

The Political Economy of Weak Treaties*

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Abstract

In recent decades, democratic countries have negotiated hundreds of international treaties and agreements. This paper analyzes the equilibrium design of treaties negotiated by political incumbents seeking reelections. We show that incumbents are prone to negotiate treaties that are "weak" in that they may or may not be complied to: this makes it possible to differentiate the alternative candidates in a way that favors the incumbent. We also show that political economy considerations lead to overambitious treaties that rely too much on technology instead of sanctions to motivate compliance. Our theory can rationalize several puzzles associated with treaties.

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1 Introduction

The presence of public goods and externalities has always been one of the fundamental market failures motivating governmental intervention. Analogously, cross-border externalities suggest that regulatory authority should be centralized or that, at the least, countries would benefit from negotiating international treaties. Externalities are thus expected to influence the design of political institutions when the institutions are endogenous, and they are certainly endogenous when it comes to international treaties and bodies, as these are being negotiated and designed at multiple high-level policy meetings every year. In the last few decades, developed and developing countries have negotiated hundreds of international environmental agreements (IEAs), for example.¹

Economic theory has failed in explaining the observed pattern of treaties, in our view. As long as there is no supra-national government in place, an individual country has an incentive to free ride instead of participating in multilateral agreements. After all, many of the agreements intend to provide regional or global public goods. Environmental agreements, for example, have targeted a wide range of goals, from forest preservation and water management to the regulation of transboundary pollution. Since standard game theory predicts free-riding and small cooperative coalitions, the rise of IEAs is a puzzle to many economists. In a survey on the "Economics of Climate Policy," Kolstad and Toman [2005] refer to the rise of IEAs as the "paradox of international agreements."²

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 surprisingly weak agreements: they generally do not include effective enforcement or monitoring mechanisms. 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).³ The second striking feature of IEAs is

¹Examples of these type of negotiations are the protocols signed under the Convention on Long-range Transboundary Pollution (CLTAP), which attempts to reduce sulphur and other hazardous emissions having transboundary effects; or those signed under the United Nations Framework Convention on Climate Change (UNFCCC), which commits state parties to reduce greenhouse gas emissions.

²Naturally, a large body of literature has been devoted to highlighting and explaining this paradox. 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.

³The Montreal protocol of 1997 regulating chlorine emissions damaging the ozone layer, for instance, did indeed permit trade sanctions to be imposed on violators. IPCC [2014:1016] discusses trade sanctions for climate agreements and it also suggests that, as an alternative, "a sanction could take the form of a temporary suspension of monetary and technological transfers if recipient countries are found in non-compliance."

that many of them, including some of the most prominent, are generally seen as ineffective.⁴ These two facts suggest that the paradox may be that so many countries are negotiating and signing *weak* agreements, rather than 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. Furthermore, "there is only one case of withdrawal from the Kyoto Protocol, that of Canada in December 2011, but more than one case in which countries have not met their agreed emission targets" (IPCC [2014:1015]). We may call this the "Paradox of Weak Agreements."

It is immensely important to understand these puzzles and to shed light on why treaties are not effectively addressing the world's most challenging problems. In our view, a realistic analysis should account for the fact that negotiations are headed by public officials and politicians who may be subject to electoral concerns. Domestic political economy considerations are of fundamental importance to any politician, and they are thus likely to influence the equilibrium design of international treaties. Our main result is that, in the presence of sufficiently strong reelection concerns, political incumbents benefit from negotiating *weak* agreements that leave the ultimate decision on compliance to the winners of future elections. Thus, equilibrium treaties 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. On the one hand, these political economy considerations explain the underprovision of international cooperation by rationalizing weak agreements when strong agreements would be optimal. On the other hand, the electoral concerns may induce governments to negotiate agreements even when having no agreement would be optimal. The theory can thus rationalize why democratic countries have negotiated hundreds of IEAs in the last few decades, and why there might be an oversupply of weak treaties. This result complements the view that "political failures" weaken the case of governmental regulation in the presence of market failures, by showing how strategic politics also limit the efficiency of international treaties.

In our benchmark model, the political incumbent in the home country negotiates a treaty with a foreign country (or a group of foreign countries). The treaty is considered because the

⁴Finus 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.

home country's action generates negative externalities on others. Our mechanism permits—but does not require—there to be a symmetric externality from the foreign country onto the home country. The treaty specifies what the home country ought to do to reduce the externalities, as well as the consequence(s) 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 better given the treaty that is negotiated in the first period: the relatively "green" party, which has more environmentally friendly preferences than the median voter does; or the relatively "brown" party, which has less environmentally friendly preferences than the median voter does. 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 complied with. We have a *weak treaty* if it includes sanctions that are not sufficiently strong to guarantee compliance (and so it may be violated 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 not always complied with, regardless of whether the first-period incumbent was green or brown. To understand the intuition behind this result, note that with no agreement or with a strong agreement, the incumbent and the challenger are identical (in this respect) from the median voter's point of view, 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 the candidates 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 compliance if the sanction is relatively severe but not otherwise. Using this insight, we show that *both* 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 *depth* of treaties, we show that electoral incentives induce a novel *over-*

shooting 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 3.1, 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. The larger the political office rent is, the weaker the treaty is in this model.

We also endogenize the compliance cost by allowing for investments in technologies. Since investments reduce the cost of compliance in the second period, the treaty is "strong" (in that it will always be complied with) if the first-period incumbent invests a lot, but the treaty is "weak" (in that only the green party will comply in the second period) if the investment level is smaller. This extension demonstrates that weak treaties emerge in equilibrium even if the sanction level is exogenous, small, or identical to zero. This extension also allows us to distinguish between external enforcement (i.e., a sanction) and internal enforcement (i.e., technology) and to predict how the two instruments will be combined. We show that, even if a strong treaty with sanctions is first best, the likely political economy equilibrium is a weak treaty that is (partially) enforced by technology.

Our work connects and contributes to two strands of literature: the literature on environmental agreements and the literature on the political economy of commitments. The importance of political economy and reelection concerns has certainly been established when they regard domestic political decisions. For example, Persson and Svensson [1989], Alesina and Tabellini [1990], and Aghion and Bolton [1990] have highlighted how public debt can be used in this sense to limit expenditures of future governments; 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; Robinson and Torvik [2005] argue that inefficient local infrastructures may intend to influence elections. Thus, there is a solid tradition for assuming that reelection concerns influence political decisions. The papers above focus on domestic political decisions, however. We connect the domestic reelection concern to decisions at the international arena in order to explain the observed puzzles mentioned above.

The traditional literature on international agreements has studied the incentives for countries to participate in the presence of free riding (Hoel [1992], Carraro and Siniscalco [1993], Barrett [1994] and [2003], Dixit and Olson [2000]).⁵ The typical prediction in this literature is that the coalition size is very small, due to the benefits of free riding. This prediction

⁵Recent papers have pointed out that the coalition can be larger if the model is dynamic, for example (Battaglini and Harstad [2016]). See also Maggi and Morelli [2006] for a study of self-enforcing international organizations in a more general context.

has motivating the view that the rising number of IEAs is a paradoxical phenomenon. Two assumptions have characterized most of these analyses: first, that countries act as individual agents with no internal politics; and second, that once established, IEAs fully enforce their provisions. Both assumptions are relaxed in our paper.

More recent research has endogenized the government’s preferences by allowing for strategic delegation or lobby groups’ influence.⁶ There is naturally also a large body of literature studying the relationship between international and national politics 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 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 have a policy implemented, which neither of the two would have been successful at implementing alone.⁷ We show 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.

Despite these strands of literature, we are not aware of any work modelling 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

⁶On "strategic delegation," 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]. Since the choice of these characteristics is also important when a treaty is renegotiated, Buisseret and Bernhardt (2017) discuss how a "hostile" incumbent may strategically negotiate a treaty that voters prefer to be renegotiated with a strong hand. On lobbying, see Grossman and Helpman [1994], Altamirano-Cabrera et al. [2007], Haffoudhi [2005], or Dietz et al. [2012]. Maggi and Rodriguez-Clare [2007] examine how trade agreements can be used as commitment devices to limit demands from lobbyists. Harstad et al. [2017] analyze how technology investments can raise credibility in repeated games. Our contribution to this literature is to analyze how electoral concerns influence and explain the design of international treaties.

⁷A 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.

explaining participation in a self-enforcing agreement and instead 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.

The paper is organized as follows. The next section presents the benchmark version of our model in which treaty and abatement decisions are zero-one variables. We derive our main results in this pedagogical setting in which the underlying intuition is most transparent. Section 3 extends this basic model in three directions: in Section 3.1, we allow the countries to choose the depth and scope of the negotiation; Section 3.2 allows for investments in green technology and relates their choice to the strength of the treaty and the choice of sanctions; finally, in Section 3.3, we show how our result on political polarization, driven by the possibility to negotiate IEAs, is strengthened once we allow for uncertainty and stochastic compliance costs. Section 4.1 discusses how the analysis sheds light on the role of domestic politics in shaping international negotiations in two recent examples, the Kyoto Protocol and Paris Agreement. Section 4.2 presents a first attempt to test some of the predictions of the theory by using a large panel of environmental treaties signed in the past 40 years. After a concluding section, the Appendix presents important proofs, while an online appendix presents other proofs and details the data.

