

Compliance Institutions in Treaties

Brett M. Frischmann
Benjamin Cardozo School of Law
55 Fifth Avenue
New York, NY 10003

James C. Hartigan
Department of Economics
University of Oklahoma
Norman, Oklahoma 73019-2103

August 18, 2010

Abstract

Due to the costs of negotiating treaties, signatories may defer the resolution of uncertainty to the future rather than include all possible states of nature in a treaty. This particularly will be the case when addressing uncertainty increases negotiating costs. In such a context, the existence and form of compliance institutions is of particular importance. We develop a formal model to consider the relationship among treaty negotiation, compliance institutions, and uncertainty over future states of nature. In our model, states of nature determine the costs of compliance with a treaty. We explain that when resolving uncertainty is deferred to the future and compliance costs are unobservable, an escape clause facilitates viability of a treaty. When escape is considered *de jure* compliance, and signatories are incompletely informed about one another's costs of compliance, an incentive for opportunistic breach arises. In such a context, we demonstrate that a dispute resolution mechanism that discloses compliance costs of a signatory invoking escape can deter spurious use of the clause. We incorporate uncertainty through the specification of a discrete time,

continuous state stochastic compliance function. Because many policies for which treaties are negotiated exhibit persistence in their costs of compliance, we contrast compliance costs processes with and without persistence. We disclose that persistence may undermine the effectiveness of an escape clause (with a dispute resolution mechanism) in promoting compliance. Persistence increases the cost of treaty negotiation by increasing expected costs of compliance. These increased negotiating costs may result in fewer commitments, further rendering the treaty less viable. To mitigate, compliance institutions can be designed to respond dynamically to evolving conditions. When an escape clause fails to preserve compliance under persistence, dynamic adjustment may be more likely, as renegotiation requires a stronger commitment to the agreement. When dynamic adjustment entails periodic scheduled reconvening of signatories, compliance is undermined and disputes are more frequent.

Key words: treaty, compliance, international law, institutions, uncertainty, escape clause, opportunistic breach

JELCodes: F13, K33

*We thank, without implicating, Indranil Chakraborty, Tom Gresik, Andrew Guzman, Sajal Lahiri, Rod Ludema, Alan Sykes, Henry Wan, an anonymous referee, and participants at the Midwest International Economics Group Meetings. Corresponding author: James C. Hartigan, Department of Economics, University of Oklahoma, Norman, Oklahoma, 73019-2103. Telephone 405-325-5501. Fax: 405325-5842. Email: hartigan@ou.edu

1 Introduction

States often enter into agreements to facilitate cooperation. How effective their cooperation may be depends upon many factors, including the nature of the problem, the states involved, and the institutional framework within which their ongoing relations are structured. Recently, scholars have questioned how agreements elicit compliance. Important insights in the analysis of this issue have been derived through the application of games¹. In this

¹Given the differing traditional foci of the two disciplines, it is not surprising the interest in international institutions developed somewhat later in economics than in legal scholarship. However, scholars from both disciplines have come to recognize that the use of games, which is replete in economics, is well suited to the analysis of international agreements.

paper, we develop a formal (game theoretic) model to better understand how the design and utility of particular compliance institutions, specifically escape clauses and dispute settlement mechanisms, depend upon *the degree and nature of uncertainty* regarding the future².

States recognize that international agreements entail noncompliance (defection) incentives of a repeated (super-game) structure. However, they are also cognizant of the possibility that the game itself may change over time. Payoffs may change in magnitude or certainty, and the costs of compliance may also evolve.

Designing institutions and procedures to address not only current incentives for compliance, but also that are sufficiently flexible to adjust to the possibility of changing conditions may render treaty negotiations to be very complex. This complexity may make negotiations protracted and costly. This cost can be managed by the negotiation of a treaty that is incomplete. That is, obligations and penalties for noncompliance in some states of nature are left unspecified³. Thus states deliberately may negotiate treaties and

Within international trade, this interest was stimulated by Bagwell and Staiger's (1999, 2004) analysis of the efficiency of the rules of negotiation of the General Agreements on Tariffs and Trade/World Trade Organization (GATT/WTO). These include reciprocity, most favored nation (MFN), and the nullification and impairment complaint. Bagwell and Staiger (2001) have also considered the global efficiency of international environmental and labor standards. Another example is Saggi's (2004) analysis of the effect upon global welfare provided by MFN.

For recent legal scholarship employing games to explore international institutions, see, for example, Guzman (2002), Goldsmith and Posner (1999), and Setear (1996, 1997). International relations scholars and political scientists have also used games to study international cooperation. Examples are Carlson (2000), Koremenos et al (2001), Oye (1985), and Snidal (1985, 2002).

²Within political science, Koremenos (2005) has addressed uncertainty in the relative benefits accruing to signatories of international agreements. She considers the optimal duration of an agreement and its renegotiation when exogenous international shocks that are independently and identically distributed may arise in each period and have a cumulative effect upon relative benefits. Her renegotiation resets the distribution of gains to that of the original agreement, with renegotiation bargaining power invariant with respect to the evolution of benefits. She contrasts the renegotiation of the distribution of benefits under international uncertainty with an escape clause providing temporary relief from obligations in response to a *domestic* shock. As she highlights, an escape clause does not allow the adjustment of an agreement. Nonetheless, if noncompliance (escape) becomes persistent due to unanticipated domestic costs of adherence to commitments, signatories may seek renegotiation or adjustment of obligations.

³Presumably these are states that are low probability events, are difficult in which to

agreements for which future performance is left uncertain. However, such uncertainty and the possibility of opportunistic breach still may threaten the viability of a treaty. To overcome these obstacles for cooperation, states frequently resort to the inclusion of escape clauses and dispute settlement procedures in the treaty. Our model explores the relationship between these institutions and assesses their effectiveness in sustaining cooperation/compliance under different conditions of prospective uncertainty. In particular, we focus upon uncertainty regarding the future costs of compliance with the treaty⁴. Because enforcing compliance with a treaty may be problematic due to the lack of a strong supranational institutional concomitant to the treaty, escape clauses may be introduced to camouflage noncompliance that would transpire anyway. This preserves the appearance of the integrity of the treaty.

Escape clauses permit a signatory to remain in *de jure* compliance while temporarily being in *de facto* noncompliance⁵. By focusing upon stochastic costs of compliance, we will establish that an escape clause may not be sufficient to preclude justifiable breach of the treaty. This is established by contrasting two mean reverting, discrete time, continuous state stochastic processes for the costs of compliance. One exhibits persistence, while the other does not. The escape clause is more likely to preserve viability in the latter case than in the former⁶. When persistence is sufficient to undermine compliance, the case for an international institution under whose auspices the renegotiation or dynamic revision of treaties takes place is much more compelling. Dynamic revision can entail the scheduling of periodic reconvening of membership to address enhanced commitment to the objectives

achieve enforcement, are difficult in which to verify compliance, are difficult in which to reach agreement, or are difficult to ratify.

⁴We thank Andrew Guzman for noting that our results would be robust to specifying the model in terms of the net benefit of the treaty in lieu of the costs of complying with it. However, variations in the costs of compliance are a source of differences in net benefits, and provide an explicit reason as to why those benefits may fluctuate. When solving for the costs of compliance for which commitments are made in the negotiation of the treaty, we use payoff functions that have compliance costs as the argument. These are, in essence, net benefit functions. Thus our difference with Guzman is primarily one of semantics.

⁵An escape clause likely will have explicit requirements, such as an investigation establishing that specific conditions are met, as well as, a maximum length of time for which the clause can be invoked. To an extent, a duration restriction can substitute for a dispute settlement mechanism because it mitigates the losses incurred by the complying state when another signatory escapes. This reduces the incentive to file a complaint.

⁶The extent of this distinction depends upon the degree of persistence, as we shall explain.

of the treaty and problems with implementation of previous commitments. The alternative is more costly treaty negotiation in the form of more detailed commitments.

An important element of our model of compliance is the possibility of treaty signatories invoking dispute resolution. This possibility is to deter spurious (opportunistic) use of the escape clause, which could jeopardize compliance. A formal dispute resolution mechanism provides for the imposition of direct sanctions in the event of spurious (non-sanctioned) noncompliance⁷. We contend that a dispute procedure is a viable deterrent to noncompliance when compliance costs are trendless and do not exhibit persistence⁸.

Frischmann (2003, 2005) has argued that focusing on the use of sanctions to enforce treaty commitments is overly narrow, and that institutional forms can be (and in fact are) more flexible in the pursuit of compliance. This includes provisions for the evolution and renegotiation of commitments. Our characterization of compliance costs that are stochastic with a persistence (auto-regressive) component underscores Frischmann's point. In our context, compliance will occur for a cost realization that falls within a negotiated set (range) of costs. A realization that is not contained by (is not an element of) this set is readily addressed by an escape clause and dispute resolution mech-

⁷In our framework, sanctions take the form of reversion to the one shot Nash equilibrium. The importance of sanctions, both direct and indirect, is an emphasis of Guzman (2002).

