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 with: 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

[1] Examples 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.

[2] Naturally, 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.

[3] The 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. 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 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

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

the home country. The treaty specifies what the home country ought to do to reduce the externalities, as well as the consequence if it does not. After the negotiation, an election decides whether the incumbent party continues to be in charge or is replaced. At this stage, voters discern which party is 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. 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 *overshooting effect* according to which the incumbent tends to make environmental commitments that, besides being weak as discussed above, are larger than what would be chosen without electoral incentives. This phenomenon, again, is remarkable because it characterizes both green and brown incumbents. As we will explain more extensively in Section 3.1, this phe-

nomenon occurs because the incumbent 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.

Finally, we show that our results generalize to a fully dynamic setting. Indeed, we show that when weak IEAs are expected in the future, then an incumbent may be even more likely select a weak treaty today.

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 on treaties.

A recent paper that has studied the effect of elections on the success of international treaties is Buisseret and Bernhardt [2018]. They consider a two-period model in which period 1 has a weight in the agents' utilities equal to $1-\delta$ and period 2 equal to δ. Focusing on the timing of elections as measured by δ (they define election to be "close" to the signature of an international agreement if δ is large), they argue that whether an agreement is signed depends on how hostile is the incumbent and close an election: if the incumbent is hostile, then the agreement is signed only if the election is not very close; if the incumbent is friendly, then only if the election is sufficiently close. Our analysis differs in that we focus on how the

international agreement is designed (weak vs. strong) and we highlight a general tendency toward weak agreements, independently of the preferences of the incumbent.[5]

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]).[6] The typical prediction in this literature is that the coalition size is very small, due to the benefits of free riding. This prediction 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.

In Battaglini and Harstad [2016], we showed that incomplete contracts can be beneficial as they help inducing more countries to participate. We followed the literature in assuming that once signed, the treaty is always ratified and respected. The incompleteness of the IEAs referred to the fact that agreements deliberately do not regulate important aspects of the environmental issue, such as investments in green technologies. In the current paper we study a related but different issue, namely why countries negotiate treaties specifying actions that they know will not necessarily be respected, even when they could sign "strong contracts" that would always be respected. We refer to these as weak treaties, a concept that is distinct from the concept of incomplete contracts.[7] Furthermore, the key mechanism of the present paper is that the treaty is designed by self-interested politicians to influence elections. Domestic politics were absent in the 2016 paper, where the driving force was hold-up problems when countries negotiated.

Recent research has also endogenized the government's preferences by allowing for strate-

[5] Another paper that has explicitly analyzed the relationship between international agreements and elections is Persson and Tabellini [1992]. They are interested in the effects of European fiscal policy integration and note that the increase in capital mobility associated to European integration induces, ceteris paribus, a reduction of capital taxation. Anticipating this, voters tend to elect policymakers who may choose a level of taxation that is higher or lower than the level preferred by the median voter. The authors model institutional changes as an exogenous reduction in the cost of capital mobility, so they do not explain the design of the international agreement.

[6] Maggi and Morelli [2006] for a study of self-enforcing international organizations in a more general context. Harstad et al. [2018] analyze how technology investments make treaties self-enforcing in a repeated-game context, while technology solves a time inconsistency problem in Harstad [2018].

[7] In the present paper, weak IEAs are not at all incomplete since they include all the relevant aspects of the agreement: In the baseline model of Section 2, green investments are not allowed, so the contract signed is complete by definition. In the extension of Section 3.2 we allow for green investments and also these investments are part of the agreement

gic delegation or lobby groups' influence.[8] 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 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.[9] 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.

In this paper, we attempt to shift the focus of the literature from simply 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, when the time horizon is infinite, we show that weak agreements may

[8] On "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, Persson and Tabellini [1992], Segendorff [1998], Buchholz et al. [2005], Eckert [2003], and Harstad [2008 and 2010]. 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. Our contribution to this literature is to analyze how electoral concerns influence and explain the design of international treaties.

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

be more likely to emerge today if they are also expected in the future. Section 3.4 is briefly discussing other extensions. Section 4.1 discusses how the analysis sheds light on the role of domestic politics in shaping international negotiations in three recent examples, including 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 (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, the results are simpler to express if we assume that the net cost of abating is positive for political parties. 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.[10] The cost of the sanction to H is $s \geq 0$ and F's cost of imposing the sanction is gs. If $g > 0$, F dislikes imposing the sanction (as, for example, when s is imposed by restricting trade with F). If $g < 0$, F benefits from imposing the sanction, perhaps because it takes the form of a monetary transfer. 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.[11]

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

[10] See 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.

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

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 the model remains relevant whether or not there is also a symmetric problem where F emits, harming H. If we assume that the effect of F's emissions on the harm generated by H's emissions is not too large, the two problems can be separated and considered independently.[12] Second, we assume that H and F are fully committed to imposing the sanction if H does not comply. Section 3.2 proves that investment in technology is one way of facilitating commitment, Section 3.3 shows when complying with the sanction is incentive compatible in a dynamic framework, 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. $-i \neq i$), while δ is some relative popularity shock in favor of the challenger. The popularity shock, realized after the treaty is signed, can refer to the importance of other policy differences, not explicitly modelled here. We assume δ to be uniformly distributed on $[-z/\sigma, (1-z)/\sigma]$, where $z \geq \frac{1}{2}$, 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:

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

3. Compliance: At the final stage of the game, the newly (re)elected policy maker

[12] This assumption may be realistic for climate change, where the marginal long-run harm of emission cannot be influenced much by an individual country's short-term emission level. The assumption is harder to defend for security and arms control agreements, however.

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

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

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 not 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.[14] In this situation, i and F would

[13] Note that G has multiple best responses when $s = \underline{s}$, while B has multiple best responses when $s = \overline{s}$. 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 $s = \overline{s}$. Thus, the set of weak treaties is closed in equilibrium.

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

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 let p_i^0 be the probability that G wins when the first-period incumbent is i and $u_M^i - u_M^{-i} = 0$. Thus, $p_i^0 = z$ if $i = G$, and $p_i^0 = 1 - z$ if $i = B$. We will also refer to the following thresholds:

$$R_i^* = \begin{cases} \frac{(1+g)c_{-i} - (p_i^0 - \sigma(c_M - c_{-i}))(e - c_i + (1+g)c_{-i})}{\sigma|c_M - c_{-i}|} & \text{if } e \leq c_i\,, \\ \frac{\left(1 - p_i^0 + \sigma(c_M - c_{-i})\right)(e - c_i + (1+g)c_{-i})}{\sigma|c_M - c_{-i}|} & \text{if } e > c_i. \end{cases} \tag{2}$$

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 $s = \overline{s}$. In both cases, the treaty is complied with if 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:

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

Thus, $u_M^G - u_M^B < 0$ if $s \in [\underline{s}, c_M)$, and $u_M^G - u_M^B > 0$ when $s \in (c_M, \overline{s}]$, implying that the ex post benefit of compliance for the median voter depends on s. Since an incumbent $i \in \{B, G\}$

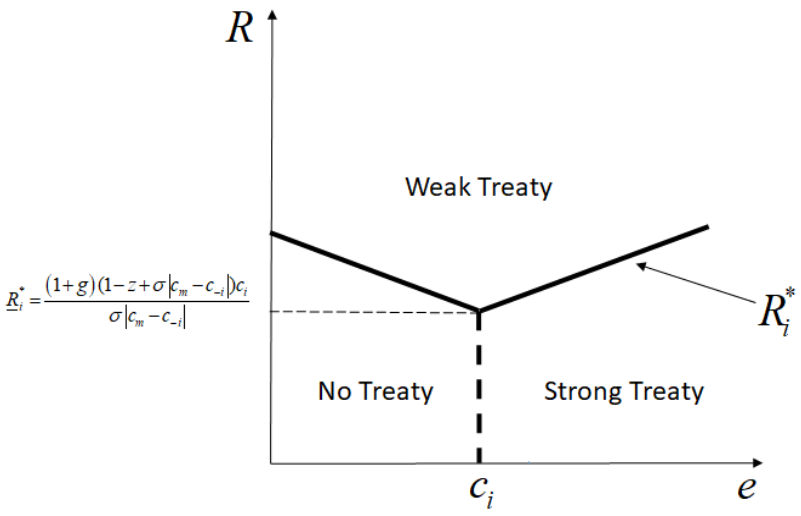

Figure 1: *The treaty is weak above the solid line, representing* R_i^* *as a function of* e.

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:

$$p_i(s) = \begin{cases} p_i^0 & \text{if } s < \underline{s} \\ p_i^0 + \sigma(s - c_M) & \text{if } s \in [\underline{s}, \overline{s}] \\ p_i^0 & \text{if } s > \overline{s} \end{cases}. \tag{3}$$

Note that $p_i(s)$ is increasing in s for $s \in [\underline{s}, \overline{s}]$ and $p_i(\overline{s}) = p_i^0 + \sigma(c_B - c_M) > p_i^0$, so the probability that G wins is maximized when $s = c_B = \overline{s}$ (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.[15] When the office rent is sufficiently large, the electoral gain is important enough to compensate a green first-period incumbent for the possibility that the agreement is repudiated by the brown party if elected. In this case, the optimal s is equal to $\overline{s}$. 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:

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

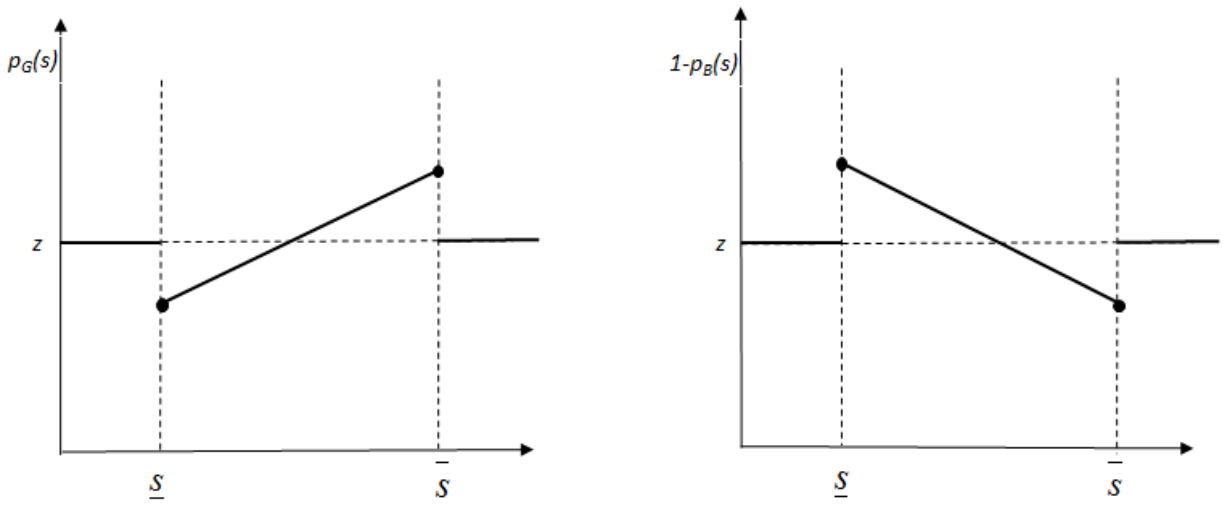

Figure 2: *Reelection probabilities when G is the incumbent (left) or B is (right).*

$1 - p_B(\underline{s}) = z + \sigma\left(c_M - c_G\right) > z$, 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:

$$\underline{R_i} = \frac{\left(1 - p_i^0 + \sigma\left(c_M - c_{-i}\right)\right)(1+g)c_{-i}}{\sigma\left|c_M - c_{-i}\right|},$$

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 large. It is interesting to note that this result highlight 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 influences 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.[16]

The third factor affecting the agreement type is the deadweight cost of a sanction, $1+g$. As 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.

