TRADE DISPUTES AND SETTLEMENT*

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Abstract

We develop a model of trade agreements with renegotiation and imperfectly verifiable information. In equilibrium, trade disputes can occur and can be resolved in a variety of ways: governments may settle “early” or trigger a court ruling, and in the latter case, they may implement the ruling or reach a post-ruling settlement. The model yields predictions on how the dispute outcome depends on the contracting environment and how it correlates with the optimal contract form. We find support for a key prediction of our model using data on the outcomes of actual trade disputes in the GATT/WTO.

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1. Introduction

Unlike the sporadic trade wars of past eras (see Coneybeare, 1987), international trade disputes are now a regular feature of the world trading system. As one prominent example, consider the recent World Trade Organization (WTO) dispute between the United States and the EU over launch-aid subsidies that the EU provides to Airbus. On September 24 2012, the New York Times reported that “[t]he EU says it has obeyed WTO rulings by eliminating the harmful effect of government loans to Airbus, but Washington disagrees and is threatening up to $10 billion in sanctions.” This may sound like the outbreak of a non-cooperative U.S.-EU trade war, but it is not: instead, the Times report describes the current status of a legal process of dispute resolution within the WTO. And the trade sanctions that Washington is threatening are WTO-authorized sanctions by which the United States would achieve compensation for the harmful trade effects of EU subsidies.

In fact, since the creation of the WTO in 1995, there have been on average approximately 25 trade disputes initiated in the WTO each year (see Horn et al, 2011). But even to the casual observer it is apparent that there is wide variation in the outcomes of these disputes. Often governments reach an “early settlement” without triggering a ruling by the court/dispute settlement body (DSB), but there are also significant numbers of cases where the governments “fight it out” all the way to a DSB ruling. And in these latter cases, sometimes the DSB ruling is implemented, while at other times governments negotiate a post-ruling settlement. In the WTO and its predecessor, the General Agreement on Tariffs and Trade (GATT), just over 50% of disputes settle early, with the remainder proceeding to a DSB ruling. And in about 20% of those GATT/WTO disputes that do go to a ruling, rather than implementing the DSB ruling the governments negotiate their own post-ruling settlement. This variation in dispute outcomes has been well documented empirically (see for example Busch and Reinhardt, 2000, 2006). And as the $10 billion in trade sanctions hanging in the balance for the Airbus dispute illustrates, there can be a great deal riding on how these disputes are resolved. It is therefore important for economists to understand why the various dispute outcomes come about.

In the economics literature on trade agreements, however, there are few models that even predict the occurrence of trade disputes; and no model can account for the diversity in dispute outcomes that we observe in reality. In this paper we develop a simple model of trade agreements that generates trade disputes and a rich set of possibilities for the outcomes of those disputes as
an equilibrium phenomenon – including outcomes in which governments settle early, or settle after the DSB has issued a ruling, or implement the ruling – and yields predictions on how the dispute outcome depends on the contracting environment and how it correlates with the contract form. We also offer an initial assessment of our model’s predictions in light of data on the outcomes of actual trade disputes in the GATT/WTO.

In our model, governments contract over trade policy in the presence of ex-ante uncertainty about the state of the world, as embodied in the joint benefits of trade protection (which can be positive or negative). Ex post, governments observe the joint benefits of protection, but these benefits are only imperfectly verifiable by the court/DSB: if invoked, the DSB conducts an investigation and observes a noisy signal of the joint benefits of protection, and it issues a ruling based on this imperfect information. Thus, at the time when governments can invoke the DSB, they are uncertain about the DSB ruling. Against this backdrop, governments can negotiate at two ex-post stages: after uncertainty about the state of the world is resolved but before any DSB ruling (bargaining “in the shadow of the law”), and after a DSB ruling is reached (bargaining “after the court has spoken”). A final and important feature of our model is that these ex-post negotiations are subject to a key transaction cost, namely that government-to-government compensation entails a deadweight loss; this assumption seems warranted because, as the Airbus example above suggests, in the context of trade disputes governments rarely have access to cash transfers and instead rely on inefficient forms of compensation such as the “self-help remedy” of trade sanctions.¹

These three features of our model – the inefficiency of government-to-government transfers, the possibility that governments negotiate an early settlement under uncertainty about the DSB ruling, and the possibility of a later settlement in which the DSB ruling is renegotiated – are key to the model’s predictions. Allowing governments to be uncertain about the DSB ruling is important because, as we explain below, it allows for the possibility that the governments may not settle early.² As a consequence, our model generates a variety of predictions regarding

¹This type of transaction cost is surely not the only one present in trade disputes. For example, private information and other bargaining frictions are probably very relevant as well. Indeed, there is a vast law and economics literature that analyzes domestic contracting problems in the presence of the latter type of transaction cost. We focus on costly transfers as the key transaction cost because this is a distinctive feature of international contracting settings, and sets it apart from domestic contracting settings, where cash transfers are typically available. An interesting question that we do not address here is why cash transfers are almost never used in the context of trade agreements and disputes. For models that highlight possible shortcomings with the use of cash transfers, see Harstad (2007) and Bagwell and Staiger (2010, especially note 10).

²As we discuss further below, the possibility in our model that the governments may not settle early also
when governments reach an early settlement or fight it out to a court ruling, and in the latter case, when the court ruling is implemented or governments reach a later settlement.

We consider a class of menu contracts that specify a baseline commitment to free trade but may allow the importing country to “breach” this commitment by imposing protection and compensating the exporting country with a certain amount of damages, where the level of damages can be contingent on the DSB signal. This class of contracts is simple but flexible enough to allow for a variety of interesting contractual forms. If the level of damages is prohibitively high, the contract is equivalent to a “property rule” (or “specific performance” contract) in the law-and-economics terminology, while if the level of damages is non-prohibitive the contract is a “liability rule.” In the case of a property rule, the commitment to free trade is treated like a property right which can only change hands by mutual consent, while in the case of a liability rule the importer can buy out of this commitment by paying the contractually specified damages. Our contract class also includes the possibility of a “property rule with escape” (the commitment to free trade is waived – with no compensation owed – in some contingencies), and that of a “liability rule with escape” (the compensation is waived in some contingencies), as well as mixtures of property and liability rules. Legal scholars (e.g., Jackson, 1997, Pauwelyn, 2008) emphasize the distinction between property rules and liability rules, and describe variation across issue areas and over time in the use of these rules in the GATT/WTO.

We first establish that all disputes, regardless of the contract form, settle early when the joint benefits of protection are sufficiently far from zero (either positive or negative). That is, in our model, trade disputes always end in early settlement if the “efficiency stakes” of the dispute – the positive or negative change in the governments’ joint surplus that would occur if the disputed policy were removed – are high enough. One might think that this result reflects a decision by the governments that with so much at stake it is too costly to proceed to a ruling and risk that the DSB might rule incorrectly. But in our model the governments can always negotiate a post-ruling settlement and implement whatever policy they want, so this cannot in fact be the reason for the result.

The key to understanding this first result is to recognize that if the efficiency stakes of the dispute are high, then there is no uncertainty as to the policy choice that a DSB ruling would induce, for the simple reason that regardless of the DSB ruling governments will always find it requires that the policies covered by their contract not be continuous. In the model we develop below, policies are dichotomous, but in the Conclusion we discuss the extension of our results to any number of discrete policy levels, and there we discuss further the continuous policy case as well.
worthwhile to implement the efficient policy and enjoy the associated large gain in joint surplus. It then follows that the only impact of proceeding to a DSB ruling when the efficiency stakes of the dispute are high is that the ruling will determine the damage payment accompanying the policy choice: but the governments can replicate the associated expected payoff in certainty equivalent terms by themselves, without triggering a DSB ruling in the first place. Hence, when the joint benefits of protection are sufficiently extreme, governments have no reason to see their dispute through to a DSB ruling and will instead settle early, and this is true regardless of whether the dispute concerns a property or a liability rule. And of course, early settlement precludes the possibility of post-ruling settlement in these states as well.

We next establish that disputes need not settle early in the remaining states of the world, where the efficiency stakes of the dispute are small. The reason is that, in these states, the policy choice itself can be impacted by the announced DSB damages level. Indeed, we show that trade disputes proceed to a ruling in our model if and only if the policy choice hinges on the possible DSB ruling: this is because when it does, the governments can utilize the policy uncertainty generated by the DSB ruling as a means of compensation; and the inefficiency associated with this method of compensation is small when the dispute’s efficiency stakes are small, making it attractive relative to the alternative of trade sanctions. This does not imply that the DSB’s only role in our model is to serve as a randomization device for the governments. On the contrary, as we discuss later in the paper, provided the DSB signal is informative (better than a coin flip), (i) the DSB’s policy choice is noisy but it selects the more efficient policy more often than not, and (ii) the DSB plays an important off-equilibrium role even when the dispute does not proceed to a ruling.

Hence, in these states of the world, our model indicates that it is possible that governments will proceed to the ruling stage of a dispute, and that they will in fact allow their dispute to proceed to the ruling stage if the policy choice hinges on the possible DSB ruling.

Having characterized the general forces in our model that determine whether governments settle their disputes early or rather fight it out to a court ruling, we next investigate the relationship between dispute outcomes and the form of the contract. We first do this taking the contract form as exogenously given. We show that the distinction between property rules and liability rules is important for predicting the outcomes of trade disputes. Specifically, we find that both early and post-ruling settlement are less likely to occur for disputes over property rules than for disputes over liability rules.

We establish this second set of results by building on our earlier finding that all disputes, regardless of contract form, settle early when the efficiency stakes of the dispute are high; and
by observing that any difference in settlement rates between disputes over property rules and disputes over liability rules must then be associated with disputes where the efficiency stakes are small. We show that in small-efficiency-stakes disputes over property rules the policy choice always hinges on the DSB ruling, and hence these property-rule disputes never settle early. Moreover, using the fact that DSB rulings can occur only when the efficiency stakes are small, we are able to show that there is never post-ruling settlement for disputes over property rules either. By contrast, in small-efficiency-stakes disputes over liability rules, the policy choice may or may not hinge on the DSB ruling, depending on the details of the liability rule, the degree of ex-ante uncertainty and the noise in the DSB signal. And so liability-rule disputes can settle early even when the efficiency stakes are small; and when they do not settle early and proceed to a DSB ruling, we show that post-ruling settlement can occur as well.

Finally, we derive the optimal contract form within our class of contracts. We focus on the degree of ex-ante uncertainty and the accuracy of the DSB information as the key determinants of the optimal contract. If ex-ante uncertainty is small or if the DSB can gather precise information, we show that the optimal contract is a property rule, possibly with escape. By contrast, if ex-ante uncertainty is large and the DSB information is imprecise, we show that the optimal contract is a liability rule (again possibly with escape). In addition to illuminating the conditions most favorable to the performance of property and liability rules, our findings here confirm that each of these two contract forms can be optimal within our model.

To understand intuitively the forces at work in delivering this last set of results, consider first the case of large uncertainty and a highly inaccurate DSB. In this case, a liability rule is optimal. It might be thought that this is so because governments will then not be held rigidly to free trade in the event of a large DSB error, where the DSB rules against protection when in fact protection is highly efficient. But in the event of such a ruling, governments would not be held to free trade even under a property rule, because they would negotiate a post-ruling settlement and agree on protection in exchange for (costly) compensation/trade sanctions. Hence, achieving the “right” policy in the presence of large DSB errors is not the appeal of a liability rule. Rather the liability rule is optimal when large DSB errors are possible because in such an environment a liability rule can keep to a minimum the magnitude of trade sanctions that governments will impose on one another in the context of dispute settlement.

Next consider the case of small uncertainty and/or high DSB accuracy. In this case large DSB errors are not possible, and a property rule is optimal. Here, the problem with a liability
rule is that it involves the use of trade sanctions whenever protection is implemented. By contrast, in such an environment disputes over property rules never result in settlement, because the efficiency consequences of correcting the possible DSB errors with a settlement can never be high enough to justify the costly trade sanctions that would have to accompany the settlement. And so unlike a liability rule, a property rule avoids the equilibrium use of trade sanctions altogether, while permitting policy mistakes with only minor efficiency consequences.

In this paper we cannot provide a systematic investigation of our model’s empirical content, but we do offer an initial assessment of one central prediction, namely, that early settlement rates should be lower in disputes over property rules than in disputes over liability rules. Data on the outcomes of actual trade disputes in the GATT/WTO supports this prediction. Specifically, looking both across rules and within rules that according to legal scholars have evolved over time, we find evidence of a significantly lower settlement rate for disputes over property rules than for disputes over liability rules.

For the questions we consider here, the relevant economics literature on trade agreements is somewhat sparse. A closely related model is the one in Maggi and Staiger (2015), but in that model governments have no uncertainty about the DSB ruling, and as a consequence there are no disputes in equilibrium. There are models of trade agreements that imply disputes in equilibrium and have an explicit role for the DSB, including Beshkar (2010, 2011), Maggi and Staiger (2011), Staiger and Sykes (2013) and Park (forthcoming). But none of these models is capable of predicting the rich dispute outcome possibilities that we describe above.\footnote{A related paper in the international law literature is Guzman and Simmons (2002), who focus on the issue of settlement versus ruling in the context of trade agreements. We discuss this paper at various points below.}

By contrast, the law-and-economics literature has long had models of settlement (see for example Bebchuck, 1984 and Reinganum and Wilde, 1986). And there is a vast literature on property/liability rules and specific-performance/damages (see Calabresi and Melamed 1972, Schwartz, 1979, Shavell, 1984, Ulen, 1984 and Kaplow and Shavell, 1996, to name just a few). But as argued in Maggi and Staiger (2011, 2015), those literatures assume the existence of cash transfers between disputants and so are not directly applicable to the trade agreements setting where, as we have already observed, such transfers are rarely available to help settle disputes.