⁸Although there is a substantial legal literature pertaining to disputes in treaties, the contributions by economists is still fairly limited. Kovenock and Thursby (1992) and Mitchell (1997) have considered the incentives for compliance provided by GATT/WTO authorized retaliation for noncompliance. Ludema (2001) modeled the DSU as a set of conditions imposed upon the punishment equilibria of a repeated game, with the conditions consistent with the WTO principles of conciliation and reciprocity. Maggi (1999) demonstrates that a DSU can verify violations of a treaty and facilitate enforcement through the informing of nonparties to a dispute. Hungerford (1991) suggested that dispute settlement under the GATT was costly and unproductive. Bown (2002) distinguishes between legal (escape clause) and illegal responses to an exogenous shock between negotiating rounds of the WTO. If a signatory is apprehended after violating the treaty, a trade dispute arises as a form of renegotiation of the agreement. Bown (2004a) provides an empirical assessment of trade disputes and escape under the GATT. Bown (2004b) assesses the potential costs imposed by the GATT/WTO DSU that permit defendant signatories to commit to trade liberalization. Bown (2005), discussing the finding that antidumping (AD) remedies have been frequently inconsistent with GATT/WTO obligations, analyzes the determinants of the decision to challenge US invocation of such remedies through the DSU. Butler and Hauser (2000) disclose that weak implementation procedures reinforce the incentives to violate the WTO agreement. For several additional contributions, see Hartigan (2009).

anism in the absence of persistence. However, when persistence is sufficiently strong, non-sanctioned or sanctioned noncompliance may be repetitive if a realization that is not an element of this set occurs⁹. The effects of persistence are particularly deleterious when it substantially increases negotiating costs for the agreement. This is despite the existence of the clause cum dispute procedure. We thus contend that renegotiation or a flexible institutional form may be needed for continued compliance. An alternative to such flexibility is the negotiation of a treaty containing more states of nature (in our context, more compliance costs realizations). Klimenko, Ramey, and Watson (2008) demonstrate that in the context of adjustment of commitments, recurrent negotiation interferes with enforcement. Thus cooperation fails, and flexibility may not be a good thing. In their framework, a dispute settlement institution facilitates compliance through the imposition of a delay (and hence a cost) in the restoration of cooperation. Although their dispute settlement procedure has no monitoring or enforcement powers, it succeeds by credibly conditioning agreements on the history of interaction by their signatories. Thus flexibility is a benefit only if combined with dispute settlement.

We begin our formal presentation by comparing and contrasting the compliance cost functions that we will utilize for our discussion of compliance with, escape from, and opportunistic breach of treaty commitments. The distinction between opportunistic breach and escape is based upon whether or not a signatory invokes the escape clause when its compliance costs are elements of the set for which compliance is agreed to occur¹⁰. Because our framework is that of an infinite horizon Prisoners' Dilemma with unobserved costs of cooperation, we consider the equilibrium to this game in the absence of a treaty as a baseline comparison. We then proceed to the development of the two player (signatory) game with a treaty of (possibly) infinite horizon in which there are three stages. As is usual under sub-game perfection, we begin the solution with the third stage. In this stage, which occurs in every period in which the treaty remains in effect, each signatory's choice set consists of whether or not to file a dispute. It will only do so when the other signatory did not comply.

⁹By sanctioned noncompliance we intend to convey a valid invocation of the escape clause.

¹⁰Opportunistic breach connotes the invocation of escape for a compliance cost for which the signatories have agreed that commitments will be fulfilled. This use of the escape clause is intended to take advantage of the incomplete information about compliance costs in periods subsequent to the negotiation of the treaty.

The second stage is the one in which the decision to comply, escape, or opportunistically breach is made. This decision depends upon the realization of a randomly drawn cost of compliance for each signatory in each period. Thus this stage occurs in every period in which the treaty remains in effect. The equilibrium in this stage is one of trigger strategies. We define the engaging in sanctioned noncompliance (escape), as abiding by the terms of the treaty.

In the first stage, which only takes place in the initial period (unless the treaty is renegotiated or there is a scheduled reconvening of members), the countries engage in a Nash bargain over the set of possible compliance cost realizations for which they agree to abide by the treaty. A treaty that imposes compliance for any level of compliance costs is a simple agreement that may be negotiated at low costs. However, it may be unenforceable if compliance costs realizations can be excessive. In that regard, a treaty with costs of compliance of zero is assumed to be negotiable at a cost of near zero. A treaty with prohibitive costs of compliance is assumed to be negotiable at a cost of near zero but is unenforceable. We suppose that the costs of negotiation are a concave function of compliance costs. We define an enforceable treaty as one for which compliance will transpire for its compliance costs. For tractability, we assume that the largest value of costs in the set of enforceable treaties is strictly less than the value of compliance costs that maximizes the concave negotiating costs function. A treaty with a greater compliance costs for which a commitment is enforceable is deemed to be a more costly treaty to negotiate.

Introducing uncertainty raises the cost of negotiation, as compliance cost realizations in excess of their expectation become possible¹¹. This requires a negotiation regarding performance commitments when compliance costs exceed their expectation for a signatory. It entails an agreement as to the level of cost in which noncompliance is permitted, and the establishment of rules and procedures pertaining to the invocation of a safeguard (escape clause). This includes the deterrence of spurious escape or opportunistic breach by instituting a dispute settlement procedure. The compliance cost generating function (with or without persistence) affects the states of nature (compliance costs) that are included in the treaty. With persistence the escape clause may be rendered less effective than in the absence of auto-

¹¹We accommodate uncertainty by assuming that negotiating costs are a concave function of expected compliance costs.

regression. This is particularly likely when the effect of persistence increases the cost of negotiating more than it raises the probability of high compliance cost realizations.

As a treaty for which compliance is permanently vitiated is not renegotiation proof, we consider three possible avenues for the reestablishment of compliance. One is the dynamic adjustment of concessions. In this instance, signatories fail to cooperate for possibly several periods, but compliance is restored through penance strategies. Another is the renegotiation of commitments. Since the latter requires a stronger commitment to the agreement, the former may be more plausible¹². Thirdly, signatories may schedule (flexibly or rigidly) the reconvening of membership to address commitments that have proven difficult to honor since a preceding revisitation.

In summary, our paper makes six points regarding compliance institutions in treaties: (1) The existence of uncertain future compliance costs mandates an escape clause. (2) The existence of private information mandates a dispute settlement procedure. (3) Persistence in compliance costs is more likely to undermine compliance than randomized variation in such costs. (4) An escape clause may be ineffective when high persistence combines with a high a realization of compliance costs. (5) Despite the greater likelihood of high compliance costs under persistence, the set of costs for which commitments are made under persistence may be smaller than the set for its absence if persistence raises negotiating costs substantially. (6) Frequent scheduled revisitation of commitments through ministerial meetings undermines compliance and increases the filing of disputes.

2 A Model

To consider the issue of compliance with international agreements, let us assume two identical countries, $i = 1, 2$. This is completely general, unless one were to address partial compliance, in which a proper subset of countries were to engage in cooperation or cooperation were to occur in a subset of negotiated commitments. We suppose that each country knows that they are identical at the time of treaty negotiation, and that this may be verified without cost. Unless we were to consider incomplete information about each country's compliance costs in the negotiation of a treaty, the assumption of

¹²A stronger commitment in our context entails the willingness to cooperate when compliance is more costly.

homogeneous (and commonly known) costs of compliance provides considerable gains in tractability at little sacrifice in generality¹³. It does preclude consideration of asymmetric bargaining over treaty parameters. However, we suppose reasonably that the country with the higher costs of compliance determines the accomplishments of the treaty under asymmetry. As the focus of this paper is on compliance, we abstract from these issues and assume initial homogeneity. As part of the assumption of homogeneity, we assume symmetric goals for the treaty. After the negotiation, compliance costs for each country are drawn randomly from the same distribution in each period. These costs are exogenous and are not subject to manipulation by the signatories.

As was noted in the introduction, we consider two possible costs of compliance functions. One is driftless with a random component. That is, it is a discrete time continuous state random walk. The other is another form of discrete time continuous state stochastic process. It is a first order autoregressive process. These are both Markov processes, and are both mean reverting. We will demonstrate that the initial specification of the compliance function can be accommodated readily by an escape clause in a treaty. The autoregressive specification, however, may require repetitive sanctioned noncompliance (escape from) and/or renegotiation of the treaty. It may alternatively require scheduled revisitation of commitments. Our solution utilizes sub-game perfection. The decision as to whether or not to file a dispute after another signatory does not comply with the treaty in any period takes place in the third stage of the game. The decision to comply, escape, or engage in non-sanctioned noncompliance is made in stage two. Stage one is the negotiation of the set of compliance costs for abiding by the treaty. We begin by specifying the compliance cost functions.

2.1 The Compliance Costs Functions

2.1.1 Driftless with a Random Component

The current cost of compliance c_0 , where $c_0 \in \mathbb{R}^+$, is known to both countries at the time of negotiation of the treaty. Alternatively, countries are able to represent their current costs credibly to one another through the process of negotiation. Possible examples of this cost entail that of implementing

¹³Of course, it would be possible to invoke the revelation principle if information about costs were asymmetric. See Myerson (1979).

environmental protection or labor standards, as well as, the cost of diffusing anti-trade interests. What is not known are the future realizations of this cost in each period of discrete time in an infinite horizon. This is a manifestation of uncertainty in the negotiation of a treaty. This uncertainty will take two forms. The first entails a constant expected cost in each future period. That is, there is no trend. However, there is a constant finite variance in the compliance cost. Thus the cost in any future period t is given by

$$c_t = c_0 + \varepsilon_t, \quad \varepsilon_t \sim (0, \sigma_c^2) \quad (1)$$

where ε_t can be viewed as the forecast error of compliance costs in period t . This error has a mean of zero and a finite variance of σ_c^2 . Thus the countries know the (well behaved) continuous probability distribution $F(c)$ and its density function $f(c)$ over future costs, but do not know their actual realizations at the time of treaty negotiation. This distribution has support over a finite interval of \mathbb{R}^+ . That support can be partitioned into compact sets of compliance costs given by Ω and Γ , which we will define subsequently. We will contend that compliance costs that are characterized by (1) can be addressed by negotiating an escape clause in the treaty¹⁴. This is because knowledge of c_t does not resolve any uncertainty about c_{t+1} . The expected value of c_{t+1} is $E(c_{t+1}) = c_0$. The countries negotiate the realization of compliance costs which will induce them to abide by the treaty. Any c_t not an element of that set may be viewed reasonably as an occasional occurrence. That is, if the realizations of compliance costs that are addressed by the treaty are a set of reasonable measure. An escape clause is well designed to address episodic, but not persistent, noncompliance. In proceeding to develop the game, we will contrast this specification of the cost of compliance with that which may undermine performance of the treaty. That is, a compliance cost generating function that may induce a frequency of escape that may dissolve the treaty or render it ineffective due to repetitive sanctioned noncompliance.