2 The Basic Model and Result

2.1 The Model

We begin our analysis by presenting a simple workhorse model with two periods and two sets of countries: the home country H and the foreign country F (alternatively, F can be the set of other countries). Country H 's action, or "emission," generates an externality $e \geq 0$ on the foreign country. Country H , however, can abate pollution and eliminate the externality by incurring a cost. Although abatement may have some value also to H , 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. Section 3 generalizes the model and allows abatement to be nonbinary, among other things.

The two countries can negotiate a treaty. The treaty specifies whether H should abate and the consequence if it does not. If the consequence is just a reputational loss, then its severity would depend on whether the treaty is legally binding, etc., but even trade sanctions on treaty violators are permitted by the Montreal Protocol.⁸ The cost of the sanction to H is

⁸See Article 4 of the Protocol and, for a more extensive discussion, Barrett [2003]. See also the discussion on sanctions by IPCC [2014], mentioned in the Introduction.

$s \geq 0$ 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. We allow g to be positive or negative, but we assume that $g \geq -1$, so that there is a deadweight loss $(1 + g)s \geq 0$ when the sanction is imposed.⁹

Both when negotiating the treaty and when deciding whether to comply, the home country's decisions are made by one of two political parties. Parties and voters have heterogeneous preferences regarding environmental conservation and regulation. Thus, the net cost (i.e., the regulatory cost minus the environmental benefit) of additional abatement is $c_G > 0$ for the political party that is relatively "green," while it is $c_B > c_G$ for the political party that is relatively "brown." The cost for the median voter, M , is in between: $c_M \in (c_G, c_B)$. Of course, there may be parties and elections also abroad, but they will not be important for our analysis.

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

We will now explain each step in more detail.

1. The negotiations: We make two important assumptions about 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 sum of two negotiators' 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 considered independently, unless they interacted in the payoff functions. Second, we assume that H and F are fully committed to imposing the sanction if H does not comply. Countries may be able to commit for reputational reasons, although we do not formalize the reasons for this commitment here. Section 3.2 proves that investment in technology is one way of facilitating commitment, while Section 3.4 argues that our results continue to hold even if s can be renegotiated.

2. Elections: After the treaty has been negotiated, there is an election in the home country. 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 when 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, realized after the treaty is signed, can refer to the

⁹Naturally, if the sanction is a pure monetary transfer, then we should expect $g = -1$.

importance of other policy differences, not explicitly modelled 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 variance in the shock is sufficiently large so that reelection probabilities are interior in $(0, 1)$. As will be shown below, this property is guaranteed if the density of the shock is so small that:

$$\sigma < \min \left\{ \frac{1-z}{c_B - c_M}, \frac{1-z}{c_M - c_G} \right\}. \quad (1)$$

Section 3.3 allows the popularity shock distribution to be arbitrary, and it allows the abatement costs to be stochastic.

3. Compliance: At the final stage of the game, the newly (re)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 $s > \bar{s} \equiv c_B > c_G$, 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 $s \in [\underline{s}, \bar{s}]$, the treaty will be complied with if the second-period incumbent is G , but not if B is in power.¹⁰ Since this treaty may or may not be complied with, we name it a *weak treaty*.

Objective functions: The payoffs are in line with the discussion above. If H complies, F receives $e > 0$ while every $i \in \{B, M, G\}$ 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.)

Payoffs	M	opponent, "i"	incumbent, "j"	F
H Complies:	$-c_M$	$-c_i$	$-c_j + R$	e
H does not comply:	$-s$	$-s$	$-s + R$	$-gs$

Generalizations: This simple model turns out to be sufficient for analyzing the political economy of weak treaties. To ensure robustness and obtain additional insight, Section 3 allows for nonbinary abatement and compliance decisions, compliance costs can be stochastic, and these costs can also be endogenous and influenced by investments in abatement

¹⁰Note that G has multiple best responses when $s = \underline{s}$, while B has multiple best responses when $s = \bar{s}$. However, it will be shown below (see footnote 12) that in every SPE, G complies when $s = \underline{s}$, while B will never comply when $s = \bar{s}$. Thus, the set of weak treaties is closed in equilibrium.

technology. The effects of political institutions and of permitting renegotiation are discussed informally. The proofs in the Appendix allow the office rent, R , to be conditioned on the identity of the second-period incumbent j , and the Online Appendix permits the office rent to be conditioned on whether j complies. These contingencies do not influence the basic result and they are thus abstracted from here.

2.2 The Optimal Treaty

It is useful to start by describing a couple of relevant benchmarks. The first benchmark is the socially optimal solution, which we define as the allocation that maximizes the sum of payoffs for F and the median voter in the home country, M . Obviously, it would be optimal for F and M to commit to abatement if $e > c_M$, while it would be optimal for F and M to abate if $e < c_M$. This outcome would be implemented if M and F signed a strong treaty when $e > c_M$ and otherwise no treaty. Note that a weak treaty is always dominated, and it is strictly dominated if $e \neq c_M$.

As a second benchmark, suppose the first-period incumbent $i \in \{B, G\}$ took as exogenous the probability that the green party G would win, p_i .¹¹ In this situation, i and F would jointly prefer that the second-period incumbent complied if $e > c_i$, but not if $e < c_i$. When the former condition holds, i and F would sign a strong treaty. Otherwise, no treaty would be signed. Again, a weak treaty is always dominated.

We can summarize these observations as follows:

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

- (i) *The socially optimal outcome is implemented if the countries sign a strong treaty if $e > c_M$, and no treaty if $e < c_M$.*
- (ii) *If the first-period incumbent i takes p_i as given, then i and F sign a strong treaty if $e > c_i$, and no treaty if $e < c_i$.*

2.3 The Equilibrium Treaty

Of course, the above benchmarks are for illustration only, since the probability of staying in power is endogenous and since 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, we use $z_i = z$ if $i = G$, and $z_i = 1 - z$

¹¹If, 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 $\sigma \rightarrow 0$, since the popularity shock will then dictate the electoral outcome.

otherwise. Thus, z_i is the probability that G wins when the first-period incumbent is i and $u_M^i = u_M^{-i}$. We will also refer to the following thresholds:

$$R_i^* = \begin{cases} \frac{(1+g)c_{-i} - (z_i - \sigma(c_M - c_{-i}))(e - c_i + (1+g)c_{-i})}{\sigma|c_M - c_{-i}|} & \text{if } e \leq c_i, \\ \frac{(1 - z_i + \sigma(c_M - c_{-i}))(e - c_i + (1+g)c_{-i})}{\sigma|c_M - c_{-i}|} & \text{if } e > c_i. \end{cases} \quad (2)$$

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

- (i) *If $R < R_i^*$, then F and H sign a strong treaty when $e > c_i$, and no treaty when $e < c_i$.*
- (ii) *If $R > R_i^*$, H and F always sign a treaty, and the treaty is always weak: a brown first-period incumbent signs a treaty with $s = \underline{s}$, while a green first-period incumbent signs a treaty with $s = \bar{s}$. In both cases, the treaty is complied with if and only if G wins the election.*

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 second-period incumbent will take the same action regarding abatement. If the treaty is weak, however, the benefit of electing G instead of B is:

$$u_M^G - u_M^B = s - c_M \text{ for } s \in [\underline{s}, \bar{s}].$$

Thus, $u_M^G - u_M^B < 0$ if $s \in [\underline{s}, c_M)$, and $u_M^G - u_M^B > 0$ when $s \in (c_M, \bar{s}]$, implying that the ex post benefit of compliance for the median voter depends on s . Since an incumbent $i \in \{B, G\}$ is reelected if and only if $u_M^i - u_M^{-i} > \delta$, and δ is uniformly distributed on $[-z/\sigma, (1-z)/\sigma]$, it follows that with a first-period incumbent i , G is elected with probability:

$$p_i(s) = \begin{cases} z_i & \text{if } s < \underline{s} \\ z_i + \sigma(s - c_M) & \text{if } s \in [\underline{s}, \bar{s}] \\ z_i & \text{if } s > \bar{s} \end{cases} . \quad (3)$$

Note that $p_i(s)$ is increasing in s for $s \in [\underline{s}, \bar{s}]$ and $p_i(\bar{s}) = z_i + \sigma(c_B - c_M) > z_i$, so the probability that G wins is maximized when $s = \bar{s}$ (see the left part of Figure 2). For such a large sanction, the median voter agrees with G that it is preferable to comply, and the voter rationally expects that party B will not comply.¹² When the office rent is sufficiently large, the electoral gain is important enough to compensate a green first-period incumbent for the

¹²Although B is indifferent between complying and not when $s = \bar{s}$, there is no SPE in which B complies with positive probability when $s = \bar{s}$. To see this, note that if such an equilibrium did exist, G would prefer the largest $s < \bar{s}$, but there is no maximal point in the open set (\underline{s}, \bar{s}) , so this cannot be an SPE. For analogous reasons, in every SPE, G must comply with probability one when $s = \underline{s}$.

