e'^{-1}(c_G)$.

(ii) If R is sufficiently large, then we have $x_B^* > x_G^*$, unless preferences are so polarized that $\sigma(c_m - c_G)(x_G^{**} - x_B^{**}) > 1 - z$.

The main message of this result is that, as election incentives increase, so does the gap between what is promised by the incumbent (i.e., x_i^*) and what is actually done if the brown party wins the election; in other words, the potential for "disappointment" over the treaty implementation increases in R. This phenomenon, however, is not only due to the fact that the brown party chooses a low abatement level in absolute terms ex post if elected; it is also driven by the fact that the incumbent, green or brown, becomes increasingly (and partly unrealistically) ambitious as R increases.

To understand part (i), note that if R is very large, Δ_i^* is also very large and this increases the probability of getting reelected. When the first-period incumbent is G and p_G approaches one, x_G^* must decline toward x_G^{**} to satisfy (5). The intuition is that when it becomes certain that G will win the election, then only x_G^* is of importance and x_G^* should be set optimally. The distortion that is necessary for the weak treaty (and the large Δ_G^*) is better ensured by increasing B's deviation Δ_G^*, since B is unlikely to be elected in any case.

The argument is similar when instead the first-period incumbent is B. When R and Δ_B^* grow and B becomes certain to stay in power, $x_B^* - \Delta_B^*$ should approach the optimal level, x_B^{**}. The large Δ_B^* is then better ensured by letting the size x_B^* grow, while $x_B^* - \Delta_B^*$ stays close to B's preferred level. The treaty is in any case unlikely to be fully complied with. For a sufficiently large R, the size x_i^* is thus larger if the first-period incumbent is B, even though the expected abatement level is smaller. This is stated in part (ii) of the proposition, and, as specified, this possibility requires that the preferences are not too polarized and that the incumbency advantage is not too large. The reason for this condition is that if the incumbency advantage is very large, then B does not need to raise Δ_B^* and x_B^* by very much in order to win for sure, and then x_B^* will never need to increase to a level that is larger than x_G^*.

3.3 Uncertainty and Persistent Polarization

A strong assumption in the analysis presented above is that the parties' preference parameters are known in advance. With complete information on these parameters, a "weak" treaty implies

that party B *never* complies while party G *always* complies. The outcome is not so clear-cut if the parameters are not fully known in the first period. For example, in a severe recession the actual cost of complying may be so large that none of the parties would like to do so; the reverse situation may occur in a boom. This section allows the cost of compliance to be a stochastic variable. While this extension shows that the basic insights from the simple model continue to hold, it also allows us to strengthen the results and derive new insights. In particular, we show that the two parties' preferred types of weak treaties remain very different, even if the preferences converge.

To illustrate the results let us return to the basic model of Section 2, without technology and with binary abatement levels. Assume that the net cost is $c_j = \widehat{c}_j + c$, where $\widehat{c}_j$ is a constant individual component for $j \in \{B, m, G\}$, while c is a stochastic common variable distributed according to the cdf F and pdf f. If the realization of c is large, everyone's c_j is large, although we always have that $c_G < c_B$. In our view, it is realistic to maintain the ranking of preferences between the green and the brown party.

When s is the sanction, party $j \in \{B, G\}$ complies with probability $\rho_j(s)$, where:

$$\rho_j(s) = \Pr(c + \widehat{c}_j < s) = F(s - \widehat{c}_j).$$

It follows that G is more likely to comply than B for any given s: $\rho_B(s) < \rho_G(s)$.

It is reasonable that c is unknown at the election stage as well as in the first period. We therefore assume that c is realized just before the second-period incumbent decides whether or not to comply. We also assume that f has the typical bell-shape. Thus, $f(c)$ is convex up to the inflection point $\underline{c}^{IN}$, where $f''\left(\underline{c}^{IN}\right) = 0$, $f(c)$ is concave for $c \in \left(\underline{c}^{IN}, \overline{c}^{IN}\right)$, where $\overline{c}^{IN}$ is the second inflection point at which $f''\left(\overline{c}^{IN}\right) = 0$, and $f(c)$ is convex for $c > \overline{c}^{IN}$.

At the election stage, the median voter understands that the election matters only if c happens to fall between the two parties' thresholds, $c \in (s - \widehat{c}_B, s - \widehat{c}_G)$. In expectations, the additional utility the median voter expects by electing G instead of B is:

$$E(\Delta u_m) = \int_{s-\widehat{c}_B}^{s-\widehat{c}_G} (s - \widehat{c}_m - c) F(c).$$

We will continue to assume that the median voter elects party G if the additional expected utility for the median voter, $E(\Delta u_m)$, is larger than some random popularity parameter favoring party B. However, rather than requiring the popularity shock to be uniformly distributed, as

above, we now allow it to be arbitrarily distributed according to some cdf H_i, where i is the incumbent. The probability that G wins the election is then $p_i(s) = H_i(E(\Delta u_m))$.

To see how s influences $p_i(s)$, note that $\partial p_i(s)/\partial s > 0$ if and only if $\partial E(\Delta u_m)/\partial s > 0$, regardless of H_i. Furthermore, it is easy to show that $\partial E(\Delta u_m)/\partial s > 0$ if and only if:

$$\frac{\int_{s-\widehat{c}_B}^{s-\widehat{c}_G} f(c)\,dc}{\widehat{c}_B - \widehat{c}_G} > \left(\frac{\widehat{c}_B - \widehat{c}_m}{\widehat{c}_B - \widehat{c}_G}\right) f(s-\widehat{c}_B) + \frac{(\widehat{c}_m - \widehat{c}_G)}{\widehat{c}_B - \widehat{c}_G} f(s-\widehat{c}_G) \tag{6}$$

The left-hand side is the average density of the shock c over the interval in which G and B disagree on the policy. On the right-hand side, we have a (weighted) average of the levels that f takes at the two thresholds. The two weights are equal if the median voter is equally likely to agree with either candidate (i.e., if $\widehat{c}_m = (\widehat{c}_B + \widehat{c}_G)/2$). Then, the inequality holds, and p_i increases in s, if and only if f is (on average) concave over the disagreement interval. If f is (on average) convex over the disagreement interval, p_i decreases in s. Since f is convex at the tails, this explains why p_i decreases in s to s_B^* before p_i increases to the peak when $s = s_G^* > s_B^*$. Figure 4 illustrates the disagreement intervals and the equilibrium sanction levels.

Proposition 6. *Suppose the compliance cost is stochastic.*

(i) There is a unique and finite s_B^* minimizing $p_i(s)$, and there is a unique and finite s_G^* maximizing $p_i(s)$. Both s_B^* and s_G^* are independent of i.

(ii) We have $s_B^* < s_G^*$, $\rho_B(s_B^*) \in \left(0, \frac{1}{2}\right)$, and $\rho_G(s_G^*) \in \left(\frac{1}{2}, 1\right)$.

(iii) Suppose $\widehat{c}_m = (\widehat{c}_B + \widehat{c}_G)/2$. Each disagreement interval covers an inflection point:

$$\begin{aligned} s_B^* - \widehat{c}_B &< \underline{c}^{IN} < s_B^* - \widehat{c}_G, \text{ and} \\ s_G^* - \widehat{c}_B &< \overline{c}^{IN} < s_G^* - \widehat{c}_G. \end{aligned}$$

Consequently, if $|\widehat{c}_B - \widehat{c}_G| \to 0$, then $s_B^* \to \underline{c}^{IN} + \widehat{c}_m$ and $s_G^* \to \overline{c}^{IN} + \widehat{c}_m$.