¹⁴For an excellent discussion and model of an escape clause in international treaties, see Rosendorff and Milner (2001). They are concerned with the optimal design (cost of invoking) of an escape clause when there is uncertainty as to the future (per period) domestic political support for the treaty. In contrast, we address the stochastic cost of compliance with the treaty and the decision to comply, escape, or opportunistically breach. Our consideration of a treaty is general, in that we do not develop our model in the context of a specific international issue. We also consider formally the optimal design (support of the density function of compliance costs for which compliance is agreed to occur) of a treaty. Rosendorff and Milner address the optimal penalty for invoking an escape clause.

2.1.2 First Order Auto-regressive Process

As the preceding paragraph suggests, persistence in the costs of compliance may undermine the treaty. That is, an escape clause may fail to address costs of compliance that are not elements of the negotiated set and are expected to remain non-elements for succeeding periods. To portray this scenario, let compliance costs follow a first order auto-regressive (AR1) process. Thus we can state that

$$c_t = c_0 + \rho c_{t-1} + \varepsilon_t, \quad \varepsilon_t \sim (0, \sigma_c^2), \quad \rho = (0, 1), \quad (2)$$

where ρ denotes the auto-regressive parameter¹⁵. Note that (2) is equivalent to (1) for $\rho = 0$. As was stated above $E(c_{t+1}) = c_0$ for (1). The expected value of c_{t+1} conditional on c_t is $E(c_{t+1} | c_t) = c_0 + \rho c_t$ for process (2). Thus if c_t is not within the set of compliance costs addressed by negotiation of the treaty, c_{t+1} is not expected to be in that set for values of ρ that equal or exceed a critical level. Hence the treaty may be vitiated, may have to be renegotiated, or some form of dynamic adjustment may be required. An escape clause may not an effective institution for addressing compliance costs that were unexpectedly large at the time of negotiation of the treaty. The long run expected value of (2) is $c_0/(1 - \rho)$ ¹⁶. For a treaty to be enforceable, compliance must occur for this expectation¹⁷.

¹⁵Note that our consideration of an escape clause as an inducement to compliance is not interesting for negative values of ρ . If compliance occurs for the initial cost c_0 , then it is expected to occur if compliance costs trend lower. What's more, the set of costs for which compliance will occur will be defined to contain the lowest possible realization of compliance costs.

¹⁶Given the long run expected value of (2), we anticipate that the realizations of compliance costs would return eventually to a level contained by the set of such costs for which compliance occurs for low values of ρ . However, for values of ρ exceeding a critical level, a signatory may be expected to remain noncompliant for too long to induce continued compliance by the other country. To determine the expected value of process (2), set $c_t = c_{t-1} = c$ and solve for c .

¹⁷Recall from the Introduction that a treaty with prohibitive and certain costs of compliance may be negotiated at a cost of near zero but is unenforceable. If $\rho = 1$, the long run expected compliance costs approach infinity. Thus we assume that for very high persistence (ρ close to unity), agreements cannot be enforced.

2.2 The Absence of a Treaty

In the absence of a treaty, each country i has actions a_{it} , $i = 1, 2$ available in each period t . The $a_{it} \in \{\gamma_{it}, d_{it}\}$, where γ_{it} is cooperate and is equivalent to comply in the presence of a treaty. The action d_{it} denotes defect, and is equivalent to the choice of either escape or non-sanctioned noncompliance if there is an agreement. It is well known (Tirole (1988)) that cooperation can arise in a game of infinite horizon if players are sufficiently patient when information is complete. It can arise in a game with private information as well (Green and Porter (1984)). We assume that the countries play grim trigger strategies in the absence of an agreement under either compliance cost generating functions. Under the standard grim trigger applied to a repeated prisoners' dilemma of infinite horizon, a player begins by acting cooperatively. They continue to act cooperatively as long as the other player has acted cooperatively in the preceding period. If a player defects in any period, each player defects in each succeeding period.

In the present framework, a country will not begin (in the period following negotiation) by acting cooperatively if the costs of doing so are deemed to be excessive. In this instance the one period gain from defection exceeds the present discounted value of the expected gains from cooperation. In any period in which a country draws such high costs of cooperation, it will defect. If a country defects, there is no mechanism (institution) by which the other country can ascertain whether the defector legitimately has high costs of cooperation or is misrepresenting its costs. Hence a country must defect in all periods subsequent to defection by the other country. If it does not defect as a response to defection, the prisoners' dilemma creates an incentive to defect irrespective of the costs of cooperation in any period.

The treaty enhances cooperation in two ways. One is that it distinguishes between legitimate (sanctioned) noncompliance and opportunistic breach (non-sanctioned noncompliance). A treaty may also specify the remedies available when opportunistic breach transpires, and the provisions through which cooperation is restored. This reduces the likelihood that a noncooperative action will induce the unraveling of cooperation, and it occurs through the negotiation of an escape clause. The second is the provision of a mechanism by which a country can challenge the play of escape by the other country. This is through the negotiation of a dispute settlement procedure. This institution requires that a country that invokes the escape clause justify its doing so by documenting its compliance costs. This is a deterrent to

opportunistic breach.

2.3 The Presence of a Treaty

2.3.1 Stage 3: The Decision to File a Dispute

Compliance Costs That Are Driftless A potential problem with the inclusion of an escape clause in a treaty is that it may be abused through invocation with excessive frequency. This particularly would be the case when the compliance/noncompliance decision takes the form of a per period Prisoners' Dilemma. That is, when a signatory's periodic payoff is highest when it does not comply and the other signatory does comply. This may undermine compliance, especially when the costs of compliance for each signatory cannot be verified or only can be verified at a nontrivial cost. We have assumed that the pair of countries is identical initially (at the stage of treaty negotiation), and that this is complete information. However, once play proceeds to the second stage in each period (subsequent to the period in which negotiation transpires) of the (possibly) infinite horizon, each country knows that their costs of compliance are drawn from the same distribution. Thus each country knows its own compliance costs, and knows the probability of each possible cost of the other signatory.

As indicated above, a signatory can play comply, escape, or non sanctioned noncompliance in the preceding stage. In this stage, the strategy set consists of two possible actions. One is to file a dispute and the other is to not file a dispute. The best response to comply is to not file a dispute. In the case of compliance, there is no basis for a dispute. The best response to escape or non-sanctioned noncompliance is to file a complaint. However, if a signatory can escape, then there is no reason to engage in non-sanctioned noncompliance¹⁸. There are two reasons as to why a country would escape in the preceding stage. One is because compliance costs are not contained by the negotiated set, which we denote by $\Omega : c_t = [0, \bar{c}]$, where $\bar{c} \in \mathbb{R}_+$, with $F(0) = 0$ and $F(\bar{c}) < 1$. We also define $\Gamma : (\Gamma/\Omega)$, where Γ is the relative

¹⁸Nonsanctioned noncompliance triggers the play of defection by both countries in succeeding periods for costs of compliance for which commitments to comply have been made. Defection under the treaty is nonsanctioned noncompliance. Escape, in the presence of a treaty, is not defection and does not induce play of nonsanctioned noncompliance in successor periods. Hence a country will always play sanctioned noncompliance when it is an option.

complement of Ω , containing those values of c which are not addressed by the treaty. Because a country is unlikely to complain if the other signatory exceeds its commitments, we assume the lowest potential realization of compliance costs is (normalized to) zero. The highest cost for which compliance will occur is \bar{c} . That is, our objective is to focus upon noncompliance induced by unexpectedly high compliance costs. Thus any realization of $c_t \notin \Omega$ is a justification for playing escape in stage 2. However, a state may also play escape in stage 2 for a realization $c_t \in \Omega$. That is, it may engage in spurious escape. This is synonymous with non-sanctioned noncompliance or opportunistic breach. This is because its per period payoff π_{it} for state i may be greater when it does not comply and signatory j does, as is standard in a Prisoners' Dilemma. Let γ_{it} , s_{it} , and e_{it} denote comply, spurious escape, and escape in period t by signatory i . We can define the set of actions available under a treaty to be $a_{it} \in \{\gamma_{it}, e_{it}, s_{it}\}$. The payoff (net benefit) functions for each signatory are $\pi_{it}(a_{it}, a_{jt}; c_{it})$ for $i, j = 1, 2$ and $i \neq j$. As higher realizations of periodic compliance costs reduce the benefits to cooperation by a signatory, we state that $\partial\pi_{it}/\partial c_{it} < 0$. The prisoners' dilemma is formalized as

$$\pi_{it}(e_{it}, \gamma_{jt}; c_{it}) > \pi_{it}(\gamma_{it}, \gamma_{jt}; c_{it}) > \pi_{it}(e_{it}, e_{jt}; c_{it}) \quad \forall i, j = 1, 2; i \neq j. \quad (3)$$

In such an instance, spurious escape may occur. That is, an escape clause may not be sufficient to deter opportunistic breach. Ordinarily defection from cooperation readily is deterred in a game of infinite horizon by sufficient patience. Cooperation unravels only if triggered through play of defection by one agent. However, allowance of escape as a strategy permits defection that is characterized as de jure cooperation, and hence defection is not serving its usual role in a trigger strategy equilibrium¹⁹. Thus the signatories would

¹⁹The grim trigger strategy is a very useful conceptual self enforcing device, as it permits the derivation of a stable co-operative equilibrium. However, it is not renegotiation proof, as future agents cannot be bound to welfare reducing noncooperative behavior. Moreover, at the WTO for example, punishment is rarely sanctioned and even more rarely invoked. Perhaps as a result, members have remained out of compliance for extended periods. In two senses, punishment sanctioned by the WTO is consistent with (not necessarily grim) trigger strategies. One is that it is prospective (forward looking) in that it does not attempt to restore the victim of defection to whole. The other is that if cooperation is restored, punishment ceases immediately. The failure to restore the complainant to whole reflects a weak supranational authority.

escape in every period. De facto and de jure cooperation can be restored by two instruments of policy. One is to impose a statutory limit as to the number of consecutive periods of escape²⁰. However, each signatory will escape as frequently as the treaty permits in equilibrium. The other is to introduce a dispute settlement mechanism, the purpose of which is to *distinguish* spurious escape from justifiable escape, and to deter non-sanctioned noncompliance²¹. With such a mechanism, each country can observe the other's cost of compliance²². We assume that the dispute mechanism provides complete information about compliance costs, and that it does so at zero cost to both the complainant and the respondent²³. Spurious escape then serves as the

²⁰The WTO permits 4 years of escape from commitments for an industry disclosed by investigation to have incurred serious and unanticipated injury through these obligations, with the possibility of 4 years of renewal. As we discuss below, a statutory limit may be excessively rigid under process (2).