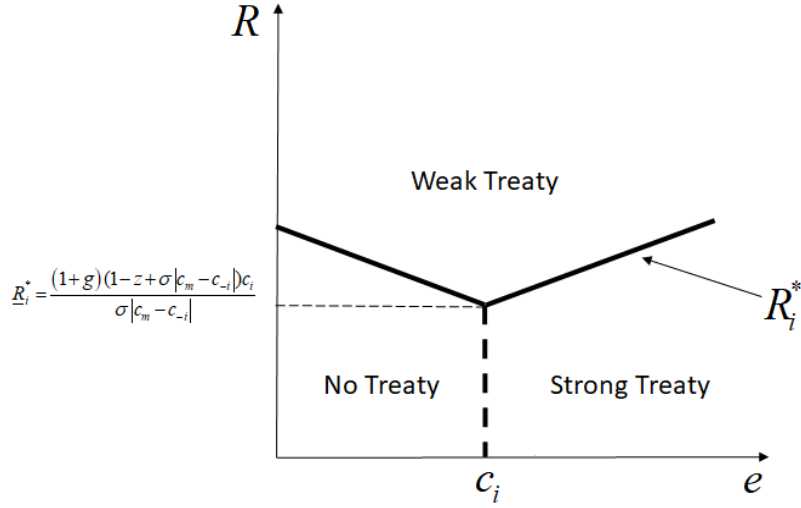


Figure 1: *The treaty is weak above the solid line, representing R_i^* as a function of e .*

possibility that the agreement is repudiated by the brown party if elected. In this case, the optimal s is equal to \bar{s} . Intuitively, the green party wants to have the highest penalty consistent with a weak agreement in which G alone would 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 B is reelected, $1 - p_B(s)$, is declining in s and maximized at $s = \underline{s}$ where we have: $1 - p_B(\underline{s}) = z + \sigma(c_M - c_G) > z$, as shown in the left part of Figure 2. With such a small sanction, the median voter shares the view of B that the cost of complying is too large, relative to the cost of the sanction, so it is preferable to not comply. 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 right part of Figure 2.

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

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

$$\underline{R}_i = \frac{(1 - z_i + \sigma(c_M - c_{-i}))(1 + g)c_{-i}}{\sigma|c_M - c_{-i}|}$$

as illustrated in Figure 1.

Thus, regardless of the size of the other parameters, the treaty will always be signed and it will always be weak—if just the benefit of winning the next election is sufficiently

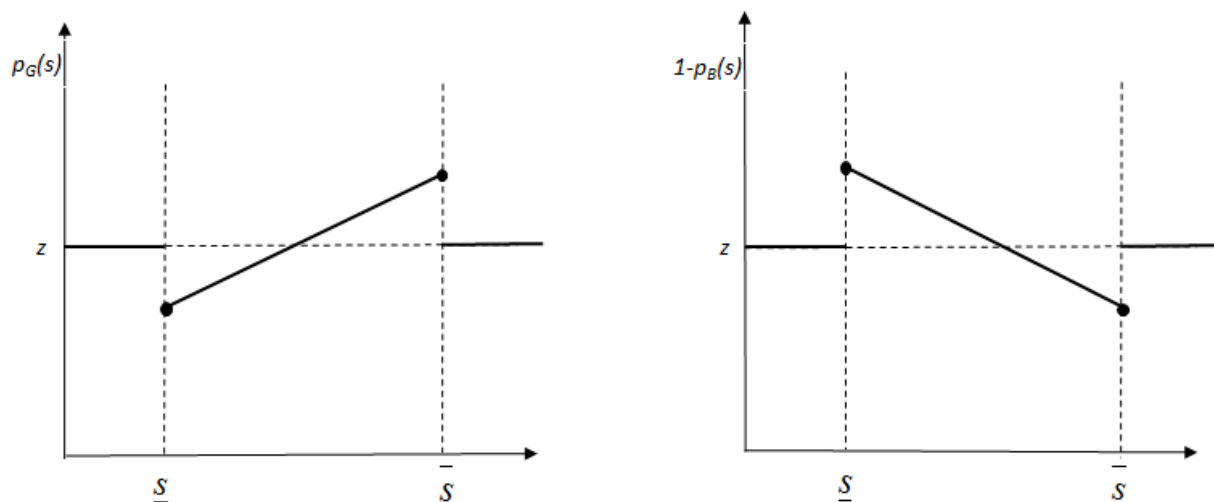


Figure 2: *Reelection probabilities when G is the incumbent (left) or B is (right).*

large. It is interesting to note that this result highlights a potential inefficiency associated with electoral competition that puts our theory at odds with the view that more political competition is necessary and sufficient for efficiency (see Wittman [1989]). In our model, in contrast, more competition may lead to weaker and thus less efficient treaties.

Parameter R can be associated with the degree of political polarization: the higher R is, the more parties are polarized. More polarization means that the decisions G and B will make on other/domestic issues are further apart, so it will be more important to win, and thus R increases. Proposition 1 suggests that an increase in polarization should lead to weaker treaties. The office rent R may also vary systematically with the type of political institution (majoritarian vs. proportional), generating predictions for how the details of the political system influence the type of treaties that will be signed. (Section 3.4 discusses these predictions.)

In addition to the office rent R , three other factors determine when we have weak agreements. The first is parameter e , measuring the salience of the issue (to the foreign country). A signed treaty is more likely to be strong if e is large. As is consistent with this prediction, Bapat and Morgan (2009) find empirically that sanctions on less salient issues succeed with a probability (17 percent) that is even lower than it is for more salient issues (44 percent). These authors classify security issues as being salient, while environmental issues are not. Thus, their finding justifies our emphasis on environmental treaties as good examples of weak treaties.

A second factor 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^* 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.¹³

The third factor affecting the agreement type is the deadweight cost of a sanction, $1 + g$. As $1 + g$ decreases, R_i^* shifts down uniformly, enlarging the region in which weak agreements prevail. The presence of distortionary sanctions makes it more likely that a strong treaty is signed, since only then can one guarantee that no sanction will be imposed.

The traditional literature on IEAs emphasizing free riding, as discussed in the Introduction, predicts that there is insufficient participation in IEAs. In a political economy setting, however, Proposition 1 is instead pointing to two other phenomena. When $e < c_M$, it is optimal with no agreement, but both parties will sign a weak agreement in equilibrium if 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 Section 4.1.

Since the distortion highlighted in Proposition 1 is intimately related to electoral incentives of political candidates, an interesting comparative static exercise consists in looking at what happens as a country becomes less democratic. This may correspond to a situation in which electoral uncertainty is small and the incumbent has a high incumbency advantage z so that the probability of winning is at a corner solution equal to one. In this case the incumbent i with the cost c_i has no incentive to manipulate the electorate, so she/he behaves as in the socially optimal solution, but using her/his own cost c_i as a benchmark, rather than the median voter's cost:

Corollary 1. *In the limit case in which an incumbent (autocrat) i is reelected with probability one, a treaty is signed if and only if $e > c_i$ and the treaty is always strong.*

This result follows straightforwardly from Propositions 0-1, but it is important because we generally do not observe the exact preferences of the incumbent and the challenger, making it hard to empirically test the prediction of Proposition 1. However, we have detailed data on whether a political regime is democratic or autocratic. Corollary 1 gives us two simple testable predictions that we can bring to the data. First, an autocratic regime is less prone than a democratic regime to sign an agreement: in a democratic regime a treaty is signed even if $e < c_i$, as long as $R > R_i^*$. Second, democratic regimes are more prone to sign weak

¹³The historical examples discussed in Section 4.1 justify the assumption that electoral incentives matter for the incumbent when negotiating an IEA (i.e., that σ appears to be sufficiently high).

treaties: a democracy signs a weak treaty if $e \geq c_i$ when $R > R_i^*$; a nondemocratic regime never signs a weak treaty. We will return to these predictions in greater detail in Section 4.2 where we present preliminary evidence in support of the theory.

3 Treaty Depth, Technology, and Risk

International treaties include many components in addition to sanctions. In fact, large portions of negotiations focus on aspects that we have deliberately ignored in the previous section, including the depth and scope of the treaty, the size of the emissions cuts, the number of industrial sectors that are to be regulated, and policy measures on green technologies. Furthermore, a country's political and economic costs of abatement may vary with the business cycle, and these costs can be unknown at the negotiation stage.