Part (i) states that the s_i^* that maximizes party i's chance of winning is independent of the identity of the incumbent. Part (ii) says that the sanction level maximizing the chance that B wins is always smaller than the sanction level maximizing the chance that G wins. It also says that, at these sanctions, party B would be more likely to not comply than to comply, while G would be more likely to comply than not comply.

Part (iii) of the proposition states that the two thresholds are always close to (and the disagreement interval includes) an inflection point of f. This is intuitive, since f is at its steepest

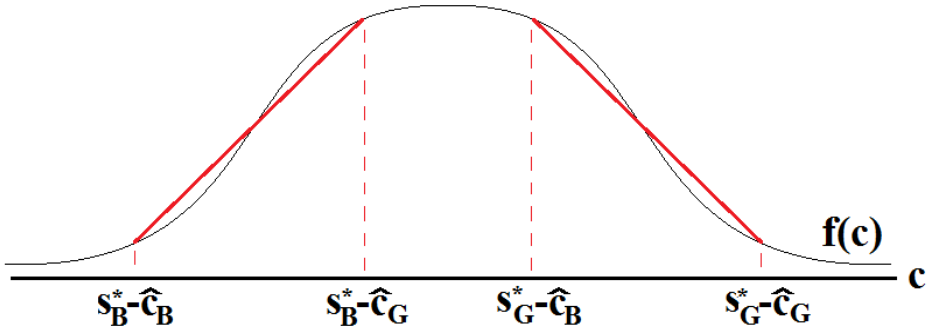

Figure 4: Incumbent B is more likely to win if the median voter expects a high cost c, conditional on c falling within the disagreement interval. This implies that B prefers f' to be large over the disagreement interval. Analogously, party G prefers f' to be small and negative over the disagreement interval.

at the inflection points. When f is steep, there is a large difference in the probabilities that the median voter m will disagree with G and that m will disagree with B. Party B thus prefers to have the thresholds close to the point at which f' is at the largest, while party G prefers a sanction such that the thresholds are close the point at which $-f'$ is at the largest. Consequently, if the objective is to win the election, the two parties continue to prefer very different versions of the weak treaty even if their preferences are similar: the two policies s^*_B and s^*_G do not converge even if the parties' preferences converge.

If uncertainty vanishes and f concentrates on a single value for c, the two inflection points converge. In this case, s^*_B and s^*_G will also converge when the preferences converge. This explains why the sanction levels will converge in the basic model in Section 2, where we assumed that c was known in advance.

4 Some evidence

Evidence on the influence of domestic politics on decisions regarding environmental treaties has long been discussed in the international relations literature (see Lantis [2006], Keleman and Vogel [2010], Hovi et al. [2012], for example). In Section 4.1, we discuss the two most recent major IEA negotiations in light of the theory presented above.[25] We argue that these cases show that

[25] We focus on recent IEAs to illustrate the importance of politics in the negotiations only for brevity. Just focusing on the U.S. experience, there is ample evidence on the effect of electoral incentives on policy makers'

electoral incentives are important factors in shaping incentives to sign and ratify IEAs. In Section 4.2, we present some new evidence on the implications of these incentives for the number of signed IEAs and their effectiveness.

4.1 Some Historical Experiences

The Kyoto Protocol. Consider first the case of the United States in the negotiations for the Kyoto Protocol of 1997. Until the final stages of its negotiations, the U.S. delegation was aiming for a modest target (GHG emissions in 2008-2012 equal to the 1990 levels). This reflected the fact that the delegation expected resistance from the Senate, at the time controlled by the Republican Party. The stance of the U.S. delegation, however, changed abruptly when Vice President Gore took charge of the negotiations (see Hovi et al. [2012]). Gore pushed the delegation toward accepting a much more ambitious target of a 7% decrease in GHG. While this was widely seen as an unrealistic goal,[26] the Clinton administration counted on a successful outcome from the impending 2000 presidential and congressional races. Lantis [2006:40] observed that "Clinton hoped that Democratic control of the House and Senate or even a Gore presidential victory in 2000 would create a better political climate for ratification." According to a senior official participating to the negotiation, "Gore, planning to run for president in 2000, anticipated that climate-change policy would become a vote getting issue."[27] He therefore pre-positioned himself to take advantage of the negotiations, pushing for an agreement that could be expected to be ratified only if he was elected to the presidency: a behavior that is in line with the logic of the model presented above. As predicted by the model, shortly after the presidential election that brought the Republican George W. Bush to power, plans to ratify the agreement were abandoned.[28] Several years later, President Bush made his famous 2008 speech on climate change, where he said that: "there is a wrong way and a right way to approach reducing greenhouse gas emissions... The

decisions concerning international environmental commitments. See, for example, Hopgood [1998] for an in-depth discussion of the political calculus in the Nixon administration regarding the United Nations Conference on the Human Environment (UNCHE) held in Stockholm in 1972, and in the Bush administration regarding the United Nations Conference in the Environment and Development (the "Earth Summit") held in Rio in 1992.

[26] Bang et al. [2012] noted that "This target left little doubt that Kyoto would be unacceptable to the Senate." Indeed, a few months after its proposal the Senate unanimously passed a resolution against it, the Byrd-Hagel resolution.

[27] See Hovi et al. [2012:144]. Based on anonymous interviews with 26 participants in the negotiations from the U.S. and Europe, Hovi et al. [2012], concluded that one of the most plausible reason for the failure at Kyoto was that the Clinton-Gore administration "essentially pushed for an agreement that would provide them a climate-friendly face."

[28] It reasonable to assume that this would not have happened if Gore were elected, especially if the election came with a change in majority in the Senate.

wrong way is to...demand sudden and drastic emissions cuts that have no chance of being realized and every chance of hurting our economy. The right way is to set realistic goals for reducing emissions consistent with advances in technology."[29] The emphasis on technology is exactly what our theory predicts that a relatively brown incumbent would do.

A similar dynamic can be found in Canada, where the incumbent negotiating the agreements was also—in the terminology used above—a "green party". In Canada, the Kyoto Agreement was signed and ratified by the liberal government of Jean Chretien, who committed his country to an ambitious reduction plan (6% reduction of GHG by 2012 from 1990 levels) without making an attempt to generate domestic support for the treaty (Lantis [2006]). As noted by Lantis [2006:36], "Chretien rested on his political advantages rather than assuaging the concerns of his opponents." This behavior appears consistent with an attempt to link the success of the treaty to the endurance of liberal governments. Indeed, as soon as the conservative prime minister Stephen Harper took office in 2006, a policy of deliberate indifference was pursued causing a sharp increase in GHG emissions.[30]

The experience with the Kyoto agreement shows that incentives to sign weak agreements do not pertain only to left-leaning incumbent governments. In New Zealand the government responsible for the negotiation in 1997 was the conservative National party. In 1999 the Labor party won the elections and the government shifted to the liberal side. Contrary to what happened in the U.S. and Canada—but in line with the model's predictions—the Kyoto agreement was indeed ratified by New Zealand in 2002. The agreement survived while the Labor party remained in charge, and it was abandoned only in 2012 when the government shifted back to the National party.[31]

A similar path has been followed by Japan, where the negotiating party in 1997 was the conservative Liberal Democratic Party party (LDP), which signed and ratified the Kyoto agreement. The agreement was not renegotiated in 2010, when the government repudiated the mandatory targets and opted for new voluntary targets. Despite watering down targets for cutting emissions by 2020, in 2013 Japan met its Kyoto Protocol obligations to lower greenhouse gas emissions only

[29] This excerpt is from President Bush's speech on climate change delivered from the Rose Garden at the White House on 16 April 2008.

[30] Canada invoked its withdrawal clause from the Kyoto agreement in 2011; see Austen [2011]. In the years since the agreement, Canadian emissions have risen by more than 30% above the 1990 target (Walsh [2011]).