²¹Although the realizations of compliance costs by each country are independent, the possibility of correlated compliance costs could permit inference of the likelihood of the legitimacy of escape without resorting to the filing of a dispute. Because we have assumed that dispute settlement is costless for convenience, this alternative to ascertaining legitimacy will not be relevant unless compliance cost realizations are perfectly correlated.

²²Although the dispute settlement procedure serves as an information revelatory mechanism, the information regarding compliance costs comes from the members themselves. The DSU of the WTO, for example, contains two formal opportunities for consultation. The initial stage of the dispute settlement process is consultations pursuant to Article 4. If a complaint is affirmed, consultations may again occur to establish a reasonable period of time for the implementation of a DSB (dispute settlement body) decision. Thus the dispute settlement procedure provides a forum for the revelation of compliance costs. We do not intend to convey that the DSB has better information about compliance costs than do the parties to the dispute. This is analogous to the signatories being completely informed as to one another's current compliance costs at the time the treaty is negotiated. That is, the negotiation process provides a forum for the revelation of current costs of compliance.

²³Each country knows its own cost, and must provide it together with verification to the dispute authority and to other parties to the dispute. This is essentially a modelling convenience. However, the assumption that the dispute settlement mechanism provides complete information about compliance costs is not innocuous. If the dispute process does not fully inform, it raises the possibility of successful spurious escape. If a signatory may opportunistically breach successfully with positive probability (but less than unity), it reduces the incentive for compliance by the other signatory. This has a pair of implications. One is that the need for a grim trigger (harsh punishment) is enhanced, as it reduces the expected gain from opportunistic breach. The second is that a reduction in the expected gain from compliance due to this possibility reduces the measure of the set of costs for which compliance will occur. Determination of this measure is discussed in stage one.

If the dispute settlement procedure can produce false positives (a determination of legitimate escape when it did not occur), there is also the possibility of false negatives and

trigger²⁴. The equilibrium profile for stage 3 entails filing a dispute whenever escape is played by the other signatory in the preceding stage of every period, because legitimate use of the escape clause may transpire. Thus disputes will occur in equilibrium and serve as the deterrent to opportunistic breach. As noted above, disputes are never filed when compliance is played.

Compliance Costs with Persistence To address persistence, we assume that the compliance cost generating function is common knowledge at the time of negotiation of the treaty. We suppose that the set of costs for which compliance will occur under persistence is denoted by Ω_ρ . We define $\Omega_\rho : c_t = [0, \tilde{c}]$, where $\tilde{c} \in \mathbb{R}_+$, with $F(0) = 0$ and $F(\tilde{c}) < 1$. We will define its relative complement as $\Gamma_\rho : (\Gamma_\rho/\Omega_\rho)$. We will explore the relationship between Ω and Ω_ρ when we address stage one. The equilibrium, depicted in the preceding subsection, holds for both specifications of the compliance costs function²⁵. A remaining, albeit very costly, possibility for resolution of

being sanctioned for legitimate escape. This increases the incentives for cooperation by the escaping signatory. It also increases the measure of the set of costs for which compliance will occur. On the other hand, it mitigates the need for draconian punishments. In addition to international institutions generally being weak supranational authorities, the possibility of both type I and type II errors provide a supportive explanation for the tendency for prospective punishment schemes as remedies for identified noncompliance.

When the dispute settlement procedure can generate false positives or false negatives, the probabilities of these errors may be a function of the level of a compliance cost realization, with the probability of an error being at a maximum around the highest value of compliance costs for which commitment to the agreement is made. This may affect the decision as to whether or not to comply for various cost realizations. However, the inability of the dispute process to provide complete information about compliance costs does not undermine the points that we are making.

²⁴In practice, an institution such as the WTO could provide for direct sanctions in the case of spurious use of the escape clause. As we previously have noted, the use of penalties by the WTO is uncommon. Because we are specifying the compliance decision as a multiple period prisoners' dilemma, we use spurious escape as a trigger that undermines cooperation (induces noncompliance) in all future periods of the game. That is, of course, unless and until renegotiation or dynamic adjustment transpires.

²⁵Our conclusion that disputes will occur in equilibrium contrasts with Bown's (2002) observation that, in an institution with "rule integrity" and a supergame of infinite horizon with a trigger strategy, disputes are not on the equilibrium path. The primary result of Bown's paper is the contradiction of this observation by demonstrating that disputes can occur in equilibrium when countries choose deliberately to make policy adjustments that are violations under the GATT/WTO. That is, they optimally take actions that are violations rather than invoking the escape clause. We also contradict this observation

the problems posed by persistence is to reframe and renegotiate the treaty. In our context, reframing and renegotiation would not occur in the absence of persistence unless objectives for the treaty or the distribution of compliance costs changed. However, renegotiation could occur under persistence without a change in objectives or the distribution of compliance costs if a sufficiently high cost was realized in any period by a treaty signatory. As has been indicated, a limited form of renegotiation in the form of periodic reconvening of membership may also transpire.

2.3.2 Stage 2: The Compliance Decision

Compliance Costs That Are Driftless with a Random Component

As the solution to the succeeding stage reveals, states make their decision to opportunistically breach, comply, or escape knowing that non-sanctioned noncompliance triggers dissolution of commitments under the treaty, and that escape induces a dispute. As long as the dispute mechanism discloses escape to be justifiable, cooperation (compliance) continues in the next period, for $c_{i,t+1} \in \Omega$, $\forall i = 1, 2$. If escape is found to be spurious, compliance ceases in all subsequent periods²⁶. Opportunistic breach terminates the cooperation in the subsequent stage, as spurious use of the escape clause is disclosed through the dispute settlement mechanism.

Using the usual Folk Theorem, spurious escape would not occur in equilibrium for sufficiently patient states²⁷. However, the condition for cooperation has to be modified to take into account the likelihood of escape upon the benefits to compliance. Let the probability that $c_{jt} \in \Omega$ be given by

$$prob(c_{jt} \in \Omega) = \int_0^{\bar{c}} f(c_j) dc_j \equiv \mu \quad j = 1, 2 \quad (4)$$

by disclosing that disputes will occur when the escape clause is invoked. It would be possible not to have a dispute filed every time the escape clause is invoked, and to have undetected instances of spurious escape if there were filing costs as well as penalties against false allegations of spurious escape. Filing costs are the more realistic, as international institutions tend to exert insufficient authority for retrospective punishments. However, our simpler assumption of zero legal costs permits us to establish our points of emphasis without introducing that complexity.

²⁶That is, unless the treaty is renegotiated or flexible institutions provide some vehicle for sustaining cooperation. Renegotiation will be addressed subsequently.

²⁷See, for example, Tirole (1988).

Each signatory knows its own compliance cost realization, and utilizes (4) to determine the other country's likelihood of compliance in each period. The expected (unnormalized) per period payoff to country i from compliance by both countries is $\mu \int_{\Omega} \pi_{it}(\gamma_{it}, \gamma_{jt}; c_{it}) f(c_{it}) dc_{it}$. As was noted above, a signatory's benefit from compliance is inversely related to its cost of doing so $\partial \pi_{it} / \partial c_{it} < 0$. However, this benefit depends upon the other state's compliance decision, not upon that state's cost. Hence the multiplication by the probability that the other state is in compliance. The expected payoff under compliance when the other signatory escapes justifiably is $(1 - \mu) \int_{\Omega} \pi_{it}(\gamma_{it}, e_{jt}; c_{it}) f(c_{it}) dc_{it}$. The expected per period payoff from de jure but not de facto compliance (justifiable escape) is $\mu(1 - \mu) \pi_{it}(e_{it}, \gamma_{jt})$ when the other signatory complies, and the expected payoff when both states justifiably escape is $(1 - \mu)^2 \pi_{it}(e_{it}, e_{jt})$. The benefit from justifiable escape does not depend upon the cost of compliance, as that cost is not incurred when this action is taken. Similarly, the gain from spurious escape is not a function of the cost of compliance. Let δ denote the discount factor. Compliance by signatory i requires that

$$\begin{aligned} & (\delta / (1 - \delta)) \left(\mu \int_{\Omega} \pi_{it}(\gamma_{it}, \gamma_{jt}; c_{it}) f(c_{it}) dc_{it} + \mu(1 - \mu) \pi_{it}(e_{it}, \gamma_{jt}) + \right. \\ & \left. (1 - \mu)^2 \pi_{it}(e_{it}, e_{jt}) + (1 - \mu) \int_{\Omega} \pi_{it}(\gamma_{it}, e_{jt}; c_{it}) f(c_{it}) dc_{it} \right) \\ & \geq \mu \pi_{it}(s_{it}, \gamma_{jt}) + (1 - \mu) \pi_{it}(s_{it}, e_{jt}). \end{aligned} \quad (5)$$

Thus a country chooses to remain in actual or de facto compliance as long as the expected present discounted value of being so exceeds the one period expected gain from spurious escape²⁸. As the right side of (5) discloses,

²⁸Compliance in our framework is a discrete (0, 1) choice. However, as the referee has noted, it may be continuous. Thus a signatory may reduce the extent to which it complies with a treaty in response to the play of escape a another country. An example may from the negotiation of tariff bindings (maximum permissible rates) under the auspices of the WTO. Members frequently set tariffs below the bound level. However, they could repond to escape by another member by setting higher tariffs that do not exceed the bound rate. This is still compliance, but provides less of a benefit to the escaping member. The effect upon the performance of the treaty is ambiguous. Each member anticipates a greater net benefit from compliance through an increase in the fourth term on the left hand side of (5). However, it expects a lesser net benefit from escape through a reduction in the second term on the left hand side of (5).

determining the gain from spurious escape requires that signatory i account for the probabilities that state j will comply or escape (justifiably). The weak inequality in (5) establishes the condition for cooperation when compliance costs are characterized by (1)²⁹. In specifying (5), we assume that neither state cooperates after at least one state engages in spurious escape, and that the payoffs to each signatory are normalized to zero under reciprocal opportunistic breach³⁰.