This section generalizes the basic model above to investigate the robustness of the basic result and to deepen our understanding of international treaties. In Section 3.1, where emission levels are nonbinary, the compliance cost depends on the size or the depth of the treaty, and we investigate how this depth is influenced by political economy considerations. Section 3.2 lets the compliance cost be endogenous and depend on how much the home country invests in green technology (for instance, renewable energy). In Section 3.3, when the compliance cost is stochastic, we show that the preferences for the treaty design remain polarized, even when the two parties' compliance costs converge. While the basic lesson from Proposition 1 continues to hold, each of these extensions sheds new light on the political economy of treaties. Additional extensions are informally discussed in Section 3.4.

3.1 The Depth of the Treaty

Assume now that the home country's 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, even the less efficient abatement opportunities are employed, inducing decreasing marginal returns to the expenditures. The optimal level for F and the median voter in H is to set x such that $e'(x) = c_M$. We interpret x as the treaty's size, scope, or depth.

When both depth and the level of sanctions are negotiated, a treaty is defined by the associated target levels of abatement x^* and sanctions $s_{x^*} : [0, x^*] \rightarrow \mathbb{R}_+$ specifying a penalty $s_{x^*}(x) \geq 0$ for each abatement level $x < x^*$. 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 social cost *per sanction unit* is $1 + g \geq 0$.

Given the treaty depth x^* and the sanction function $s_{x^*}(x)$, payoffs are:

Payoffs	M	opponent, "i"	incumbent, "j"	F
If H complies $x \leq x^*$:	$-c_M x - s_{x^*}(x)$	$-c_i x - s_{x^*}(x)$	$-c_j x - s_{x^*}(x) + R$	$e(x) - g s_{x^*}(x)$

The second-period policymaker $j \in \{B, G\}$ prefers an abatement level that minimizes the total costs:

$$x_{s^*}^j = \arg \min_x \{c_j x + s_{x^*}(x)\}. \quad (4)$$

In equilibrium, H and F always prefer to sign a treaty in which at least the green party fully complies with the treaty, so $x_{s^*}^G = x^*$.¹⁴ However, (4) implies that $x_{s^*}^B \leq x^*$, so we can write $x_{s^*}^B = x_{s^*}^G - \Delta_{s^*}$ where $\Delta_{s^*} \geq 0$ measures party B 's level of noncompliance.

With this, we can have two types of treaties: We have a *strong treaty* when $\Delta_{s^*} = 0$. In this case, compliance is complete and the parties look identical to the voters. For a strong treaty, it is necessary that the sanction be so large that any deviation is unattractive for every party. We have a *weak treaty*, in contrast, when $\Delta_{s^*} > 0$. In this case, the compliance level 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 simple dichotomy of a weak vs. strong treaty, we have different degrees of weaknesses: the larger the value of Δ_{s^*} , the weaker the treaty.

Clearly, party B prefers to not comply if $s_{x^*}(x^* - \Delta_{s^*}) \leq c_B \Delta_{s^*}$, while G prefers to comply if $s_{x^*}(x^* - \Delta_{s^*}) \geq c_B \Delta_{s^*}$. Thus, when the treaty is weak and complied with only by party G , we must have $S_{s^*} \in [c_G, c_B]$, where S_{s^*} is defined as the average sanction per "unit of deviation":

$$S_{s^*} \equiv \frac{s_{x^*}(x_{s^*}^B)}{\Delta_{s^*}}.$$

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 having endogenous depth and sanction. We use starred superscripts to denote the equilibrium, and subscripts to denote the identity of the first-period incumbent negotiating the treaty.¹⁵

¹⁴To see this, suppose that $x_{s^*}^G < x^*$. Then no matter who is elected, a positive sanction will be paid. By reducing x^* to $x_{s^*}^G$, incumbent s can reduce the expected sanction by $s(x^*) - s(x_{s^*}^G)$ without changing the probability of winning since it increases the utility provided by both parties by the same amount.

¹⁵Thus, when i is the first-period incumbent, $x_i^* = x_{s^*}^G$ 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.

Thus, given the equilibrium choices of B and G , we can summarize the equilibrium treaty negotiated by first-period incumbent $i \in \{B, G\}$ as $(x_i^*, \Delta_i^*, S_i^*)$ where $S_i^* \in [c_G, c_B]$ if $\Delta_i^* > 0$.

To guarantee interior solutions when x is continuous, condition (1) for the binary case should be strengthened to a condition $\sigma < \bar{\sigma}$, where the threshold $\bar{\sigma}$ is derived and presented in the Appendix. We henceforth assume $\sigma < \bar{\sigma}$.

Proposition 2. *Let the first-period incumbent $i \in \{B, G\}$ negotiate the treaty $(x_i^*, \Delta_i^*, S_i^*)$, and consider 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 by:*

$$e'(x_i^{**}) \equiv c_i.$$

(ii) *If $R > \widehat{R}_i$, the size x_i^* is larger but the treaty is weak:*

$$x_i^* - \Delta_i^* < x_i^{**} < x_i^*.$$

As in the analysis in Section 2, the first-period incumbent is motivated to negotiate a weak treaty by the prospect of sufficiently large office rents. In addition, we can shed light on two other 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 wants to comply; the brown party will choose a sanction sufficiently small so that the green party but not the median voter wants 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, 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, given S_i^* and Δ_i^* , the incumbent can choose the "second-best" depth that maximizes his expected utility. In a strong agreement, the optimal size is x_i^{**} , the level at which the

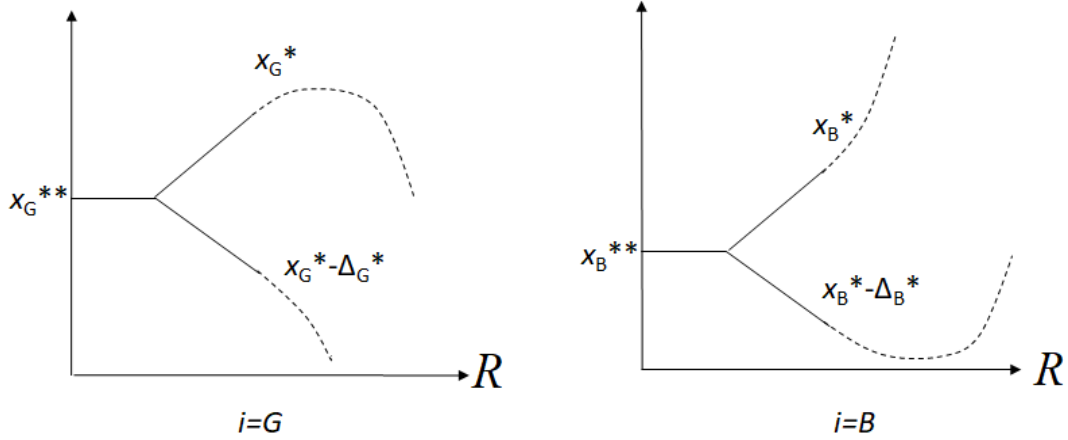


Figure 3: *If the office rent R is large, the equilibrium treaty is deeper but it is also weaker.*

marginal benefit equals the marginal cost: $e'(x_i^{**}) = c_i$. Given the uncertainty of a weak treaty, it is optimal that the size is such that the *expected* marginal externality for F equals the marginal cost for the first-period incumbent:

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

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 $x_i^* > x_i^{**}$. Figure 3 illustrates all this.

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

Proposition 3. *If $R > \widehat{R}_i$ increases, then $\Delta_i^* > 0$ increases. Furthermore, the size x_B^* increases monotonically and $x_B^* - \Delta_B^* \rightarrow e'^{-1}(c_B)$, while $x_G^* - \Delta_G^*$ declines monotonically and $x_G^* \rightarrow e'^{-1}(c_G)$.*

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 due only 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 the second part of the proposition, and the dotted lines in Figure 3, note that if R is very large, Δ_i^* is also very large and this increases the probability of being

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 almost 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 of staying in power, $x_B^* - \Delta_B^*$ should approach the optimal level, x_B^{**} . The large Δ_B^* is then better ensured by letting the promised level 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.¹⁶

3.2 Endogenous Technology and Compliance

The development of new technology is essential for solving many environmental problems. It is also realistic to let the compliance cost be endogenous and dependent on how much a country has invested in new technology. To isolate the effect of technology, we will return to the basic model of Section 2 (with binary abatement levels) but assume that the home country can invest in an abatement technology $y \in [0, Y]$ at a cost $qy \geq 0$ as part of the negotiation. After the investment y , the abatement cost is reduced to $c_i - y$ for all types $i \in \{G, M, B\}$.¹⁷ We start by considering the situation where s is fixed, before letting both y and s be negotiated.