[31] New Zealand's conservative Government announced in 2012 that it would not agree to the legally binding second Kyoto Protocol commitment period (Small [2012]). However, it said it would make a pledge to voluntarily reduce greenhouse gas emissions under the parallel "United Nation Convention Framework."

by buying carbon credits as actual emissions rose (Reuters [2013]).

As in New Zealand and Japan, the negotiations of the Kyoto agreement were conducted by a conservative government in Australia. The government signed the agreement in 1998, but the conservative government of John Howard delayed ratification until the end of the mandate.[32] The Kyoto agreement was officially ratified only in December 2007 after the Labor Party (with Kevin Rood as prime minister) assumed control.[33]

The Paris Accord. While it is early to evaluate the success of the Paris Accord, it is clear that decisions surrounding this agreement are influenced by electoral considerations in the U.S. Signed by the Obama Administration just one year before the 2016 Presidential elections, its ratification and implementation was a hot issue in the presidential campaign. Along with the negotiations, the Obama administration has committed to various measures incentivising investments in green technologies, exactly as described in Section 3.2: by attempting to reduce emissions from power plants using the regulatory power provided by the Clean Air Act; by tightening fuel economy standards for heavy-duty vehicles; and by developing standards to address methane emissions from landfills and the oil and gas sector.[34] The theory predicts that these investments will be sufficient to commit a Democratic candidate, but not a Republican. It is indeed the case that the Republican President elect pledged "to rip up Paris Climate Agreement" (Sarlin [2016]) while the Democratic candidate vowed to uphold the U.S. commitment to climate actions signed by the Obama administration (Cohan [2016]).

4.2 A First Take at the Data

The theory presented above makes two predictions worth further discussion. First, it predicts that countries in which governments have electoral concerns are more likely to sign IEAs. Second, it predicts these agreements to be particularly weak, and thus less effective in reducing emissions. In this section, we present a preliminary quantitative evaluation of these predictions using a large panel data set on post-World War II environmental treaties.

[32] Howard's government also managed to negotiate extraordinarily lax targets that allowed emissions in GHG to increase by as much as 8% from the 1990 levels (Hamilton [2015]).

[33] The liberal party remained in power until 2013, after the date at which Australia could withdraw from the treaty (three years after the ratification). The treaty is still in effect.

[34] See the "Intended Nationally Determined Contribution" (INDC) submitted to the UN.: http://newsroom.unfccc.int/ unfccc-newsroom/united-states-submits-its-climate-action-plan-ahead-of- 2015-paris-agreement/#downloads. Accessed on October 10th, 2016.

Table 1 examines whether, as predicted in Propositions 1 and 2, democracies are more prone to sign international agreements. To this goal we have collected a data set of 151 countries on the major environmental treaties signed from 1976 to 2001. To select the treaties we refer to the list in Appendix 6.1 from Barrett [2003]. The data set includes 31 agreements. We estimate a logit model in which the dependent variable is a dummy variable equal to one if a country signs a treaty during the first five years that an agreement is open for signature and zero otherwise. The independent variables corresponds to characteristics of the country during the first year that the agreement was open for signature. Our key independent variable is a measurement of democracy.[35] We use two alternative measurement variables for democracy: $polity2_t$ from the Polity IV Project, which measures the country's degree of democratization, for columns 1-4; and a dummy variable $democracy_t$, which is equal to one if and only if $polity2_t$ is larger than 0, for columns 5-8.[36] We consider alternative sets of control variables. Specifically, we include a set of geographical dummies, a variable qualifying the electoral regime and, importantly, country or treaty fixed effects to capture different types of unobservable factors. As can be seen from Table 1, in all specifications $polity2_t$ and $democracy_t$ appear positive and significant, suggesting that democratic regimes are indeed more prone to signing international environmental agreements even after controlling for other relevant characteristics. This finding provides support for our first theoretical prediction that regimes with larger electoral concerns are more prone to sign IEAs. This result is corroborated by previous empirical works that have also highlighted the fact that democracies are more prone to sign IEAs (see, for example, Congleton [1992], Midlarsky [1998] and Neumayer [2002]). The results in Table 1 extend these previous results by exploiting a more extensive data set and a larger set of controls.[37]

The finding that democracies sign more IEAs is perhaps not surprising; the prediction that democracies are more prone to sign weak and less effective agreements appears more controversial.

[35] The list of treaties and the description of the data sources for Table 1 and 2 is presented in the online appendix.

[36] For the Polity IV Project see http://www.systemicpeace.org/polity/polity4.htm. To assess if a country is democratic we construct the *democracy* variable following Persson and Tabellini [2006] and Besley et al. [2011].

[37] Congleton [1992] considers two treaties: the Convention for the Protection of the Ozone Layer and the Montreal Protocol on Substances that Deplete the Ozone Layer. Neumayer [2002] considers four treaties: the Protocol to the United Nations Framework Convention on Climate Change (Kyoto Protocol), the Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade (the Rotterdam Convention), the Copenhagen Amendment to the Montreal Protocol, and the Cartagena Protocol on Biosafety to the Convention on Biological Diversity (Cartagena Protocol on Biosafety). Our dataset cointains thirty-one agreements, and except for the Copenhagen Amendment, all the previous treaties are included.

Is there evidence supporting it? As mentioned in the Introduction, there is certainly clear evidence that many IEAs signed or ratified by democracies are weak. The U.S., for instance, signed 11 agreements between 1989 and 2011, all of which have failed to achieve ratification (Bang et al. [2012]).[38] The specific question of whether democracies are better at dealing with environmental issues has been addressed by a large literature (see, for instance, Congleton [1992], Barrett and Graddy [2000]), Murdoch, J. T. Sandlerb and W. Vijverberga [2003]. Perhaps unsurprisingly, however, given the endogeneity of the political regime and the number of potential omitted variables affecting both the democratic regime and the environmental outcome, this literature has obtained mixed results.

In Table 2, we investigate the marginal effect of signing an agreement on reductions in CO_2 (the leading greenhouse gas). More importantly, we also examine how the political regime affects the marginal benefit of signing another treaty.[39] To this goal, we have collected a large panel of 143 countries over 7 environmental treaties that belong to the *Convention On Long-Range Transboundary Air Pollution* lineage, which aims to control CO_2 or indirectly induce CO_2 reductions.[40]

The data cover the period 1960-2011. The dependent variable in Table 2 is the (log of) the level of CO_2 emissions per year (in kilotons). The target independent variables are as follows. First, $\#treaties_{t-\mathbf{1}}$ reports the number of greenhouse emission treaties on CO_2 emissions signed by a country up to period $t-1$. Second, $polity2_t$ and $democracy_t$ measure democracy at t as described above. Third, and most importantly, we have interaction effects $polity2_t \cdot \#treaties_{t-\mathbf{1}}$ and $dem_t \cdot \#treaties_{t-\mathbf{1}}$.

Columns 1-4 report simple OLS estimates with various regional, economic, and institutional controls. Results here are mixed, both in terms of the effect of the number of treaties and in terms of democracy: $\#treaties_{t-\mathbf{1}}$ is significant at the 1% level in specifications 3-4; $polity2_t$ and $democracy_t$ are not significant; and, more importantly for us, the interaction effects are negative. These results suggest that treaties have a larger effect on CO_2 when democracies sign them, a result that is in conflict with our previous findings.

[38] Ratification of the Paris Accord of 2015 is an open political question. The administration claims it does not need a Senate vote since it sees the accord as an "executive agreement", not a formal treaty.

[39] For this analysis, we follow Slechten and Verardi [2014] who previously studied the effectiveness of treaties using CO_2 emissions. Slechten and Verardi [2014], however, did not study the effect of political institutions on the effect of treaties, which is the variable of interest for our work.