[16] Of course, the mimimum level on σ to obtain a weak treaty can be consistent with eq. (1). For example, if $e > c_B$, then $R \geq R_i^*$ if $\sigma \geq \frac{\left(1-p_i^0\right)(e-c_i+(1+g)c_{-i})}{|c_M-c_{-i}|R-(e-c_i+(1+g)c_{-i})(c_M-c_{-i})}$. These thresholds are always lower than the threshold in eq. (1) when R is sufficiently large. The 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, but not so large that the electoral outcome is certain).

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 and 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 treaties: a democracy signs a weak treaty if $R > R_i^*$; 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 Dynamics

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, policy measures on green technologies, or the long-term future.

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. 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 $s_{x^*} : [0, x^*] \to \mathbb{R}_+$ 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 policy maker $j \in \{B, G\}$ prefers an abatement level that minimizes the total costs:

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

In equilibrium, H and F always prefer to sign a treaty in which at least the green party fully complies with the treaty, so $x^G_{s^*} = x^*$.[17] However, (4) implies that $x^B_{s^*} \leq x^*$, so we can write $x^B_{s^*} = x^G_{s^*} - \Delta_{s^*}$ 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"**:**

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

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

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

$[c_M, c_B]$ 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.[18] 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 $\sigma < \overline{\sigma}$, where the threshold $\overline{\sigma}$ is derived and presented in the Appendix. We henceforth assume $\sigma < \overline{\sigma}$.

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 the 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

[18] Thus, 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.

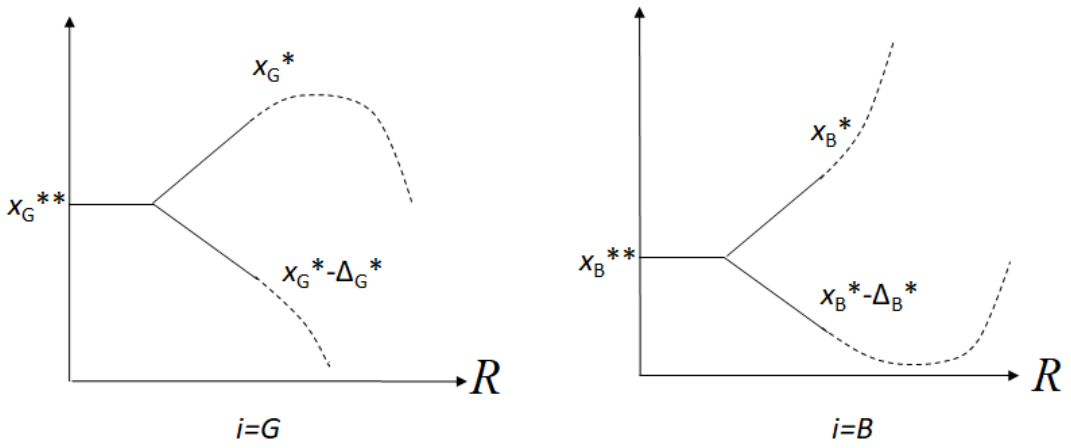

Figure 3: *If the office rent R is large, the equilibrium treaty is deeper but it is also weaker.*

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 the expected utility. In a strong agreement, the optimal size is x_i^{**}, the level at which the marginal benefit equals the marginal cost: $e'(x_i^{**}) = c_i$. 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:

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

Since party B will not fully comply, the size must be larger so that the *expected* compliance stays at the right level. This implies that G must abate more than the first-best level, and the size of the treaty is thus also larger than the first-best size. Formally, (5) implies that, when $\Delta_i^* > 0$, we have $e'(x_i^*) < c_i$, so $x_i^* > x_i^{**}$. 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 the office rent $R > \widehat{R}_i$ increases, the treaty becomes weaker (i.e., Δ_i^* increases), the negotiated size x_B^* increases, while the effective size $x_G^* - \Delta_G^*$ declines. Furthermore:*

$$e'(x_B^* - \Delta_B^*) \to c_B \text{ and } e'(x_G^*) \to c_G.$$

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 final 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.[19]

3.2 Endogenous Technology and Compliance

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 $i \in \{G, M, B\}$.[20] 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 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

[19] While 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.

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

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 M 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.

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:

$$y \in \left[\underline{y}, \overline{y}\right], \text{ where } \underline{y} \equiv c_G - s \text{ and } \overline{y} \equiv c_B - s. \tag{6}$$

Party G will comply with the treaty if $y \geq \underline{y}$, while B will not if $y \leq \overline{y}$. By choosing $y = \overline{y} \equiv c_B - s$, 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 $y = \overline{y}$, 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 $p_G^* \equiv z + \sigma\left(c_B - c_M\right)$, as in Section 2.

Similarly, a B incumbent can improve the 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 $p_B^* \equiv 1 - z - \sigma\left(c_M - c_G\right)$, as in Section 2.

The following result characterizes the equilibrium with fixed exogenous s when the green technology investment is efficient (i.e., $q < 1$). The proof and the definitions of R_i^s are in the Appendix.

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 $e > c_i - Y\left(1 - q\right)$, 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 $\overline{y} = c_B - s$. In both cases, only G will comply.

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 $y \in \left[\underline{y}, \overline{y}\right]$. If the investment level $y \in \left[\underline{y}, \overline{y}\right]$ 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 $y \in \{\underline{y}, \overline{y}\}$.

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. 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 $y = \overline{y}$ such that $s + \overline{y} - c_B = 0$: 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.[21]

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 thresholds $R_i^* > 0$ 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 $s > c_B$ if $q > 1$.
(ii) If $R > R_i^*$, F and H sign a weak treaty, it is complied with at probability p_i^*, and:

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

When R is sufficiently small (i.e., $R < R_i^*$), electoral incentives are not sufficiently strong to lead to a weak agreement. In this case, we either have no agreement or a strong agreement,

[21] An 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 $e > c_i - \max\{(1-q)\overline{y}, Y(1-q)\}$, a larger s makes it more likely that we move to a setting with a strong treaty. If instead $e < c_i - \max\{(1-q)\overline{y}, Y(1-q)\}$, a larger s makes it more likely that we move to a setting with no treaty.

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 $q_i^* \equiv 1 + g\left(1 - p_i^*\right)$. 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.[22] 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, $(1+g)\left(1 - p_i^*\right)$. Clearly, partial compliance is better ensured by technology if $q - p_i^* < (1+g)\left(1 - p_i^*\right) \Rightarrow q < q_i^* \equiv 1 + g - g p_i^*$. 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...*"

[22] The 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 An Infinite Time Horizon

The previous sections allowed for only two electoral periods. The result and the intuition can however be generalized to an infinite horizon environment in a straightforward way; and indeed such a dynamic extension provides new insight to the analysis. In this section we characterize conditions under which weak treaties arise as an Markov-perfect equilibrium (MPE) of the dynamic game when H and F can only make short term, one period commitments.[23] Among the new insights, we find that if weak IEAs are expected in the future, then an incumbent may be even more likely select a weak treaty today.

The timing in each period is as follows. If a treaty has already been negotiated, then the incumbent $j \in \{B, G\}$ first decides whether to comply at cost c_j or face the sanction negotiated in the past. Second, j (re)negotiates a new treaty, specifying the sanction level for the next period. Finally, there is an election, exactly as in Section 2. Every player is forward-looking and applies the same discount factor $\beta \in (0, 1)$.

We also make the following assumptions. Country H has all the bargaining power, and the transfer from F benefits everyone in H, just as the sanction imposed by F was assumed to harm everyone in H. Given the transfers at the negotiation stage, it is both natural and simplifying to assume that also the sanction is a transfer from H to F, so that $g = -1$. Finally, in order to isolate the endogenous incumbency advantage, we assume that $z = 1/2$ and that M is positioned exactly in between G and B:

$$c_G - c_M = c_M - c_B \equiv h. \tag{7}$$

With these assumptions, the Appendix defines two thresholds, R^L and R^H, and proves that Proposition 1 continue to hold, qualitatively, as is reflected in parts (i) and (ii) of the following proposition.

Proposition 6. *In every equilibrium of the dynamic game, a G-incumbent complies if $s \geq c_G$ while a B-incumbent complies if $s > c_B$.*
(i) An MPE without any treaty exists if and only if $e \leq c_G$ and $R \leq R^H$, while an MPE with always a strong treaty exists if and only if $e \geq c_B$ and $R \leq R^H$.
(ii) An MPE with always a weak treaty exists if and only if $R \geq R^L$. In this MPE, incumbent $i \in \{B, G\}$ signs a weak treaty with sanction level $s = c_{-i}$
(iii) It is possible that $R \in \left(R^L, R^H\right)$. Then, there are multiple equilibria, so that treaties are weak today if and only if they are expected to be weak in the future.
(iv) The endogenous incumbency advantage is stronger for G than for B if and only if $c_M < e$, i.e., when a treaty is socially optimal:

[23] The analysis extends in a straightforward way to the case in which we assume that H and F can commit to a finite number of periods.

$$p_G^* = \frac{1}{2} + h\sigma + \frac{e - c_M}{1/2\beta h\sigma^2 - 1/\sigma};\ \ 1 - p_B^* = \frac{1}{2} + h\sigma - \frac{e - c_M}{1/2\beta h\sigma^2 - 1/\sigma}.$$

The intuition for parts (i) and (ii) is the same as before. In the dynamic framework, part (ii) implies that every time a relatively green (brown) incumbent is replaced by the opponent, then the next (re)negotiated treaty will be weaker (stronger).