Finally, there exists a sizable literature on contract design with renegotiation, two prominent examples being Segal and Whinston (2002) and Watson (2007). Relative to this class of models, we allow the court to conduct a noisy investigation ex post, which in turn implies that the parties
may go to court in equilibrium; we allow the parties to renegotiate both before and after the court ruling; and we assume costly government-to-government transfers, whereas the typical models of contracting with renegotiation assume transferable utility. At the same time, however, we impose some restrictions to make the model tractable. First, we focus on a binary policy; this is a price paid for tractability, although as we later observe this assumption captures many trade-related policies that are discrete in practice. And second, we focus on a class of menu contracts, which as we noted includes the contractual forms most relevant for the GATT/WTO; but this is not the most general class of feasible mechanisms.5

The rest of the paper proceeds as follows. Section 2 lays out the basic model. Section 3 focuses on the outcome of disputes. Section 4 characterizes the optimal contract. Section 5 presents evidence from GATT/WTO disputes. Section 6 concludes. An Appendix contains proofs not included in the body of the paper.

2. The Model

We introduce our model in two steps. First we describe the economic and contracting environment, and then we describe a number of specific contract types that will feature prominently in our subsequent analysis.

2.1. The Economic and Contracting Environment

We begin by describing the economic environment, which is similar to Maggi and Staiger (2015). We consider a single industry in which the Home country is the importer and the Foreign country is the exporter. The Home government chooses a binary trade policy for the industry, which we denote by $T \in \{FT, P\}$: “Free Trade” or “Protection.” Many trade disputes in the GATT/WTO focus on non-tariff policy choices that are discrete in practice, such as regulatory regimes or product standards, and our assumption of a binary policy instrument is a simple way to capture this property. In the Conclusion, we discuss how our results can be extended to

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5In particular we do not consider mechanisms based on messages sent by the disputing players, but it is an open question whether or not such mechanisms can improve upon menu contracts in our setting. In a related though different setting, Segal and Whinston (2002) show that a (continuous) mechanism based on two-sided messages may or may not improve upon a menu contract, depending on the specifics of the contracting problem. In any case, as we argue elsewhere (Maggi and Staiger, 2015), in practice trade policies are applied on a continuing basis, so it would be very costly to run message games with high frequency in response to potentially changing states of the world.
more general discrete policies (not necessarily binary) and to the case of continuous policies.\footnote{In their empirical study of WTO disputes, Guzman and Simmons (2002) draw a similar distinction between issues such as health and safety standards that have an “all or nothing” character and policies that are continuous and more “flexible” in nature such as tariffs. We discuss their empirical findings further in the Conclusion.} Finally, we assume that the Foreign government is passive in this industry.

When the Home government makes its trade policy choice, a transfer may also be exchanged between the governments, but we assume that such transfers are costly to orchestrate, i.e., they entail a deadweight loss. With this assumption we attempt to capture an important feature of real-world trade disputes: their resolution rarely involves cash transfers.\footnote{\textit{For example, with two exceptions (the US-Copyright case – see WTO, 2007, pp. 283-286 – and the Brazil-Cotton case – see Schnepf, 2010), the resolution of GATT/WTO disputes has never involved cash transfers.}} Yet in the GATT/WTO countries do sometimes achieve compensation indirectly through the “self help” remedy of tariff retaliation in other sectors, and disputes that are settled by a “mutually agreed solution” may involve a variety of indirect and imperfect compensation mechanisms. To capture this feature of trade disputes in a simple way, we let $b$ denote a (positive or negative) transfer from Home to Foreign, and we let $c(b)$ denote the deadweight loss associated with the transfer level $b$. For tractability we impose a linear cost of transfers: $c(b) = c \cdot |b|$. The role of this assumption will become clear below. We assume as well that the marginal cost of transfers is less than one, or $c \in (0, 1)$, and that the Home country always bears the deadweight loss $c(b)$. These two assumptions ensure that Home’s total cost of the transfer inclusive of deadweight loss, $b + c(b)$, is increasing for all $b$.\footnote{If the deadweight loss were instead borne by the Foreign country, none of our qualitative results would change, provided $b - c(b)$ is increasing for all $b$. But this is assured by our assumption on $c$.}

With the policies and transfer costs defined, we represent the Home government’s payoff by $\omega = v(T) - b - c(b)$, where $v(T)$ is the Home government’s valuation of the policy $T$, which can be interpreted as corresponding to a weighted sum of producer surplus, consumer surplus and revenue, with the weights possibly reflecting political economy concerns (along the lines of e.g., Baldwin, 1987, and Grossman and Helpman, 1994). As noted, the Foreign government is passive in this industry, and so its payoff is simply $\omega^* = v^*(T) + b$, where $v^*(T)$ is the Foreign government’s valuation of the policy $T$. The joint payoff of the two governments is given by $\Omega \equiv v(T) + v^*(T) - c(b)$.

Home is assumed always to gain from protection, with the gain interpreted as arising from some combination of terms-of-trade and political considerations. We denote this gain as $\gamma \equiv v(P) - v(FT) \geq 0$. Foreign is assumed to always lose from protection, and we denote this loss
as $\gamma^* \equiv v^*(FT) - v^*(P) \geq 0$. The joint (positive or negative) gain from protection is then $\Gamma \equiv \gamma - \gamma^*$. In this setting, the joint-surplus maximizing outcome – which we will refer to simply as the “first best” – is easily described: if $\Gamma > 0$ (or $\gamma > \gamma^*$), the first best is $T = P$ and $b = 0$, and if $\Gamma < 0$ (or $\gamma < \gamma^*$), the first best is $T = FT$ and $b = 0$. Notice that $b$ is always zero under the first best, because transfers are costly to execute.

Governments are ex-ante uncertain about the joint gains from protection $\Gamma$, but they observe ex post. If $\Gamma$ were perfectly verifiable (i.e., observed ex post by the court/DSB), of course the governments could write a complete contingent contract. Actual trade agreements, however, seem very far from the complete-contract ideal, and so we are interested instead in an imperfect-contracting scenario, where such a complete contingent contract cannot be written.\footnote{In addition to Maggi and Staiger (2015) on which we build here, other papers that also model trade agreements as incomplete contracts include Copeland (1990), Bagwell and Staiger (2001), Horn (2006), Costinot (2008), Horn, Maggi and Staiger (2010) and Maggi and Staiger (2011).}

For simplicity, we assume that $\gamma^*$ is known ex-ante, so that all the uncertainty in $\Gamma$ originates from $\gamma$, which as we describe further below is only imperfectly verifiable.\footnote{Whether uncertainty over $\gamma$ reflects underlying uncertainty about $v(FT)$ or $v(P)$ or both is immaterial for our results, but for simplicity (and without loss of generality) we normalize $v(FT)$ to be the same across states of the world. We note that our informational assumptions – that uncertainty is one-dimensional and that the uncertain parameter is observed by both parties but not verifiable by the court – are relatively standard assumptions in the literature on contract design with renegotiation (see for example Segal and Whinston, 2002), though our modeling of imperfect verifiability is more novel.} The ex-ante distribution of $\gamma$ is common knowledge and has density $h(\gamma)$, defined over $\gamma \in [0, \infty)$. We let $\underline{\gamma}$ and $\overline{\gamma}$ denote the bounds of the support of $\gamma$: that is, $\underline{\gamma} = \inf\{\gamma : h(\gamma) > 0\}$ and $\overline{\gamma} = \sup\{\gamma : h(\gamma) > 0\}$. To make the problem interesting, we assume $\gamma < \gamma^* < \overline{\gamma}$, so that the first best is $P$ in some states (when $\gamma > \gamma^*$, and hence $\Gamma > 0$) and $FT$ in some states (when $\gamma < \gamma^*$, and hence $\Gamma < 0$).

We will focus on a simple class of menu contracts that allow the Home government to choose between (i) setting $FT$ and (ii) setting $P$ and compensating the Foreign government with a contractually specified payment $b^C$ (“damages”). In Maggi and Staiger (2015) we assume that $\gamma$ is not verifiable by the DSB and the contract specifies a fixed amount of damages. Here we depart from that setup and allow $\gamma$ to be imperfectly verifiable, in the sense that the DSB can observe a noisy signal of $\gamma$, denoted $\gamma_{\text{dsb}}$, which we interpret as the outcome of an independent investigation. And given that $\gamma$ is imperfectly verifiable, it is natural to allow the level of damages to be contingent on the DSB’s signal $\gamma_{\text{dsb}}$. In particular, we suppose that the contract specifies a contingent compensation schedule $b^C(\gamma_{\text{dsb}})$, and that the DSB
is instructed, if invoked, to draw its signal and announce the compensation level according to $b^C(\alpha_{dsb})$ evaluated at the realized signal. We will refer to this announced compensation level as the DSB’s ruling, and we assume that it will be enforced in the event of an ultimate breakdown in ex-post negotiations. The assumption of enforceable contracts is a strong assumption in the context of international trade agreements, but it seems like the natural starting point for examining the questions we are interested in here.

Notice that the DSB is committed to ruling according to the schedule $b^C(\alpha_{dsb})$. With this commitment assumption we exclude scenarios where the DSB is itself an active player who can deviate from $b^C(\alpha_{dsb})$ ex post. Modeling the DSB as an active player would be an interesting extension, but note that if governments can commit the DSB to act in the way we have assumed here, then it is optimal for them to do so. Given this commitment assumption, there is no loss of generality in conditioning $b^C$ only on $\alpha_{dsb}$. Finally, to rule out uninteresting cases, we assume that the optimal contract is non-empty.\footnote{We will use the same notation for the random variable $\alpha_{dsb}$ and for its realization, as this should not cause ambiguity.}

We impose a minimum of structure on the DSB signal technology, by requiring that the joint density of $\alpha$ and $\alpha_{dsb}$ is log-supermodular. This condition is relatively standard and is satisfied by several common distributions (see Athey, 2002, especially footnote 15). And we let $\underline{\alpha}_{dsb}$ and $\overline{\alpha}_{dsb}$ denote the bounds of the support of $\alpha_{dsb}$.

We consider the following timing: (0) Governments write the contract $b^C(\alpha_{dsb})$; (1) $\alpha$ is realized and observed by the governments; (2) Governments Nash bargain over the policy $T$ and the transfer $b$; (3) If governments fail to agree, the DSB observes its signal $\alpha_{dsb}$ and issues its ruling $b^C(\alpha_{dsb})$; (4) If the stage of DSB ruling is reached, governments Nash bargain over the policy and the transfer, and if governments fail to agree, the DSB ruling $b^C(\alpha_{dsb})$ applies (so the Home government can choose between setting $FT$ and setting $P$ with compensation $b^C(\alpha_{dsb})$).

We will refer to stage 0 as the “ex ante” stage, to the stage-2 Nash bargain as “pre-ruling

\footnote{This follows because in our model the only other information that the DSB observes when it is called upon to issue a ruling is that governments have failed to reach a settlement. And while governments could design a schedule which instructed the DSB to make inferences from the governments’ failure to reach settlement, given that the contract is relevant only as a disagreement point there is nothing to be gained from such a schedule relative to the simpler schedule $b^C(\alpha_{dsb})$. To see this, consider the schedule $b^C(\alpha_{dsb}, d)$, where $d = 1$ if governments have disagreed in the prior negotiation. Because the contract is relevant only as a disagreement point, the governments will only consider $b^C(\alpha_{dsb}, 1)$ when they bargain; hence governments can achieve the same outcome with the schedule $b^C(\alpha_{dsb}) = b^C(\alpha_{dsb}, 1)$.}

\footnote{This is guaranteed, for example, if in expectation free trade is sufficiently jointly preferable relative to protection, as then the empty contract is dominated by a noncontingent $FT$ contract.}
negotiation” and to the stage-4 Nash bargain as “post-ruling negotiation.” We assume that the governments have symmetric bargaining power.

Notice the importance of costly transfers. If efficient transfers were available, governments could achieve the first best by simply waiting to negotiate until after the resolution of uncertainty, and there would be no role for contracting ex ante. But when transfers are costly, the first best cannot be achieved in general, and it may be beneficial to write a contract ex ante.\footnote{For example, this possibility becomes particularly transparent in the extreme case where transfers are prohibitively costly, so that in the absence of an ex ante contract the outcome would be $P$ (and no transfer) for all realizations of $\gamma$. In this case, it is clear that even a non-contingent $FT$ contract – generating the outcome $FT$ (and no transfer) for all realizations of $\gamma$ – would strictly improve upon no contract provided that $E[\gamma] < \gamma^*$.}

Finally notice that, after the ex-ante contract has been signed, governments are allowed to negotiate at two stages. A first opportunity occurs in stage 2, where after observing the realization of $\gamma$ governments can bargain “in the shadow of the law.” At this stage the threat point for negotiations is based on a forecast of the ruling that the DSB would issue in stage 3 should stage-2 negotiations break down. The second opportunity occurs in stage 4, when governments can negotiate “after the court has spoken.” Here the DSB has issued its ruling, and the governments may negotiate their own resolution of the dispute against the threat point given by the implementation of the DSB ruling, which is itself an option, as the importer can choose between $(T = P, b = b^C(\gamma^{dsb}))$ and $(T = FT, b = 0)$.