[40] To select the treaties with effects on CO_2, we have followed Slechten and Verardi [2014]. The list of treaties is presented in the online appendix. As we show in the online appendix, the analysis is, however, robust to using the more comprehensive list used in Table 1.

Naturally $democracy_t$ and $polity2_t$ are correlated with a number of other important variables that can determine the success of a treaty: the presence of a civil society, the history of the country, and the quality of the judicial system. To control for these and other country specific variables, we perform the regression analysis with country fixed effects in columns 5-8. Results are then qualitatively very different. Now $\#treaties_{t-1}$ is highly significant in all specifications; $polity2_t$ and $democracy_t$ remain insignificant and small; but the interaction effects are now positive and very significant. This suggests that treaties indeed have an impact on greenhouse gas (GHG) emissions, but signing a treaty has a smaller impact on CO_2 reductions for democratic regimes relative to other regimes—exactly as the theory would predict.

5 Conclusions

This paper sheds light on the connections between domestic and international politics. International treaties influence, and perhaps even limit, what domestic policymakers can do. The incentives provided by a treaty may affect different political candidates in different ways, and thus they might also influence domestic elections. Anticipating this, political incumbents will seek to negotiate and sign treaties strategically and in a way that both ties the hands of the next policymaker and improves the odds of staying in office. Our theory is built to deepen our understanding of these trade-offs and it results in a number of testable predictions.

First, political incumbents will be reluctant to sign "strong" treaties with which their countries must necessarily comply. A strong treaty will level the playing field since any future politician will behave in the same way. A "weak" treaty, in contrast, may or may not be upheld. A relatively green party is more likely to comply with the treaty than a relatively brown party, and the median voter's preferred choice will depend on the negotiated consequence—or sanction—facing a country that does not comply. With a small sanction, the median voter prefers the brown party that does not comply; but with a somewhat larger sanction, he prefers that the green party is in power. Thus, some kind of weak treaty can maximize the reelection probability regardless of the identity of the incumbent.

Second, we show that treaties may also be too large in size or scope. The explanation is that when the incumbent prefers a weak treaty that may not be fully complied with, there is an "overshooting" effect that makes the treaty very large. A large size is helpful to the incumbent both because the expected marginal externality to the foreign country can then stay at the right

level, even when the treaty may not be fully complied with, but also because a large treaty will have a larger impact on the election.

Third, countries might in equilibrium invest more in technology than what the first best would require. The reason is that, since a weak treaty may or may not be upheld, there is a fair chance of facing the sanction and the deadweight loss this involves. This deadweight loss can be avoided if one instead invests in technologies that raise the motivation to comply with the treaty. In this way, the probability of compliance may be increased to a moderate level (characterizing a weak treaty) without risking the deadweight loss that comes with sanctions.

To summarize, our theory predicts that political incumbents prefer treaties too often, and benefit from treaties that are too weak, too broad in scope, and are enforced by technology investments. This is true even when a strong treaty enforced by sanctions is first best. The incumbents' preferences are particularly strong when the perks from staying in office are large and there are many swing-voters who pay attention to the policy.

These predictions fit well with the preliminary evidence discussed in Section 4: democratic countries are more likely than others to sign international treaties, existing treaties are surprisingly weak, and treaties are enforced less by explicit sanctions than by countries' investments in complementary technology. Our analysis has resulted in a large number of other testable predictions as well, and future research should aim to take the theory more carefully to the data.

Future research may also develop the theory in reasonable directions. To illustrate the results in a simple and intuitive way, we have limited attention to a three-stage model with only two countries and two candidates. We have also abstracted from asymmetric information, the possibility of renegotiating the sanction, and alternative ways in which the treaty may interact with domestic politics. However, our model is tractable enough to be used as a workhorse in analyzing a wide range of such extensions. And these extensions will be immensely important; in our view, the political economy of treaties must be better understood before we can successfully address the global challenges ahead.

6 Appendix

6.1 Proof of Proposition 1

The countries will reach an agreement that maximizes the surplus of the ruling parties in the two countries. Let $U_i(s)$ be the utility generated in the domestic country for the incumbent i and $U_F(s)$ for the incumbent in the foreign country. When the incumbent is i, the equilibrium agreement s_i solves:

$$\max_s \{U_i(s) + U_F(s)\} \tag{7}$$

Consider how the objective function $W^i(s) = U_i(s) + U_F(s)$ changes with s. There are two cases to consider: when the incumbent is a green party, and when it is a brown party. In the main text, we assumed that both candidates have the same office rent R; in the following, for additional generality, we allow the office rents to be different for the two candidates: R_j for $j = G, B$.

6.1.1 Case 1: The green party is the incumbent

If both G and B comply at $t = 2$, the objective function in (7) is: $W^G_{BG}(s) = zR_G - c_G + e$. If G only complies at $t = 2$:

$$W^G_G(s) = p_G(s)(R_G - c_G + e) - (1 - p_G(s))\,(1 + g)\,s. \tag{8}$$

If there is no agreement or if there is an agreement and $s < \underline{s}$:

$$W^G_\emptyset(s) = zR_G - (1 + g)\,s.$$

Note that, since $p_G(s)$ increases in s, $W^G_G(s)$ is convex in s. Using this fact and the formulas above, we have:

Lemma 1.1. *The green party signs an agreement if $e > e^*_G(R_G)$ with $e^*_G(R_G)$ a nonnegative and nonincreasing function of R_G.*

Proof. The case with no agreement cannot occur if $W^G_\emptyset(0) < W^G_{BG}(s)$ or if $W^G_\emptyset(0) < W^G_G(s)$. Consider the first case first. The condition $W^G_\emptyset(0) < W^G_{BG}(s)$ can be written as:

$$zR_G - c_G + e = W^G_{BG}(s) > W^G_\emptyset(s) = zR_G \Rightarrow e > c_G.$$

Consider now the second condition. Since $W^G_G(s)$ is convex in s we have two cases: $s = \overline{s} = c_B$ and $s = \underline{s} = c_G$. We now show that it is never optimal to set $s = \underline{s} = c_G$, since in this case it is

better to have $s \geq c_B$. With (2), we have $W_G^G(\underline{s}) > W_{BG}^G(s)$ only if:

$$\begin{aligned} W_G^G(\underline{s}) &= (z + \sigma(\underline{s} - c_m))(R_G - c_G + e) \\ &\quad - (1 - z - \sigma(\underline{s} - c_m))(1 + g)\,\underline{s} > zR_G - c_G + e. \end{aligned}$$

Since $\underline{s} = c_G$, this condition holds only if:

$$\sigma(c_G - c_m) R_G > (1 - z - \sigma(c_G - c_m))(e + gc_G).$$

But since $c_G - c_m < 0$ and $e > c_G$, the previous inequality is impossible.