Part (iii) shows, in addition, that there can be multiple equilibria. In particular, an incumbent can be more likely to negotiate a weak treaty today if a weak treaty is expected in the future. In other words, the presence of weak treaties can be self-fulfilling. The intuition for this possibility is that in the equilibrium with weak treaties, it will be more important for an incumbent to win the next election, since the future policy maker is going to decide on the *type* of weak treaties in the next period. In contrast, if the next period will lead to either a strong treaty or no treaty, then two rivals will implement the same policy in the future, and the only remaining motive for winning the election is the office rent.[24]

Part (iv) of the proposition shows that if $e > c_M$, then the endogenous incumbency advantage is larger for party G. The intuition for this is that, when G is in power, the country will be more likely to comply in the following period and, anticipating this, the home country can extract larger favors from F. The net effect of this is positive for M if and only if $e > c_M$. Larger international externalities are thus predicted to lead to larger vote shares for green parties (on average), even if both parties sign weak treaties in equilibrium.

Throughout the paper, we have assumed that the parties can commit to the sanction (for one period, at least). To conclude, it is useful to note that when the players are sufficiently patient it is possible to construct subgame-perfect equilibria in which in every period H and F sign a weak treaty, as in part (ii) of Proposition 6, even without assuming any commitment. As an illustration, the Online Appendix considers the case in which reducing pollution is Pareto efficient, so $e > c_i$ for $i \in \{G, M, B\}$, and where cooperation breaks down forever if H does not pay s when promised. In this case, the equilibrium above can be supported as a subgame-perfect equilibrium unless the preferences of G and B are too dissimilar or if the parties are not sufficiently patient. Intuitively, when abatement is socially optimal, there is an efficiency loss when cooperation breaks down. Thus, paying the sanction after non-compliance is incentive compatible if the discount factor is sufficiently high, as traditional folk theorems suggest.[25]

[24] In addition to the equilibria discussed above, there can be asymmetric equilibria in which only one of the two parties sign (weak) treaties.

[25] Naturally, one may consider more complicated and powerful punishments to sustain such an equilibrium. We discuss the reversion to no cooperation because this punishment is natural, simple, and sufficient for our

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. In most of the text, we 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: First, Section 3.2 proved 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. Second, Section 3.3 showed that complying with the sanction can be incentive compatible for H in a dynamic framework, if just the discount factor is sufficiently large. Third, we now argue that, even in the basic model, our results would be strengthened if the sanction or the treaty can be renegotiated: the treaty may be *more* likely to be weak when renegotiation is possible.

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 this situation, the above formulae hold if just g is replaced by $-\gamma < g$.[26] 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 policy maker in H has decided on whether to comply. If F has all the bargaining power in this situation, the policy makers 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

illustrative argument.

[26] The 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.

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 countries.

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 $\sigma = \epsilon\widetilde{\sigma}$, $c_i = \epsilon\widetilde{c_i}$, and $e = \epsilon\widetilde{e}$, so that we can reduce the salience 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.

The political system. We have observed 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 policy makers' 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 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 three recent examples in which the influence of domestic politics has been particularly evident and that are broadly consistent with our theory. Section 4.2 takes a first look at the data.

4.1 Historical experiences

The Kyoto Protocol (1997)

Green incumbents. 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,[27] 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 getting issue."[28] He therefore pre-positioned himself to take advantage of the negotiations, pushing for an agreement that could not be ratified if the opponents won the election: a behavior in line with the logic of our theory.

[27] Bang 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.

[28] See 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."

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.[29]

A similar dynamic can be found in Canada, where the incumbent negotiating the agreement 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. 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]).

Brown incumbents. 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, "brown parties"). Despite this, all these countries signed the Kyoto Protocol, although in weak forms and ratifications of the signed agreements followed a pattern similar to the logic of the model, as we will now argue.

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. The Protocol was signed in Australia in 1998, but the conservative government of John Howard delayed ratification until the end of its mandate.[30]

[29]It 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.

[30]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 offi-

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]).

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.[31]

The Convention on Biological Diversity (1993)

A less well known episode in which an international environmental agreement was seen as important for a presidential election in the U.S. is the one concerning the *Convention on Biological Diversity* signed at the *1993 Earth Summit* in Rio de Janeiro. This example is interesting because it illustrates how, as predicted by the model, even a "brown" party may first promote an IEA before an election, promising to do the agreement in the "right way," only to refuse to ratify it in the final stage after the election.

According to Hopgood [1998], environmental issues were important in the 1988 Presidential campaign, in which Vice-President George H. R. Bush was a candidate: "One difference he [George H. R. Bush] immediately faced [with respect to the 1984 Reagan reelection campaign] was the resurgence of the environment as an election issue, a problem with which Ronald Reagan had not to contend in 1984."[32] With the presidential elections in the horizon, starting from 1987 the Reagan administration through the Vice-President's *Council in Competitiveness* was one of the major promoters of the idea of a treaty to protect global biodiversity.[33] The issue was highly contentious since by potentially requiring "the sharing of technological developments, changes to law in intellectual property rights (IPRs) and patents, and new and additional funds for finance, the treaty played on several areas of existing sensitivity not just in American foreign policy but also in the South." (Hopgood [1998: 168]). By exposing influential industries and lobbies to the possibility of a treaty with

cially ratified only in December 2007 after the Labor Party (with Kevin Rood as prime minister) assumed government control.

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

[32] See Hopgood [1998: 129].

[33] See Hopgood [1998: 168].

potentially negative effects, the administration made the identity of the president ultimately negotiating its terms salient. Indeed, after the 1988 election in which George H. R. Bush was elected president, the Bush administration did not invest political capital in the negotiations of the final ratification.[34] As a result, the United States was the only state among the United Nations members not to ratify it in Rio de Janeiro, June 1993.

With respect to the theory presented above, we should note that the Reagan-Bush administration did not commit to a treaty before the election, so no explicit penalties were established. By setting up the process for a biodiversity conference, however, the administration reduced the cost of a treaty for a democratic president quite dramatically and made the outcome contingent on the election, thus energizing its base.[35]

The Paris Agreement (2015)

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.[36] 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]) while the Democratic candidate had vowed to uphold the U.S. commitment to climate actions signed by the Obama

[34] According to Hopgood [1995], senior white house officials had not been debating biodiversity in the way they had for other issues on the table: "the absence of more senior-level involvement played to the sceptics' advantage because it meant that little or no political effort was expended trying to pressure other governments domestically to relent and make further concessions at UNEP (the United Nations Environment Program)." Hopgood [1995: 169]

[35] In terms of the model of the previous sections, therefore, the "investment" in 1987 in promoting the treaty in biodiversity can be seen as analogous to the investment in green technologies at $t = 1$ that reduces the cost of signing a IEA at $t = 2$, as studied in Section 3.2.

[36] See the "Intended Nationally Determined Contribution" (INDC) submitted to the UN: https://unfccc.int/process/the-paris-agreement/nationally-determined-contributions/ndc-registry#eq-4 Accessed on October 17, 2018.

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 policy makers. 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 there exist 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.[37] 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.[38] We consider alternative sets of control variables. Specifically, we include a set of geographical dummies, a variable qualifying the electoral regime and, importantly, country or treaty fixed effects to capture different types of unobservable factors. As can be seen from Table 1, in all specifications $polity2_t$ and $democracy_t$ appear positive and significant, suggesting that democratic regimes are indeed more prone to signing IEAs

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

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

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.[39]

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.[40] 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.[41] The data cover the period 1960-2011. The dependent variable in Table 2 is

[39] Congleton [1992] considers two treaties: the Convention for the Protection of the Ozone Layer and the Montreal Protocol on Substances that Deplete the Ozone Layer. Neumayer [2002] considers four treaties: the Protocol to the United Nations Framework Convention on Climate Change (Kyoto Protocol), the Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade (the Rotterdam Convention), the Copenhagen Amendment to the Montreal Protocol, and the Cartagena Protocol on Biosafety to the Convention on Biological Diversity (Cartagena Protocol on Biosafety). Our data set contains 31 agreements, and except for the Copenhagen Amendment, all the previous treaties are included.

[40] For 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.

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

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

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: $\#treaties_{t-\mathbf{1}}$ is significant at the 1% level in specifications 3-4; $polity2_t$ and $democracy_t$ are not significant; and, more importantly for us, the interaction effects are negative. These results 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 policy makers can do. The incentives provided by a treaty may affect different political candidates in different ways, and thus they could also influence domestic elections. Anticipating this, political incumbents may seek to negotiate and sign treaties strategically and in a way that both ties the hands of the next policy maker and improves the odds of staying in office. Our theory is built to deepen our understanding of these trade-offs and it results in a number of testable predictions.

First, political incumbents will be reluctant to sign "strong" treaties with which their countries must necessarily comply. A strong treaty will level the playing field since any future politician will behave in the same way. A "weak" treaty, in contrast, may or may not

be upheld. A relatively green party is more likely to comply with the treaty than a relatively brown party 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, the green party is more attractive. 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 simple 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 extensions. These extensions will be immensely important; the political economy of treaties must be better understood before we can successfully address the global challenges ahead.