In order to complete characterization the equilibrium, the actions of the signatories subsequent to opportunistic breach must be specified. As noted, the countries cease cooperating after spurious escape has been detected through the dispute settlement procedure. Rather than add another strategy (violate) to the set of actions, we will assume that a signatory will continue to escape for $c_{it} \notin \Omega$ and will engage in non-sanctioned noncompliance for $c_{it} \in \Omega$ when the other country has been detected as having opportunistically breached in a predecessor period. Recalling that $E(c_t) = c_0$ and that the treaty is enforceable, we can characterize the equilibrium in stage two for $i, j = 1, 2$ and $i \neq j$ as

- Play γ_{i0} .
- Play $\gamma_{it} \forall t$ in which $c_{it} \in \Omega$ and j has never played $s_{j\tilde{t}} \forall \tilde{t} < t$.
- Play $e_{it} \forall t$ in which $c_{it} \notin \Omega$ and j has never played $s_{j\tilde{t}} \forall \tilde{t} < t$
- Play $s_{it} \forall t$ in which $c_{it} \in \Omega$ and play $e_{it} \forall t$ in which $c_{it} \notin \Omega$ and j has ever played $s_{j\tilde{t}} \forall \tilde{t} < t$

2.3.3 Compliance Costs Exhibiting Auto-regression

When compliance costs are characterized by (2), cooperation may be more difficult to sustain. What's more, the escape clause with a dispute settlement mechanism may not be an effective institution in addressing compliance costs that were perceived as being unexpectedly large at the time of negotiation of the treaty. Persistence in the costs of compliance does not preclude cooperation amongst signatories to a treaty. Enforceability requires that the long

²⁹For compliance to occur for lower levels of c_{it} and escape for higher values over $\Omega \cup \Gamma$, it is sufficient that the benefit to compliance relative to escape declines monotonically as the cost of compliance rises.

³⁰Although we do not explore the issue, there may be models that would generate an equilibrium in which one signatory continued to comply while the other did not. However, this would seem to require heterogeneity with regard to objectives for participation in the treaty, capacity to comply, or relative size of the members.

run expected value of (2) must be contained by Ω_ρ . A cost of compliance for either signatory that is not an element of Ω_ρ may never be realized. In order to evaluate the effect of persistence upon the sustainability of compliance when a $c_{it} \notin \Omega_\rho$ is realized, note that the functions $\pi_{it}(\gamma_{it}, \gamma_{jt}; c_{it})$, $\pi_{it}(e_{it}, \gamma_{jt})$, $\pi_{it}(\gamma_{it}, e_{jt}; c_{it})$ and $\pi_{it}(e_{it}, e_{jt})$ are unaffected. The set Ω_ρ may be affected, having been chosen in the preceding stage³¹. What is affected are the density functions $f(c)$ in (5). Realizations of compliance costs c_{it} are no longer independent of $c_{i,t-1}$. Hence we must substitute conditional density functions for the density functions in (5). Given the auto-regressive process, these density functions are conditional upon the expectation of c_{t-1} , which is denoted by $E(c_{t-1}; \rho)$ ³². Let us define these functions as $f(c_t|E(c_{t-1}; \rho))$. Thus country i 's calculation of the probability that $c_{jt} \in \Omega_\rho$ in period t is given by

$$\text{prob}(c_{jt} \in \Omega_\rho | E(c_{t-1})) = \int_0^{\tilde{c}} f(c_{jt} | E(c_{j,t-1}; \rho)) dc_{jt} \equiv \mu_t \quad , \quad i = 1, 2 \quad (6)$$

Country i 's assessment of the probability of j realizing any value of c_{jt} is conditional upon the expectation of j 's compliance costs formed by country i in the preceding period and the auto-regressive parameter³³. Country i knows its own compliance costs in each period. Hence it utilizes the density function $f(c_{it}|c_{i,t-1}; \rho)$ to determine the expected benefit of compliance in period t . Compliance for signatory i in period t for an arbitrary dispute history (calculation of μ_t based upon the number of periods since a dispute

³¹The set Ω_ρ is chosen in stage one based upon a calculation by the signatories of what they will play rationally in stage two. Thus persistence may affect the measure of Ω_ρ relative to that of Ω .

³²If justifiable escape by a signatory occurred in $t-1$, then $E(c_{t-1})$ is replaced by c_{t-1} , as the dispute process reveals a signatory's compliance costs to the other member, and a dispute is always filed when escape occurs.

³³If compliance has always occurred (from the initial implementation of the treaty in period $t=0$), the expectation by country j of country i 's compliance costs is calculated as $E(c_{t-1}|c_0) = c_0(1 + \rho + \rho^2 + \rho^3 + \dots + \rho^{t-1})$. If justifiable escape was played n periods ago, the expectation is $E(c_{t-1}|c_{t-n}) = c_0(1 + \rho + \rho^2 + \rho^3 + \dots + \rho^{n-2}) + \rho^{n-1}c_{t-n}$.

That is, justifiable escape discloses a signatory's compliance costs, and in this instance, the most recent disclosure is c_{t-n} . If justifiable escape occurred in the preceding period, the expectation is $E(c_t|(c_{t-1}))$.

was filed against the other signatory) requires

$$\begin{aligned}
& \sum_{t=1}^{\infty} \delta^t (\mu_t \int_{\Omega_\rho} \pi_{it}(\gamma_{it}, \gamma_{jt}; c_t) f(c_{it}|c_{i,t-1}; \rho)) dc_{it} + \mu_t (1 - \mu_t) \pi_{it}(e_{it}, \gamma_{jt}) + \\
& (1 - \mu_t)^2 \pi_{it}(e_{it}, e_{jt}) + (1 - \mu_t) \int_{\Omega_\rho} \pi_{it}(\gamma_{it}, e_{jt}; c_t) f(c_{it}|c_{i,t-1}; \rho) dc_{it} \\
& \geq \mu_t \pi_{it}(s_{it}, \gamma_{jt}) + (1 - \mu_t) \pi_{it}(s_{it}, e_{it}). \tag{7}
\end{aligned}$$

For compliance by signatory i to occur in period t , (7) must hold. For auto-regression to undermine compliance and the effectiveness of an escape clause, there must be at least one realization of $c_{j,t-1}$ for which the escape clause would be expected to be invoked for a sufficient number of successive periods by j to reverse inequality (7) for i . For a realization $c_{jt} \notin \Omega$, the future realizations of $c_{j,t+n}$ are forecast to be

$$c_{j,t+n} = c_0(1 + \rho + \rho^2 + \rho^3 + \dots + \rho^{n-1}) + \rho^n c_{jt} \tag{8}$$

It is reasonable to assume that the expectation of (2) is an element of Ω_ρ for a treaty to be enforceable. We have also assumed that $\rho = (0, 1)$. Hence (8) will converge to the set Ω_ρ . From (8) we can calculate the expected number of periods $n := [1, \infty)$ before which $c_{j,t+n} \in \Omega_\rho$. That is, for which $c_{j,t+n} \leq \tilde{c}$. Thus for any pair $(c_{j,t-1}, \rho)$, we can determine from (6) if inequality (7) is reversed. We will define a set $\Lambda(c, \rho)$ as containing for each value of $\rho = (0, 1)$, those values of (non-empty) c for which the inequality in (7) is reversed. Compliance will cease after a realization in Γ for which ρ and c_{it} are sufficiently high that the signatories anticipate that justifiable escape will continue in a requisite number of succeeding periods to reverse (7). (This would not be verified by a dispute disclosing compliance costs in the corresponding stage of each subsequent period because neither member would be complying and they both know this.) If Λ is not the null set, then an escape clause is less

efficacious than in the absence of persistence for a given treaty measure^{34, 35}.

Thus we can characterize the equilibrium in stage two for $i, j = 1, 2$ and $i \neq j$ as

Play γ_{i0}

Play $\gamma_{it} \forall t$ in which $c_{it} \in \Omega$ and j has never played $s_{j\tilde{t}} \forall \tilde{t} < t$.

Play $e_{it} \forall t$ in which $c_{it} \notin \Omega$ and j has never played $s_{j\tilde{t}} \forall \tilde{t} < t$.

Play $s_{it} \forall t$ in which $c_{it} \in \Omega$ and play $e_{it} \forall t$ in which $c_{it} \notin \Omega$ if j has ever played $s_{j\tilde{t}} \forall \tilde{t} < t$.