We must therefore have that, when the agreement is weak, $s = \overline{s} = c_B$.[41] Such an IEA is preferred to no IEA if:

$$W_G^G(\overline{s}) = \begin{pmatrix} (z + \sigma(\overline{s} - c_m))(R_G - c_G + e) \\ - (1 - z - \sigma(\overline{s} - c_m))(1 + g)\,\overline{s} \end{pmatrix} > zR_G = W_\emptyset^G(0).$$

So:

$$[\sigma(c_B - c_m) R_G + [z + \sigma(c_B - c_m)]((1 + g)c_B - c_G + e) - (1 + g)\,c_B] > 0.$$

This is true if:

$$e > \widetilde{e}_G^*(R_G) = \frac{(1 + g)\,c_B - (z + \sigma(c_B - c_m))((1 + g)c_B - c_G) - \sigma(c_B - c_m) R_G}{z + \sigma(c_B - c_m)}.$$

where, we note, $e_G^*(R_G)$ is decreasing in R_G. Putting together the two conditions we have that party G chooses to sign an IEA if $e > e_G^*(R_G) = min\{c_G, \widetilde{e}_G^*(R_G)\}$. ■

We now prove the following result:

Lemma 1.2. *There is a threshold $e_G^{**}(R_G) \geq e_G^*(R_G)$ such that the green party finds it optimal to sign a weak agreement if $e \in (e_G^*(R_G), e_G^{**}(R_G))$, and a strong agreement if $e > e_G^{**}(R_G)$.*

Proof. Consider the green party first. For $e < e_G^*(R_G)$ we have $W_{BG}^G(s) < W_\emptyset^G(s)$ and $W_G^G(s) < W_\emptyset^G(s)$, so no agreement is signed. For $e \geq e_G^*(R_G)$, a strong agreement is signed if $W_G^G(s) < W_{BG}^G(s)$, that is:

$$((z + \sigma(s - c_m))(R_G - c_G + e) - (1 - z - \sigma(s - c_m))(1 + g)s) < zR_G - c_G + e,$$

[41] Note that at $s = c_B$, B is indifferent. There is however no loss of generality in assuming that when $s = c_B$, B chooses not to comply since as it is easy to verify this is the unique behavior compatible with an equilibrium.

where $s = c_B$. This implies:

$$e > \widetilde{e}_G^{**}(R_G) = \frac{(1 - z - \sigma(c_B - c_m)[c_G - (1+g)c_B] + \sigma(c_B - c_m) R_G}{1 - z - \sigma(c_B - c_m)},$$

where, we note, $\widetilde{e}_G^{**}(R_G)$ is increasing in R_G. For the result define $e_G^{**}(R_G) = \max\{e_G^*(R_G), \widetilde{e}_G^{**}(R_G)\}$.

■

Let $\underline{R}_G$ be defined as $e_G^*(\underline{R}_G) = c_G$. It is easy to verify that:

$$\underline{R}_G = \frac{(1+g)(1 - z - \sigma(c_B - c_m))c_B}{\sigma(c_B - c_m)}.$$

Note that at the point $(c_G, \underline{R}_G)$ we have $W_G^G(s) = W_\emptyset^G(s)$ and $W_{BG}^G(s) = W_\emptyset^G(s)$, implying that $W_G^G(s) = W_{BG}^G(s)$ and so $\widetilde{e}_G^{**}(\underline{R}_G) = c_G$: so the loci $e_G^*(R_G), e_G^{**}(R_G)$ and c_G intersect at $(c_G, \underline{R}_G)$.

Define $R_G^*(e)$ to be equal to $[e_G^*]^{-1}(e)$ for $e \leq c_G$ and to $[e_G^{**}]^{-1}(e)$ for $e > c_G$, where $[e_G^*]^{-1}(e)$ and $[e_G^{**}]^{-1}(e)$ are the inverse of $e_G^*(e)$ and $e_G^{**}(e)$. So:

$$R_G^*(e) = \begin{cases} \frac{(1+g)c_B - (z+\sigma(c_B - c_m))[e - c_G + (1+g)c_B]}{\sigma(c_B - c_m)} & e \leq c_G \\ \frac{(1-z-\sigma(c_B - c_m))[e - c_G + (1+g)c_B]}{\sigma(c_B - c_m)} & e > c_G \end{cases}.$$

The definition of $R_G^*(e)$ implies that for $R_G > R_G^*(e)$ we have $e \in (e_G^*(R_G), e_G^{**}(R_G))$, so by Lemma 1.2 we have that the green party finds it optimal to sign a weak agreement. If $R_G < R_G^*(e)$ and $e \geq e_G^*$, we have $e > e_G^*(e)$ and $e > e_G^{**}(e)$, Lemma 1.1 and A1.2 implies that the green party finds it optimal to sign a strong agreement. Finally, when $R_G < R_G^*(e)$ and $e < e_G^*$, we have $e < e_G^*(e)$, and Lemma 1.1 implies that the green party finds it optimal to sign no strong agreement.

6.1.2 Case 2: The brown party is the incumbent

The welfare generated if both B and G comply is, for B and F: $W_{BG}^B(s) = zR_B - c_B + e$. If G only complies, then the sum of payoffs is:

$$W_G^B(s) = [1 - z + \sigma(s - c_m)](e - c_B) + [z - \sigma(s - c_m)](R_B - (1+g)s).$$

Note that $W_G^B(s)$ is convex in s. We have:

Lemma 1.3. *The brown party signs an agreement if $e > e_B^*(R_B)$ with $e_B^*(R_B)$ nonincreasing in R_B.*

Proof. The case with no agreement cannot occur if $W_{\emptyset}^{B}(0) < W_{BG}^{B}(s)$, implying $e > e_B^* = c_B$, or if $W_{\emptyset}^{B}(0) < W_{G}^{B}(s)$. Since $W_{G}^{B}(s)$ is convex in s we have two cases: $s = \overline{s} = c_B$ and $s = \underline{s} = c_G$, but it is easy to check that $\overline{s}$ is dominated, since $W_{G}^{B}(\overline{s}) > W_{G}^{B}(\underline{s}) \Rightarrow W_{BG}^{B}(s) > W_{G}^{B}(\overline{s})$. So, for a weak IEA, $s = \underline{s}$. B and F prefer such a weak IEA to no IEA if $W_{G}^{B}(\underline{s}) > W_{\emptyset}^{B}(0)$, implying:

$$(1 - z + \sigma(\underline{s} - c_m))(e - c_B) - [z - \sigma(\underline{s} - c_m)]((1 + g)\underline{s} - R_B) > zR_B,$$

which can be written as:

$$e > \widetilde{e}_B^*(R_B) \equiv \frac{[1 - z - \sigma(c_m - c_G)]c_B + [z + \sigma(c_m - c_G)](1 + g)c_G - \sigma(c_m - c_G)R_B}{1 - z - \sigma(c_m - c_G)},$$

that, we note, is decreasing in R_B. Putting together the two conditions we have that party G chooses to sign an IEA if $e > e_B^*(R_B) = min\{e_B^*, \widetilde{e}_B^*(R_B)\}$. ■

We now prove the following lemma:

Lemma 1.4. *There is a threshold $e_B^{**}(R_B)$ such that the brown party signs a weak agreement if $e \in (e_B^*(R_B), e_B^{**}(R_B))$, and a strong agreement if $e > e_B^{**}(R_B)$.*

Proof. For $e < e_B^*(R_B)$ we have $W_{BG}^{B}(s) < W_{\emptyset}^{B}(0)$ and $W_{G}^{B}(s) < W_{\emptyset}^{B}(0)$, so no agreement is signed. For $e \geq e_B^*(R_B)$, a strong agreement is preferred to a weak agreement if $W_{G}^{B}(\underline{s}) < W_{BG}^{B}(s)$, that is:

$$(1 - z + \sigma(\underline{s} - c_m))(e - c_B + (1 + g)\underline{s} - R_B) - (1 + g)\underline{s} + R_B < zR_B - c_B + e.$$

That is, if:

$$e > \widetilde{e}_B^{**}(R_B) = \frac{[z + \sigma(c_m - c_G)](c_B - (1 + g)c_G) + \sigma(c_m - c_G)R_B}{z + \sigma(c_m - c_G)},$$

which increases in R_B. For the result define $e_B^{**}(R_B) = \max\{e_B^*(R_B), \widetilde{e}_B^{**}(R_B)\}$. ■