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Table 1: Probability of sign an IEA

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

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

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

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

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

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:

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

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: $W^G_{BG}(s) = zR_G - c_G + e$. If G complies at $t = 2$:

$$W^G_G(s) = p_G(s)(R_G - c_G + e) - (1 - p_G(s))\,(1 + g)\,s. \tag{9}$$

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

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

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

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

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

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

Consider now the second condition. Since $W^G_G(s)$ is convex in s we have two cases: $s = \overline{s} = c_B$ and $s = \underline{s} = c_G$. We now show that it is never optimal to set $s = \underline{s} = c_G$, since in this case it is better to have $s \geq c_B$. With (3), we have $W^G_G(\underline{s}) > W^G_{BG}(s)$ only if:

$$\begin{aligned} W^G_G(\underline{s}) \;=\; & (z + \sigma\,(\underline{s} - c_M))(R_G - c_G + e) \\ & - (1 - z - \sigma\,(\underline{s} - c_M))\,(1 + g)\,\underline{s} > zR_G - c_G + e. \end{aligned}$$

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

$$\sigma\left(c_G - c_M\right) R_G > \left(1 - z - \sigma\left(c_G - c_M\right)\right)\left(e + g c_G\right).$$

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, $s = \overline{s} = c_B$.[42] Such an IEA is preferred to no IEA if:

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

So:

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

This is true if:

$$e > \widetilde{e}_G^*(R_G) = \frac{(1+g)\,c_B - \left(z + \sigma\left(c_B - c_M\right)\right)\left((1+g)c_B - c_G\right) - \sigma\left(c_B - c_M\right) R_G}{z + \sigma\left(c_B - c_M\right)}. \tag{10}$$

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

We now prove the following result:

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

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

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

where $s = c_B$. This implies:

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

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

[42] Note that at $s = c_B$, B is indifferent. There is however no loss of generality in assuming that when $s = c_B$, B chooses not to comply since 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:

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

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

Define $R^*_G(e)$ to be equal to $\left[e^*_G\right]^{-1}(e)$ for $e \leq c_G$ and to $\left[e^{**}_G\right]^{-1}(e)$ for $e > c_G$, where $\left[e^*_G\right]^{-1}(e)$ and $\left[e^{**}_G\right]^{-1}(e)$ 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: $W^B_{BG}(s) = zR_B - c_B + e$. If only G complies, then the sum of payoffs is:

$$W^B_G(s) = \left[1-z+\sigma\left(s-c_M\right)\right](e-c_B) + \left[z-\sigma\left(s-c_M\right)\right]\left(R_B-(1+g)\,s\right).$$

Note that $W^B_G(s)$ 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 $W^B_\emptyset(0) < W^B_{BG}(s)$, implying $e > e^*_B = c_B$, or if $W^B_\emptyset(0) < W^B_G(s)$. Since $W^B_G(s)$ is convex in s we have two cases: $s = \overline{s} = c_B$ and $s = \underline{s} = c_G$, but it is easy to check that $\overline{s}$ is dominated, since $W^B_G(\overline{s}) > W^B_G(\underline{s}) \Rightarrow W^B_{BG}(s) > W^B_G(\overline{s})$. So, for a weak IEA, $s = \underline{s}$. B and F prefer such a weak IEA to no IEA if $W^B_G(\underline{s}) > W^B_\emptyset(0)$, implying:

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

which can be written as:

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

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

We now prove the following lemma:

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

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

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

That is, if:

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

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

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

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

The definition of $R_B^*(e)$ implies that for $R_B > R_B^*(e)$ we have $e \in (e_B^*(R_G), e_B^{**}(R_G))$, so 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:

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

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

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

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:

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

The second-order condition is:

$$\begin{aligned} &\sigma\left(c_B - c_M\right)\left[e'\left(x_G^* - \Delta_G^*\right) + (1+g)c_B - c_G\right] \\ &+\sigma\left(c_B - c_M\right)\left[e'\left(x_G^* - \Delta_G^*\right) + (1+g)c_B - c_G\right] \\ &+(1-p)\, e''\left(x_G^* - \Delta_G^*\right) < 0 \Rightarrow \end{aligned}$$

$$\sigma < \overline{\sigma}_G^s \equiv \frac{(1-p)\left|e''\left(x_G^* - \Delta_G^*\right)\right|}{2\left(c_B - c_M\right)\left[e'\left(x_G^* - \Delta_G^*\right) + (1+g)c_B - c_G\right]}, \tag{16}$$

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 $p \to 1$, we must also assume that:

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

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

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 $p_G^* \to 1$, (14) also implies that $e'(x_G^*) \to c_G + k_G$, so $x_G^* \to x_G^{**}$. ■

6.4 Proofs of Propositions 4, 5, and 6

See Online Appendix. ■

7 ONLINE APPENDIX

7.1 Proof of Propositions 2 and 3 when $i = B$.

As advertised in the paper, we here allow for office rents that can vary between the parties and that can depend on whether the policy maker complies. For incumbent $i \in \{B, G\}$, the office rent is R_i if i does not abate, while it is $R_i - k_i x_i$ if i abates at the level x_i. Thus, parameter k_i may measure the policy makers private cost of transferring resources from i's favorite perks (or local public goods) to an effort to abate.

We assume here that the first-period incumbent is $i = B$.

The expected sum of payoffs for B and F is:

$$p\begin{bmatrix} e\left(x_B^*\right) - e\left(x_B^* - \Delta_B^*\right) \\ -\Delta_B^* c_B + (1+g)\Delta_B^* S_B^* - R_B \\ +k_B\left(x_B^* - \Delta_B^*\right) \end{bmatrix} + \begin{bmatrix} R_B - k_B\left(x_B^* - \Delta_B^*\right) \\ +e\left(x_B^* - \Delta_B^*\right) \\ -\left(x_B^* - \Delta_B^*\right) c_B - (1+g)\Delta_B^* S_B^* \end{bmatrix},$$

where $p = 1 - z + \sigma\left(S_B^* - (c_M + k_M)\right)\Delta_B^*$. It is easy to see that also this expression is convex in S_B^* and that the largest S_B^* satisfying $S_B^* \in [c_B + k_B, c_G + k_G]$ is dominated by either $S_B^* = 0$ or $S_B^* > c_G + k_G$. Thus, *if* F and G implements a weak treaty, then

$$S_B^* = c_G + k_G.$$

The first-order condition with respect to x_B^* is:

$$\begin{aligned} p\left[e'\left(x_B^*\right) - e'\left(x_B^* - \Delta_B^*\right) + k_B\right] - k_B + e'\left(x_B^* - \Delta_B^*\right) - c_B &= 0 \Rightarrow \\ pe'\left(x_B^*\right) + (1-p)\, e'\left(x_B^* - \Delta_B^*\right) &= c_B + (1-p)\, k_B, \end{aligned} \quad (18)$$

while the second-order condition trivially holds.

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

$$\begin{aligned} - \quad & \sigma\left(c_M - c_G + k_M - k_G\right)\begin{bmatrix} e\left(x_B^*\right) - e\left(x_B^* - \Delta_B^*\right) + (1+g)S_B^* \\ -\Delta_B^* c_B - R_B + k_B\left(x_B^* - \Delta_B^*\right) \end{bmatrix} \\ & -(1-p)\left[e'\left(x_B^* - \Delta_B^*\right) + (1+g)\left(c_G + k_G\right) - c_B - k_B\right]. \end{aligned}$$

The second-order condition is:

$$\begin{aligned} -\sigma\left(c_M - c_G + k_M - k_G\right)\left[e'\left(x_B^* - \Delta_B^*\right) + (1+g)\left(c_G + k_G\right) - c_B - k_B\right] \\ -\sigma\left(c_M - c_G + k_M - k_G\right)\left[e'\left(x_B^* - \Delta_B^*\right) + (1+g)\left(c_G + k_G\right) - c_B - k_B\right] \\ +p\left[-e''\left(x_B^* - \Delta_B^*\right)\right] + e''\left(\overline{x} - \Delta_B^*\right) < 0 \Rightarrow \end{aligned}$$

$$\left[\begin{array}{c} -2\sigma\left(c_M - c_G + k_M - k_G\right)\left[e'\left(x_B^* - \Delta_B^*\right) + (1+g)\left(c_G + k_G\right) - c_B - k_B\right] \\ + (1-p)\, e''\left(x_B^* - \Delta_B^*\right) \end{array}\right] < 0,$$

which is trivially satisfied when e is concave. With this, note that $\Delta_B^* = 0$ is optimal if the first order condition for Δ_B^* is negative at $\Delta_B^* = 0$:

$$\begin{aligned} & -\sigma\left(c_M - c_G + k_M - k_G\right)\left[-R_B + k_B x_B^*\right] \\ & -z\left[e'\left(x_B^*\right) + (1+g)\left(c_G + k_G\right) - c_B - k_B\right] \leq 0 \Rightarrow \\ R_B \;\leq\; & R_B^* \equiv \frac{z\left[e'\left(x_B^*\right) + (1+g)\left(c_G + k_G\right) - c_B - k_B\right]}{\sigma\left(c_M - c_G + k_M - k_G\right)} + k_B x_B^* \end{aligned}$$

In this case, the first order condition for the size boils down to $x_B^* = x_B^{**}$, given by:

$$\begin{aligned} & e'\left(x_B^{**}\right) - c_B - z k_B = 0 \Rightarrow \\ R_B^* \;\equiv\; & \frac{z\left[(1+g)\left(c_G + k_G\right) - (1-z)\, k_B\right]}{\sigma\left(c_M - c_G + k_M - k_G\right)} + k_B e'^{-1}\left(c_B + z k_B\right). \end{aligned}$$

From the above, it is clear that $\Delta_B^* > 0$ is optimal if $R_B > R_B^*$. While R_B does not influence (18) directly, the first order condition for Δ_B^* increases in R_B so Δ_B^* must increase to ensure that the expression equals zero. If $k_B = 0$, a larger R_B and thus $\Delta_B^* > 0$ implies that $e'\left(x_B^*\right) < c_B < e'\left(x_B^* - \Delta_B^*\right)$ for (18) to hold. When $p \to 0$, (18) implies that $e'\left(x_B^* - \Delta_B^*\right) \to c_B + k_B$. To avoid that p reaches zero, we here assume that

$$\sigma < \overline{\sigma}_G^p \equiv \frac{1-z}{\left(c_M - c_G + k_M - k_G\right)\Delta_B^*},$$

where $\overline{\sigma}_G^p$ takes into account that Δ_B^* is an increasing function of σ. ■

7.2 Proof of Proposition 4

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

$$\max_{y \in [0,Y]} W^i(y), \text{ where } W^i(y) \equiv U_i(y) + U_F(y). \tag{19}$$

As for 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 also assume the more general case in which the office rent is reduced by $k_j \geq 0$ if the second-period incumbent j abates.

Case 1: The green party is the incumbent Consider first the case when the first-period incumbent is G. If y is so large that both G and B comply, the objective function in (19) can be written as:

$$\begin{aligned}\max_{y\in[\overline{y},Y]} W_{BG}^{G}(y) &= z\left(R_G - k_G\right) - c_G + e + \max_{y\in[\overline{y},Y]} y\left(1-q\right) \\ &= z\left(R_G - k_G\right) - c_G + e + Y\left(1-q\right).\end{aligned}$$

If there is no agreement, clearly it is optimal with $y = 0$, and we may write the sum of payoffs as $W_{\emptyset}^{G}(0) = zR_G$. This sum is lower than for a strong agreement if: $e > c_G + zk_G - Y\left(1-q\right)$. In the simple model in the text, where $k_G = 0$, this inequality simplifies to: $e > c_G - Y\left(1-q\right)$. If only G complies, we may write the sum of payoffs as:

$$W_{G}^{G}(y) = p(s+y)(R_G - k_G - c_G + y + e) - \left(1 - p(s+y)\right)\left(1+g\right)s - qy, \tag{20}$$

where:

$$p\left(s+y\right) = \begin{cases} z & \text{if } y < \underline{y} \\ z + \sigma\left(s + y - c_M\right) & \text{if } y \in \left[\underline{y}, \overline{y}\right] \\ z & \text{if } y > \overline{y} \end{cases}.$$

and $\overline{y} = c_B + k_B - s$ and $\underline{y} = c_G + k_G - s$. It follows that: $p\left(s+\overline{y}\right) = z + \sigma\left(\left(c_B + k_B\right) - c_M\right)$. Thus, $W_{G}^{G}(y)$ is convex in y.