We will characterize the contract $b^C(\gamma^{dsb})$ that maximizes the ex-ante joint payoff of the governments $E[\Omega]$.\footnote{Our focus on the maximization of the governments’ ex ante joint surplus seems reasonable, based on two considerations. First, it seems plausible that at the ex ante stage, when the institution is created, governments can orchestrate more efficient compensation mechanisms than in the ex post context of a trade dispute, because in an ex-ante setting such as a GATT/WTO negotiating round many issues are on the table at once (see, for example, the discussion in Hoekman and Kostecki, 1995, Ch. 3). And second, if we considered a symmetric two-sector version of our model, then at the ex-ante bargaining stage (given symmetric bargaining powers) governments would select the symmetric point of the Pareto frontier, which maximizes the sum of their payoffs.}

2.2. Specific Contract Types

We now describe the main contract types that will feature prominently in what follows. To do so, we consider the family of contracts where $b^C$ is weakly decreasing in $\gamma^{dsb}$ – which we will later prove is a feature of the optimal contract in our environment – and describe a number of
contract types that emerge as special cases of this family of contracts.\footnote{We note that, while it is natural to focus here on contracts where $b_C$ is weakly decreasing in $\gamma^{dsb}$ since this is a feature of an optimal contract, our results on dispute outcomes in section 3 do not rely on this feature.}

A first possibility, illustrated in the top left panel of Figure 1, is a contract that specifies a prohibitively high level of damages for all DSB signals. In this and all panels of Figure 1, we use the label "$b^{prohib}$" to denote the minimum level of damages such that Home prefers $(T = FT, b = 0)$ to $(T = P, b = b^{prohib})$ for all realizations of $\gamma$ in its support (conditional on $\gamma^{dsb}$). This type of contract specifying an extreme level of damages is outcome-equivalent to a “property rule” (or a “specific-performance” contract) in the law-and-economics terminology: such a contract establishes a strict $FT$ commitment, which is treated like a property right that can only change hands by mutual consent. On the basis of this observation, throughout the paper we refer to this type of contract simply as a property rule. A related type of contract, depicted in the bottom left panel of Figure 1, establishes a strict $FT$ obligation but waives this obligation under some contingencies. Here, escape is allowed for a range of high DSB signals, where $b_C(\gamma^{dsb}) = 0$ and hence no compensation for $P$ is required, while for all lower DSB signals escape is not allowed and the level of damages $b_C(\gamma^{dsb})$ is prohibitively high. We will refer to this contract type as a “property rule with escape”.\footnote{In Maggi and Staiger (2015) we use the property-rule terminology to refer both to a contract that allocates the right of free trade to the exporter (a “prohibitive property rule”) and a contract that allocates the right of protection to the importer (a “discretionary property rule”), whereas here we refer to the former as simply a “property rule” and we de-emphasize the latter when it is noncontingent (the empty contract) and refer to it as an “escape” when it occurs in a contingent fashion.}

The two contracts we have described thus far represent property rules (with or without escape), because $b_C(\gamma^{dsb})$ is set at a prohibitively high level (or else zero). An alternative is a contract that allows breach of the $FT$ commitment in exchange for nonprohibitive damages – a “liability rule” in the law-and-economics terminology. We define a liability rule as a contract with $b_C(\gamma^{dsb})$ below the prohibitive level for all $\gamma^{dsb}$ – meaning that for any $\gamma^{dsb}$ there will be some realization of $\gamma$ in its support (conditional on $\gamma^{dsb}$) such that Home prefers $(T = P, b = b_C(\gamma^{dsb}))$ to $(T = FT, b = 0)$. And when the liability rule includes an escape we have $b_C(\gamma^{dsb}) = 0$ for high values of $\gamma^{dsb}$; we depict this contract in the bottom right panel of Figure 1.

A final interesting possibility is the contract depicted in the top right panel of Figure 1, a mixture of a property rule and a liability rule with escape. We will sometimes refer to this contract as a “mixed rule.” It requires strict adherence to the $FT$ commitment for low values of $\gamma^{dsb}$, while for high values of $\gamma^{dsb}$ it allows escape without damage payments; and for
intermediate values of $\gamma_{dmb}$, breach is permitted in exchange for (nonprohibitive) damages. We will have more to say about the presence of these various contract forms in GATT/WTO in later sections, but we note here that aspects reminiscent of this last contract can be seen in the WTO rules on “escape clause” actions, which establish a baseline commitment to $FT$, but under some conditions permit the importer to compensate the exporter and protect, and under more stringent conditions permit the importer to protect without paying compensation.\footnote{More specifically, under the WTO escape clause the importing country can compensate the exporting country and impose protection to address injury to its domestic import-competing industry if the injury is “serious” and results from rising import penetration, but compensation need not be paid at all (for the first three years of an escape clause action) if the injury can be traced to a rise in the absolute level of imports. This is broadly in line with the final contract we describe in the text under the assumption that the efficient response to domestic injury is more likely to involve trade protection ($\gamma$ is high) when the more-stringent (absolute rise in imports) injury criterion is met.}

We have observed that a property rule is outcome-equivalent in our formal model to an extreme liability rule where the level of damages is set prohibitively high, an observation that is shared by Kaplow and Shavell (1996) as well as Maggi and Staiger (2015).\footnote{In practice property rules only approximate prohibitive liability rules, in the sense that they rarely if ever achieve perfect deterrence: auto thefts do occur and jail times are served. Presumably this is so because there is a distribution of types in the population and in the level of punishment that achieves deterrence, and the possibility of error makes the most extreme punishments unattractive. We abstract from these issues here.} This outcome equivalence is convenient for our formal analysis, but it should be kept in mind that in reality property rules are typically enforced by means other than extreme financial compensation. In domestic legal systems, property rules are usually enforced with criminal sanctions (e.g., jail time). In the context of trade agreements, there are no jails into which violators of property rules can be thrown, and the sanctions for violating property rules must take a different form, possibly the undermining of the system of rules itself, in addition to conventional trade sanctions.\footnote{This point is discussed at length by Pauwelyn (2008), who argues that in the WTO property rules are enforced by a combination of conventional trade sanctions and a “kicker,” which can take the form of an erosion of the WTO member countries’ goodwill in future negotiations toward a country violating a property rule, or even worse the threat of a collapse of the institution itself.} In any event, for our formal model the exact nature of the prohibitive penalty associated with violation of a property rule is immaterial, because it remains off the equilibrium path.

\section*{3. Trade Disputes}

We now examine the implications of our model for the resolution of disputes. A first step is to map model outcomes to the occurrence of disputes and their resolution.

We begin by discussing the notion of “dispute” in our setting. In particular, we need to...
identify those stage-2 outcomes for which we will say that a dispute has arisen. A first case is easy: whenever the DSB is invoked and issues its ruling in stage 3, we will say that a dispute has arisen. The more difficult case occurs when the governments reach agreement in stage 2. Suppose governments agree in stage-2 that the Home government will set \( T = FT \) and that no transfer will be exchanged: Should this be called a dispute with early settlement, or is it more appropriate to think of this as no dispute at all? Our formal model provides no guidance on this interpretive issue, and so we must reach for guidance outside the model. Here we appeal to the fact that in reality the import policy is under the unilateral control of the importing government, while compensation is typically a matter for negotiation between the two governments.\(^{21}\) And so an ad-hoc but reasonable approach to this interpretive issue is the following: if at stage 2 governments reach an agreement that involves a non-zero transfer \( b \neq 0 \), we call this a dispute with early settlement, and if at stage 2 governments reach an agreement that involves no transfer, we say that there is no dispute.\(^{22}\)

Having defined the no-dispute outcome, we next interpret each of the remaining three possible model outcomes. A first possibility is that governments agree on a policy \( T \) and a non-zero transfer \( b \) before any DSB ruling. We will refer to this outcome as one of early settlement. A second possibility is that the DSB issues a ruling and the ruling is implemented. This occurs when governments fail to reach agreement in stage 2, the DSB issues a ruling \( b^C(\gamma^{dsb}) \) and the Home government behaves according to the ruling, that is it chooses one of the two options \((T = FT, b = 0)\) or \((T = P, b = b^C(\gamma^{dsb}))\). When a dispute is resolved in this way, we will simply say that the DSB ruling is implemented. A final possibility is that the DSB issues a ruling, but the ruling is not implemented and instead the governments negotiate a different resolution to their dispute in stage 4. We will refer to this outcome as one of post-ruling settlement.

These model dispute outcomes suggest two key questions around which we organize the remainder of this section: (1) When do disputes arise, and when is there early settlement?; and

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\(^{21}\) In fact, the GATT/WTO requires that governments consult whenever a possible retaliation is involved.

\(^{22}\) A more formal way to justify these interpretations is to consider a slightly richer game that captures some of the more realistic features described above, as follows. Consider replacing stage 1 with an augmented stage 1 in which, after \( \gamma \) is realized, Home selects \( T \in \{P, FT\} \) and then Foreign chooses whether or not to “request consultation.” If Foreign does not request consultation in this augmented stage 1, then the game ends after stage 1 with Home’s selected policy and no compensation. If instead Foreign requests consultation, then the game proceeds to stage 2 as before. Also assume that if Foreign is indifferent, it does not request consultation. In this augmented game, it is natural to say that there is a “dispute” if and only if governments proceed to stage 2. It is straightforward to show that this augmented game ends after stage 1 if and only if the outcome of the original game is a stage-2 agreement described by either \((T = FT, b = 0)\) or \((T = P, b = 0)\); hence this augmented game provides a simple way to capture our more informal discussion in the text.
When is there post-ruling settlement? We begin by considering the first question, and then turn to the second question.

### 3.1. Early Settlement and DSB Rulings

When do disputes arise, and when is there early settlement? To answer these questions, we begin by developing a figure which can be used to characterize the stage-2 outcomes.

For fixed $\gamma^*$, we partition the potential values of $\gamma$ into three intervals or “regions:” Region I, $\gamma \in [0, (1 - c)\gamma^*]$; Region II, $\gamma \in ((1 - c)\gamma^*, (1 + c)\gamma^*)$; and Region III, $\gamma \in [(1 + c)\gamma^*, \infty)$. For realizations of $\gamma$ in Regions I and III, the “efficiency stakes” of the dispute – the positive or negative change in joint surplus generated by a change in the policy – are high; in Region II the efficiency stakes are low.

In Figure 2 we depict the bargaining frontier for $\gamma$ in each of these regions, with the Home and Foreign government payoffs on the vertical and horizontal axis respectively. For each region, the bargaining frontier corresponds to the outer envelope of two piecewise-linear sub-frontiers, one passing through point $P$ (and associated with $T = P$ and various levels of the transfer $b$), the other passing through point $FT$ (and associated with $T = FT$ and various levels of $b$): the piecewise-linearity of each sub-frontier reflects the piecewise-linearity of $c(b)$, with the slope of each sub-frontier given by $-(1 - c)$ for $b < 0$ and by $-(1 + c)$ for $b > 0$ and each sub-frontier kinked at $b = 0$. Recalling our assumption that the value $\gamma^*$ is in the interior of the marginal support of $\gamma$, it follows that $\gamma$ falls in Region II with positive ex-ante probability. By contrast, Regions I and/or III are relevant only if the support of $\gamma$ is sufficiently large.

The top left panel of Figure 2 depicts the bargaining frontier for Region I. Here, $\gamma$ is far below $\gamma^*$, so the efficiency gains from $FT$ are large, and as a consequence, achieving the frontier always requires $T = FT$; note that in this case the frontier is globally concave. The bottom panel of Figure 2 depicts the bargaining frontier for Region III. Here $\gamma$ is far above $\gamma^*$ and the efficiency gains from $P$ are large, and so achieving the frontier always requires $T = P$; again, in this case the frontier is globally concave. Finally, the top right panel of Figure 2 depicts the bargaining frontier for Region II. Here, $\gamma$ is relatively close to $\gamma^*$ and as a consequence neither of the policies $FT$ or $P$ Pareto-dominates the other: the frontier is not globally concave, because both the policy $T$ and the transfer $b$ change along the frontier.

What remains is to determine the position of the disagreement point for the stage-2 bargain in the various regions of Figure 2. In case of disagreement in stage 2, there will be a DSB ruling
followed by post-ruling bargaining (at stage 4). Thus we need to proceed by backward induction, solve for the equilibrium payoffs of the post-ruling bargaining for each possible ruling $b^C$, and then take the expectation of those payoffs over the possible values of $b^C$ conditional on $\gamma$ (given the contract $b^C(\gamma^{dsb})$). Formally, letting $\tilde{\omega}(b^C, \gamma)$ and $\tilde{\omega}^*(b^C, \gamma)$ denote the Home and Foreign payoffs in the stage-4 subgame given $b^C$ and $\gamma$, and $G(\gamma^{dsb}|\gamma)$ the c.d.f. of $\gamma^{dsb}$ conditional on $\gamma$, we may express the expected Home and Foreign disagreement payoffs for the stage-2 bargain given $\gamma$ as $\int \tilde{\omega}(b^C(\gamma^{dsb}), \gamma) dG(\gamma^{dsb}|\gamma)$ and $\int \tilde{\omega}^*(b^C(\gamma^{dsb}), \gamma) dG(\gamma^{dsb}|\gamma)$, respectively.