Exogenous sanctions (or no sanctions at all). We start by introducing two assumptions that are both relaxed below. First, to let technology be important, suppose an exogenous sanction satisfies $s < c_G$ 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 agreement with full compliance. Second, suppose $q < 1$, so that the investment cost is smaller than the return. Then, signing an environmental agreement and complying is optimal for F and the median voter in H if and only if $e > c_M - (1 - q)Y$. If this condition holds, the first-best treaty is strong, that is, it is never optimal to leave any uncertainty about compliance.

¹⁶While these effects are interesting, these parts of the lines in Figure 3 are dotted since it may be unrealistic to expect that the treaty would influence the election to such a large extent.

¹⁷It 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 section can be extended to allow for decreasing marginal returns to investments.

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, second, a *strategic* effect determining when the agreement is implemented. A very high level of investment makes compliance optimal for both B and G ; similarly, a very low investment in green technology makes compliance suboptimal for both G and B . Incumbents may prefer to make compliance dependent on the winner, since that can boost their reelection probabilities, as explained in Section 2. They can achieve this goal if:

$$y \in [\underline{y}, \bar{y}], \text{ where } \underline{y} \equiv c_G - s \text{ and } \bar{y} \equiv c_B - s. \quad (6)$$

The first inequality guarantees that G will comply with the treaty, and the second inequality guarantees that B will not. By choosing $y = \bar{y} \equiv c_B - s$, a green incumbent achieves two goals: compliance will be achieved if G is reelected *and* this possibility can raise G 's reelection probability. To see the second point, note that $c_M < c_B$, so when $y = \bar{y}$, we have $s + y - c_M > 0$, implying that the median voter prefers compliance ex post. The probability that G is reelected is maximized at $p_G^* \equiv z + \sigma(c_B - c_M)$, as before.

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 will be reelected and the probability becomes $p_B^* \equiv 1 - z - \sigma(c_M - c_G)$, as before.

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

Proposition 4. *Let the first-period incumbent be $i \in \{B, G\}$ and assume $q < 1$. There exist thresholds R_i^s , $i \in \{B, G\}$, such that:*

- (i) *If $R < R_i^s$, 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 $y = 0$.*
- (ii) *If $R > R_i^s$, the treaty is always weak: If $i = B$, investments are $\underline{y} = c_G - s$, while if $i = G$, investments are $\bar{y} = c_B - s$. In both cases, only G will comply.*

The proof and the definition of R_i^s is in the Appendix. 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 and $y \in [\underline{y}, \bar{y}]$. If the investment level $y \in [\underline{y}, \bar{y}]$ is large, the median voter is likely to prefer compliance and party G ; if y is instead closer to \underline{y} , the median voter is more likely to prefer party B . If the office rent is sufficiently large, the electoral concerns outweigh other concerns, a weak treaty is always signed, and $y \in \{\underline{y}, \bar{y}\}$.

The proposition provides a couple of interesting implications. First, 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 differentiate the parties' preferences.

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 $R > R_i^s$, 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, G chooses $y = \bar{y}$ such that $s + \bar{y} - c_B = 0$: an increase in s will reduce y but not affect compliance. Similarly, if B is the incumbent, B chooses $y = \underline{y}$ such that $s + \underline{y} - c_G = 0$: once again, an increase in s will reduce y but not affect compliance. In both cases, an increase in s has no impact whatsoever on the strength of the agreement.¹⁹

Endogenous sanctions and technology. We now let both the sanction level and green investments be endogenous and negotiated before the election. This model (and timing) allows us to make a comparison between internal and external enforcement of the home country's climate policy and to shed light on how this choice is influenced by political economy considerations.

Proposition 5. *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 $R < R_i^*$, 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 $q < 1$, but $y = 0$ and $s > c_B$ otherwise.*

(ii) *If $R > R_i^*$, F and H sign a weak treaty, and it is complied with at probability p_i^* . Furthermore,*

$$\begin{aligned} y &= 0 \text{ and } s = c_{-i} \text{ if } q > 1 + g(1 - p_i^*); \\ y &= c_{-i} \text{ and } s = 0 \text{ if } q < 1 + g(1 - p_i^*). \end{aligned}$$

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

¹⁸An example of this change is the recent design of the Paris Agreement 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 Agreement 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.

¹⁹An increase in s can influence the type of the treaty only if R is close to the thresholds R_i^s in Proposition 4. In this case, it becomes more costly to stick with a weak treaty when the sanctions are larger. If $e > c_i - \max\{(1 - q)\bar{y}, Y(1 - q)\}$, a larger s makes it more likely that we move to a setting with a strong treaty. If instead $e < c_i - \max\{(1 - q)\bar{y}, Y(1 - q)\}$, a larger s makes it more likely that we move to a setting with no treaty.

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 efficient investment is $y = Y$ and the effective 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, there may be underinvestment since an efficient technology is not adopted if $q \in (q_i^*, 1)$, where $q_i^* \equiv 1 + g(1 - p_i^*)$. In the second case, we may have overinvestments since a suboptimally large level of investment is chosen when $q \in (1, q_i^*)$.

Interestingly, when $g > 0$, 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. As in the analysis in the previous section, when R is large, the G incumbent's payoff 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, or $s + y = c_G$, 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. If the treaty is complied with (and the technology is used) with probability p_i^* , the net cost of investing is $q - p_i^*$, which is compared to the expected total cost of a unit of the sanction, $(1 + g)(1 - p_i^*)$. Clearly, partial compliance is better ensured by technology if $q - p_i^* < (1 + g)(1 - p_i^*) \Rightarrow q < q_i^* \equiv 1 + g - gp_i^*$. Since a treaty negotiated by B is less likely to be complied with (since $p_B^* < p_G^*$), B is more likely to prefer (partial) compliance by technology than by sanctions than is G when $g > 0$.

Consistent with this prediction, Republicans in the U.S. have often been in favor of supporting green innovation and technology, while Democrats have more often supported traditional abatement policies. In his 2008 speech on climate change, President George W. Bush said that "*The right way [to address climate change] is to adopt policies that spur investments in the new technologies needed...*"

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

3.3 Stochastic Compliance Costs and Robust Polarization

A strong assumption in the analysis presented above is that the parties' cost and 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 political cost of complying may be so large that none of the parties would like to do so; the political cost may be smaller 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 isolate the effects of this extension, let us return to the basic model in Section 2, without technology and with binary abatement levels. Assume that the net cost is $c_j = \hat{c}_j + c$, where \hat{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 $c_G < c_M < c_B$. It is realistic to maintain the ranking of preferences between the parties, in our view.

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

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

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 $f''(\underline{c}^{IN}) = 0$, $f(c)$ is concave for $c \in (\underline{c}^{IN}, \bar{c}^{IN})$, where \bar{c}^{IN} is the second inflection point at which $f''(\bar{c}^{IN}) = 0$, and $f(c)$ is convex for $c > \bar{c}^{IN}$.

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

$$E(\Delta u_M) = \int_{s - \hat{c}_B}^{s - \hat{c}_G} (s - \hat{c}_M - c) dF(c).$$

We 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

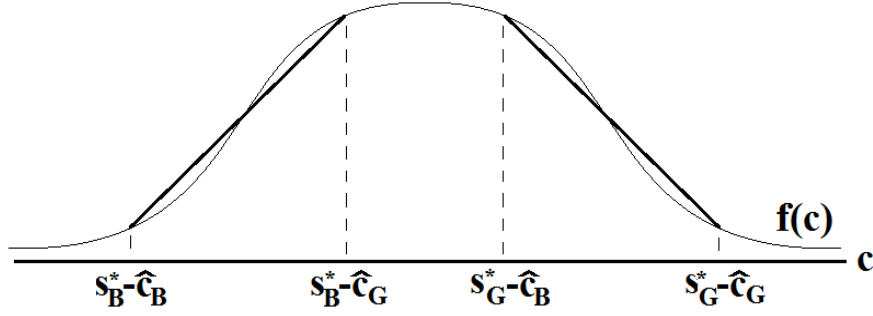


Figure 4: Incumbent B is more likely to win if the median voter expects a high cost c , conditional on c falling within the disagreement interval. This implies that B prefers f' to be large over the disagreement interval. Analogously, party G prefers f' to be small and negative over the disagreement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

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:

$$\frac{\int_{s-\hat{c}_B}^{s-\hat{c}_G} f(c) dc}{\hat{c}_B - \hat{c}_G} > \left(\frac{\hat{c}_B - \hat{c}_M}{\hat{c}_B - \hat{c}_G} \right) f(s - \hat{c}_B) + \frac{(\hat{c}_M - \hat{c}_G)}{\hat{c}_B - \hat{c}_G} f(s - \hat{c}_G) \quad (7)$$

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 $\hat{c}_M = (\hat{c}_B + \hat{c}_G) / 2$). 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 $s_B^* < s_G^*$, and $\rho_B(s_B^*) \in (0, \frac{1}{2})$ while $\rho_G(s_G^*) \in (\frac{1}{2}, 1)$.*

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.