Lemma 2.1: *For G, $\underline{y}$ is dominated if $q < 1$.*

Proof. If $y = \underline{y}$, the sum of payoffs is larger than if $y = 0$ when:

$$W_{G}^{G}(\underline{y}) = \begin{bmatrix} \left(z - \sigma\left(c_M - \left(c_G + k_G\right)\right)\right)\left(R_G - s + e\right) \\ -\left(1 - z + \sigma\left(c_M - \left(c_G + k_G\right)\right)\right)\left(1+g\right)s - q\left(\left(c_G + k_G\right) - s\right) \end{bmatrix} > zR_G.$$

For this to hold, $R_G - s + e > 0$ is necessary. Then, we can write the condition as:

$$\sigma\left(c_M - \left(c_G + k_G\right)\right)\left(R_G - s + e + (1+g)s\right) < z(e-s) - (1-z)\left(1+g\right)s - q\left(\left(c_G + k_G\right) - s\right). \tag{21}$$

At the same time, the sum of benefits declines if we increase y from $\underline{y}$ to (slightly above) $\overline{y}$ if:

$$\begin{aligned}&\left(e + (1+g)s\right)\left[1 - z + \sigma\left(c_M - \left(c_G + k_G\right)\right)\right] + \underline{p}\left(c_G - \left(c_G + k_G\right) + s\right) \\ &-c_G + \left(c_B + k_B\right) - s + \sigma\left(c_M - \left(c_G + k_G\right)\right)\left(R_G - k_G\right) - q\left(\left(c_B + k_B\right) - \left(c_G + k_G\right)\right) < 0\end{aligned}$$

This implies:

$$\sigma\left(c_M-(c_G+k_G)\right)\left[R_G-s+(1+g)s+e\right]<\left[\begin{array}{c}(q-1)\left((c_B+k_B)-(c_G+k_G)\right)\\+(1-z)\left(s-(1+g)s-e-k_G\right).\end{array}\right] \quad (22)$$

Since (21) and (22) must hold at the same time, we can write:

$$\left[\begin{array}{c}\sigma\left(c_M-(c_G+k_G)\right)\\\cdot(R_G-s+(1+g)s+e)\end{array}\right]<\min\left\{\begin{array}{c}(q-1)\left((c_B+k_B)-(c_G+k_G)\right)\\+(1-z)\left(s-(1+g)s-e-k_G\right),\\z(e-s)-(1-z)(1+g)s-q\left((c_G+k_G)-s\right)\end{array}\right\}.$$

In the basic model, this inequality becomes:

$$\sigma\left(c_M-c_G\right)\left(R_G-s+(1+g)s+e\right)<\left[\begin{array}{c}-(1-z)(1+g)s\\+\min\left\{\begin{array}{c}(q-1)\left(c_B-c_G\right)-(1-z)\left(e-s\right),\\-q\left(c_G-s\right)+z(e-s)\end{array}\right\}\end{array}\right].$$

Clearly, this condition never holds when R is sufficiently large. Necessary conditions for the above inequality to hold are the two arguments in the brackets are both positive:

$$\begin{array}{rcl}(q-1)\left(c_B-c_G\right)-(1-z)\left(e-s\right) & > & 0, \text{ and}\\ -q\left(c_G-s\right)+z(e-s) & > & 0.\end{array}$$

These inequalities can never hold when $q<1$. ■

Thus, under the specified assumptions, we only need to consider a weak agreement of type $\overline{y}$. In this case, the sum of payoffs is:

$$W_G^G(\overline{y}))=\left[\begin{array}{c}\left(z+\sigma\left((c_B+k_B)-c_M\right)\right)\left(R_G-(c_G+k_G)+\overline{y}+e\right)\\-\left(1-z-\sigma\left((c_B+k_B)-c_M\right)\right)(1+g)s-q\overline{y}.\end{array}\right]$$

So, $W_G^G(\overline{y})>\max_{y\in(\overline{y},Y]}W_{BG}^G(y)$ if

$$\sigma\left((c_B+k_B)-c_M\right)R_G>\left[\begin{array}{c}\left(1-z-\sigma\left((c_B+k_B)-c_M\right)\right)\left(e-(c_G+k_G)+\overline{y}+(1+g)s\right)\\+(1-z)\,k_G+(Y-\overline{y})\,(1-q),\end{array}\right],$$

which, in the basic model, becomes:

$$\begin{array}{rcl}R & > & \dfrac{\left(1-z-\sigma\left(c_B-c_M\right)\right)\left(e-c_G+\overline{y}+(1+g)s\right)+(Y-\overline{y})\,(1-q)}{\sigma\left(c_B-c_M\right)}\\ & = & \dfrac{(1-\overline{p})\left(e+gs+c_B-c_G\right)}{\overline{p}-z}+\dfrac{(Y-\overline{y})\,(1-q)}{\overline{p}-z}.\end{array}$$

Also, $W_G^G(\overline{y}) > W_\emptyset^G(0) = zR_G$ if

$$\sigma\left(\left(c_B + k_B\right) - c_M\right) R_G > \left[\begin{array}{c} \left(z + \sigma\left(\left(c_B + k_B\right) - c_M\right)\right)\left(\left(c_G + k_G\right) - \overline{y} - e\right) \\ + \left(1 - z - \sigma\left(\left(c_B + k_B\right) - c_M\right)\right)(1+g)s + q\overline{y} \end{array}\right] \Rightarrow$$

$$\begin{aligned} R &> \frac{\left(z + \sigma\left(c_B - c_M\right)\right)\left(c_G - \overline{y} - e\right) + \left(1 - z - \sigma\left(c_B - c_M\right)\right)(1+g)s + q\overline{y}}{\sigma\left(c_B - c_M\right)} \\ &= \frac{\left[1 + \left(1 - \overline{p}\right)g - q\right]s + qc_B - \overline{p}(c_B - c_G + e)}{\overline{p} - z}, \end{aligned}$$

in the basic model. ■

Case 2: The brown party is the incumbent If both G and B comply, the objective function becomes:

$$\begin{aligned} W_G^B(y) &= z\left(R_B - k_B\right) - c_B + e + \max_{y \in (\overline{y}, Y]} y\left(1 - q\right) \\ &= z\left(R_B - k_B\right) - c_B + e + Y\left(1 - q\right). \end{aligned}$$

since $q < 1$. If there is no agreement, clearly it is optimal with $y = 0$, so $W_\emptyset^B(0) = zR_B$, which is worse than a strong agreement if: $e > c_B + zk_B - Y\left(1 - q\right)$. In the basic model in the text, this simplifies to: $e > c_B - Y\left(1 - q\right)$. If only G complies, the sum of payoffs for B and F is:

$$W_G^B(y) = p(y)\left(e - c_B + y\right) + \left(1 - p(s + y)\right)\left(R_B - (1+g)\,s\right) - qy$$

Clearly, $W_G^B(y)$ is convex in y and, for B, $\overline{y}$, is clearly dominated by either $y < \underline{y}$ or $y > \overline{y}$, so we only need to compare the latter two cases to the weak agreement $\overline{y}$. Thus, write:

$$W_G^B(\overline{y}) = \left(1 - z - \sigma\left(c_M - \left(c_G + k_G\right)\right)\right)\left(e - c_B + \underline{y}\right) + \left(z + \sigma\left(c_M - \left(c_G + k_G\right)\right)\right)\left(R_B - (1+g)\,s\right) - q\underline{y}.$$

So, $W_G^B(\overline{y}) > W_G^B(y)$ if

$$\begin{aligned} & \left(1 - z - \sigma\left(c_M - \left(c_G + k_G\right)\right)\right)\left(e - c_B + \underline{y}\right) + \left(z + \sigma\left(c_M - \left(c_G + k_G\right)\right)\right)\left(R_B - (1+g)\,s\right) - q\underline{y} \\ > \;& z\left(R_B - k_B\right) - c_B + e + Y\left(1 - q\right) \end{aligned}$$

This implies:

$$\sigma\left(c_M - \left(c_G + k_G\right)\right) R_B > \left[\begin{array}{c} \left(z + \sigma\left(c_M - \left(c_G + k_G\right)\right)\right)\left(e - c_B + \underline{y} + (1+g)s\right) \\ + \left(q - 1\right)\underline{y} - zk_B + Y\left(1 - q\right) \end{array}\right].$$

In the basic model, this can be written as:

$$R > \frac{(z + \sigma(c_M - c_G))(e - c_B + \underline{y} + (1+g)s) + (q-1)\underline{y} + Y(1-q)}{\sigma(c_M - c_G)}.$$

Similarly, $W_G^B(\overline{y}) > W_\emptyset^B(0)$ if:

$$(1 - z - \sigma(c_M - (c_G + k_G)))(e - c_B + \underline{y}) + (z + \sigma(c_M - (c_G + k_G)))(R_B - (1+g)s) - q\underline{y} > zR_B \Rightarrow$$

$$\sigma(c_M - (c_G + k_G))R_B > (z + \sigma(c_M - (c_G + k_G)))\big(e - c_B + \underline{y} + (1+g)s\big) + (q-1)\underline{y} - (e - c_B).$$

In the basic model, this becomes:

$$R > \frac{(z + \sigma(c_M - c_G))\big(e - c_B + \underline{y} + (1+g)s\big) + (q-1)\underline{y} - (e - c_B)}{\sigma(c_M - c_G)}.$$

This completes the proof. ■

7.3 Proof of Proposition 5

We here only consider the case where the first-period incumbent is G, since the proof is analogous when $i = B$. The probability that G wins is $p_G(s+y)$, given by the equation for $p_G(s)$ in Section 2.2 if just the argument s is replaced by the argument $s+y$. Define, as before, $p_G^* \equiv p_G(c_B) = z + \sigma(c_B - c_M)$.