For the purposes of our next results, we do not need to go through the full backward-induction analysis to determine the precise position of the disagreement point for the stage-2 bargain in the various regions of Figure 2. Instead we only need to make a key remark about the position of the disagreement point: this point can never lie strictly below the bargaining frontier, and in particular, if $\gamma$ falls in Region I or III the disagreement point for the stage-2 bargain always lies on the bargaining frontier, while if $\gamma$ falls in Region II it may lie either on the bargaining frontier or above it.

To see this, fix a value of $\gamma$ and consider the possible stage-4 outcomes if governments trigger a DSB ruling. After the ruling governments can bargain again (at stage 4), and since bargaining is efficient, the stage-4 payoff point will lie on the bargaining frontier regardless of the ruling. Moreover it can easily be shown, and is intuitively clear, that for any $\gamma$ the stage-4 payoff point can never lie on the left branch of the $P$ sub-frontier or the right branch of the $FT$ sub-frontier; that is, it can never be the case that the policy is $P$ and the importer receives a payment ($b < 0$), or the policy is $FT$ and the exporter receives a payment ($b > 0$).

Now let us consider each of the three possible intervals of $\gamma$. If $\gamma$ falls in Region I, given the observations made just above, all possible stage-4 payoff points lie on the left branch of the $FT$ sub-frontier (the red line in the top left panel of Figure 2), and since all these points lie on a single line, the expected payoff point must also lie on this line, and we can therefore conclude that the disagreement point for the stage-2 bargain in Region I lies on the bargaining frontier. We depict such a disagreement point with the label $ED$ in the top left panel of Figure 2.

Similarly, if $\gamma$ falls in Region III, all possible stage-4 payoff points lie on the right branch of the $P$ sub-frontier (the red line in the bottom panel of Figure 2), thus the expected payoff point must also lie on this line, and we can conclude that the disagreement point for the stage-2 bargain in Region III must also lie on the bargaining frontier. We depict such a disagreement point with the label $ED$ in the bottom panel of Figure 2.
Finally, suppose $\gamma$ falls in Region II. In this case, the stage-4 payoff point must lie either on the left branch of the $FT$ sub-frontier or on the right branch of the $P$ sub-frontier, thus the set of possible stage-4 payoff points is a weakly convex locus (the red locus in the top right panel of Figure 2).\textsuperscript{23} It follows immediately that the expected stage-4 payoff point – that is, the disagreement point for the stage-2 bargain – may lie either on the bargaining frontier or above it, but never strictly below it. We depict two possible disagreement points, both labeled $ED$, in the top right panel of Figure 2. And whether the $ED$ point is on the frontier or above it depends on whether the set of possible stage-4 payoff points includes points on both branches of the bargaining frontier or only one of them; we will later examine conditions under which each case arises.

We are now ready to consider the questions posed at the beginning of this section. First, when do disputes arise? In light of our convention that the no-dispute outcome corresponds to a stage-2 agreement involving no transfers, the answer to this first question is immediate from Figure 2 and our observation just above that governments obtain exactly their expected disagreement payoffs in the stage-2 bargain. The no-dispute outcome arises for $\gamma$ in Region I if and only if the stage-2 disagreement point corresponds to the point $FT$ in the top left panel of Figure 2, for $\gamma$ in Region III if and only if the stage-2 disagreement point corresponds to the point $P$ in the bottom panel of Figure 2, and for $\gamma$ in Region II if and only if the stage-2 disagreement point corresponds to the point $P$ or $FT$ in the top right panel of Figure 2.

We next turn to the question of how disputes are resolved: Does the dispute settle early, or does it proceed to a ruling? The answer hinges on whether the disagreement point lies above the bargaining frontier or rather on it: in the former case, a DSB ruling will be triggered; in the latter case, the governments are indifferent between triggering a DSB ruling and agreeing on the certainty-equivalent terms of the disagreement payoff, and we assume that this indifference is broken in favor of early settlement. A first result is thus clear: since, as we observed above, in Regions I and III the disagreement point always lies on the bargaining frontier, in these regions disputes are always settled early, regardless of the contract. We may therefore state:

**Proposition 1.** If $\gamma$ lies in Region I or III, where the efficiency stakes are high, any dispute will end in early settlement.

\textsuperscript{23}It is important to keep in mind that the red locus highlighted in each panel of Figure 2 includes all possible stage-4 payoff points for the corresponding region of $\gamma$, but the set of possible stage-4 payoff points will be a subset of this red locus that depends on the contract and the possible DSB signal realizations.
Proposition 1 reflects the fact that, as Figure 2 depicts, when the efficiency stakes of the dispute are high (i.e., for $\gamma$ in Regions I or III) there is no uncertainty as to the policy choice that a DSB ruling would induce. For example, if $\gamma$ falls in Region III, protection will be the result regardless of the level of damages announced by the DSB: if the DSB-announced damages are not too high, then the DSB ruling will be implemented by a choice of protection and the payment of the DSB stipulated damages; otherwise, there will be a post-ruling settlement under which protection will again be chosen and governments will settle with a level of damages that is lower than that stipulated by the DSB. A similar logic implies that free trade will be the result regardless of the level of damages announced by the DSB when $\gamma$ falls in Region I. Hence, in these circumstances the only impact of proceeding to a DSB ruling is to pin down the damage payment for protection. But then the expected payoff to the two governments if they trigger a DSB ruling is simply the payoff associated with the chosen policy and the expected damage payment, and this is a payoff that the two governments can replicate in certainty equivalent terms by themselves, without triggering a DSB ruling in the first place. For this reason, the governments settle early in Regions I and III, regardless of the nature of the contract.

Let us now consider disputes that arise in Region II, where the efficiency stakes of the dispute are low. Here it is possible that the disagreement point for the stage-2 bargain lies above the bargaining frontier and hence possible that the dispute will proceed to a DSB ruling. To understand when this can happen, the first step is to consider the possible outcomes of the post-ruling (stage-4) bargaining depending on the DSB ruling $b^C$. Figure 3 provides the needed detail. The green locus of points in Figure 3 traces out the outcome of the post-ruling bargaining for $\gamma$ in Region II as $b^C$ varies between zero and infinity. Clearly, for $b^C = 0$ the outcome is at the point $P$. As $b^C$ increases from zero, initially the disagreement point travels down along the $P$ sub-frontier, and the outcome of the post-ruling bargain coincides with the disagreement point. As $b^C$ increases beyond a certain level, the disagreement point dips below the bargaining frontier and travels along the dotted green line in Figure 3, triggering a post-ruling settlement and an outcome diagonally above the disagreement point on the $FT$ sub-frontier. Finally, as $b^C$ increases beyond the prohibitive level, so that Home prefers to choose free trade rather than protect and pay damages, the disagreement point jumps to point $FT$. Having traced out the outcome of the post-ruling bargaining as $b^C$ varies, the final step is to consider the expectation over all possible outcomes in light of the contract $b^C(\gamma^{dsb})$ and the distribution of $\gamma^{dsb}$ conditional on $\gamma$. This delivers the disagreement point for the stage-2 bargain in Region II,
and as we have observed the dispute proceeds to a ruling if and only if the disagreement point lies above the bargaining frontier.

We may now make the following observation: a DSB ruling is triggered in Region II if and only if the policy hinges on the DSB ruling. If this is the case, then the possible outcomes of the post-ruling bargain lie on both of the sub-frontiers in Region II, and hence the disagreement point lies strictly above the bargaining frontier, such as at the point labeled $ED$ in Figure 3, and the dispute will proceed to a ruling. If the policy does not hinge on the DSB ruling, on the other hand, the possible outcomes of the post-ruling bargain lie only on one of the sub-frontiers in Region II, and hence the disagreement point lies on the bargaining frontier and the outcome of the dispute will be an early settlement. We may now summarize with:

**Proposition 2.** If $\gamma$ lies in Region II, where the efficiency stakes are low, a dispute may settle early or it may proceed to a DSB ruling. The dispute will proceed to a DSB ruling if and only if the contract is such that the policy choice hinges on the ruling.

According to Proposition 2, disputes proceed to a ruling in our model when the policy choice hinges on the DSB ruling, and this can occur only for $\gamma$ in Region II, where the efficiency stakes of the dispute are low.$^{24}$ The reason is that, in these circumstances, a new method of compensation is introduced that would not be available to the governments if they settled early and did not trigger the ruling: the governments can utilize the policy uncertainty generated by the DSB ruling as a means of compensation and damage payments. And the inefficiency associated with this method of compensation is small when the dispute’s efficiency stakes are small, making it attractive relative to the alternative of trade sanctions. Of course, as long as the DSB signal is informative the role of the DSB ruling goes beyond that of providing governments with a randomization device in these circumstances, because the DSB choice of policy is noisy but it also selects the more efficient policy with more than a 50% probability.$^{25}$ Nevertheless, it is the uncertainty in the DSB ruling that makes proceeding to the ruling itself appealing to the governments in these circumstances.

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$^{24}$Note that this is not a statement about the size of the stakes for either the importer ($\gamma$) or the exporter ($\gamma^*$). It is only a statement about the size of the joint stakes $|\gamma - \gamma^*|$. It may also now be seen why with continuous policies there would typically be no rulings: this is because, with continuous policies, under some regularity conditions the convexity of the bargaining frontier that is necessary for DSB rulings to occur in our model would not arise. We discuss the continuous-policy case further in the Conclusion.

$^{25}$As we noted in the Introduction, the DSB also plays an important off-equilibrium role even when the dispute does not proceed to a ruling, a point we return to in the next section.
Thus far we have said nothing about the relative likelihood of early settlement across contract forms. We now demonstrate that the distinction between property rules and liability rules is important for predicting the likelihood of early settlement. In what follows, by “likelihood of early settlement” we mean the ex-ante probability of early settlement conditional on a dispute.

By Propositions 1 and 2, differences in the likelihood of early settlement across different contracts can arise only for $\gamma$ in Region II. We now argue that, if a dispute over a property rule occurs for $\gamma$ in Region II, it will never settle early. To see this note that in the case of a property rule there are only two possibilities: (i) if there is no uncertainty as to whether the DSB ruling would grant an escape, then the stage-2 disagreement point is either point $P$ or point $FT$ in the top right panel of Figure 2, and hence there will be no dispute; (ii) if there is uncertainty as to whether the DSB will grant an escape, then the stage-2 disagreement point will lie somewhere on the (interior of the) dashed line that connects $P$ and $FT$ in Figure 3, hence a dispute occurs, and since the disagreement point is above the bargaining frontier the dispute proceeds to a ruling. By contrast, if a dispute over a liability (or mixed) rule occurs for $\gamma$ in Region II, it may proceed to a ruling or it may settle early, depending on whether the possible realizations of $b^C(\gamma^{dsb})$ lead to outcomes along both or only one of the two subfrontiers in Region II; and it is easy to show that both of these cases are possible.

With the likelihood of early settlement the same across all contracts when $\gamma$ falls in Regions I or III, and (weakly) lower for property rules than for liability (or mixed) rules when $\gamma$ falls in Region II, we may now state:

**Proposition 3.** The likelihood of early settlement for disputes over property rules is (weakly) lower than for disputes over liability (or mixed) rules.

Intuitively, disputes proceed to a DSB ruling in our model if and only if the policy choice hinges on the ruling, and this will be the case for (weakly) more states of the world when the dispute concerns a property rule than when it concerns a liability (or mixed) rule.

### 3.2. Post-Ruling Settlement

We next turn to post-ruling settlement. Using Propositions 1-2, we can focus our discussion of post-ruling settlement on realizations of $\gamma$ in Region II, that is for $\gamma \in ((1 - c)\gamma^*, (1 + c)\gamma^*)$, because these are the only realizations of $\gamma$ for which a dispute may proceed to a DSB ruling. Recall that for $\gamma$ in Region II, the shape of the bargaining frontier is as depicted in Figure 3.
A first point is easily established: if the ruling concerns a property rule there can never be post-ruling settlement. To see this, consider Figure 3. Notice that both points $P$ and $FT$ are on the bargaining frontier; intuitively, even if one policy is more efficient than the other, switching from the less efficient to the more efficient policy cannot make both parties better off in Region II (where the efficiency stakes of the dispute are low), due to the inefficiency of the transfer. Next observe that under a property rule, the disagreement point in the post-ruling negotiation is either point $FT$ or (if an escape is granted) point $P$, hence in either case there is no possible Pareto improvement over the disagreement point, and therefore no post-ruling settlement is possible.

Next we argue that, if the ruling concerns a liability or a mixed rule, it is possible that governments will reach a post-ruling settlement. To establish this, we can continue to focus on Figure 3. Suppose that, given the contract and the realization of $\gamma^{dsb}$, the resulting level of damages $t_C(\gamma^{dsb})$ is such that (i) Home prefers setting policy $P$ and paying damages rather than setting policy $FT$, and (ii) the resulting payoff point is strictly below the efficiency frontier. In terms of Figure 3, this means that the disagreement point in the post-ruling negotiation is a point somewhere on the (interior of the) dotted red line. In this case, since the disagreement point is strictly below the bargaining frontier, clearly there will be post-ruling settlement. But we also need to ask: can a scenario like the one just described occur under an optimal contract? The answer is yes: this scenario can occur for some realizations of $\gamma^{dsb}$ under an optimal contract if, for example, the contract looks as in the top right panel of Figure 1. And as we discuss in the next section, there exist conditions under which this type of contract is indeed optimal. We may now state:

**Proposition 4.** Post-ruling settlement can never occur in the case of disputes over property rules, while it can occur in the case of disputes over liability (or mixed) rules.