Part (ii) also says that, at these sanctions, party B would be less likely to comply than not, while G would be more likely to comply than not.

Just as in the other extensions discussed above, our main result (from Proposition 1) is not only confirmed, but the extension also sheds new light on the equilibrium treaty.

Proposition 7. *Suppose $\widehat{c}_M = (\widehat{c}_B + \widehat{c}_G) / 2$.*

(i) *Each disagreement interval includes an inflection point:*

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

(ii) *Consequently, if $|\widehat{c}_B - \widehat{c}_G| \rightarrow 0$, then $s_B^* \rightarrow \underline{c}^{IN} + \widehat{c}_M$ and $s_G^* \rightarrow \bar{c}^{IN} + \widehat{c}_M$.*

Proposition 7 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 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.²¹

3.4 Other Extensions

Our basic model is simple and can be used as a workhorse for several other extensions. Although most extensions must await future research, we conclude our analysis with an informal discussion of the role of renegotiation, the policy's salience, and the political system. **Renegotiating the treaty.** So far, we have made the assumption that country F commits to impose the sanction on H , if H does not comply. This assumption is useful but not necessary for our main results. After all, we have proven above that the basic insight of our model continued to hold if the countries did not negotiate sanctions but instead technologies that were sunk (and thus committed to) before the compliance stage. In addition, one may argue that our results would be strengthened if the sanction or the treaty could be renegotiated: the treaty may be *more* likely to be weak when renegotiation is possible.

²¹However, 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.

To see this in the simplest way, suppose that F has all the bargaining power when F and H renegotiate after the election. To fix ideas, consider first the situation where H has failed to comply and F is ready to impose the sanction on H . If F has the upper hand in such renegotiations, then F may propose to H to drop imposing the sanction in return for some other favors that could benefit F . If this favor has the cost $\xi \geq 0$ to H and the benefit $\gamma\xi \geq 0$ to F , then H is willing to accept F 's offer for any favor if size $\xi \leq s$, and thus F proposes $\xi = s$ and benefits γs . Of course, such renegotiation is beneficial for F and H only if $\gamma > -g$. In that case, all our formulae above hold if just g is replaced by $-\gamma < g$.²² Since the cost of signing a weak treaty is smaller when such renegotiation is possible, it will be preferred by F and H 's first-period incumbent for a larger set of parameters.

A similar argument applies if F and H can renegotiate *before* the second-period policymaker in H has decided on whether to comply. If F has all the bargaining power in this situation, the policymakers and the voters in H will not be affected by the possibility to renegotiate and their payoffs and incentives will be just as described above. But since F reaps a benefit from the offer to renegotiate the sanction, the social cost of negotiating a weak treaty is mitigated and it will be preferred by F and H 's first-period incumbent for a larger set of parameters.

Empirical analyses of the credibility of sanctions are few. Kim (2009), however, shows that sanctions are more credible (and effective) if the "sender" (player F in our model) is a democratic country. There is thus an interesting effect also of the domestic political institutions in the F -country, suggesting that future research should analyze political economy forces in both the sender and the target for the sanction.

Salience of the policy. Is compliance to international treaties sufficiently high on the political agenda to influence elections? If other policy differences are much more important, then the popularity of these differences will dictate the election outcome. This possibility can be captured in our model by letting the popularity shock be drawn from a large support (so, σ would be small). In line with this intuition, the above equations do imply that a treaty is less likely to be strategically weak when σ is small.

That said, the point of this paper is *not* that treaties will influence elections, but instead that the prospects of elections will influence how treaties are designed. If the environmental policy/treaty is not very important compared to other political issues, then distorting the policy/treaty may not be very costly. Formally, if the environmental policy/treaty is unimportant in that σ is small, then the compliance costs and benefits are arguably also relatively small. Thus, we may write $\sigma = \epsilon\tilde{\sigma}$, $c_i = \epsilon\tilde{c}_i$, and $e = \epsilon\tilde{e}$, so that we can reduce the salience

²²The assumption $g \geq -1$ implies $\gamma \leq 1$, meaning that the favor cannot be more beneficial to F than it is costly to H . If instead $\gamma > 1$, one would think that the favor would have already been negotiated in another agreement.

of the issue by reducing ϵ . Interestingly, parameter ϵ will cancel out in the above formulae (consider the thresholds for R in Propositions 1 and 2, for example). Consequently, in this setting, the salience parameter ϵ will not influence whether a treaty is weak.

As argued in Section 2, one may also think that (especially) parameter e is small when the issue is not salient (for F). As mentioned in Section 2, Bapat and Morgan (2009) find empirically that sanctions succeed with a smaller probability for less salient issues (such as environmental ones) than for more salient issues (such as security issues), as is consistent with our model.

The political system. We have emphasized above that while nondemocracies may be characterized by Proposition 0 (where p_i were fixed), the weak treaties predicted by Proposition 1 are more likely for democratic countries, since democratic leaders are more accountable to the voters. The larger is the effect of utility on the probability for staying in power, the larger parameter σ is, and thus the more likely it is that the equilibrium treaty will be weak. Following this line of reasoning, one may also argue that the importance of utilities (σ) and the policymakers' office rent (R) may systematically vary across political/electoral systems. For example, the office rent may be larger in presidential systems than in parliamentary systems in which power is shared among a larger number of legislators. Similarly, in (majoritarian) winner-takes-all electoral systems, the winner of the election may keep more of the office rent. If this translates into a larger R , such systems should be more likely to sign weak treaties, according to our results. On the other hand, electoral competition may be less intense if there are several electoral districts (as is typically the case in majoritarian electoral systems), particularly if gerrymandering has made the electoral outcomes predictable in many districts. Less competition can be translated into a smaller σ in our model, and that effect may reverse or cancel the effect of a larger R . The combination of these arguments suggests that political systems can have nontrivial effects on the design of treaties, and that further research is necessary to sort out the effects in detail.

4 Domestic Politics and Treaties: Some Evidence

The theory analyzed above provides a number of testable predictions. Of course, there are alternative explanations for why treaties are weak. When the compliance cost is stochastic and unverifiable, even an optimal treaty will be weak in that it may or may not be complied with. According to that argument, however, we may expect the treaty to be complied with unless the economy is hit by shocks (Propositions 6 and 7 provide additional predictions when contractual incompleteness is combined with electoral concerns). Alternatively, one may argue that a green party would prefer a weak treaty so as to signal its type when it

later complies. That theory, however, cannot explain why a brown party signs a weak treaty which it later ignores.

The significance of domestic politics for international relations (and more specifically international agreements) has indeed 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 two recent examples in which the influence of domestic politics has been particularly evident and that are broadly consistent with our theory.²³ Section 4.2 takes a first look at the data.

4.1 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 a long-standing cautious position taken by the previous administrations and 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,²⁴ the Clinton administration was looking forward to the upcoming 2000 presidential election 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 in the negotiations, "Gore, planning to run for president in 2000, anticipated that climate-change policy would become a vote

²³For the sake of brevity, we focus on recent IEAs to illustrate the importance of politics in the negotiations. Just focusing on the U.S. experience, there is ample evidence on the effect of electoral incentives on policy makers' 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 on the Environment and Development (the "Earth Summit") held in Rio in 1992.

²⁴Bang et al. [2012:759] 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.

getting issue."²⁵ 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 discussed in the introduction.

Two features of this agreement are worth noting in light of our model. First, the agreement pushed by Vice President Gore was overly ambitious given the political realities and it involved a fair amount of posturing. Second, it was weak and without explicit sanctions. Shortly after the presidential election that brought the Republican George W. Bush to power, plans to comply with the agreement were abandoned. It is reasonable to assume that this would not have happened if Gore had been elected, especially if the election had changed the majority in the Senate.²⁶

A similar dynamic can be found in Canada, where the incumbent negotiating the agreements was also—in the terminology used above—a "green party". Canada signed the Kyoto Protocol and it was 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) but, notably, 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. Canada invoked its withdrawal clause from the Kyoto Protocol in 2011; see Austen [2011]. In the years since the withdrawal from the Protocol, Canadian emissions have risen by more than 30% above the 1990 target (Walsh [2011]).

The experience with the Kyoto Protocol shows that incentives to sign weak agreements do not pertain only to left-leaning incumbent governments. In Japan, Australia and New Zealand, for example, the governments responsible for the negotiations were all supported by conservative parties unsympathetic to environmental issues (in the terminology of the model,

²⁵See Hovi et al. [2012:144]. Based on anonymous interviews with 26 participants in the negotiations from the United States and Europe, Hovi et al. concluded that one of the most plausible reasons for the failure at Kyoto was that the Clinton-Gore administration "essentially pushed for an agreement that would provide them a climate-friendly face."

²⁶It is important to note that while the Kyoto agreement was never ratified by the United States, it still had real effects since the Clinton administration used the Environmental Protection Agency (EPA) to implement regulations in preparation for the agreement before its ratification (see for example Bugnion and Reiner [1999]). As shown in Section 3.2, the investments in green technology triggered by this type of regulation can be used strategically by the incumbent to manipulate the median voter's preferences even in the absence of explicitly ratified sanctions.