Play $s_{it} \forall t$ in which $c_{it} \in \Omega$ and play $e_{it} \forall t$ in which $c_{it} \notin \Omega$ when a dispute proceeding has determined $c_{j,t-1} \notin \Omega_\rho$ and $(c_{j,t-1}, \rho)$ are sufficiently large to reverse (7).

2.3.4 Stage 1: Negotiation of the Treaty

As we have noted above, we are limiting our investigation to enforceable treaties. In the Introduction, we provide justification for our assumption that negotiation costs are a concave function of compliance costs under certainty and expected compliance costs with uncertainty. Under our consideration of stochastic compliance costs, concavity implies an expected level of compliance costs $E(c^*)$ that uniquely maximize negotiation costs. An enforceable treaty is one for which compliance will transpire for its expected compliance costs. This implies that ρ cannot be too close to unity, as the expectation of process (2) is $c_0/(1 - \rho)$. We limit consideration of values of $\rho : c_0/(1 - \rho) < E(c^*)$. The negotiation of the treaty consists of the establishment of a set of possible realizations of compliance costs for which commitments under the treaty are to be honored, given the expectation of compliance costs³⁶. A set of such

³⁴Note that extending the number of periods for which escape is permissible under the treaty would have no effect here, as it does not effect the calculation in (7). What's more, a dispute would still have to be filed in each period to deter spurious escape. Even if escape is disclosed by a dispute to be justifiable in t , there can be a positive probability that $c_{i,t+1} \notin \Omega_\rho$. It is possible, however, for a maximum duration of escape to undermine the treaty if that maximum is less than the number of periods of escape for which (7) holds. In this instance, compliance is too costly for one signatory beyond the statutory limit, and the other member would still comply if the escaping signatory remained in de facto non-compliance.

³⁵Treaty measure is discussed in the subsequent section.

³⁶Although Scott and Triantis (2005) addressed contract design rather than treaties, their analysis has implications for the negotiation of the latter. In particular, our assumption of costless dispute resolution providing complete information regarding compliance

costs of greater measure is assumed to be more costly to negotiate than one of lesser measure³⁷.

Negotiation without Auto-regression in Compliance Costs Now that we have considered the equilibria for stages three and two of the game for compliance cost processes (1) and (2), the solution proceeds to the first stage of the game. This is the negotiation for the set of compliance costs Ω for which the countries will abide by the treaty. Recall that we have assumed that the countries are identical in their compliance costs when negotiation commences. They each have the same (verifiable through the negotiation process) costs of compliance and they are completely informed of this. They know that they will draw future costs of compliance from the same distribution, and they know that the treaty that they will negotiate will be in effect for a possibly infinite horizon. Their compliance costs are characterized by the same zero persistence parameter, and this is known to them. We do not specify the subject of the treaty.

The payoff possibilities set $\Pi \subset \mathbb{R}^2$ is convex and closed. We assume that the treaty is conveyed by the expectation of the cost of complying with it $E(c_t)$. The cost of negotiation is given by a concave function g ³⁸. The signatories negotiate the measure of Ω . That is, the costs of compliance for

costs imposes structure upon the negotiation process. Scott and Triantis depict a contract as entailing front and back end investments. Higher front end investments encompass more specific and precise language, which is often manifest through greater reliance upon rules. Higher back end investments entail a greater reliance upon standards and more vagueness and less precision in the expression of the contract. This reduces negotiation costs. The level of enforcement and verification costs are inversely related to the precision of the language in which the contract is specified.

By assuming costless filing of petitions and complete revelation of pertinent information (compliance costs) through the dispute settlement procedure, we implicitly reduce the incentives for front end investments in the negotiation of the treaty. With lower negotiating costs, the measure of the set of compliance costs for which commitments are made is enlarged. Thus subgame perfection exposes a relationship between the ease with which disputes are resolved and the extent of commitments that are made in the negotiation of a treaty.

³⁷Note that we assume negotiation takes place in the initial period with a verifiable realization of compliance costs equal to the expectation of process (1), the absence of persistence. If the timing of negotiation was endogenous, the relationship between compliance cost realizations and preferences for the timing of negotiations could be examined. We leave this to future investigation.

³⁸Our conception of g is broad. It includes both the direct costs of time and effort by negotiators of the treaty, and the costs of diffusing domestic opposition to the agreement.

which the signatories agree to abide by the treaty is contained by the closed interval $[0, \bar{c}]$. It has Lebesgue measure $\bar{c} - 0 = \bar{c}$ ³⁹. Thus we can specify negotiation costs as $g(c_0, \bar{c})$, recalling that c_0 is the expectation of process (1). We have justified an assumption of concavity of negotiating costs in the expectation of compliance costs. We further suppose that inclusion in an enforceable treaty of states of nature for which compliance costs are high (a greater measure of compliance costs for a given expectation) have higher negotiation costs than a treaty of lesser measure for that expectation. It is assumed additionally that $\bar{c} < E(c^*)$. Thus g is concave in both arguments. (These costs increase at a decreasing rate over the range of enforceability.)

To determine the optimal measure of Ω , recall that the signatories draw future compliance costs from the same distribution, and the probability of each of them realizing any c is $f(c)$. Their per period net benefit functions are identical, and are given by $\pi_i(\gamma_i, \gamma_j; c) \forall i = 1, 2$, and $i \neq j$. Since the countries are identical, their bargaining power will be identical. The criterion for inclusion of a compliance cost \bar{c} in Ω is that the expected product of equally weighted per period payoffs from doing so, when each signatory realizes this cost, is at least as great as the cost of negotiating that inclusion. Although the payoff to signatory i depends upon c_i and whether or not signatory j complies, we must specify $c_j = c_i = \bar{c}$. This is because it is possible that both signatories realize \bar{c} in a given period. Since $\partial\pi_i/\partial c_i = \partial\pi_j/\partial c_j < 0$, any \bar{c} should only be included in Ω if the gain from doing so when both signatories realize this cost is at least as great as the cost $g(\bar{c})$ of negotiating its inclusion.

The set of costs for which compliance occurs is given by

$$\Omega = \{ \bar{c} : f(\bar{c})^2 \pi_i(\gamma_i, \gamma_j; \bar{c})^{1/2} \pi_j(\gamma_i, \gamma_j; \bar{c})^{1/2} - g(c_0, \bar{c}) \geq 0 \}. \quad (9)$$

Negotiation with Auto-regression in Compliance Costs Inequality (9) portrays the criterion for inclusion of \bar{c} in Ω when the compliance cost

It may also include the mobilization of domestic constituencies that would be inclined to support the treaty. Negotiation costs are to be distinguished from the costs of compliance once the treaty has been accepted into domestic law. Compliance costs may also include include the need to appease domestic constituencies that perceive their interests to be affected adversely by the treaty.

³⁹While any $c_t \leq E(c_t)$ will induce compliance, with resistance arising for $c_t > E(c_t)$, we choose \bar{c} as the simplest expression of the measure of the accomplishment of negotiators in securing commitments.

process is given by (1). Let us denote the measure of the set of compliance costs for which commitment to abide by the treaty is made as \tilde{c} for persistence. Hence we specify negotiating costs by $g(c_0/(1 - \rho), \tilde{c})$. In determining the measure of set Ω_ρ , we consider the gain from inclusion of \tilde{c} in the treaty when it is realized by both of the signatories in a given period. Given that a treaty typically is expected to be of substantial duration and negotiation reflects that expectation, realization of the maximum compliance cost \tilde{c} for which obligations are to be fulfilled is conditional upon the expectation of process (2). Recall that this is $c_0/(1 - \rho)$. The signatories' compliance costs are characterized by the same nonzero persistence parameter, and this parameter is known to them. This alters criterion (9) because the density functions must be replaced by conditional density functions. Let this conditional density function be expressed as $f(\tilde{c}|c_0/(1 - \rho))$. That is, the conditional expectation gives the probability of realizing any \tilde{c} after realizing the expectation of process (2) in the preceding period. Thus the criterion for inclusion of any state of nature \tilde{c} in the treaty is

$$\Omega_\rho = \left\{ \begin{array}{l} \tilde{c} : f(\tilde{c}|c_0/(1 - \rho))^2 \pi_i(\gamma_i, \gamma_j; \tilde{c})^{1/2} \pi_j(\gamma_i, \gamma_j; \tilde{c})^{1/2} \\ -g(c_0/(1 - \rho), \tilde{c}) \geq 0 \end{array} \right\} \quad (10)$$

A Comparison of Persistence with its Absence and Implications for the Escape Clause To compare the treaty under persistence in compliance costs to the treaty in the absence of persistence, it is instructive to contrast the measures of the sets Ω and Ω_ρ . Recall that negotiation cost are a function of the expectation of compliance costs under implementation of the treaty and the measure of the set of realizations of compliance costs for which commitments are to be honored. Since $c_0/(1 - \rho) > c_0 \forall \rho = (0, 1)$, negotiation costs are higher for persistence, if $\bar{c} = \tilde{c}$. Comparing \tilde{c} and \bar{c} requires a comparison of the sets generated by (9) and (10). Persistence has no effect upon the net benefit functions π_i , $i = 1, 2$. However, expected benefits from the agreement are still likely to differ. Integrating the density functions $f(c)$ and $f(c|c_0/(1 - \rho))$ over their identical (finite) support yields the cumulative density functions $F(\bar{c})$ and $F_\rho(\tilde{c}|c_0/(1 - \rho))$. Because $c_0/(1 - \rho) > c_0$, $F_\rho(\tilde{c}|c_0/(1 - \rho))$ would (first order) stochastically dominate $F(\bar{c})$ with probability directly related to the value of the parameter ρ . For a given value of $\bar{c} : \bar{c} = \tilde{c} > c_0/(1 - \rho)$ the expected gain from its inclusion in the treaty is likely to be greater under persistence than it is with non-autoregression. However, the negotiating cost of its inclusion is also likely to be higher since

$c_0/(1 - \rho) > c_0$. Thus the relationship between \tilde{c} and \bar{c} depends upon the relative magnitudes of $f(\tilde{c}|c_0/(1 - \rho)) - f(\bar{c})$ and $g(c_0/(1 - \rho), \tilde{c}) - g(c_0, \bar{c})$. Since \bar{c} is given by $f(\bar{c})^2 \pi_i(\gamma_i, \gamma_j; \bar{c})^{1/2} \pi_j(\gamma_i, \gamma_j; \bar{c})^{1/2} - g(c_0, \bar{c}) = 0$, we can state that if (10) is nonbinding for \bar{c} , then $\tilde{c} > \bar{c}$ and $\Omega \subseteq \Omega_\rho$.