As in the previous subsection, we can show that the loci $e_B^*(R_B), e_B^{**}(R_B)$ and e_B^* intersect at the same point, $(c_B, \underline{R}_B)$ with $\underline{R}_B = \frac{[z+\sigma(c_m-c_G)](1+g)c_G}{\sigma(c_m-c_G)}$. Define $R_G^*(e)$ to be equal to $[e_B^*]^{-1}(e)$ for $e \leq c_B$ and to $[e_B^{**}]^{-1}(e)$ for $e > c_G$, where $[e_B^*]^{-1}(e)$ and $[e_B^{**}]^{-1}(e)$ are the inverse of $e_B^*(e)$ and $e_B^{**}(e)$. So:

$$R_B^*(e) = \begin{cases} \frac{[z+\sigma(c_m-c_G)][e-c_B+(1+g)c_G]-(e-c_B)}{\sigma(c_m-c_G)} & e \leq c_B \\ \frac{[z+\sigma(c_m-c_G)][e-c_B+(1+g)c_G]}{\sigma(c_m-c_G)} & e > c_B \end{cases}.$$

The definition of $R_B^*(e)$ implies that for $R_B > R_B^*(e)$ we have $e \in (e_B^*(R_G), e_B^{**}(R_G))$, so by Lemma 1.4 we have that the brown party finds it optimal to sign a weak agreement. If $R_B < R_B^*(e)$ and $e \geq e_B^*$, we have $e > e_B^*(e)$ and $e > e_B^{**}(e)$, Lemma 1.3 implies that the brown party finds it optimal to sign a strong agreement. Finally, when $R_B < R_B^*(e)$ and $e < e_B^*$, we have $e < e_B^*(e)$, Lemma 1.3 implies that the brown party finds it optimal to sign no strong agreement.

Restating the formulas of $R_G^*(e)$ and $R_B^*(e)$ in a unified notation we have the threshold stated in Proposition 1. ■

6.2 Proof of Proposition 2

See Online Appendix. ■

6.3 Proof of Proposition 3

See Online Appendix. ■

6.4 Proof of Proposition 4

As in Proposition 1 and 3, in the following, we allow the office rents to be different for the two candidates for additional generality: R_j for $j = G, B$. We only consider the case in which the first-period incumbent is $i = G$; the proof for a B incumbent is analogous and presented in the Online Appendix.

(i) As explained in the text, an equilibrium treaty can be summarized as the triplet $(x_i^*, \Delta_i^*, S_i^*)$. When p is the probability that G wins, and there is full compliance, the expected sum of payoffs for G and F is:

$$p \left[\begin{array}{c} e\left(x_G^*\right) - e\left(x_G^* - \Delta_G^*\right) \\ \\ +(1+g)\Delta_G^* S_G^* - \Delta_G^* c_G + R_G \end{array} \right] + e\left(x_G^* - \Delta_G^*\right) - \left(x_G^* - \Delta_G^*\right) c_G - (1+g)\Delta_G^* S_G^*,$$

where $p = z + \sigma\left(S_G^* - c_m\right)\Delta_G^*$. It is easy to see that this expression is convex in S_G^* and that the smallest S_G^* satisfying $S_G^* \in [c_G, c_B]$ is dominated by either $S_G^* = 0$ or $S_G^* > c_G$. Thus, *if* F and G implement a weak treaty, then in the equilibrium: $S_G^* = c_B$. Given this S_G^*, the first-order condition with respect to x_G^* is:

$$\begin{aligned} p\left[e'\left(x_G^*\right) - e'\left(x_G^* - \Delta_G^*\right)\right] + e'\left(x_G^* - \Delta_G^*\right) - c_G &= 0 \Rightarrow \\ pe'\left(x_G^*\right) + (1-p)\, e'\left(x_G^* - \Delta_G^*\right) &= c_G, \end{aligned} \tag{9}$$

while the second-order condition trivially holds.

The first order condition with respect to Δ_G^* is found by taking the derivative with respect to Δ_G^* of the payoff sum and setting this derivative equal to zero. The derivative itself is:

$$\begin{aligned}&\sigma\left(c_B-c_m\right)\left[e\left(x_G^*\right)-e\left(x_G^*-\Delta_G^*\right)+(1+g)\Delta_G^*S-\Delta_G^*c_G+R_G\right] \\ &-(1-p)\left[e'\left(x_G^*-\Delta_G^*\right)+(1+g)c_B-c_G\right].\end{aligned} \tag{10}$$

The second-order condition is:

$$\begin{aligned}&\sigma\left(c_B-c_m\right)\left[e'\left(x_G^*-\Delta_G^*\right)+(1+g)c_B-c_G\right] \\ &+\sigma\left(c_B-c_m\right)\left[e'\left(x_G^*-\Delta_G^*\right)+(1+g)c_B-c_G\right] \\ &+(1-p)\,e''\left(x_G^*-\Delta_G^*\right)<0\Rightarrow \\ \sigma<\overline{\sigma}_G^s\equiv&\frac{(1-p)\left|e''\left(x_G^*-\Delta_G^*\right)\right|}{2\left(c_B-c_m\right)\left[e'\left(x_G^*-\Delta_G^*\right)+(1+g)c_B-c_G\right]},\end{aligned} \tag{11}$$

which, for any σ, holds if e is sufficiently concave. In the following, we assume that (11) holds. Then, when σ increases, Δ_G^* must increase to ensure that (10) holds. To avoid that $p\to 1$, we must also assume that:

$$\begin{aligned}p &= z+\sigma\left(S_G^*-c_m\right)\Delta_G^*<1\Rightarrow\sigma<\frac{1-z}{\left(c_B-c_m\right)\Delta_G^*}\Rightarrow \\ \sigma &< \overline{\sigma}_G^p,\end{aligned} \tag{12}$$

where $\overline{\sigma}_i^p$ is defined such that the inequality in (12) holds with equality. Combined with (11), we henceforth assume $\sigma<\overline{\sigma}_G\equiv\min\left\{\overline{\sigma}_G^p,\overline{\sigma}_G^s\right\}$. The Online Appendix derives the analogous threshold when $i=B$, so that we can define $\overline{\sigma}\equiv\min\left\{\overline{\sigma}_B,\overline{\sigma}_G\right\}$.

With this, note that $\Delta_G^*=0$ is optimal if (10) is negative even at $\Delta_G^*=0$. This requires:

$$\begin{aligned}\sigma\left(c_B-c_m\right)R_G-(1-z)\left[e'\left(x_G^*\right)+(1+g)c_B-c_G\right] &\leq 0\Rightarrow \\ R_G\leq\widehat{R}_G\equiv\frac{(1-z)\left[e'\left(x_G^*\right)+(1+g)c_B-c_G\right]}{\sigma\left(c_B-c_m\right)}&.\end{aligned}$$

In this case, (9) boils down to $e'\left(x_G^*\right)-c_G=0$. When this equality is substituted into the equation for $\widehat{R}_G$, we can rewrite it as:

$$\widehat{R}_G\equiv\frac{(1-z)\left[(1+g)c_B\right]}{\sigma\left(c_B-c_m\right)}.$$

From the above, it is clear that $\Delta_G^*>0$ is optimal if $R_G>\widehat{R}_G$. A larger R_G and thus $\Delta_G^*>0$ implies that $e'\left(x_G^*\right)<c_G<e'\left(x_G^*-\Delta_G^*\right)$ for (9) to hold. And, when $\widehat{R}_G$ increases, Δ_G^* must increase for (10) to continue to equal zero, given that second order condition holds.

6.5 Proof of Proposition 5

(i) Assume $i = G$ (the case with $i = B$ is in the Online Appendix, which also contains the proof of part (ii) of the proposition). While R_G does not influence (9) directly, (10) increases in R_G so Δ_G^* must increase to ensure that the expression equals zero. Let $k_G = 0$. If R_G and thus Δ_G^* increase, the larger p_G reduces the left-hand side of (9), and, for the condition to continue to hold, $x_G^* - \Delta_G^*$ must decline. As $p_G^* \to 1$, (9) also implies that $e'(x_G^*) \to c_G + k_G$, so $x_G^* \to x_G^{**}$. ■

6.6 Proof of Proposition 6

The proof follows relatively straightforwardly from (6), and it is thus omitted. ■

References

Aakvik, A. and S. Tjotta (2011), "Do Collective Actions Clear Common Air? The Effect of International Environmental Protocols on Sulphur Emissions," *European Journal of Political Economy*, 27: 343-351.