Intuitively, DSB rulings only occur if the efficiency stakes of the dispute are low, and in these circumstances neither policy ($P$ or $FT$) is Pareto-dominated, because any efficiency gains from switching policy would be outweighed by the inefficiency of the transfer needed to redistribute such gains. Under a property rule dispute, the disagreement point in the post-ruling negotiation is given by either policy $FT$ (and no transfer) or policy $P$ (and no transfer), the disagreement point is Pareto-undominated, and hence there cannot be post-ruling settlement. With a dispute over a liability (or mixed) rule, on the other hand, it may well happen that the disagreement
point in the post-ruling negotiation is below the efficiency frontier, and therefore post-ruling settlement is possible.

It is also interesting to note that, if post-ruling settlement does occur, it must go in the direction of liberalizing trade, in the sense that governments agree on policy $FT$ (with Foreign compensating Home) against a disagreement point where Home would have chosen policy $P$ (and paid the DSB-stipulated damages). This can be seen easily from Figure 3: as explained above, post-ruling settlement occurs when the disagreement point lies on the dotted red line (which entails policy $P$), and the outcome of the bargain lies on the part of the frontier associated with policy $FT$.\footnote{Maggi and Staiger (2015) derive a similar result concerning the direction of renegotiation, but their result requires the optimality of the contract while here the result follows from the selection of $\gamma$’s into DSB rulings implied by the early settlement decision. Note also that here the result applies to post-ruling settlement but not to early settlement, whereas in Maggi and Staiger (2015) there is only one kind of settlement.}

4. The Optimal Contract

We now characterize the optimal contract. We first provide a general characterization, and then consider how the optimal contract form depends on features of the contracting environment.

In principle we must solve for the subgame-perfect equilibrium of the game for any given contract $b^C(\gamma_{dsb})$, and then derive the contract that maximizes the ex-ante (subgame-perfect-equilibrium) joint payoff. However a complicating factor in solving this problem is that, in the stage-2 negotiation, governments face uncertainty over the signal that the DSB will observe if negotiations fail, and this makes the analysis quite involved. This is where the linear-cost-of-transfers assumption provides tractability: under this assumption, as we establish below, the problem of finding the $b^C(\gamma_{dsb})$ schedule that maximizes the ex-ante joint payoff $E[\Omega]$ is equivalent to a simpler problem, namely, finding the level of $b^C$ that maximizes the expected joint payoff as viewed from stage 3, where the signal $\gamma_{dsb}$ has been observed but the true $\gamma$ is unknown. With a nonlinear cost of transfers, this equivalence would not hold, and the problem would then be more complex.

We let $\bar{\Omega}(b^C, \gamma)$ denote the equilibrium joint payoff in the stage-4 subgame given DSB-determined damages level $b^C$ and realized $\gamma$. From the perspective of stage 3, the expected joint payoff is $E[\bar{\Omega}(b^C, \gamma)|\gamma_{dsb}] = \int \bar{\Omega}(b^C, \gamma)dH(\gamma|\gamma_{dsb})$, where $H(\gamma|\gamma_{dsb})$ is the c.d.f. of $\gamma$ conditional on $\gamma_{dsb}$. The following Lemma is proved in the Appendix:
Lemma 1. With $c(b) = c \cdot |b|$, the optimal contract $b^C(\gamma^{dsb})$ solves $\max_{b^C} E[\tilde{\Omega}(b^C, \gamma)|\gamma^{dsb}]$.

This result is a consequence of the fact that, as we have earlier observed, the linear cost of transfers ensures that for each $\gamma$ the bargaining frontier is never strictly concave over the relevant range, and so in the stage-2 bargain governments obtain exactly their expected disagreement payoffs. Therefore, the problem boils down to choosing the $b^C(\gamma^{dsb})$ schedule that maximizes the expected joint disagreement payoff $E[\tilde{\Omega}(b^C, \gamma)|\gamma^{dsb}]$.

We now provide a general characterization of the optimal $b^C(\gamma^{dsb})$ schedule. For this purpose, Lemma 1 allows us to focus on the game as viewed from stage 3, where the DSB signal $\gamma^{dsb}$ has been observed. In effect, we need to optimize $b^C$ for $\gamma$ distributed according to $h(\gamma|\gamma^{dsb})$. Recall that $(\gamma^{dsb}, \bar{\gamma}^{dsb})$ denotes the support of $\gamma^{dsb}$ and $(\bar{\gamma}(\gamma^{dsb}), \bar{\gamma}(\gamma^{dsb}))$ denotes the support of $\gamma$ conditional on $\gamma^{dsb}$. Further, while we have earlier described in the context of Figure 1 what it means for $b^C(\gamma^{dsb})$ to be set at a prohibitively high level, we now define this more formally: we say that $b^C$ is prohibitive given the signal $\gamma^{dsb}$ if it is such that Home would choose $T = FT$ for all $\gamma$ in its conditional support $(\bar{\gamma}(\gamma^{dsb}), \bar{\gamma}(\gamma^{dsb}))$, and we let $\bar{p}_{prohib}(\gamma^{dsb})$ denote the minimum such level of $b^C$. A final complication in this setting is that the objective $E[\tilde{\Omega}(b^C, \gamma)|\gamma^{dsb}]$ is not guaranteed to be globally concave in $b^C$. To make the analysis tractable we assume that the objective admits at most one interior maximum, which (it can be shown) is guaranteed provided that $h(\gamma|\gamma^{dsb})$ does not increase too quickly with $\gamma$. In the Appendix we prove:

Proposition 5. (i) There exist critical levels $(\gamma_1^{dsb}, \gamma_2^{dsb})$, with $\gamma_2^{dsb} \leq \gamma_1^{dsb} \leq \bar{\gamma}^{dsb}$, such that the optimal $b^C$ is prohibitive for $\gamma^{dsb} \in (\gamma_2^{dsb}, \gamma_1^{dsb})$, decreasing for $\gamma^{dsb} \in (\gamma_1^{dsb}, \gamma_2^{dsb})$ and zero for $\gamma^{dsb} \in (\gamma_2^{dsb}, \bar{\gamma}^{dsb})$. (ii) The optimal $b^C$ is (weakly) increasing in $\gamma^*$. 

Proposition 5 establishes that the optimal level of damages $b^C$ is (weakly) decreasing in $\gamma^{dsb}$ and (weakly) increasing in $\gamma^*$. An interesting aspect of this result is that, contrary to the standard logic of efficient breach whereby damages should reflect only the level of harm caused by breach ($\gamma^*$), here the optimal damages may depend not only on $\gamma^*$ but also on the (signal of the) benefit that breach provides to the Home government ($\gamma^{dsb}$). Intuitively, since it is not optimal in general to set damages at the level $\gamma^*$ that fully compensates the Foreign government in our costly-transfer setting, making the damages sensitive to the estimated benefit that the Home government gains from breach helps to ensure that breach will occur only when it is likely to be efficient.
With the aid of Figure 1, we earlier interpreted specific contract forms from the set of optimal contracts identified by Proposition 5. We next highlight conditions under which these contract forms are optimal.

It is convenient to begin with the case in which ex-post uncertainty about $\gamma$ is small, meaning that the DSB has little uncertainty about $\gamma$ given its observed signal $\gamma^{\text{dsb}}$. We use the support of $\gamma$ conditional on $\gamma^{\text{dsb}}$ as a crude but simple measure of the DSB’s uncertainty, so we say that the DSB’s uncertainty about $\gamma$ is small if the support of $\gamma|\gamma^{\text{dsb}}$ is small for all $\gamma^{\text{dsb}}$.

There are two distinct ways that the DSB’s uncertainty about $\gamma$ can be small. First, the DSB signal $\gamma^{\text{dsb}}$ can be very accurate, even if ex-ante uncertainty is large. And second, since the support of $\gamma|\gamma^{\text{dsb}}$ can be no larger than the unconditional support of $\gamma$, the latter support can be small, meaning that there is small ex-ante uncertainty about $\gamma$. Our next result applies under either possibility.

We now establish that when the DSB’s uncertainty is small, the optimal $b^C(\gamma^{\text{dsb}})$ schedule is a property rule, with or without escape, that is $\gamma^{\text{dsb}}_1 = \gamma^{\text{dsb}}_2$. Here we provide an intuitive argument, relegating the complete proof to the Appendix. The logic mirrors that of a similar result in Maggi and Staiger (2015). In that model, the DSB does not observe any signal, so the only possible type of uncertainty is ex-ante uncertainty about $\gamma$; and there we show that, if the support of $\gamma$ is small, the optimal contract is a property rule. The basic argument here is similar, except that we need to consider the support of $\gamma$ conditional on $\gamma^{\text{dsb}}$.

Note first that, if the support of $\gamma|\gamma^{\text{dsb}}$ does not include $\gamma^*$, clearly the optimal $b^C$ is prohibitive (zero) if the support lies below (above) $\gamma^*$. Next suppose the support of $\gamma|\gamma^{\text{dsb}}$ includes $\gamma^*$. If this support is sufficiently small, when $b^C$ is prohibitive or zero there is no renegotiation for any $\gamma$ (we show this in the Appendix), and hence no transfers in equilibrium. Setting $b^C$ at a positive but non-prohibitive level may achieve a state-contingent policy, but the associated benefit is small because the support of $\gamma$ around $\gamma^*$ is small. On the other hand, the cost of achieving this state-contingency is not small, because it requires a non-negligible level of transfer payments in equilibrium. We can thus state:

**Proposition 6.** If the support of $\gamma|\gamma^{\text{dsb}}$ is sufficiently small for all $\gamma^{\text{dsb}}$, then a property rule (with or without escape) is optimal: $\gamma^{\text{dsb}}_1 = \gamma^{\text{dsb}}_2$. Furthermore, the optimal $b^C$ is prohibitive (given $\gamma^{\text{dsb}}$) if $E[\Gamma|\gamma^{\text{dsb}}] \leq 0$ and zero otherwise.

As Proposition 6 indicates, if the DSB information is very accurate and/or ex-ante uncertainty
is small, the optimal $b^C(\gamma^{dsb})$ schedule is a property rule, possibly with escape, and its features can be described very simply: a contract that establishes a strict $FT$ obligation, but which may be waived if the DSB estimates the joint benefit from protection to be high. This contract form is reminiscent of the WTO approach to a variety of baseline contractual obligations – such as the national treatment obligation and the prohibitions on quantitative restrictions and export subsidies – which have been interpreted by legal scholars (e.g. Pauwelyn, 2008) as property rules, but which can be waived under the general exceptions for health, welfare and national security reasons contained in GATT Articles XX and XXI. According to our model the role of the DSB in this context would be to rule on whether or not an exception to the baseline obligation can be applied.\footnote{Notice also that it is possible that the optimal contract as described by Proposition 6 is in fact a noncontingent property rule, that is a prohibitive $b^C$ for all $\gamma^{dsb}$: this will be the case if $E[\Gamma|\gamma^{dsb}] \leq 0$ for all $\gamma^{dsb}$. Here the DSB is not given the role of determining when the $FT$ commitment should be upheld and when an exception should be granted. Denying the DSB this role can be optimal if ex-ante uncertainty is small but the DSB signal is sufficiently uninformative.}

We next focus on an environment where the DSB’s uncertainty is large, and establish that if the support of $\gamma|\gamma^{dsb}$ is sufficiently large for all $\gamma^{dsb}$, the optimum is a liability rule (with or without escape), that is $\gamma^{dsb} = \gamma^{dsb}_0 < \gamma^{dsb}_1$. The basic intuition is the following. Consider a given value of $\gamma^{dsb}$, and suppose the support of $\gamma|\gamma^{dsb}$ is very large. Can a prohibitive level of $b^C(\gamma^{dsb})$ – so that Home would rather choose free trade than protect and pay damages – be optimal? If the support of $\gamma|\gamma^{dsb}$ includes very large values of $\gamma$, for these values of $\gamma$ the $FT$ policy would be very inefficient, so governments will renegotiate toward the policy $P$; but this renegotiation will entail a transfer whose size exceeds $\gamma^*$ (the minimum level needed to convince Foreign to switch from $FT$ to $P$), which is itself inefficient. Intuitively, then, if $b^C$ is reduced from the prohibitive level to the level $b^C = \gamma^*$, this will not affect the policy outcome ($P$) and will reduce the size of the transfer made in equilibrium, thus improving on the original contract. In the Appendix we prove:

**Proposition 7.** If the support of $\gamma|\gamma^{dsb}$ is sufficiently large for all $\gamma^{dsb}$, then the optimum is a liability rule (with or without escape): $\gamma^{dsb} = \gamma^{dsb}_1 < \gamma^{dsb}_2$.