"brown parties"). Despite this, all these countries signed the Kyoto Protocol, although in weak forms that did not eventually survive. Ratifications of the signed agreements followed a pattern similar to the logic of the model. In Japan and Australia, the signature of the Protocol was followed by conservative administrations that delayed or watered down its content as much as possible.²⁷ In New Zealand, signature of the Protocol was followed in 1999 by the election of a "green party" that managed to stick to the agreement in 2002. The agreement survived only for the period in which the Labor Party remained in charge, however, and it was abandoned in 2012 when the government shifted back to the National Party, the very party that negotiated it.²⁸

The Paris Agreement. While it is too early to evaluate the success of the 2015 Paris Agreement on climate change, it is clear that decisions surrounding this agreement were influenced by electoral considerations in the United States. Signed by the Obama administration just one year before the 2016 presidential elections, its ratification and implementation were debated in the presidential campaigns. Along with the negotiations, the Obama administration had committed to various measures incentivizing investments in green technologies: 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.²⁹ Our theory predicts that these investments should be sufficient to commit a Democratic candidate, but not a Republican. It is indeed the case that, after the election, the Republican president-elect pledged "to rip up Paris Climate Agreement" (Sarlin [2016])

²⁷The Protocol was signed in Australia in 1998, but the conservative government of John Howard delayed ratification until the end of its mandate. Howard's government also managed to negotiate extraordinarily lax targets that allowed emissions of GHG to increase by as much as 8% from the 1990 levels (Hamilton [2015]). The Kyoto Protocol was officially ratified only in December 2007 after the Labor Party (with Kevin Rudd as prime minister) assumed government control. A similar path has been followed by Japan, where the negotiating party in 1997 was the conservative Liberal Democratic Party (LDP), which signed and ratified the Kyoto Protocol. 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 GHG emissions only by buying carbon credits as actual emissions rose (Reuters [2013]).

²⁸New 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 GHG emissions under the parallel "United Nations Convention Framework."

²⁹See 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 10, 2016.

while the Democratic candidate had vowed to uphold the U.S. commitment to climate actions signed by the Obama administration (Cohan [2016]). On August 4, 2017, the U.S. State Department submitted a notification to the UN that the administration intended to withdraw from the Paris Agreement.

4.2 A First Look at the Data

In this section, we present a preliminary quantitative evaluation of the model using a large-panel data set on post-World War II environmental treaties. As discussed in Section 2.3, it is generally hard to test the theoretical predictions of the previous sections because we typically do not observe the true preferences of the policymakers. Proposition 1 and Corollary 1, however, give us simple testable hypotheses that depend on whether a country is democratic or not. First, our theory predicts that democracies are more likely to sign IEAs than non-democracies; second, our theory predicts that democracies are prone to weak agreements; in autocracies, agreements may or may not be signed, but they are strong when signed. We can test these hypotheses because we have pretty good data on the types of regimes, the signed treaties, and, to some extent, their quality.

Table 1 examines whether democracies are more prone to sign international agreements. To investigate this 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 correspond 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.³⁰ 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; or a dummy variable $democracy_t$, which is equal to one if and only if $polity2_t$ is larger than 0, for columns 5-8.³¹ 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

³⁰The list of treaties and the description of the data sources for Tables 1 and 2 are presented in the online appendix.

³¹For 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].

and significant, suggesting that democratic regimes are indeed more prone to signing IEAs 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.³²

The finding that democracies are more likely to sign IEAs is perhaps not surprising; the prediction that democracies are more prone to sign weak and less effective agreements appears more controversial. As mentioned in the Introduction, there is certainly clear evidence that many IEAs signed or ratified by democracies are weak. The United States, for instance, signed 11 agreements between 1989 and 2011, all of which have failed to achieve ratification (Bang et al. [2012]). The specific question of whether democracies are better at dealing with environmental issues has been addressed by a large body of literature (see, for instance, Congleton [1992], Barrett and Graddy [2000] and Murdoch et al. [2003]). Perhaps unsurprisingly, however, given the endogeneity of the political regime and the number of potentially 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 GHG). More importantly, we also examine how the political regime affects the marginal effect of signing another treaty.³³ For 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.³⁴ The data cover the period 1960-2011. The dependent variable in Table 2 is

³²Congleton [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 data set contains 31 agreements, and except for the Copenhagen Amendment, all the previous treaties are included.

³³For this analysis, we follow Slechten and Verardi [2014], who previously studied the effectiveness of treaties by analyzing 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.

³⁴To 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,

(the log of) the level of CO_2 emissions per year (in kilotons). The target independent variables are as follow. First, $\#treaties_{t-1}$ reports the number of treaties (related to 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 $polity2_t \cdot \#treaties_{t-1}$ and $dem_t \cdot \#treaties_{t-1}$.

Columns 1-4 report simple OLS estimates with various regional, economic, and institutional controls. From a superficial read, results here appear mixed, both in terms of the effect of the number of treaties and in terms of democracy: $\#treaties_{t-1}$ 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 would suggest that treaties have a larger effect on CO_2 when democracies sign them, a result that is in conflict with our previous findings. It is however the case that $democracy_t$ 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. Without controlling for these dependencies, we obtain only spurious results.

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 and clearly support our theoretical predictions: The variable $\#treaties_{t-1}$ is now highly significant in all specifications; $polity2_t$ and $democracy_t$ remain insignificant and small; but the interaction effects are now positive and very significant. These results suggest that treaties indeed have an impact on GHG emissions, but signing a treaty has a smaller impact on CO_2 reductions for democratic regimes than for 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

robust to using the more comprehensive list used in Table 1.

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 is, 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 be in power. Thus, some kind of weak treaty can maximize the incumbent's reelection probability regardless of the identity of the incumbent.

Second, we show that treaties may also be too large in scope or depth. 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. Depth is helpful to the incumbent 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.

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 sign treaties too often, and benefit from treaties that are too weak, too broad in scope, and that are (partially) enforced by technology investments. This preference is 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 4.2: 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 to the data more carefully.

Future research may also develop the theory in new directions. To illustrate the results in a simple and intuitive way, we have limited attention to a three-stage model with only two sets of countries and two political candidates. We have also abstracted from asymmetric information 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; 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 $U_F(s)$ be the utility for the incumbent in the foreign country. When the incumbent is i , the equilibrium agreement s_i solves:

$$\max_s \{U_i(s) + U_F(s)\} \quad (8)$$

Consider how the objective function $W^i(s) = U_i(s) + U_F(s)$ depends on 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 generalization, we allow the office rents to be different for the two candidates: R_j for $j = G, B$.

Case 1: The green party is the incumbent

If both G and B comply at $t = 2$, the objective function in (8) is: $W_{BG}^G(s) = zR_G - c_G + e$. If G complies at $t = 2$:

$$W_G^G(s) = p_G(s)(R_G - c_G + e) - (1 - p_G(s))(1 + g)s. \quad (9)$$

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

$$W_\emptyset^G(s) = zR_G - (1 + g)s.$$

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 $W_\emptyset^G(0) < W_{BG}^G(s)$ or if $W_\emptyset^G(0) < W_G^G(s)$. Consider the first case first. The condition $W_\emptyset^G(0) < W_{BG}^G(s)$ can be written as:

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

Consider now the second condition. Since $W_G^G(s)$ is convex in s we have two cases: $s = \bar{s} = c_B$ 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 (3), 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, when the agreement is weak, $s = \bar{s} = c_B$.³⁵ Such an IEA is preferred to no IEA if:

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

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:

$$e > \tilde{e}_G^*(R_G) = \frac{(1 + g)c_B - (z + \sigma(c_B - c_M))((1 + g)c_B - c_G) - \sigma(c_B - c_M)R_G}{z + \sigma(c_B - c_M)}. \quad (10)$$

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 $e > e_G^*(R_G) = \text{Min}\{c_G, \tilde{e}_G^*(R_G)\}$. ■

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:

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

where $s = c_B$. This implies:

$$e > \tilde{e}_G^{**}(R_G) = \frac{[1 - z - \sigma(c_B - c_M)][c_G - (1 + g)c_B] + \sigma(c_B - c_M)R_G}{1 - z - \sigma(c_B - c_M)}, \quad (11)$$

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

³⁵Note 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 it is easy to verify that this is the unique behavior compatible with an equilibrium.

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 $\tilde{e}_G^{**}(\underline{R}_G) = c_G$: 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 imply 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 agreement.