Aghion, Philippe and Bolton, Patrick (199), "Government Domestic Debt and the Risk of Default: A Political-Economic Model of the Strategic Role of Debt," in Rudiger Dornbusch and Mario Draghi, eds., *Public debt management: Theory and History*. Cambridge: Cambridge University Press, pp. 315– 45.

Alesina, A. and G. Tabellini (1990), "A Positive Theory of Fiscal Deficits and Government Debt," *Review of Economic Studies*, 57(3): 403–14.

Altamirano-Cabrera, J-C., Weikard, H-P., and Haffoudhi, H. (2007), "Influence of political pressure groups on the stability of international climate agreements," NCCR Climate Working Paper 2007-03. University of Bern-EPFL-Paul Scherrer Institute: Bern.

Antras, P. and G. Padro i Miquel (2011), "Foreign influence and welfare," *Journal of International Economics* 84: 135-48.

Austen, I. (2011), "Canada Announces Exit from Kyoto Climate Treaty," *New York Times*, 12/12/2011, <http://www.nytimes.com/2011/12/13/science/earth/ canadaleavingkyoto protocolonclimatechange.html>

Bang G., J. Hovi and D. Sprinz (2012), "US presidents and the failure to ratify multilateral environmental agreements," *Climate Policy*, 12: 755–763

Barrett, S. (1994), "Self-enforcing international environmental agreements," *Oxford Economic Papers*, 46, p. 878-94.

Barrett, S. (2003), *Environment and Statecraft*, Oxford University Press.

Barrett S. and K. Graddy (2000), "Freedom, growth, and the environment," *Environment and Development Economics*, 5: 433–456.

Battaglini, M. and B. Harstad (2016), "Participation and Duration of Environmental Agreements," *Journal of Political Economy*, 124(1): 160-204

Besley, T. and S. Coate (1998), "Sources of Inefficiency in a Representative Democracy: A Dynamic Analysis," *American Economic Review*, 88(1): 139–56.

Besley, T., Montalvo, J. G. and Reynal-Querol, M. (2011), "Do Educated Leaders Matter?" *The Economic Journal*, 121: F205–227

Biais, B. and E. Perotti (2002), "Machiavellian Privatization," *American Economic Review*, 92(1): 240-258.

Buchholz, W., A, Haupt and W. Peters (2005), "International Environmental Agreements and Strategic Voting, " *Scandinavian Journal of Economics*, 107(1): 175-195.

Carraro, Carlo and Siniscalco, Domenico (1993), "Strategies for the international protection of the environment," *Journal of Public Economics* 52 (3): 309-28.

Conconi, P. (2003), "Green lobbies and transboundary pollution in large open economies," *Journal of International Economics*, 59: 399-422.

Congleton R. (1992), "Political Institutions and Pollution Control," *The Review of Economics and Statistics*, 74(3): 412-421.

Cohan, D. (2016), "Clinton vows to meet Paris climate pledge, but it won't be easy," TheHill, 01/08/2016, <http://thehill.com/blogs/pundits-blog/energy-environment/ 289952-clinton-vows-to-meet-paris-climate-pledge-but-it-wont>

Dietz, S. C. Marchiori and A. Tavoni (2012), "Domestic politics and the formation of international environmental agreements," Centre for Climate Change Economics and Policy Working Paper No. 100.

Dixit, A. and M. Olson (2000), "Does voluntary participation undermine the Coase Theorem?" *Journal of Public Economics* 76 (3): 309-35.

Eckert, H. (2003), "Negotiating Environmental Agreements: Regional or Federal Authority?" *Journal of Environmental Economics and Management*, 46:1-24.

Evans, P., H. K. Jacobson, and R. D. Putnam (1993), *Double-Edged Diplomacy: International Bargaining and Domestic Politics*, University of California Press.

Fearon J. (1998a), "Bargaining, Enforcement, and International Cooperation," *International Organization*, 52(2): 269-305.

Fearon J. (1998b), "Domestic Politics, Foreign Policy, and Theories of International Relations," *Annual Review of Political Science*, 1: 289-313.

Finus, M. and S. Tjotta (2003), "The Oslo Protocol on sulfur reduction: the great leat forward?" *Journal of Public Economics*, 87: 2013-2048.

Grossman, G. and E Helpman (1994), "Protection for Sale," *American Economic Review*, 84(4): 833-850.

Haffoudhi, H. (2005), "Political-support Lobbies responses to IEAs," *Cahiers de la Maison des Sciences Économiques*, 2005-53, Paris: University of Paris I.

Hamilton, C. (2015), "Australia hit its Kyoto target, but it was more a threeinch putt than a hole in one," *The Conversation*, 15/07/2015. <http://theconversation.com/australia-hit-its-kyoto-target-but-it-was-more-a -three-inch-putt-than-a-hole-in-one-44731>

Harstad, B. (2008), "Do Side Payments Help? Collective Decisions and Strategic Delegation," *Journal of the European Economic Association P&P,* 6(2-3): 468-477

Harstad, B. (2010), "Strategic Delegation and Voting Rules," *Journal of Public Economics* 94(1-2): 102-113.

Hoel, Michael (1992), "International environmental conventions: the case of uniform reductions of emissions," *Environmental and Resource Economics* 2(2): 141-159.

Hopgood, S. (1998), *American foreign environmental policy and the power of the state*, Oxford: Oxford University Press.

Hovi, J., Sprinz, D., Bang, G. (2012), "Why the United States did not become a party to the Kyoto Protocol: German, Norwegian and U.S. perspectives," *European Journal of International Relations*, 18: 129–150.

Keleman, D. and D. Vogel (2010), "Trading Places: The Role of the United States and the European Union in International Environmental Politics," *Comparative Political Studies*, 43(4): 427-456.

Kehoe, E. (1989), "Policy cooperation among benevolent governments may be undesirable," *Review of Economic Studies* 56:289-296.

Kolstad, C. D. and Toman, M. (2005), "The Economics of Climate Policy," *Handbook of Environmental Economics* 3: 1562-93.

Lantis, J. (2006), "The Life and Death of International Treaties: Double-Edged Diplomacy and the Politics of Ratification in Comparative Perspective," *International Politics*, 43:24-52.

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

Midlarsky, M. (1998), "Democracy and the Environment: An Empirical Assessment," *Journal of Peace Research*, 35(3): 341-361.

Milesi-Ferretti, G. M. and Spolaore, E. (1994), "How Cynical Can an Incumbent Be? Strategic Policy in a Model of Government Spending." *Journal of Public Economics*, 55(1): 121–40.

Murdoch, J. T. Sandlerb and W. Vijverberga (2003), "The participation decision versus the level of participation in an environmental treaty: a spatial probit analysis," *Journal of Public Economics*, 87: 337–362.

Neumayer, E. (2002), "Do Democracies Exhibit Stronger International Environmental Commitment? A Cross-Country Analysis," *Journal of Peace Research*, 39(2): 139–164.

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

Persson, T. and G. Tabellini (1995), "Double-edged incentives: Institutions and Policy Coordination," in G. Grossman and K. Rogoff (Eds.), *Handbook of Development Economics*, Vol. III. Elsevier Science B.V.

Persson, T. and G. Tabellini (2006), "Democracy and Development: The Devil in the Details," *American Economic Review*, 96(2): 319-324.