Persistence is more likely to yield higher compliance cost realizations than non-autoregression. However, this may not translate into a set of compliance costs of greater measure being embodied in the treaty if the effect upon negotiation costs through a larger expected cost of compliance and the added cost of including more states of nature (compliance costs realizations) dominate the greater expected benefit of including those states in the treaty. This has implication for the effectiveness of an escape clause in augmenting the performance of commitments, particularly if $\Omega_\rho \subseteq \Omega$. Persistence increases the likelihood of escape, being directly related to the value of ρ . Persistence also increases the cost of negotiating the agreement. The likelihood of escape may be increased through its effect upon the measure of Ω_ρ as well. This strengthens the case for flexible institutions that dynamically adjust treaty obligations to sustain cooperation. However, an escape clause does not permit adjustment of an agreement (Koremenos (2005)). Thus while escape clauses do not have provisions for dynamic adjustment of commitments, treaties with escape clauses do have such provisions.

A Consideration of the Agreement on Safeguards of the WTO The Agreement on Safeguards (ASG) of the WTO provides an instructive example for analysis of the limitations of an escape clause in an agreement. The ASG imposes several conditions upon the duration and degree of escape. Unlike our formal model, escape is not a discrete choice under the ASG. The maximum duration of a safeguard (SG) action is four years. It is permissible to extend the action for another four years conditional on an evidentiary requirement of adjustment. The total duration of the invocation of escape *normally* cannot exceed eight years. SG measures in effect for more than one year are to be progressively liberalized at regular intervals. If the action is renewed after four years, the measure's restrictiveness cannot exceed that of the original application and *should* be liberalized at regular intervals.

There are also frequency restrictions. There is a requirement of a two year interval between the expiration of one measure and the introduction of another. A successor measure cannot be applied until a period of time has elapsed equal to the duration of the predecessor measure, if the predecessor

had been in effect for more than two years. A brief (180 days) invocation may be taken if there has been at least a year since a predecessor measure, and there have been at most two predecessor measures in the preceding five years.

A look at process (2) reveals the potential difficulties that the frequency and duration restrictions of the ASG pose. Recall that ε_t is normally distributed with a mean of zero. It is equally likely to be positive or negative. Recall also that ρ is a positive number in the interval $(0, 1)$. Thus $c_t > c_{t-1}$ with probability directly related to ρ . If escape occurs for c_{t-1} , compliance costs will not necessarily decline monotonically. The extent to which an escape clause has the flexibility to address a sequence of increasing compliance costs that exceed the levels for which compliance is committed is a matter of the force embodied in *should*. The flexibility to manage a sequence of (not necessarily increasing) compliance costs that are not elements of Ω_ρ for more than eight years is a matter of the force embodied in *normally*. If this language is compelling, then the ASG may fail to provide effective discipline, and compliance by WTO members is undermined. In such an instance, the textual interpretation is unduly rigid and the intended discipline fails. Renegotiation of commitments or dynamic adjustment may be required. As discussed below, this also may be addressed through periodic formal reconvening of the membership.

An additional reason for the failure of the ASG must be considered. This would occur if (7) were reversed for an invocation of escape of less than eight years (or for a sanctioned number of years less than eight). Such an outcome would not be sub-game perfect, and would be deflected in stage one in the negotiation of the duration of escape under the ASG.

2.4 Dynamic Adjustment and Renegotiation

As we have noted above, dynamic adjustment or renegotiation of treaty commitments may be necessary when an escape clause does not serve its intended function. This does not require a solution for stage 1 in any such period t if dynamic adjustment of commitments transpires. However, a stage 1 equilibrium must be provided if commitments of the agreement are renegotiated.

2.4.1 Compliance Costs That Are Driftless

We would not observe adjustment or renegotiation under compliance costs generating function (1) unless there were a reduction in negotiating costs, an increase the importance accorded to commitments (net benefits), or a shift in the distribution of compliance cost realizations. This would entail replacement of g , π , or f by \tilde{g} , $\tilde{\pi}$, or \tilde{f} , respectively. Appropriate substitutions would be made in (9), yielding Ω , a new set of compliance costs for which signatories agree to abide by the treaty.

2.4.2 Compliance Costs with Persistence

Dynamic adjustment may be necessary under the original functions π , f , and g with auto-regression in compliance costs, as given by the process (2). Suppose that a $c_{it} \in \Lambda \subset \Gamma$ is realized by one of the members, and is confirmed by the dispute resolution process. Neither member will comply in the succeeding period due to the Prisoners' Dilemma of our compliance decision. There are four possibilities for the evolution of the game: permanent non-compliance (countries play either legitimate or spurious escape, depending upon the compliance cost realization), dynamic adjustment, renegotiation of treaty commitments, and periodic reconvening of the membership. The latter is discussed in a section below.

As is well known, a grim trigger strategy is not a renegotiation proof equilibrium for an infinite horizon game. Thus we would not expect permanent noncompliance, particularly since, as noted above, $c_0/(1 - \rho) \in \Omega_\rho$. Hence each signatory's compliance cost is expected eventually to return to a level at which it is willing to abide by the treaty. Permanent noncompliance, therefore, is not an equilibrium outcome.

Dynamic adjustment can restore the equilibrium in each period to mutual compliance without renegotiation through invocation of a penance strategy. Once again, let a $c_{it} \in \Lambda$ be realized by one of the members, and be confirmed by the dispute resolution process. Neither member complies in $t + 1$. Suppose that in period $t + n$, $\forall n > 1$, signatory i draws $c_{i,t+n} \in \Omega_\rho$. Signatory i complies in period $t + n$, but signatory j , $\forall i \neq j$ does not. Both members comply in period $t + n + 1$ ⁴⁰. Compliance continues unless another realiza-

⁴⁰Once a realization in Λ occurs and is verified through the dispute settlement mechanism, no additional disputes are filed during the interval of mutual noncompliance. Signatories expect to be out of compliance during this time.

tion in Λ occurs. Non-sanctioned temporary noncompliance is a much better depiction of actual experience with treaties than is abrogation or permanent noncompliance. The penance strategy can be implemented without direct communication between members. One signatory can simply indicate its willingness to restore compliance through incurring a single period reduction in net benefits by complying when the other member does not. In practice, however, dynamic adjustment is likely to entail communication (informal or formal negotiation specific to a disagreement, but not at the level of the provisions of the treaty) leading to a resumption of compliance by both disputants. Because the dispute settlement procedure of the WTO, for example, does not restore a complainant to whole, there may not be sufficient leverage to induce a respondent to incur a period of penance.

Another possibility is a renegotiation of commitments. However, the determination of the set Ω_ρ in (10) discloses that its measure does not change in response to a $c_{it} > \tilde{c}$. If the costs of compliance (density function f) and the costs of negotiating commitments (function g) are not under the direct control of the state, renegotiation of commitments can result in the inclusion of greater levels of c_{it} in Ω_ρ if the objectives of governments for the treaty are enhanced. That is, $\tilde{\pi}_i(\gamma_i, \gamma_j; c_i) > \pi_i(\gamma_i, \gamma_j; c_i) \forall c_i \in \mathbb{R}^+$.

The choice between dynamic adjustment and renegotiation is not obvious. With dynamic adjustment, signatories incur n periods for which their (normalized) payoff is zero. What's more, the state for which compliance is anticipated to be excessively costly must incur one period of penance in the periodic Prisoners' Dilemma. However, the members do not incur renegotiation costs. Renegotiation, in our model, takes place in a single period. Renegotiation may be protracted in practice, and may take longer than dynamic adjustment. The Uruguay and Doha rounds are examples. However, as we have disclosed, renegotiation requires a stronger commitment to the treaty as manifest through the substitution of $\tilde{\pi}_i(\gamma_i, \gamma_j; c_i)$ for $\pi_i(\gamma_i, \gamma_j; c_i) : \tilde{\pi}_i(\gamma_i, \gamma_j; c_i) > \pi_i(\gamma_i, \gamma_j; c_i)$ in (10). This will entail a set $\tilde{\Omega}_\rho$ of larger measure than Ω_ρ . Hence escape will be less likely in the future, and the benefits of compliance will be greater.

2.5 Formal Revisitation of Commitments through Ministerial Meetings

As the referee has noted, an escape clause and formal adjustment in commitments may serve as valuable complements. An example of the latter is the negotiating rounds that have transpired under the GATT/WTO approximately every decade. This, with the exception of the Uruguay Round completed in 1994, does not entail renegotiation of all or most of the treaty. Neither does it encompass dynamic adjustment and restoration of commitments in response to temporary noncompliance by the signatories in the absence of formal renegotiation. Although the schedule for a formal adjustment in obligations may be flexible and endogenous, let us suppose that ministerial meetings transpire every T periods and are completed in that period. This does not alter stage three of the game, as a dispute will still be filed in response to every instance of escape⁴¹.