There are three possibilities: The IEA is ineffective if $s + y < c_G$, and then the sum of payoffs for F and G is maximized by setting $s = y = 0$, giving $W_\emptyset^G = zR_G$. The IEA is instead strong if $s + y > c_B$, and then the sum of payoffs is maximized by investing the maximal amount if $q < 1$, and by investing zero and ensuring compliance by a high sanction ($s > c_B$) if $q > 1$. Therefore, the sum of payoffs can be written as:

$$W_{BG}^G = zR_G + e - c_G + \max\{0, (1-q)Y\}.$$

Finally, the IEA is weak if $s + y \in [c_G, c_B]$. In this case, the sum of payoffs for F and G is:

$$W_G^G(s,y) = p_G(s+y)(R_G - c_G + y + (1+g)s + e) - (1+g)s - qy, \tag{23}$$

Since $p_G(s+y)$ increases linearly in $s+y$, $W_G^G(s,y)$ is convex in s and y and we only need to consider the two possibilities $s + y \in \{c_G, c_B\}$.

Lemma 3.1. *A weak IEA with $s + y = c_G$ is never optimal.*

Proof. A weak IEA with $s + y = c_G$ is better than no IEA if:

$$\begin{aligned} p_G(c_G)(R_G - c_G + y + (1+g)s + e) - (1+g)s - qy > zR_G \Rightarrow \\ p_G(c_G)(e - c_G + y) + zR_G - qy \\ -(1 - p_G(c_G))(1+g)s - (z - p_G(c_G))R_G - qy > zR_G, \end{aligned}$$

which requires that $e - c_G + y > 0$. But when $e - c_G + y > 0$, the left-hand side of the previous equation is less than $(e - c_G + y) + zR_G$, the payoff we achieve by keeping y fixed while raising the sanction so much that the IEA becomes strong. ‖

Thus, for weak IEAs, we only need to consider $s + y = c_B$.

Lemma 3.2. *If the IEA is weak, then $y = c_B$ and $s = 0$ if $q < 1 + g - gp_G^*$, while $y = 0$ and $s = c_B$ otherwise.*

Proof. Consider an increase in y and a decrease in s, keeping the sum constant. The change in $W_G^G(s, y)$, given by (23), is positive if the following is positive:

$$\frac{\partial W_G^G(s,y)}{\partial y} - \frac{\partial W_G^G(s,y)}{\partial s} = p_G^* + (1 - p_G^*)(1 + g) - q,$$

which is a constant that is positive if and only if $q < 1 + g - gp_G^*$. ‖

With this, we can write the equilibrium $W_G^G(s, y)$ as:

$$\begin{aligned} W_G^G &= p_G^*(R_G - c_G + e) - \min\left\{c_B\left(q - p_G^*\right), c_B\left(1 + g\right)\left(1 - p_G^*\right)\right\} \\ &= p_G^*(R_G - c_G + e) - p_G^* c_B - c_B \cdot \min\left\{q, 1 + g - gp_G^*\right\}. \end{aligned}$$

When we compare the different cases, we get $W_G^G > W_{GB}^G$ if $R_G > R_G^{GB}$, defined as:

$$R_G^{GB} \equiv \frac{(e - c_G)(1 - p_G^*) + \max\{0, (1 - q)Y\} + p_G^* c_B + c_B \cdot \min\{q, 1 + g - gp_G^*\}}{p_G^* - z},$$

while $W_G^G > W_\emptyset^G$ if $R_G > R_G^\emptyset$, defined as:

$$R_G^\emptyset \equiv \frac{p_G^*(c_G + c_B - e) + c_B \cdot \min\{q, 1 + g - gp_G^*\}}{p_G^* - z}.$$

For a weak IEA to be strictly optimal, both conditions must be satisfied, i.e., $R_G > R_G^* \equiv \max\left\{R_G^{GB}, R_G^\emptyset\right\}$.

When $R_G < \max\left\{R_G^{GB}, R_G^\emptyset\right\}$, a weak IEA is dominated, so the comparison will be between a strong IEA and no IEA. A strong IEA is clearly better if $W_{GB}^G > W_\emptyset^G \Leftrightarrow e > c_G - \max\{0, Y(1 - q)\}$.

For the result define $e_G^{**}(q, R) = \max\{e_G^*(q, R), \widetilde{e}_G^*(q, R)\}$. Note that $e_G^{**}(q, R)$ is increasing in q. ■

7.4 Proof of Proposition 6

To characterize the equilibria, it is useful to precisely layout the timeline of the dynamic game. In every period t, at time *t.1*, if a treaty has already been negotiated in the past, then the incumbent $j \in \{B, G\}$ first decides whether to comply at cost c_j or face the

sanction negotiated in the past. At this time, the incumbent also receives R; and a player $l \in \{B, G, M\}$ receives $e - c_l$ if there is compliance, and $-s$ if there is no compliance (where s is the penalty selected in the previous period). At time $t.2$, j (re)negotiates a new treaty, specifying the sanction level for the next period. Finally, at $t.3$ there is an election, exactly as in Section 2.

We now proceed as follows. First, we characterize conditions for the existence of an equilibrium in which in every period incumbent i signs a IEA with $s = c_{-i}$; a green party complies with a previously signed IEA if $s \geq c_G$, and the brown if $s \geq c_G$. On the equilibrium path, therefore, G complies and B pays s. We refer to this as a "weak IEA" equilibrium. This will address point (ii) of Proposition 6. Second, we characterize the existence of equilibria with no agreement, and with strong agreement in which both G and B comply all the time on the equilibrium path. Finally, we show that multiple equilibria are possible and we prove point (iv) in Proposition 6.

Existence of a Weak IEA Equilibrium

Let $W_j(i)$ measure the expected continuation of $j \in \{B, M, G\}$ value evaluated at t of stage *(t+1).2* when the incumbent at *t+1* is $i \in \{B, G\}$.[43] Note that at *t.1*, in an MPE, the only state variables are the identity of the incumbent and s. It follows that, no matter what the expectation is regarding future equilibria, a G-incumbent complies in equilibrium if $s \geq c_G$, a B-incumbent complies if $s > c_B$, and the treaty is "weak" if and only if $s \in [c_G, c_B]$, just as in Section 2.

We now proceed in 3 steps. In Step 1, we characterize the relevant equilibrium value functions for the median voter. In Step 2 we characterize when the incumbent selects a weak treaty. In Step 3, we wrap up the conditions for existence.

Step 1. In line with (3) in Section 2, M elects G with probability:

$$p_i = \frac{1}{2} + \sigma \left[s - c_M + W_M(G) - W_M(B) \right], \; i \in \{B, G\},$$

Since in a equilibrium with weak treaties, i selects $s = c_{-i}$ (this is confirmed below), we have:

$$p_i = \frac{1}{2} + \sigma \left[c_{-i} - c_M + W_M(G) - W_M(B) \right]. \tag{24}$$

Just as before, i's preferred weak treaty raises i's odds of winning by σh, relative to no treaty or to a strong treaty. On the contrary, if the treaty is strong or there is no treaty, we have:

$$p_i^0 = \frac{1}{2} + \sigma \left[W_M(G) - W_M(B) \right], \; i \in \{B, G\}.$$

[43] A formal definition is presented in equation (25), (27) and (29) below.

We can now characterize the equilibrium value function given p_i. For the median voter, M:

$$\begin{aligned} W_M(G)/\beta &= p_G(e - c_M + W_M(G)) + (1 - p_G)(-c_B(1+g) + W_M(B)); \quad (25) \\ W_M(B)/\beta &= p_B(e - c_M + W_M(G)) + (1 - p_B)(-c_G(1+g) + W_M(B)). \end{aligned}$$

So, when $1 + g = 0$:

$$\begin{aligned} \frac{W_M(G) - W_M(B)}{\beta} &= 2\sigma h(e - c_M + W_M(G) - W_M(B)) \Rightarrow \\ W_M(G) - W_M(B) &= \frac{e - c_M}{1/2\beta\sigma h - 1}. \quad (26) \end{aligned}$$

For G, instead, we have:

$$\begin{aligned} W_G(G)/\beta &= p_G(R + e - c_G + W_G(G)) + (1 - p_G)(-c_B(1+g) + W_G(B)); \quad (27) \\ W_G(B)/\beta &= p_B(R + e - c_G + W_G(G)) + (1 - p_B)(-c_G(1+g) + W_G(B)). \end{aligned}$$

So,

$$W_G(G) - W_G(B) = \frac{R + e - c_G}{1/2\beta\sigma h - 1}. \quad (28)$$

Finally, for B we have:

$$\begin{aligned} W_B(G)/\beta &= p_G(e - c_B + W_B(G)) + (1 - p_G)(R - c_B G + W_B(B)); \quad (29) \\ W_B(B)/\beta &= p_B(e - c_B + W_B(G)) + (1 - p_B)(R - c_G G + W_B(B)). \end{aligned}$$

So,

$$W_B(B) - W_B(G) = \frac{R - c_B + e}{1/2\beta\sigma h - 1}. \quad (30)$$

Step 2. We now show that if a weak treaty is signed then i indeed selects $s = c_{-i}$. Since s does not influence any $W_j(i)$ directly in an MPE, the s that maximizes the probability of winning is exactly the same as in Section 2. Formally, G's optimal choice of s is especially simple when we assume, as natural to do, that G prefers to win, i.e. if $R + e - c_G + W_G(G) > W_G(B)$. This occurs when:

$$(R + e - c_G)\left[1 + \frac{1}{1/2\beta\sigma h - 1}\right] > 0,$$

which holds if $R > c_G - e \equiv R_{1a}^L$. In this case, since H can capture F's benefit of the treaty, G's preferred type of weak treaty is:

$$s_G = \arg\max_{s \in [c_G, c_B]} \left\{ \begin{array}{c} p_G(R + e - c_G + W_G(G)) \\ + (1 - p_G)[-s(1+g) + W_G(B)] \end{array} \right\} = c_B,$$

In the analogous situation for B, B's preferred choice among weak treaties will be $s = c_G$ if

$$R > c_B - e \equiv R_{1b}^L. \tag{31}$$

Note that we have $R_{1b}^L > R_{1a}^L$.