Putnam, R. (1988), "Diplomacy and domestic politics: The logic of two-level games," *International Organization* 42:427-460.

Reuters (2013), "Japan uses offsets to meet Kyoto emission goal," 11/21/2016, <http://www.reuters.com/article/ us-climate-japan-co-id USBRE9AG02420131117>

Ringquist E. and T. Kostadinova (2005), "Assessing the Effectiveness of International Environmental Agreements: The Case of the 1985 Helsinki Protocol," *American Journal of Political Science*, 49: 86-102.

Robinson, J. A. and Torvik, R. (2005), "White Elephants," *Journal of Public Economics*, 89(2-3): 197-210.

Rogoff, K. (1985), "Can international monetary policy coordination be counterproductive?" *Journal of International Economics* 18:199-217.

Sarlin, B. (2016), "Donald Trump Pledges to Rip Up Paris Climate Agreement in Energy Speech," Nbcnews, 26/05/2016, <http://www.nbcnews.com/politics/2016election/donaldtrumppledgesripparisclimateagreementenergyspeechn581236>

Slechten, A. and V. Verardi (2014), "Assessing the effectiveness of global air-pollution treaties on CO2 emissions," Lancaster University working paper n. 011.

Segendorff B. (1998), "Delegation and Threat in Bargaining," *Games and Economic Behavior*, 23: 266-283.

Small V. (2012), "Government 'turns its back' on Kyoto commitment," *Stuff.co.nz*, 9/11/2012, <http://www.stuff.co.nz/national/politics/7929764/Government-turns-its-back-on-Kyoto-commitment>

Vollenweider J. (2013), "The Effectiveness of International Environmental Agreements," *International Environmental Agreements*, 13: 343-367.

Walsh B. (2011), "Bienvenue au Canada: Welcome to Your Friendly Neighborhood Petro-State," Time.com, 14 December, <http://science.time.com/2011/12/14/bienvenueaucanadawelcometoyourfriendlyneighborhoodpetrostate/>

Table 1: Probability of sign an IEA

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Polity2$_t$	0.079***	0.067***	0.030**	0.034**				
	(0.016)	(0.018)	(0.014)	(0.016)				
Democracy$_t$ (=1)					0.775***	0.661***	0.393**	0.412**
					(0.199)	(0.235)	(0.176)	(0.185)
Plurality$_t$ (=1)	-0.339	-0.387*	0.305	0.272	-0.460*	-0.480**	0.277	0.249
	(0.234)	(0.223)	(0.353)	(0.358)	(0.241)	(0.223)	(0.335)	(0.345)
Regime durability$_t$		0.011***		0.004		0.012***		0.003
		(0.003)		(0.006)		(0.003)		(0.006)
Africa (=1)		-0.376		-1.389		-0.470*		-1.860*
		(0.260)		(1.096)		(0.254)		(0.988)
Latin America (=1)		-0.827***		0.498		-0.825***		0.096
		(0.286)		(1.009)		(0.290)		(0.860)
East Asia (=1)		-0.612		-1.033		-0.602		-1.309
		(0.389)		(1.011)		(0.404)		(0.967)
Intercept	-2.035***	-2.092***	0.492	-0.274	-2.131***	-2.204***	0.429	-0.058
	(0.254)	(0.269)	(0.414)	(1.114)	(0.288)	(0.301)	(0.400)	(1.032)
Country effects	No	No	Yes	Yes	No	No	Yes	Yes
Treaty effects	Yes	Yes	No	No	Yes	Yes	No	No
Log likelihood	-1663.72	-1586.47	-1843.34	-1843.02	-1699.65	-1606.90	-1843.25	-1843.10
Number of observations	3314	3314	3251	3251	3314	3314	3251	3251
Pseudo-R^2	0.25	0.29	0.16	0.16	0.24	0.28	0.16	0.16

Notes: Logit estimation results. Standard errors clustered at the country level in parentheses.
$^*p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$

Table 2: Effect of the number of signed agreements on CO_2 emissions (dependent variable: $\log(CO_2)$)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
#Treaties$_{t-1}$	0.353**	0.235*	0.252***	0.151***	-0.145***	-0.145***	-0.174***	-0.173***
	(0.160)	(0.131)	(0.046)	(0.051)	(0.030)	(0.030)	(0.039)	(0.039)
Polity2$_t$	-0.008	-0.010			0.001	0.001		
	(0.012)	(0.010)			(0.004)	(0.003)		
Polity2$_t$ · #Treaties$_{t-1}$	-0.043**	-0.029**			0.010***	0.010***		
	(0.016)	(0.013)			(0.002)	(0.002)		
Democracy$_t$ (=1)			-0.020	-0.065			-0.010	-0.006
			(0.126)	(0.121)			(0.038)	(0.037)
Democracy$_t$ · #Treaties$_{t-1}$			-0.292***	-0.185***			0.126***	0.125***
			(0.059)	(0.060)			(0.027)	(0.026)
Proportional representation$_t$ (=1)	-0.026	-0.055	-0.039	-0.065	-0.013	-0.013	-0.016	-0.017
	(0.106)	(0.109)	(0.105)	(0.109)	(0.041)	(0.041)	(0.041)	(0.042)
log(GDP$_t$)	0.900***	0.876***	0.867***	0.874***	0.895***	0.897***	0.891***	0.893***
	(0.086)	(0.095)	(0.082)	(0.095)	(0.093)	(0.093)	(0.094)	(0.094)
log(Population$_t$)	0.168*	0.168*	0.208**	0.177**	0.304*	0.298*	0.317**	0.312*
	(0.095)	(0.090)	(0.091)	(0.089)	(0.161)	(0.161)	(0.160)	(0.160)
log(Openness$_t$)	0.324***	0.189*	0.345***	0.193*	0.062	0.065	0.065	0.068
	(0.108)	(0.102)	(0.111)	(0.104)	(0.053)	(0.054)	(0.054)	(0.054)
GDP growth rate$_t$	-0.015***	-0.017***	-0.015***	-0.017***	-0.006***	-0.006***	-0.006***	-0.006***
	(0.005)	(0.004)	(0.005)	(0.004)	(0.002)	(0.001)	(0.002)	(0.002)
log(Prop. Agriculture$_t$)	0.001	-0.038	0.010	-0.024	0.224**	0.221*	0.222*	0.219*
	(0.109)	(0.118)	(0.106)	(0.117)	(0.112)	(0.114)	(0.113)	(0.116)
log(Prop. Industry$_t$)	0.788***	0.716***	0.881***	0.768***	0.198***	0.198***	0.199***	0.198***
	(0.174)	(0.159)	(0.176)	(0.157)	(0.067)	(0.067)	(0.067)	(0.067)
Africa (=1)		-0.623***		-0.654***				
		(0.179)		(0.178)				
East Asia (=1)		-0.145		-0.181				
		(0.165)		(0.170)				
Latin America (=1)		-0.315*		-0.362**				
		(0.160)		(0.161)				
OECD$_t$		-0.440**		-0.555***		-0.059		-0.052
		(0.196)		(0.201)		(0.060)		(0.062)
Intercept	-18.803***	-16.933***	-19.087***	-17.221***	-18.393***	-18.323***	-18.505***	-18.457***
	(1.280)	(1.447)	(1.320)	(1.485)	(1.823)	(1.843)	(1.850)	(1.868)
Country effects	No	No	No	No	Yes	Yes	Yes	Yes
Number of countries	143	143	143	143	143	143	143	143
Number of observations	2983	2983	2983	2983	2983	2983	2983	2983
R^2	0.92	0.93	0.92	0.93				
Within R^2					0.70	0.70	0.70	0.70

Notes: OLS estimates results. Standard errors clustered at the country level in parentheses.
$^*p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$