Inequalities (5) and (7) would be affected, as the discounting horizon would be considerably shorter. Cooperation would occur in $t = 0$, the period in which the treaty is negotiated because compliance costs are common knowledge. As the revisitation takes place in $T - 1$, cooperation transpires in that period. For the intervening periods, $\delta/(1 - \delta)$ in (5) is replaced by $\sum_{t=1}^{T-2} \delta^t$. The functions π and f are not affected. In (7), $\sum_{t=1}^{\infty} \delta^t$ is replaced by $\sum_{t=1}^{T-2} \delta^t$ as well, and the functions remain pertinent. These substitutions reduce the present value of compliance in both inequalities. Because the ministerial meetings reestablish cooperation if it has been derailed by opportunistic breach, compliance is undermined. Thus frequent revisitation of commitments increases the propensity for disputes. Very low costs for the renegotiation of cooperation induce players to always defect despite always agreeing to cooperate (Hartigan (2000)). To mitigate this effect, the scheduling of ministerial meetings should be less predictable, and even more importantly, their success in resolving disagreement through reconvening should not be certain. For example, readdressing commitments at a sufficiently general level may be unable to resolve detailed bilateral disagreement. However, this is beyond the purview of the model. In summary, uncertain success in reestablishing compliance through irregularly scheduled ministerial meetings shifts the onus back to the escape clause and the dispute settlement

⁴¹If filing were costly or disputes did not fully inform, signatories would be less likely to file complaints if formal revisitation provided an alternative format for their resolution and were sufficiently frequent in occurrence.

procedure, with the meetings serving as a backstop for addressing intransigent problems. That is, the temptation to engage in opportunistic breach is mitigated by the uncertainty in the success and timing of the reconvening of membership. The play of escape is more likely to be legitimate, with the clause and dynamic adjustment through revisitation serving mutually enforcing roles.

In modeling the revisitation, the formal approach depicted for renegotiation would be appropriate for stage one. Although the distinction is not presented formally, the breadth of renegotiation would be less under revisitation. The costs of revisitation may be less than for renegotiation, if it is less ambitious. However, if revisitation confronted intransigent problems, they may not be less.

3 Conclusion

Uncertainty of future costs of compliance may induce signatories of a treaty to negotiate an incomplete agreement. That is, one in which commitments for unexpectedly high compliance costs are left unspecified. This particularly will be the case when the addressing of uncertainty mandates a more detailed treaty, and when the cost of negotiation increases in expected compliance costs and the measure of the set of compliance costs for which responsibilities are specified. In such a context, the existence and form of compliance institutions is of particular importance⁴². We incorporate uncertainty through the specification of a discrete time, continuous state stochastic compliance function. This function takes two forms: one without persistence and the other with persistence. We explain that when the resolution of uncertainty is deferred to the future and compliance costs are unobservable, an escape clause can sustain viability of a treaty. While an escape clause creates the potential for strategic opportunism- the spurious use of escape- this can be addressed by instituting a dispute resolution mechanism to the treaty that is able to reveal opportunistic breach. However, we find that an escape clause may be less effective when the compliance cost process exhibits persistence. Persistence increases the likelihood of high compliance cost realizations, inducing the negotiation of commitments under such costs in the agreement. How-

⁴²Even in the absence of uncertainty, compliance institutions are important, as a signatory may gain through defection when other signatories comply. Thus the role of a compliance institution in this context is to deter defection.

ever persistence also increases the cost of negotiation by raising expected compliance costs, inducing the non-inclusion of responsibilities under high costs of compliance into the treaty. The net effect of persistence upon the agreement is determined by the relative impacts of these countervailing inducements. If the impact of persistence upon negotiating costs dominates its effect upon the likelihood of high compliance cost realizations, the performance of the escape clause is more plausibly undermined. When an escape clause fails to preserve compliance under persistence, three possibilities for the restoration of compliance emerge. One is the dynamic adjustment of concessions, which is enforced by penance strategies. Under this punishment scheme, both signatories do not comply until the one that has invoked the escape clause cooperates for a single period. Another is the renegotiation of commitments. As this requires a stronger commitment to the treaty, it may be less likely than dynamic adjustment. This appears consistent with actual practice regarding the implementation of treaties. A third possibility is the scheduling of a reconvening of membership to periodically review the treaty. This may undermine compliance and increase the incidence of disputes.

References

- [1] Bagwell, Kyle and Robert W. Staiger (1999) "An Economic Theory of the GATT," *American Economic Review* 89, 214-48.
- [2] Bagwell, Kyle and Robert W. Staiger (2001) "Domestic Politics, National Sovereignty, and International Economic Institutions," *Quarterly Journal of Economics* 116, 519-62.
- [3] Bagwell, Kyle and Robert W. Staiger (2004) "Multilateral Trade Negotiations, Bilateral Opportunism, and the Rules of the GATT/WTO," *Journal of International Economics* 63, 1-29.
- [4] Bown, Chad P. (2002) "The Economics of Trade Disputes, the GATT's Article XXIII and the WTO's Dispute Settlement Understanding," *Economics and Politics* 14, 283-323.
- [5] Bown, Chad P. (2004a) "Trade Disputes and the Implementation of Protection under the GATT: An Empirical Assessment," *Journal of International Economics* 62, 263-94.

- [6] Bown, Chad P. (2004b) "On the Economic Success of the GATT/WTO Dispute Settlement," *Review of Economics and Statistics* 86, 811-23.
- [7] Bown, Chad P. (2005) "Trade Remedies and the World Trade Organization Dispute Settlement: Why Are So Few Challenged?" *Journal of Legal Studies* 34, 503-55.
- [8] Butler, Monika and Heinz Hauser (2000) "The WTO Dispute Settlement System: First Assessment from an Economic Perspective," *Journal of Law, Economics and Organization* 16, 503-33.
- [9] Carlson, Lisa (2000) "Game Theory: International Trade, Conflict, and Cooperation," in Ronen Palan ed. *Global Political Economy: Contemporary Theories*, London, Routledge.
- [10] Frischmann, Brett (2003) "A Dynamic Institutional Theory of International Law," *Buffalo Law Review* 51, 679-808.
- [11] Frischmann, Brett (2005) "A Comparative Analysis of Compliance Institutions in International Trade Law and International Environmental Law," in E. Kwan Choi and James C. Hartigan, eds. *Handbook of International Trade vol. II: Economic and Legal Analyses of Trade Policy and Institutions*, London, Blackwell.
- [12] Goldsmith, Jack L. and Eric A. Posner (1999) "A Theory of Customary International Law," *University of Chicago Law Review* 66, 1113-77.
- [13] Green, Edward J. and Robert H. Porter (1984) "Noncooperative Collusion under Imperfect Price Information," *Econometrica* 52, 87-100.
- [14] Guzman, Andrew T. (2002) "A Compliance-Based Theory of International Law," *California Law Review* 90, 1823-87.
- [15] Hartigan, James C. (2000) "An Antidumping Law can be Procompetitive," *Pacific Economic Review* 5, 5-14.
- [16] Hartigan, James C. (2009) *Trade Disputes and the Dispute Settlement Understanding of the WTO: an Interdisciplinary Assessment*, Bingley, Emerald.

- [17] Hungerford, Thomas L. (1991) "GATT: A Cooperative Equilibrium in a Noncooperative Trading Regime?" *Journal of International Economics* 31, 357-69.
- [18] Klimenko, Mikhail, Garey Ramey, and Joel Watson (2008) "Recurrent Trade Agreements and the Value of External Enforcement," *Journal of International Economics* 74, 475-99.
- [19] Koremenos, Barbara (2005) "Contracting around International Uncertainty," *American Political Science Review* 99, 549-65.
- [20] Koremenos, Barbara, Charles Lipson, and Duncan Snidal (2001) "The Rational Design of International Institutions," *International Organization* 55, 761-800.
- [21] Kovenock, Dan and Marie Thursby (1992) "GATT, Dispute Settlement, and Cooperation," *Economics and Politics* 4, 151-70.
- [22] Ludema, Rodney D. (2001) "Optimal International Trade Agreements and Dispute Settlement Procedures," *European Journal of Political Economy* 72, 355-76.
- [23] Maggi, Giovanni (1999) "The Role of Multilateral Institutions in International Trade Cooperation," *American Economic Review* 89, 190-214.
- [24] Mitchell, Shannon, K. (1997) "Dispute Settlement and Cooperation: A Note," *Economics and Politics* 9, 87-93.
- [25] Myerson, Roger B. (1979) "Incentive Compatibility and the Bargaining Problem," *Econometrica* 47, 61-74.
- [26] Oye, Kenneth A. (1985) "Explaining Cooperation under Anarchy: Hypotheses and Strategies," *World Politics* 38, 1-24.
- [27] Rosendorff, B. Peter and Helen Milner (2001) "The Optimal Design of International Institutions: Uncertainty and Escape," *International Organization* 55, 829-57.
- [28] Saggi, Kamal (2004) "Tariffs and the Most Favored Nation Clause," *Journal of International Economics* 63, 341-68.

- [29] Scott, Robert E. and George G. Triantis (2005) "Principles of Contract Design," *Yale Law Journal* 115, 814-81.
- [30] Setear, John K. (1996) "An Iterative Perspective on Treaties: A Synthesis of International Relations Theory and International Law," *Harvard International Law Journal* 37, 139-230.
- [31] Setear John K. (1997) "Responses to Breach of a Treaty and Rationalist International Relations Theory: The Rules of Release and Remediation in the Law of Treaties and the Law of State Responsibility," *Virginia Law Review* 83, 1-126.
- [32] Snidal, Duncan (1985) "Coordination versus Prisoners' Dilemma: Implications for International Cooperation and Regimes," *American Political Science Review* 79, 923-42.
- [33] Snidal, Duncan (2002) "Rational Choice and the Theory of International Relations," in Walter Carlsnaes et al ed. *Handbook of International Relations*, London, Sage.
- [34] Tirole, Jean (1988) *The Theory of Industrial Organization*, Cambridge, MIT Press.