Proposition 7 indicates that, when ex-ante uncertainty is large and there is large noise in the DSB signal, the optimal $b^C(\gamma^{dsb})$ schedule is a liability rule. Accordingly, for every DSB signal realization $\gamma^{dsb}$ there is a range of high $\gamma$ such that the Home government prefers to set $T = P$. 
and pay \( b^C(\gamma^{dsb}) \) rather than setting \( T = FT \). And if the liability rule includes an escape (i.e., if \( \gamma_2^{dsb} < \bar{\gamma}^{dsb} \)), then for sufficiently high values of \( \gamma^{dsb} \) the Home government can set \( T = P \) without paying any compensation at all.

Together Propositions 6 and 7 extend to a setting of imperfect verifiability the insights of Maggi and Staiger (2015, Proposition 2) concerning the impact of uncertainty on the optimal contract form. To bring into sharp relief the way in which the optimal contract depends on the degree of uncertainty, we have considered two rather extreme cases, one where the DSB’s uncertainty is small for all \( \gamma^{dsb} \), and one where the DSB’s uncertainty is large for all \( \gamma^{dsb} \), and we have described conditions under which property rules and liability rules, possibly with escape, of the kind highlighted in the top left and bottom panels of Figure 1 are optimal. If the degree of the DSB’s uncertainty is less extreme, it is intuitively clear (and easy to show with examples) that the optimal rule can be a mixture of the rules described in Propositions 6 and 7 along the lines of the mixed rule highlighted in the top right panel of Figure 1.

Finally, we make two further observations related to the optimal contract. A first observation is that in our model the DSB has an important off-equilibrium role to play, in addition to any on-equilibrium role that it plays through its rulings. This can be seen easily by considering the limiting case where the DSB information is perfect. In that case, the optimal contract is a property rule, and under the optimal contract and with the perfectly informed DSB there would be no disputes and hence no DSB rulings; yet despite the absence of rulings, governments would achieve the first best, and it is the presence of the DSB in combination with the optimal contract that makes this achievement possible.

A second observation concerns the nature of the information available to governments at the time that they design the contract. We have examined the optimal contract assuming that the relevant parameters (e.g. the degree of DSB accuracy) are known for the setting to which the contract will apply. But an alternative assumption is that, at the time governments design the contract, these parameters are only known in an expected sense over a variety of settings to which the contract will apply, and that it is too costly to re-optimize the contract once these parameters become known in each setting. Under this alternative assumption, the contract would be optimized in expectation across the settings to which the contract will apply, and the results of Propositions 6 and 7 would apply in this expected sense; but in any given setting the contract need not conform to the predictions of Propositions 6 and 7. Here is where the significance of our earlier observation – that the results of Propositions 1-4 do not depend on
the optimality of the contract – comes in. Under this alternative interpretation those results remain valid.

5. Evidence

Providing a systematic investigation of our model’s empirical content is beyond the scope of this paper, but in this section we offer an initial assessment of one central prediction (Proposition 3), namely, that early settlement rates should be lower in disputes over property rules than in disputes over liability (or mixed) rules.28 We test this prediction with data on the outcomes of trade disputes in the GATT/WTO, looking both across rules and within rules that according to legal scholars have evolved over time.

GATT/WTO legal scholars describe an evolution in the legal rules of the GATT/WTO, from a system of liability rules in the earlier GATT decades to a system that, by the time of the creation of the WTO, had become a collection of property rules with a few specific exceptions that remained liability rules (see Jackson, 1997, and Pauwelyn, 2008).29 With regard to the portion of this evolution that occurred during the GATT era, the major change was arguably related to the reform of the dispute settlement procedure in the Tokyo Round, which was concluded in April 1979.30 For the purposes of our empirical investigation, we therefore treat the GATT years 1979-94 as a transitional period and exclude this period from our analysis, and we group the GATT/WTO disputes into two periods: GATT-I (1948-78) and WTO (1995-present). Our maintained assumption is that GATT-I operated as a system of liability rules, and that the WTO operates as a system of property rules with a few specific exceptions that are treated as liability rules.

We collect data on GATT/WTO disputes and their resolution from two main sources: Hudec

28 We focus here on the model’s predictions about early settlement and leave for future work its predictions about post-ruling settlement (as well as other predictions), because analysis of post-ruling settlement raises a host of familiar econometric issues that are especially difficult to handle with small samples such as ours.

29 Jackson (1997, pp. 62-63) expresses the view that, while the early GATT years were ambiguous on this point, “...by the last two decades of the GATT’s history..., the GATT contracting parties were treating the results of an adopted panel report as legally binding...” and that the WTO “...clearly establishes a preference for an obligation to perform the recommendation...” (emphasis in the original). In support of Jackson’s view, see also Charnovitz (2003), Pauwelyn (2008) and Pelc (2009). For a dissenting view, see Hippler Bello (1996) and especially Schwartz and Sykes (2002).

30 The argument made by Jackson (1997) and other scholars is that, with the strengthening of the dispute settlement procedure, the remedies for breach of GATT/WTO obligations were gradually elevated to the status of “specific performance” remedies, corresponding to our notion of a property rule (see note 29). See also Hudec (1993, Chapter 4) for a discussion of the particular significance of the Tokyo Round reform of the DSB.
(1993) augmented by Reinhardt (1996, 2001) for the GATT era disputes, and the World Bank’s WTO Dispute Settlement Database (see Horn, Johannesson and Mavroidis, 2011) for the WTO disputes. Hudec’s coverage includes every GATT dispute that occurred over the period 1948-1989. The WTO Dispute Settlement Database currently includes every WTO dispute that occurred over the period 1995-2011, but we include only the period 1995-2009 to avoid the problem of unknown outcomes for disputes whose resolution may be as yet incomplete. We provide a detailed description of this data, as well as a description of data for various controls, in our Online Data Appendix. Here we describe four of the most salient data issues.

First, the typical GATT/WTO dispute raises a variety of claims, not just a single claim as in our simple model. Yet all we observe is either that a dispute ends in settlement or that it does not (i.e., we do not observe directly whether their might have been settlement on some claims and a lack of settlement on other claims within a single dispute). Hence for our main results we will adopt the dispute as our unit of observation, and we will consider whether the inclusion of individual claims in a dispute moves the probability of settlement for that dispute in the direction suggested by our model. Later we will describe an approach that allows us to also consider claim-level evidence for a subset of GATT/WTO disputes.

Second, GATT/WTO disputes sometimes involve multiple claimants. We follow the standard convention (see, e.g., Reinhardt, 2001, Guzman and Simmons, 2002, and Horn et al, 2011) and treat each claimant-respondent pair as a separate dispute. As a result our dataset includes 109 GATT-I disputes and 348 WTO disputes.

A third issue is what to count as a settlement. Ideally, disputants report their settlement agreements to the GATT/WTO, but in practice this does not always happen (especially in the GATT era, where there was no official requirement to do so) and so reported settlements are unlikely to be a reliable indicator of actual settlements. For this reason, we include in our measure of settlement both disputes that record an official settlement agreement (a “mutually agreed solution”) and disputes where the complaint is withdrawn or simply suspended.

And a fourth issue is the allocation of claims within the WTO era between property rules and liability rules. We adopt Pauwelyn’s (2008) classification, which is summarized in Table 1. Table 1 also records the frequency with which each claim was brought in a GATT/WTO

31In most cases involving multiple claimants, there are material differences across the claims made by the individual claimants, and so the GATT/WTO typically forms separate panels of judges to assess the claims of each claimant and issue separate panel reports and rulings, consistent with our treatment of multiple claimant cases here. As described below, we also include controls for multiple-claimant disputes in the logits we estimate.
dispute over the two eras. While all claims were considered liability rules in the GATT-I era, as Table 1 makes clear most claims evolved to property rules by the WTO era. In addition, of the GATT Articles that remained liability rules in the WTO era, the most frequently invoked in GATT/WTO disputes are nonviolation claims (which concern policy measures that are claimed to have eroded negotiated market access commitments but do not violate explicit GATT/WTO commitments) and claims against domestic subsidies.\textsuperscript{32} We have excluded claims about WTO commitments that have no counterpart in the GATT (e.g., claims about violations of TRIPS, TRIMS or GATS commitments); this choice seems natural given our focus.

To get an initial feel for the data, we start with some simple descriptive findings. We first compare average rates of early settlement for property rule claims with average rates of early settlement for liability rule claims, to see if there is broad support for our model’s prediction that the former should be lower than the latter. In particular, we calculate the mean rate of early settlement across all claims that in the WTO era are considered property rules ($ES_{P,WTO}$), and compare this to the mean rate of early settlement across all claims that in the WTO era are considered liability rules ($ES_{L,WTO}$).\textsuperscript{33} We plot $ES_{P,WTO}$ and $ES_{L,WTO}$ for the two eras in Figure 4. For the WTO era Figure 4 shows $ES_{P,WTO} < ES_{L,WTO}$, with the mean rate of early settlement equal to 0.63 for liability rule claims and dropping to 0.53 for property rule claims. For the GATT-I era the inequality is reversed, with $ES_{P,WTO} > ES_{L,WTO}$.

Is Figure 4 consistent with our model’s prediction that early settlement rates should be lower in disputes over property rules than in disputes over liability rules? The fact that $ES_{P,WTO} < ES_{L,WTO}$ for the WTO era is clearly consistent with this prediction. Next consider the GATT-I

\textsuperscript{32}As discussed in section 4, in the context of our model the WTO escape clause can be interpreted as a mixed property/liability rule, and so there is a degree of arbitrariness in our Table 1 classification of the escape clause as a property rule in the WTO era. But if a rule evolves from a pure liability type to a mixed type (as was the case for the escape clause in going from GATT to the WTO), our model is suggestive that settlement rates may be expected to drop, since the rule is moving in the direction of a property rule, hence our classification of the escape clause as a WTO-era property rule in Table 1. In addition, we classify the export subsidy provisions in the Tokyo Round Subsidies Code as the first real export subsidy commitments in the GATT era (see Sykes, 2005, for a detailed discussion of the evolution of subsidy provisions in the GATT/WTO), but other classifications (e.g., classifying the export subsidy reporting requirements contained in GATT Article XVI as export subsidy commitments) do not materially alter the results we report below.

\textsuperscript{33}Specifically, letting $P_{WTO}$ denote the set of claims listed in Table 1 which are classified as property rules in the WTO era, and letting $L_{WTO}$ denote the set of claims listed in Table 1 which are classified as liability rules in the WTO era, we define $ES_{P,WTO} = \frac{\sum_{i\in P_{WTO}} \sum_{j} C_{ij} D_{j}}{\sum_{i\in P_{WTO}} \sum_{j} C_{ij}}$ and $ES_{L,WTO} = \frac{\sum_{i\in L_{WTO}} \sum_{j} C_{ij} D_{j}}{\sum_{i\in L_{WTO}} \sum_{j} C_{ij}}$, where $j$ indexes disputes and $i$ indexes claims, and where $C_{ij} = 1$ if claim $i$ was raised in dispute $j$ and 0 otherwise and $D_{j} = 1$ if dispute $j$ ended in early settlement and 0 otherwise. We focus only on early settlement here, in anticipation of the similar focus that we adopt for the logit estimates presented below.
era. Recall that all rules were liability rules under GATT-I, and so our model does not yield sharp predictions regarding the comparison between $ES_{PWTO}$ and $ES_{LWTO}$ for the GATT-I era. However, the model is suggestive of a possible explanation for the finding that $ES_{PWTO} > ES_{LWTO}$ under GATT-I. Recall that $ES_{LWTO}$ is the mean rate of early settlement across those rules that are liability rules under GATT-I and will remain liability rules under the WTO. A possibility suggested by the model is that these rules may have remained liability rules *because* they were characterized by a relatively low degree of DSB accuracy; and if this is the case, one would expect early settlement rates to be lower for these rules under GATT-I.\(^{34}\)

We next estimate some simple logits over the two GATT/WTO eras. We continue to focus on early settlement, and consider first a comparison across rules in the WTO era. With the left-hand-side variable defined as the log odds of early settlement for dispute $j$, we estimate logits that on the right-hand side include variables indicating whether each of the claims listed in Table 1 was raised in dispute $j$, as well as a number of controls.\(^{35}\) The controls include year and HS1 industry fixed effects, a multiple-claimant dummy, and dummies indicating whether the claimant and/or respondent is a developed or developing country. We find that the only control variable that is consistently statistically significant across specifications is a dummy variable indicating whether the respondent is a developing country, and so in the specifications we present here only this control variable is included, but including the other controls does not change the results we emphasize below. We also exclude those claims that lack statistical significance in any of our specifications, but again their inclusion does not alter the results we emphasize below. The claims that we highlight are the following: five claims that in the WTO era are considered property rules, namely, national treatment, antidumping/countervailing duties, administration of trade regulations and fees and formalities,\(^{36}\) escape clause, and export subsidies;

\(^{34}\)Suppose the noise in DSB rulings is composed of two components, one that is common to all issue areas and the other that varies across issue areas. Suppose also that the common component of the noise is smaller in the WTO era than in the GATT-I era, as might be expected for example because, with the creation of the WTO, a formal appeals process and standing panel of appellate judges was instituted with the purpose of providing a safeguard against incorrect decisions by the DSB panel. Then one would expect the higher-noise issue areas to be the last ones to be converted into property rules. And for disputes that arise when the efficiency stakes are low (and where therefore the early settlement rate depends on the contract), a high level of noise in the DSB signal makes it less likely that the dispute will settle early.