We can now characterize when selecting a weak treaty is optimal for the incumbent. Note that p_i^0 is the same if i and F sign no treaty or a strong treaty. Thus, i and F prefer no treaty to a strong treaty if and only if $e \leq c_i$. Furthermore, when $e \leq c_G$, G prefers to negotiate a weak treaty rather than no treaty if (here, the net cost of B's non-compliance decision is zero because $1 + g = 0$ and H captures F's surplus in the negotiations):

$$\begin{aligned} p_G\left[R + W_G(G) - W_G(B) - (c_G - e)\right] &> p_G^0\left[R + W_G(G) - W_G(B)\right] \Rightarrow \\ \sigma h\left[R + W_G(G) - W_G(B)\right] &> (c_G - e)\, p_G \\ &= (c_G - e)\left(\frac{1}{2} + \sigma\left[\begin{array}{c} c_B - c_M \\ +W_M(G) - W_M(B) \end{array}\right]\right). \end{aligned}$$

This can be rewritten to:

$$R > \left(\frac{c_G - e}{\sigma h}\right)\left(\frac{1}{2} + \sigma\left[h + W_M(G) - W_M(B)\right]\right) - \left[W_G(G) - W_G(B)\right]. \tag{32}$$

Using (28), we have:

$$\begin{aligned} R &= \left(\frac{c_G - e}{\sigma h}\right)\left(\frac{1}{2} + \sigma\left[h + \frac{e - c_M}{1/2\beta\sigma h - 1}\right]\right) - \frac{R + e - c_G}{1/2\beta\sigma h - 1} \Rightarrow \\ R &> R_{N,G}^L \equiv (1 - 2\beta\sigma h)\left(\frac{c_G - e}{\sigma h}\right)\left(\begin{array}{c} \frac{1}{2} \\ +\sigma\left[h + \frac{e - c_M}{1/2\beta\sigma h - 1}\right] \end{array}\right) + 2\beta\sigma h\,(c_G - e) \end{aligned}$$

Analogously, if $e < c_B$, B would prefer to negotiate B's preferred type of weak treaty, rather than no treaty, if and only if:

$$\begin{aligned} & p_B\left[W_B(G) - W_B(B) - (c_B - e) - R\right] > p_B^0\left[W_B(G) - W_B(B) - R\right] \Rightarrow \\ R &> \left(\frac{c_B - e}{\sigma h}\right)\left(\frac{1}{2} + \sigma\left[-h + W_M(G) - W_M(B)\right]\right) - \left[W_B(B) - W_B(G)\right]. \end{aligned}$$

Using (30), we can write this as:

$$R > R_{N,B}^L \equiv (1 - 2\beta\sigma h)\left(\frac{c_B - e}{\sigma h}\right)\left(\frac{1}{2} + \sigma\left[-h + \frac{e - c_M}{1/2\beta\sigma h - 1}\right]\right) + 2\beta\sigma h\,(c_B - e). \tag{33}$$

If $e > c_G$, G prefers to negotiate a weak treaty rather than a strong treaty if:

$$\begin{aligned} & p_G\left[R + W_G(G) - W_G(B) + e - c_G\right] > p_G^0\left[R + W_G(G) - W_G(B)\right] + e - c_G \\ & \Rightarrow R > \left(\frac{e - c_G}{\sigma h}\right)\left(\begin{array}{c} \frac{1}{2} \\ -\sigma\left[h + W_M(G) - W_M(B)\right] \end{array}\right) - \left[\begin{array}{c} W_G(G) \\ -W_G(B) \end{array}\right]. \end{aligned} \tag{34}$$

We can write this as:

$$R > R^L_{S,G} \equiv (1-2\beta\sigma h)\left(\frac{e-c_G}{\sigma h}\right)\left(\begin{array}{c}\frac{1}{2}\\ -\sigma\left[h+\frac{e-c_M}{1/2\beta\sigma h-1}\right]\end{array}\right)-2\beta\sigma h\,(e-c_G)\,.$$

Finally, if $e > c_B$, B would prefer to negotiate B's preferred type of weak treaty, rather than a strong treaty, if and only if:

$$\begin{aligned} p_B\left[W_B(G)-W_B(B)+e-c_B-R\right] &> p^0_B\left[W_B(G)-W_B(B)-R\right]+e-c_B \qquad (35)\\ \Rightarrow \sigma h\left[R+W_B(B)-W_B(G)\right] &> (e-c_B)(1-p_B)\\ = (c_B-e)\left(\frac{1}{2}-\sigma\left[c_G-c_M+W_M(G)-W_M(B)\right]\right) &\Rightarrow\\ R > \left(\frac{e-c_B}{\sigma h}\right)\left(\frac{1}{2}-\sigma\left[-h+W_M(G)-W_M(B)\right]\right)&-\left[W_B(B)-W_B(G)\right]. \end{aligned}$$

We can write this as:

$$\begin{aligned} R &> \left(\frac{e-c_B}{\sigma h}\right)\left(\frac{1}{2}-\sigma\left[-h+\frac{e-c_M}{1/2\beta\sigma h-1}\right]\right)-\frac{R-c_B+e}{1/2\beta\sigma h-1} \Rightarrow\\ R &> R^L_{S,B} \equiv (1-2\beta\sigma h)\left(\frac{e-c_B}{\sigma h}\right)\left(\frac{1}{2}-\sigma\left[-h+\frac{e-c_M}{1/2\beta\sigma h-1}\right]\right)-2\beta\sigma h\,(e-c_B)\,. \end{aligned}$$

Step 3. We can now wrap up the condition for existence. Define:

$$R^L_2 \equiv \left\{\begin{array}{c}\max\left\{R^L_{N,G},R^L_{N,B}\right\} \text{ if } e<c_G;\\ \max\left\{R^L_{S,G},R^L_{N,B}\right\} \text{ if } e\in[c_G,c_B];\\ \max\left\{R^L_{S,G},R^L_{S,B}\right\} \text{ if } e>c_B.\end{array}\right\}.$$

and $R^L \equiv \max\{R^L_{1b}, R^L_2\}$, where R^L_{1b} is defined in (31). It is clear from the analysis above that exists an MPE in which the treaty is always weak if and only if $R \geq R^L$. Point (iv) of Proposition 6 follows when (24) is combined with (26).

Strong Equilibria and Equilibria with no treaties

If there is never any treaty in equilibrium, or if there is always a strong treaty, then, $W_M(G) = W_M(B)$, $p^0_i = 1/2$, and $W_i(i) = W_i(-i)$. When these equations are substituted into the reversed versions of (32) and (33), we find that G and B will indeed negotiate no treaty (rather than a weak treaty) if $e < c_G$ and:

$$R \leq (c_G-e)\left(\frac{1}{2\sigma h}+1\right) \text{ and } R \leq (c_B-e)\left(\frac{1}{2\sigma h}-1\right).$$

Let R_N^H be defined as the minimum of the two thresholds. Clearly, when $R \leq R_N^H$ and $e < c_G$, then there is an equilibrium in which there is never any treaty.

When $e > c_B$ and we consider (34) and (35), we get instead that G and B will indeed negotiate a strong treaty (rather than a weak treaty) if:

$$R \leq (e - c_G)\left(\frac{1}{2\sigma h} - 1\right) \text{ and } R \leq (e - c_B)\left(\frac{1}{2} + \sigma h\right).$$

Let R_S^H be defined as the minimum of the two thresholds and let R^H be defined as:

$$R^H \equiv \left\{ \begin{array}{l} R_N^H \text{ if } e < c_G; \\ R_S^H \text{ if } e > c_B. \end{array} \right\}.$$

Note that, for Proposition 6(i), R^H does not need to be defined for $e \in (c_G, c_B)$ since, in this case, there is no equilibrium with always a strong treaty, nor any equilibrium with never any treaty.

Multiplicity

From the previous analysis we know that multiple equilibria exist if $R \in (R_L, R_H)$. To see that the interval (R_L, R_H) is nonempty for some set of fundamentals suppose $e < c_G \approx c_B$. Then, $R^H = R_N^H = (c_B - e)\left(\frac{1}{2\sigma h} - 1\right)$ while $R^L < 0$, according to (32) and (33). Thus, for $R \in \left(0, R_N^H\right)$, there exist an equilibrium with weak treaties always as well as an equilibrium without any treaty. ■

7.5 A Weak IEA equilibrium without commitment

In this section show that when the preference of G and B are not too dissimilar (that is h is positive but sufficiently small), then the Weak IEA equilibrium is a subgame perfect equilibrium of the dynamic game even if H can not commit to paying s in case of non-compliance.

In the game without commitment, the timing is as follows. In every period t, at time *t.1*, if a treaty has already been negotiated in the past, then the incumbent $j \in \{B, G\}$ first decides whether to comply at cost c_j or face the sanction negotiated in the past. At time *t.2*, if there is no compliance, H decides to respect the treaty or exit and refuse to pay s. At this time, the incumbent also receives R; and a player $l \in \{B, G, M\}$ receives $e - c_l$ if there is compliance, pays $-s$ if there is no compliance (where s is the penalty selected in the previous period) but the treaty is respected, and pays zero if there is no compliance and the treaty is not respected. At time $t.4$, j (re)negotiates a new treaty, specifying the sanction level for the

next period. Finally, at *t.5* there is an election, exactly as in Section 2. We now construct an equilibrium that is identical to the Weak IEA Equilibrium of Section 6.5.1, except after a situation in which B or G do not comply and do not pay s (i.e. they violate the treaty). In this case, H and F never sign a IEA anymore. It is easy to see that this is a subgame perfect equilibrium that generates continuation values equal to $(1-\beta)V(i) = R/(1-\beta)$ for $i = B, G$. To verify that this construction constitutes a subgame perfect equilibrium we only need to show that, given this punishment, neither B nor G have an incentive to violate the agreement at *t.2*.

The G party

The G party does not violate the IEA commitment to pay s in a weak IEA equilibrium if:

$$\begin{aligned} R + e - c_G + W_G(G) &\geq R + \frac{\beta R}{2(1-\beta)} \\ &\Leftrightarrow (1-\beta) W_G(G) \geq \frac{\beta R}{2} - (1-\beta)(e - c_G) \end{aligned}$$

We have:

$$\begin{aligned} (1-\beta) W_G(G) &= \beta p_G (R + e - c_G + W_G(G) - W_G(B)) \\ &= \beta p_G \frac{1/(2\beta\sigma h)}{1/(2\beta\sigma h) - 1} (R + e - c_G) \end{aligned}$$

Thus:

$$\beta p_G \frac{1/(2\beta\sigma h)}{1/(2\beta\sigma h) - 1} (R + e - c_G) \geq \frac{\beta R}{2} - (1-\beta)(e - c_G)$$

or

$$\frac{1}{2}\frac{\beta}{1-\beta}\left[2p_G \frac{1/(2\beta\sigma h)}{1/(2\beta\sigma h) - 1}(R + e - c_G) - R\right] \geq -(1-\beta)(e - c_G)$$

When $e - c_G > 0$, this is always verified since $2p_G \frac{1/(2\beta\sigma h)}{1/(2\beta\sigma h)-1} > 1$.