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 only G 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: $s = \bar{s} = c_B$ and $s = \underline{s} = c_G$, but it is easy to check that \bar{s} is dominated, since $W_G^B(\bar{s}) > W_G^B(\underline{s}) \Rightarrow W_{BG}^B(s) > W_G^B(\bar{s})$. 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:

$$e > \tilde{e}_B^*(R_B) \equiv \frac{[1 - z - \sigma(c_M - c_G)]c_B + [z + \sigma(c_M - c_G)](1+g)c_G - \sigma(c_M - c_G)R_B}{1 - z - \sigma(c_M - c_G)}, \quad (12)$$

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

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:

$$e > \tilde{e}_B^{**}(R_B) = \frac{[z + \sigma(c_M - c_G)](c_B - (1 + g)c_G) + \sigma(c_M - c_G)R_B}{z + \sigma(c_M - c_G)}, \quad (13)$$

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

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 for 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

As in Proposition 1, 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 consider only the case in which the

first-period incumbent is $i = G$; the proof for a B incumbent is analogous and is presented in the Online Appendix.

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:

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

where $p = z + \sigma(S_G^* - c_M)\Delta_G^*$. 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:

$$\begin{aligned} p[e'(x_G^*) - e'(x_G^* - \Delta_G^*)] + e'(x_G^* - \Delta_G^*) - c_G &= 0 \Rightarrow \\ pe'(x_G^*) + (1-p)e'(x_G^* - \Delta_G^*) &= c_G, \end{aligned} \quad (14)$$

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:

$$\begin{aligned} \sigma(c_B - c_M)[e(x_G^*) - e(x_G^* - \Delta_G^*) + (1+g)\Delta_G^* S - \Delta_G^* c_G + R_G] \\ - (1-p)[e'(x_G^* - \Delta_G^*) + (1+g)c_B - c_G]. \end{aligned} \quad (15)$$

The second-order condition is:

$$\begin{aligned} \sigma(c_B - c_M)[e'(x_G^* - \Delta_G^*) + (1+g)c_B - c_G] \\ + \sigma(c_B - c_M)[e'(x_G^* - \Delta_G^*) + (1+g)c_B - c_G] \\ + (1-p)e''(x_G^* - \Delta_G^*) < 0 \Rightarrow \\ \sigma < \bar{\sigma}_G^s \equiv \frac{(1-p)|e''(x_G^* - \Delta_G^*)|}{2(c_B - c_M)[e'(x_G^* - \Delta_G^*) + (1+g)c_B - c_G]}, \end{aligned} \quad (16)$$

which, for any σ , holds if e is sufficiently concave. In the following, we assume that (16) holds. Then, when σ increases, Δ_G^* must increase to ensure that (15) holds. To avoid that $p \rightarrow 1$, we must also assume that:

$$\begin{aligned} p = z + \sigma(S_G^* - c_M)\Delta_G^* < 1 \Rightarrow \sigma < \frac{1-z}{(c_B - c_M)\Delta_G^*} \Rightarrow \\ \sigma < \bar{\sigma}_G^p, \end{aligned} \quad (17)$$

where $\bar{\sigma}_i^p$ is defined such that the inequality in (17) holds with equality. Combined with (16), we henceforth assume $\sigma < \bar{\sigma}_G \equiv \min \{\bar{\sigma}_G^p, \bar{\sigma}_G^s\}$. The Online Appendix derives the analogous threshold when $i = B$, so that we can define $\bar{\sigma} \equiv \min \{\bar{\sigma}_B, \bar{\sigma}_G\}$.

With this, note that $\Delta_G^* = 0$ is optimal if (15) is negative even at $\Delta_G^* = 0$. This requires:

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

In this case, (14) boils down to $e' (x_G^*) - c_G = 0$. When this equality is substituted into the equation for \widehat{R}_G , we can rewrite it as:

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

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 $e' (x_G^*) < c_G < e' (x_G^* - \Delta_G^*)$ for (14) to hold. And when \widehat{R}_G increases, Δ_G^* must increase for (15) to continue to equal zero, given that the second-order condition holds. ■

6.3 Proof of Proposition 3

Assume $i = G$ (the case with $i = B$ is in the Online Appendix). While R_G does not influence (14) directly, (15) 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 (14), and, for the condition to continue to hold, $x_G^* - \Delta_G^*$ must decline. As $p_G^* \rightarrow 1$, (14) also implies that $e' (x_G^*) \rightarrow c_G + k_G$, so $x_G^* \rightarrow x_G^{**}$. ■

6.4 Proofs of Propositions 4 and 5

See Online Appendix. ■

6.5 Proofs of Propositions 6 and 7

The proofs follow relatively straightforwardly from (7), and they are thus omitted. ■

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Table 1: Probability of sign an IEA

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Polity2 _t	0.079*** (0.016)	0.067*** (0.018)	0.030** (0.014)	0.034** (0.016)				
Democracy _t (=1)					0.775*** (0.199)	0.661*** (0.235)	0.393** (0.176)	0.412** (0.185)
Plurality _t (=1)	-0.339 (0.234)	-0.387* (0.223)	0.305 (0.353)	0.272 (0.358)	-0.460* (0.241)	-0.480** (0.223)	0.277 (0.335)	0.249 (0.345)
Regime durability _t		0.011*** (0.003)		0.004 (0.006)		0.012*** (0.003)		0.003 (0.006)
Africa (=1)		-0.376 (0.260)		-1.389 (1.096)		-0.470* (0.254)		-1.860* (0.988)
Latin America (=1)		-0.827*** (0.286)		0.498 (1.009)		-0.825*** (0.290)		0.096 (0.860)
East Asia (=1)		-0.612 (0.389)		-1.033 (1.011)		-0.602 (0.404)		-1.309 (0.967)
Intercept	-2.035*** (0.254)	-2.092*** (0.269)	0.492 (0.414)	-0.274 (1.114)	-2.131*** (0.288)	-2.204*** (0.301)	0.429 (0.400)	-0.058 (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 CO₂ emissions (dependent variable: log(CO₂))

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
#Treaties _{t-1}	0.353** (0.160)	0.235* (0.131)	0.252*** (0.046)	0.151*** (0.051)	-0.145*** (0.030)	-0.145*** (0.030)	-0.174*** (0.039)	-0.173*** (0.039)
Polity2 _t	-0.008 (0.012)	-0.010 (0.010)			0.001 (0.004)	0.001 (0.003)		
Polity2 _t · #Treaties _{t-1}	-0.043** (0.016)	-0.029** (0.013)			0.010*** (0.002)	0.010*** (0.002)		
Democracy _t (=1)			-0.020 (0.126)	-0.065 (0.121)			-0.010 (0.038)	-0.006 (0.037)
Democracy _t · #Treaties _{t-1}			-0.292*** (0.059)	-0.185*** (0.060)			0.126*** (0.027)	0.125*** (0.026)
Proportional representation _t (=1)	-0.026 (0.106)	-0.055 (0.109)	-0.039 (0.105)	-0.065 (0.109)	-0.013 (0.041)	-0.013 (0.041)	-0.016 (0.041)	-0.017 (0.042)
log(GDP _t)	0.900*** (0.086)	0.876*** (0.095)	0.867*** (0.082)	0.874*** (0.095)	0.895*** (0.093)	0.897*** (0.093)	0.891*** (0.094)	0.893*** (0.094)
log(Population _t)	0.168* (0.095)	0.168* (0.090)	0.208** (0.091)	0.177** (0.089)	0.304* (0.161)	0.298* (0.161)	0.317** (0.160)	0.312* (0.160)
log(Openness _t)	0.324*** (0.108)	0.189* (0.102)	0.345*** (0.111)	0.193* (0.104)	0.062 (0.053)	0.065 (0.054)	0.065 (0.054)	0.068 (0.054)
GDP growth rate _t	-0.015*** (0.005)	-0.017*** (0.004)	-0.015*** (0.005)	-0.017*** (0.004)	-0.006*** (0.002)	-0.006*** (0.001)	-0.006*** (0.002)	-0.006*** (0.002)
log(Prop. Agriculture _t)	0.001 (0.109)	-0.038 (0.118)	0.010 (0.106)	-0.024 (0.117)	0.224** (0.112)	0.221* (0.114)	0.222* (0.113)	0.219* (0.116)
log(Prop. Industry _t)	0.788*** (0.174)	0.716*** (0.159)	0.881*** (0.176)	0.768*** (0.157)	0.198*** (0.067)	0.198*** (0.067)	0.199*** (0.067)	0.198*** (0.067)
Africa (=1)		-0.623*** (0.179)		-0.654*** (0.178)				
East Asia (=1)		-0.145 (0.165)		-0.181 (0.170)				
Latin America (=1)		-0.315* (0.160)		-0.362** (0.161)				
OECD _t		-0.440** (0.196)		-0.555*** (0.201)		-0.059 (0.060)		-0.052 (0.062)
Intercept	-18.803*** (1.280)	-16.933*** (1.447)	-19.087*** (1.320)	-17.221*** (1.485)	-18.393*** (1.823)	-18.323*** (1.843)	-18.505*** (1.850)	-18.457*** (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.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$