\(^{35}\)As pointed out in the 2011 WTO *World Trade Report* (WTO, 2011, p. 179), some claims listed in a GATT/WTO dispute may be subsidiary to other listed claims and hence are not truly at issue in the dispute, and the Report lists a set of simple rules for eliminating these subsidiary claims from those listed in a dispute. In unreported logits we have adopted these rules and find that they have no material impact on our results.

\(^{36}\)This reflects a combination of the related claims associated with (a) Administration of trade regulations and (b) fees and formalities. For the purposes of our logit estimation, we combine these two sets of claims in
and two claims that in the WTO era are considered liability rules, namely, nonviolation and domestic subsidies.\textsuperscript{37}

Column 1 of Table 2 presents the logit coefficient estimates for the WTO era. These estimates are broadly supportive of our model’s prediction: the inclusion of any of the five property rule claims in a dispute reduces the odds of early settlement for that dispute, an impact that is in each case statistically significant at either the 1\%, 5\% or 10\% level; while the inclusion of either of the two liability rule claims in a dispute increases the odds of early settlement for that dispute, though this impact is significant at the 10\% level only for the nonviolation claim.\textsuperscript{38}

We turn next to a comparison across rules in the GATT-I era. During this era GATT operated as a system of liability rules, and so for this period our model does not yield strong predictions on the signs of coefficients. Indeed if we were to find a similar pattern across estimated coefficients in the GATT-I era to the pattern we found in the WTO era, there would be reason to doubt the interpretation that our results for the WTO era provide support for our model: and so it is reassuring that, in fact, our estimated coefficients over the GATT-I era do not show a pattern similar to our results from the WTO era. But, as in the more descriptive analysis of the previous section, we do find one interesting pattern in the data for the GATT-I era, and the model is suggestive of a possible explanation for it. More specifically, column 2 of Table 2 presents the GATT-I-era logit coefficients, and now the point estimates of the coefficients on the WTO-era property rule claims are evenly split between positive and negative with none statistically significantly different from zero; but notice that the estimated coefficient

\textsuperscript{37} We treat the selection of disputes, and hence the selection of GATT Articles claimed in a given dispute, as exogenous. While in principle one could attempt to estimate an equation predicting when trade disputes arise between GATT/WTO members, from a practical standpoint the data limitations associated with identifying the possible disputes that might arise between each pair of GATT/WTO members make this infeasible (see Bown, 2005, for further discussion of the data constraints in this regard). We see our model as primarily designed to illuminate issues associated with settlement rather than with the initiation of disputes, and so we feel that this focus accurately captures the model’s central empirical content.

\textsuperscript{38} A potential concern with these estimates is that early settlement can occur either after the “consultation” phase of a dispute but before the formation of a “panel” of judges has been requested, or after the request for a panel has been made but before the panel has issued its ruling. Because our claims variables are defined based on the claims made at the request for consultation, they are relevant for early settlements that occur before the request for a panel, but may be less relevant for early settlements that occur after the request for a panel has been made, if the claims at that stage are different. To address this possibility, we have also utilized data from the WTO Dispute Settlement Database on the claims made at these two different stages and estimated two separate (sequential) logits with the appropriate claims variables on the right-hand side. Our results, which are available on request, are similar to those we report in column 1 of Table 2.
on both of the WTO-era liability rule claims is now negative (and statistically significant for nonviolation claims). This is the analog of our Figure 4 finding that $ES_{\text{P WTO}} > ES_{\text{L WTO}}$ under GATT-I. And as we described in the context of Figure 4, a possible explanation suggested by our model is that the accuracy of DSB rulings on nonviolation and domestic subsidy claims was particularly low in the GATT-I era, and this relatively low level of accuracy both reduced the odds of early settlement in the GATT-I era and helped ensure that nonviolation and domestic subsidy claims would remain liability rules in the WTO era (see also note 34).

Thus far we have focused on pure cross-sectional comparisons across rules within a given era. The results of these comparisons are consistent with a key prediction of the model—that disputes over property rules should be less likely to settle early, other things equal, than disputes over liability rules—but a more convincing probe of this prediction would arguably be to perform a test of the difference-in-differences type.

To see the basic difference-in-differences idea, suppose for a moment that each dispute involved a single rule. Then our model would predict a larger drop in settlement rates for disputes over rules that evolved from liability to property rules than for disputes over rules that remained of the liability type. This idea must be adapted to take into account that each dispute typically involves multiple rules, but before we proceed, let us start with a cursory comparison of the estimated coefficients in the cross-sectional regressions across the GATT-I WTO eras. Looking across columns 1 and 2 of Table 2, it appears that the impact on settlement rates of WTO-era property rules (i.e. those that evolved from liability to property) has become more strongly negative between the GATT-I era and WTO era than has the impact of WTO-era liability rules (i.e. those that did not evolve), as suggested by our model.

To go beyond the pure cross-sectional regressions and perform a difference-in-difference type analysis, we therefore now pool the WTO-era and GATT-I era data and estimate the logit equation from column 2 of Table 2, augmented to include a WTO-era dummy as well as interaction terms between each claim variable and the WTO-era dummy. The results are reported in column 3 of Table 2. According to our model, we expect that each of the estimated coefficients on the four property-rule interaction terms should be more negative than any of the estimated coefficients on the two liability-rule interaction terms. Our point estimates bear out this prediction.

This explanation seems especially compelling for the statistically negative coefficient on nonviolation claims in the GATT-I era logit presented in column 2 of Table 2, because as we noted earlier these are claims about the market access implications of policy measures that did not violate any explicit GATT/WTO commitments, and so it seems natural to expect that the DSB accuracy would be particularly low in evaluating these claims.
for seven of the eight coefficient comparisons, and when we conduct formal hypothesis testing, we cannot reject the hypothesis that each of the coefficients on the property-rule interaction terms is more negative than any of the coefficients on the liability-rule interaction terms.\footnote{We also test the null hypothesis that, in contradiction to our model, all of the coefficients on the property-rule interaction terms are greater than or equal to each of the coefficients on the liability-rule interaction terms, and find that we can reject this hypothesis at any standard level of significance. To implement these tests we follow Wolak (1991) and Andrews and Soares (2010). The results are available upon request.}

Thus far we have adopted the dispute as our unit of observation, and we have used the claims included in a dispute to help predict whether the dispute will settle or not. But an alternative approach is also possible with regard to WTO-era disputes, in light of the detailed claim-level data available from the WTO Dispute Settlement Database. Specifically, this database records the claims made at two distinct junctures in a dispute: first, when one government – the claimant – requests that another government engage with it in formal “consultation” (the initial step in any formal GATT/WTO dispute); and second, when the claimant requests that a “panel” of judges be formed to consider the arguments of both sides in the dispute and issue a ruling. The WTO database also records those claims that are ruled upon in each dispute.

Utilizing this more detailed claim-level WTO data, and under the assumption that any claim made that was not ultimately ruled upon must have been settled prior to the panel ruling, we now take as our unit of observation the individual claim, whether it is made at the request-for-consultation stage or the request-for-panel stage (or both) in a given dispute; and we define that claim as settled prior to the ruling (“early settlement”) if and only if there was no ruling on it. The resulting claim-level definition of early settlement then includes claims that were listed in the request for consultation but not listed in the request for a panel (which we interpret as settled prior to the request-for-panel stage) and it also includes claims that were listed in the request for a panel but were not ruled upon (which we interpret as settled after the panel was formed but prior to the panel ruling).

With early settlement defined at the claim level in this way, our sample of claims filed in WTO disputes contains 916 observations. The mean rate of early settlement across all property rule claims ($ES_{P,WTO}$) and all liability rule claims ($ES_{L,WTO}$) in WTO disputes is now 76% and 97% respectively, confirming the model’s prediction that the former should be lower than the latter. And analogous to the WTO-era dispute-level logit in column 1 of Table 3, the coefficient estimates for the claim-level logit presented in column 4 of Table 2 (with the new indicator variable Property taking the value of 1 if the claim is a property rule and 0 otherwise)
confirm that property rule claims exhibit significantly lower odds of early settlement in the WTO era than do liability rule claims, as our model predicts. As with the dispute-level logit in column 1 of Table 2, our claim-level findings are similar when we include year and HS1 digit industry fixed effects.\footnote{As with the dispute-level logit (see note 38), we also estimate two sequential claims-level logits corresponding to the request-for-consultation and the request-for-panel stages, and we find results (available on request) which are similar to those we report in column 4 of Table 2.} Hence, the claim-level pattern of settlement in the WTO era provides further support for our model.

6. Conclusion

What explains the wide variation in the observed resolution of trade disputes? We have developed a model of trade agreements with imperfectly verifiable information that can generate a variety of dispute outcomes in equilibrium: governments may reach “early” settlement, they may trigger a DSB ruling and implement it, or they may reach a post-ruling settlement. The model generates predictions on how the dispute outcome depends on the contracting environment and how it correlates with the optimal contract form. We have examined a central prediction of the model in light of data on the outcomes of actual trade disputes in the GATT/WTO, and find support for this prediction.

To keep our results sharp we have relied on a number of simplifying assumptions. Key among them is our focus on binary policies. As we indicated, trade disputes in the GATT/WTO often focus on non-tariff measures that are discrete in practice, such as regulatory regimes or product standards, and our assumption of a binary policy instrument is a simple way to capture this property. And even policies that might in principle appear to be continuous, such as domestic and export subsidies, are in practice often implemented with complex programs that are difficult to alter ex-post in a marginal and continuous way. But it is nevertheless important to consider a richer set of policy options than our model allows. In the related model of Maggi and Staiger (2015) we are able to demonstrate that it is indeed the discreteness of the policy rather than its dichotomous nature that is important for the results, and we conjecture that the same is true for our results here. And if we were to allow for continuous policies in our analysis, it is not hard to see that our model would likely imply a further prediction: all else equal, the frequency of settlement should be higher for policies that are more continuous, and as we have indicated above (see note 24) for truly continuous policies there would typically be no rulings.
Guzman and Simmons (2002) draw a similar distinction between issues such as health and safety standards that have an “all or nothing” character and policies that are continuous and more “flexible” in nature such as tariffs, and in their empirical study of WTO disputes indeed find that settlement rates are higher for disputes over more continuous policies. Hence we view the consideration of more continuous policies as an important direction for extending our theoretical and empirical analysis, but we leave this extension for future research.

We have assumed that there is no cost to initiating disputes, but including such costs in our model could yield interesting predictions about the conditions under which disputes arise in equilibrium. Relatedly, introducing asymmetries in litigation costs between large and small countries and/or developed and developing countries – possibly coupled with asymmetries in bargaining power – could yield insights regarding how the design of legal remedies for breach could best serve a heterogeneous membership.

And finally, we have assumed that contracts are automatically enforced, but in reality international contracts must be self-enforcing.\footnote{As a simplification for characterizing the optimal legal rules, this assumption finds some support from legal scholars, who readily acknowledge the limitations on enforcement of international agreements but emphasize that issues of enforcement are logically distinct from the choice between property and liability rules (see Jackson, 1997, p. 63, and see also Pauwelyn, 2008, pp. 148-197, for an especially detailed discussion of this point). Such a logical distinction does not of course imply that there is no interaction between enforcement issues and legal rules. Papers that model the self-enforcing nature of trade agreements include Bagwell and Staiger (1990), Maggi (1999), Ederington (2001), Klimenko et al. (2008) and Park (forthcoming).} Extending our analysis along these lines is a complex task, but it could have a big payoff. In particular, we have emphasized costly transfers as a feature that sets international contracting apart from domestic contracting, but the same might be said about enforcement constraints, suggesting that an analysis of trade disputes and settlement in an environment with both costly transfers and weak enforcement could yield novel insights. We see this as an important direction for future research.

7. Appendix

Proof of Lemma 1:

Consider an arbitrary contract $b^C(\gamma^{dsb})$. Recall that $\tilde{\omega}(b^C(\gamma^{dsb}), \gamma)$ and $\tilde{\omega}^*(b^C(\gamma^{dsb}), \gamma)$ denote the Home and Foreign payoffs in the stage-4 subgame, and the expected disagreement payoffs are $\int \tilde{\omega}(b^C(\gamma^{dsb}), \gamma) dG(\gamma^{dsb} | \gamma) + \int \tilde{\omega}^*(b^C(\gamma^{dsb}), \gamma) dG(\gamma^{dsb} | \gamma)$, respectively. Recall also that, as we argued in the main text, in the stage-2 bargain governments obtain exactly their expected disagreement payoffs for all $\gamma$.\footnote{As a simplification for characterizing the optimal legal rules, this assumption finds some support from legal scholars, who readily acknowledge the limitations on enforcement of international agreements but emphasize that issues of enforcement are logically distinct from the choice between property and liability rules (see Jackson, 1997, p. 63, and see also Pauwelyn, 2008, pp. 148-197, for an especially detailed discussion of this point). Such a logical distinction does not of course imply that there is no interaction between enforcement issues and legal rules. Papers that model the self-enforcing nature of trade agreements include Bagwell and Staiger (1990), Maggi (1999), Ederington (2001), Klimenko et al. (2008) and Park (forthcoming).}
Now move back to stage 0, where \( b^C(\gamma^{dsb}) \) is chosen to maximize \( E_{\gamma}(E[\bar{\omega}(b^C(\gamma^{dsb}), \gamma) \mid \gamma] + E[\bar{\omega}^*(b^C(\gamma^{dsb}), \gamma) \mid \gamma]) \), which is given by:

\[
\int \left[ \int (\bar{\omega}(b^C(\gamma^{dsb}), \gamma) + \bar{\omega}^*(b^C(\gamma^{dsb}), \gamma)) h(\gamma^{dsb} \mid \gamma) d\gamma^{dsb} \right] h(\gamma) d\gamma
\]

\[
= \int \left[ \int (\bar{\omega}(b^C(\gamma^{dsb}), \gamma) + \bar{\omega}^*(b^C(\gamma^{dsb}), \gamma)) h(\gamma \mid \gamma^{dsb}) d\gamma \right] z(\gamma^{dsb}) d\gamma^{dsb}
\]

where \( h(\gamma) \) is the marginal density of \( \gamma \) and \( z(\gamma^{dsb}) \) is the marginal density of \( \gamma^{dsb} \). Clearly, maximizing the objective boils down to maximizing \( \int (\bar{\omega}(b^C(\gamma^{dsb}), \gamma) + \bar{\omega}^*(b^C(\gamma^{dsb}), \gamma)) h(\gamma \mid \gamma^{dsb}) d\gamma \) for each given \( \gamma^{dsb} \). QED

**Proof of Proposition 5:**

Given Lemma 1, the optimal contract is given by the schedule \( b^C(\gamma^{dsb}) \) that maximizes \( E[\bar{\Omega}(b^C, \gamma) \mid \gamma^{dsb}] \). We start by developing a figure that illustrates the outcome of the stage-4 negotiation given the DSB ruling \( b^C \) and the realization of \( \gamma \).