The B party

The B party does not violate the IEA commitment to pay s in a weak IEA equilibrium if:

$$R - c_B + W_B(B) \geq R + \frac{\beta R}{2(1-\beta)}$$

Thus:

$$(1-\beta) W_B(B) \geq \frac{\beta R}{2} + (1-\beta) c_B \tag{36}$$

Using (30) we have:

$$W_B(B)/\beta = p_B(e - c_B + W_B(G)) + (1 - p_B)(R + W_B(B))$$
$$\Leftrightarrow W_B(B) = \beta p_B\left(e - c_B - R - \frac{R - c_B + e}{1/(2\beta\sigma h) - 1}\right) + \beta R + \beta W_B(B)$$

Thus:

$$\begin{aligned}(1-\beta)W_B(B) &= \beta R + \beta p_B\left(e - c_B - R - \frac{R - c_B + e}{1/(2\beta\sigma h) - 1}\right) \\ &= \beta\left(1 - p_B\frac{1/(2\beta\sigma h)}{1/(2\beta\sigma h) - 1}\right)R + \beta p_B\frac{1/(2\beta\sigma h) - 2}{1/(2\beta\sigma h) - 1}(e - c_B)\end{aligned}$$

Inserting in (36), we have:

$$\beta\left(1 - p_B\frac{1/(2\beta\sigma h)}{1/(2\beta\sigma h) - 1}\right)R + \beta p_B\frac{1/(2\beta\sigma h) - 2}{1/(2\beta\sigma h) - 1}(e - c_B) \geq \frac{\beta R}{2} + (1-\beta)c_B \qquad (37)$$
$$\Leftrightarrow \beta\left(\frac{1}{2} - p_B\frac{1/(2\beta\sigma h)}{1/(2\beta\sigma h) - 1}\right)R + \beta p_B\frac{1/(2\beta\sigma h) - 2}{1/(2\beta\sigma h) - 1}(e - c_B) \geq (1-\beta)c_B$$

As $\beta \to 1$ this inequality is satisfied if:

$$\frac{1}{2} - p_B\frac{1/(2\sigma h)}{1/(2\beta\sigma h) - 1}R + \beta p_B\frac{1/(2\beta\sigma h) - 2}{1/(2\beta\sigma h) - 1}(e - c_B) \geq (1-\beta)c_B$$

where, recall that:

$$\begin{aligned}p_B &= \frac{1}{2} + \sigma\left[c_G - c_M + W_M(G) - W_M(B)\right] \\ &= \frac{1}{2} + \sigma\left[\frac{e - c_M}{1/(2\beta\sigma h) - 1} - h\right]\end{aligned}$$

As $h \to 0$, we have that $p_B \to 1/2$, and the left hand side of (37) converges to $(e - c_B)/2 > 0$. It follows that as $h \to 0$ (37) is satisfied if $\beta \geq \left(\frac{3}{2}c_B - e\right)/c_B < 1$. We conclude that there is an $h^* > 0$ and a $\beta^* < 1$ such that a Weak IEA equilibrium is an equilibrium of the game with no commitment if $h < h^*$ and $\beta > \beta^*$. ■

7.6 Data description and sources:

Enviromental Treaties: The dataset includes for each considered treaty the participant countries and the corresponding dates of signature, ratification, entry into force, and withdraw. Source: International Environmental Agreements Database Project (https://iea.uoregon.edu/).

For the logit model, the treaties we consider are[44]:

[44]In parentheses is shown the year that the agreement was opened for signature.

1. Convention on the Prohibition of Military or Any Other Hostile Use of Environmental Modification Techniques (1976)
2. Protocol to the International Convention for the Prevention of Pollution From Ships - Protocol and Annexes I and II (1978)
3. Convention on Long-Range Transboundary Air Pollution (1979)
4. Convention on the Conservation of Migratory Species of Wild Animals (1979)
5. Convention on the Physical Protection of Nuclear Material (1980)
6. Convention on the Conservation of Antarctic Marine Living Resources (1980)
7. United Nations Convention on the Law of the Sea (1982)
8. Convention for the Protection of the Ozone Layer (1985)
9. United Nations Convention on Conditions for Registration of Ships (1986)
10. Convention on Early Notification of a Nuclear Accident (1986)
11. Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency (1986)
12. Montreal Protocol on Substances that Deplete the Ozone Layer (1987)
13. Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal (1989)
14. International Convention on Salvage (1989)
15. International Convention on Oil Pollution Preparedness, Response and Cooperation (1990)
16. Convention on Environmental Impact Assessment in a Transboundary Context (1991)
17. Convention on the Transboundary Effects of Industrial Accidents (1992)
18. United Nations Framework Convention on Climate Change (1992)
19. Convention on Biological Diversity (1992)
20. Convention on the Prohibition of the Development, Production, Stockpiling and Use of Chemical Weapons and on their Destruction (1993)

21. Convention to Combat Desertification in Those Countries Experiencing Serious Drought and/or Desertification, Particularly in Africa (1994)

22. Agreement Relating to the Implementation of Part XI of the United Nations Convention on the Law of the Sea (1994)

23. Convention on Nuclear Safety (1994)

24. Agreement for the Implementation of the Law of the Sea Convention Relating to the Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks (1995)

25. International Convention on Liability and Compensation for Damage in Connection with the Carriage of Hazardous and Noxious Substances by Sea (1996)

26. Convention on the Law of the Non-Navigational Uses of International Watercourses (1997)

27. Protocol to the United Nations Framework Convention on Climate Change (1997)

28. Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management (1997)

29. Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade (1998)

30. Cartagena Protocol on Biosafety to the Convention on Biological Diversity (2000)

31. Convention on Persistent Organic Pollutants (2001)

The selection criteria in this case was based on the multilateral enviromental agreements list presented in Appendix 6.1 from the book *"Environment and Statecraft"* by Scott Barrett (2003). According to Barrett even when this is one of the most comprehensive list of agreements it is still incomplete. For example, it excludes treaties not intentionally designed to protect the environment but that have implications for environmental protection. Moreover, it omits certain protocols and amendments [Barret. 2003:134]. In our case, from the total sample of agreements in Appendix 6.1 we restricted attention to treaties opened for signature after 1976 and with a global perspective.

In the logit model the dependent variable was a dummy equal to one if the country signed the treaty during the first five years that it was open for signature. As shown in Table 3 the results do not change if we consider ratification rather than signature.

The independent variables in the model capture the characteristics of the country at the year that the agreement was open for signature.

For the effectiveness regressions, the treaties we consider are[45]:

1. Protocol on the Reduction of Sulphur Emissions or their Transboundary Fluxes by at Least 30 per cent to the Convention on Long-Range Transboundary Air Pollution (1985)

2. Protocol Concerning the Control of Emissions of Nitrogen Oxides or their Transboundary Fluxes to the Convention on Long-Range Transboundary Air Pollution (1988)

3. Protocol Concerning the Control of Emissions of Volatile Organic Compounds or their Transboundary Fluxes to the Convention on Long-Range Transboundary Air Pollution (1991)

4. Protocol on Further Reduction of Sulphur Emissions to the Convention on Long-Range Transboundary Air Pollution (1994)

5. Protocol On Heavy Metals to the Convention on Long-Range Transboundary Air Pollution (1998)

6. Protocol on Persistent Organic Pollutants to the Convention on Long-Range Transboundary Air Pollution (1998)

7. Protocol to Abate Acidification, Eutrophication and Ground-Level Ozone to the Convention on Long-Range Transboundary Air Pollution (1999)

We follow Slechten and Verardi [2014] in order to select the agreements in this case. The treaties we consider belong to the Convention On Long-Range Transboundary Air Pollution lineage, and consists of agreements against conventional air-pollutants.

The dependent variable in Table 2 is the number of agreements signed at time $t-1$. However, if we consider as dependent variable the number of agreements ratified at time $t-1$ the conclusions are maintained (see Table 4)

The panel data in Table 2 and 4 cover the period 1960-2011.

Moreover, as is shown in Table 5 and 6 the conclusions on effectiveness are maintained if we consider all the agreements in the logit model that relate to air pollution issues. These agreements are:

1. Convention on Long-Range Transboundary Air Pollution (1979)

[45] In parentheses is shown the year that the agreement was opened for signature.

2. Convention for the Protection of the Ozone Layer (1985)

3. Montreal Protocol on Substances that Deplete the Ozone Layer (1987)

4. United Nations Framework Convention on Climate Change (1992)

5. Protocol to the United Nations Framework Convention on Climate Change (1997)

Polity2: this variable is a score for democracy. It ranges from +10 (string democratic) to -10 (strong autocratic). Source: Polity IV Project
(http://www.systemicpeace.org/polity/polity4.htm)

Democracy: it is a dummy variable, and takes the value of one if Polity2 is strictly positive.

Regime durability: the number of years since the most recent regime change. Source: Polity IV Project (http://www.systemicpeace.org/polity/polity4.htm)

Plurality: dummy variable equal to one if the electoral rule is plurality. In this system the legislators are elected using a winner-take-all/first past the post rule. Source: Database of Political Institutions 2012
(http://econ.worldbank.org/WBSITE/EXTERNAL/EXTDEC/EXTRESEARCH/0 „contentMDK:20649465 pagePK:64214825 piPK:64214943 theSitePK:469382,00.html)

Proportional representation: dummy variable equal to one if the electoral rule is proportional representation. In this system the candidates are elected based on the percent of votes received by their party. Source: Database of Political Institutions 2012 (http://econ.worldbank.org/ WBSITE/EXTERNAL/EXTDEC/EXTRESEARCH/0„ contentMDK:20649465 pagePK:64214825 piPK:64214943 theSitePK:469382,00.html)

Africa: regional dummy indicating whether country is located in Africa. Source: Persson and Tabellini [2003]

East Asia: regional dummy indicating whether country is located in East Asia. Source: Persson and Tabellini [2003]

Latin America: regional dummy indicating whether country is located in Latin America. Source: Persson and Tabellini [2003]

OECD: dummy indicating whether country is an OECD member.
Source: List of OECD Member countries - Ratification of the Convention on the OECD
(http://www.oecd.org/about/membersandpartners/ list-oecd-member-countries.htm)

CO_2: level of CO_2 emissions in kilotons. Source: World Development Indicators Dataset.
(http://data.worldbank.org/indicator?tab=all)

GDP: Gross Domestic Product in constant 2010 US dollars. Source: World Development Indicators Dataset.
(http://data.worldbank.org/indicator?tab=all)

Population: Total Population. Source: World Development Indicators Dataset.

(http://data.worldbank.org/indicator?tab=all)

Openness: Trade openness, is the sum of exports and imports of goods and services measured as a share of GDP.

Source: World Development Indicators Dataset.

(http://data.worldbank.org/indicator?tab=all)

GDP growth rate: the GDP growth rate is estimated from the GDP variable.

Prop. Agriculture: share of agricultural production in GDP. Source: World Development Indicators Dataset.

(http://data.worldbank.org/indicator?tab=all)

Prop. Industry: share of industrial production in GDP. Source: World Development Indicators Dataset.

(http://data.worldbank.org/indicator?tab=all)