Let us consider whether or not a given level of damages \( b^C \) will be renegotiated at stage 4 given the realization of \( \gamma \). Recall that the threat point in the stage-4 negotiation is defined by the DSB ruling \( b^C \), so if the negotiation fails, Home may choose between \((T = FT, b = 0)\) and \((T = P, b = b^C)\). Letting \( S(b) \equiv b + c \cdot |b| \) denote the total cost of the transfer \( b \) inclusive of deadweight loss, it is clear that for \( \gamma < S(b^C) \) Home would choose \((T = FT, b = 0)\), while for \( \gamma > S(b^C) \) it would choose \((T = P, b = b^C)\). The line \( \gamma = S(b^C) \), where Home is indifferent between the two options, is depicted in Figure 5. Consider first the case \( \gamma < S(b^C) \). Here the threat point is \((T = FT, b = 0)\), and governments renegotiate to the policy \( P \) if and only if there exists a transfer \( b^e \) such that both governments gain by switching to \((T = P, b = b^e)\), which requires \( \gamma > S(b^e) \) (for the importer) and \( b^e > \gamma^* \) (for the exporter). Clearly, this is the case if and only if \( \gamma > S(\gamma^*) \). Thus governments renegotiate toward policy \( P \) when \( S(\gamma^*) < \gamma < S(b^C) \); the corresponding region is identified in Figure 5 by the label \( P_R \). Note that \( b^e < b^C \) in this region, because \( S(b^e) < \gamma < S(b^C) \) and \( S(\cdot) \) is increasing. Consider next the case \( \gamma > S(b^C) \). Here the threat point is \((T = P, b = b^C)\), and governments renegotiate toward policy \( FT \) if and only if there exists a (negative) transfer \( b^e \) such that both governments gain by switching to \((T = FT, b = b^e)\), which requires \( S(b^C) - S(b^e) > \gamma \) (for the importer) and \( \gamma^* > b^C - b^e \) (for the exporter). Clearly, such a transfer exists if and only if \( \gamma < S(b^C) - S(b^C - \gamma^*) \equiv R(b^C) \). Hence,

\[ \text{Figure 5 focuses on non-negative values of } b^C. \text{ It is easy to show and intuitively clear that } b^C < 0 \text{ can never be optimal for any } \gamma^{dsb}. \]
governments renegotiate toward policy $FT$ when $S(b^C) < \gamma < R(b^C)$. The corresponding region is identified in Figure 5 by the label $FT_R$. Note that $R(b^C)$ is a line with slope $2c$ satisfying $R(0) = (1-c) \cdot \gamma^*$ and $R(\gamma^*) = S(\gamma^*) = (1+c)\gamma^*$.

We now make an important observation: it can never be strictly optimal to have $b^C > \gamma^*$, because as Figure 5 makes clear, setting $b^C > \gamma^*$ induces the same policy outcome as setting $b^C = \gamma^*$ (namely $FT$ for $\gamma < S(\gamma^*)$ and $P$ for $\gamma > S(\gamma^*)$), but $b^C = \gamma^*$ implies a weakly lower expected transfer. This second claim can be seen as follows. Start with any $b^C = \tilde{b}^C > \gamma^*$. If this is replaced with $b^C = \gamma^*$, the expected equilibrium transfer falls (weakly), because: (1) if $\gamma > S(\tilde{b}^C)$, the importer would have chosen $(T = P, b = \tilde{b}^C)$ without renegotiating and now chooses $(T = P, b = \gamma^*)$, so the transfer obviously decreases, and (2) if $\gamma \in (S(\gamma^*), S(\tilde{b}^C))$, the contract would have been renegotiated under $b = \tilde{b}^C$ but will not be renegotiated under $b = \gamma^*$, and as we established above the equilibrium transfer $b^e$ is higher than $\gamma^*$.

The next step is to write an explicit expression for $E[\tilde{\Omega}(b^C, \gamma)|\gamma^{dab}]$. First note that, since it can never be strictly optimal to have $b^C > \gamma^*$, we can focus on the range $b^C \in [0, \gamma^*]$. Second, by note on inspection of Figure 5 that the equilibrium policy outcome is $T = FT$ for $\gamma < R(b^C)$ and $T = P$ for $\gamma > R(b^C)$. Third, recall that the range of $\gamma$ for which a given level of damages $b^C$ is renegotiated at stage 4 is the one depicted by the $FT_R$ region in Figure 5. And finally, we need to derive the transfer $b^e$ paid by the exporter when renegotiation occurs, that is in the $FT_R$ region. Given the Nash bargaining assumption, it is direct to verify that $b^e = \frac{2b^C - (1-c)\gamma^* - \gamma}{2(1-c)} < 0$. Armed with these observations, and letting $V^{FT} \equiv v(FT) + v^*(FT)$, we can write the optimization problem as:

$$
\max_{b^C \in [0, \gamma^*]} E[\tilde{\Omega}(b^C, \gamma)|\gamma^{dab}] = \left\{ V^{FT} + \int_{R(b^C)}^{\infty} (\gamma - \gamma^*)dH(\gamma|\gamma^{dab}) \right\} - c \cdot \left\{ b^C \left[ 1 - H(R(b^C)|\gamma^{dab}) \right] + \int_{S(b^C)}^{R(b^C)} |b^e(b^C, \gamma)|dH(\gamma|\gamma^{dab}) \right\}.
$$

The expression for $E[\tilde{\Omega}(b^C, \gamma)|\gamma^{dab}]$ is given by the difference between two terms. The term in the first set of curly brackets is the joint payoff associated with the $FT$ policy, plus the gain in expected joint payoff associated with allowing the policy $P$ for $\gamma$ above $R(b^C)$. It is simple to see

\footnote{Note that we only claim that $b^C > \gamma^*$ is “weakly” dominated by $b^C = \gamma^*$, because if the support of $\gamma$ around $\gamma^*$ is sufficiently small, the expected equilibrium transfer is the same in the two cases, as all states $\gamma > S(\gamma^*)$ have zero density.}
that this term by itself is maximized when \( b^C \) satisfies \( R(b^C) = \gamma^* \). However, weighing against this first term is the deadweight loss associated with the transfers. The expected transfer is given by the second set of curly brackets, and is composed of the transfer \( b^C \) that accompanies the policy \( P \) \( (\text{when } \gamma > R(b^C)) \) and the transfer \( b^c \) that accompanies the renegotiated policy \( FT \) \( (\text{when } \gamma \in (S(b^C), R(b^C))) \).

We now argue that we can focus on values of \( \gamma^* \) between \( b \) and \( b^c \). This implies that as \( \gamma^* \) increases, \( b^C \) cannot increase with \( \gamma^* \). In fact we can say more: if we start with an optimal level of \( \gamma^* \) different from \( b \), then it must satisfy \( dE[\tilde{\Omega}(b^C, \gamma) | \gamma^*] \leq 0 \), and \( b^C \) must then decrease with \( \gamma^* \), and if we start with an optimal level of \( b^C = 0 \), then it must satisfy \( dE[\tilde{\Omega}(b^C, \gamma) | \gamma^*] \leq 0 \), and \( b^C \) must then remain at 0 as \( \gamma^* \) increases.

We now prove part (i) of the proposition. Here we will ignore the possibility that the optimal level of \( \gamma^* \) may have jumps. The extension of the argument to allow for the possibility of jumps is available upon request.

We first establish that, at any value of \( \gamma^* \) such that the optimal \( b^C \) is non-prohibitive, the schedule \( b^C(\gamma^*) \) must be locally non-increasing; and moreover, if the optimal \( b^C \) is strictly between 0 and \( b^{\text{prohib}} \), then \( b^C(\gamma^*) \) is strictly decreasing. To establish this claim, recall that we have assumed that there is at most one interior local optimum for \( b^C \) given \( \gamma^* \). Also, recalling that we can focus on values of \( b^C \) that are lower than \( \gamma^* \), we can write:

\[
\frac{dE[\tilde{\Omega}(b^C, \gamma)] | \gamma^*}{db^C} = c(1 + c) \cdot |b^c(b^C, S(b^C))| \cdot h(S(b^C) | \gamma^*)
+ \frac{c}{1 - c} [H(R(b^C) | \gamma^*) - H(S(b^C) | \gamma^*)] - c[1 - H(R(b^C) | \gamma^*)].
\]

We now argue that \( \frac{dE[\tilde{\Omega}(b^C, \gamma)] | \gamma^*}{db^C} \) is decreasing in \( \gamma^* \) when evaluated at a value of \( b^C \) satisfying \( dE[\tilde{\Omega}(b^C, \gamma)] | \gamma^* \leq 0 \), which encompasses both the case where the optimal \( b^C(\gamma^*) \) is \( (0, b^{\text{prohib}}) \) and that where the optimum is \( b^C(\gamma^*) = 0 \).

To see this, note that the first and second terms in \( \frac{dE[\tilde{\Omega}(b^C, \gamma)] | \gamma^*}{db^C} \) are positive, while the third term is negative. But then the log-supermodularity of \( h(\gamma | \gamma^*) \) ensures that as \( \gamma^* \) increases, \( h(\gamma | \gamma^*) \) increases proportionally more for higher values of \( \gamma \). This implies that as \( \gamma^* \) increases, the negative term increases proportionally more than the sum of the two positive terms. Coupled with the fact that, when evaluated at \( b^C \) satisfying \( dE[\tilde{\Omega}(b^C, \gamma)] | \gamma^* \leq 0 \), the negative term is equal or greater in magnitude to the sum of the positive terms, this implies that as \( \gamma^* \) increases, the negative term increases in magnitude by more than the sum of the positive terms, and hence \( \frac{dE[\tilde{\Omega}(b^C, \gamma)] | \gamma^*}{db^C} \) decreases. And given that we were starting from an optimal level of \( b^C \) satisfying \( \frac{dE[\tilde{\Omega}(b^C, \gamma)] | \gamma^*}{db^C} \leq 0 \), it follows that the optimal \( b^C \) cannot increase with \( \gamma^* \). In fact we can say more: if we start with an optimal level of \( b^C \in (0, b^{\text{prohib}}) \), then it must satisfy \( \frac{dE[\tilde{\Omega}(b^C, \gamma)] | \gamma^*}{db^C} = 0 \), and \( b^C \) must then decrease with \( \gamma^* \); and if we start with an optimal level of \( b^C = 0 \), then it must satisfy \( \frac{dE[\tilde{\Omega}(b^C, \gamma)] | \gamma^*}{db^C} \leq 0 \), and \( b^C \) must then remain at 0 as \( \gamma^* \) increases.
We now turn to part (ii). Note that: (a) \( R(b^C) \) is increasing in \( \gamma^* \); (b) \( |b^e(b^C, \gamma)| \) is increasing in \( \gamma^* \); (c) \( S(b^C) \) is independent of \( \gamma^* \); and (d) \( H(\cdot | \gamma^{dsb}) \) is increasing. Thus \( \frac{dE[\tilde{\gamma}(b^C, \gamma)|\gamma^{dsb}]}{db^C} \) is increasing in \( \gamma^* \), and the claim follows. QED

Proof of Proposition 6:

Consider Figure 5. Note first that, if the support of \( \gamma|\gamma^{dsb} \) does not include \( \gamma^* \), clearly the optimal \( b^C \) is prohibitive (zero) if the support lies below (above) \( \gamma^* \). Next suppose the support of \( \gamma|\gamma^{dsb} \) includes \( \gamma^* \). If this support is sufficiently small, and in particular if it is contained within the interval \( [(1 - c)\gamma^*, (1 + c)\gamma^*] \), then it can be seen by inspection of Figure 5 that when \( b^C \) is prohibitive or zero there is no renegotiation for any \( \gamma \), and hence no transfers in equilibrium. Setting \( b^C \) at a positive but non-prohibitive level may achieve a state-contingent policy, but the associated benefit is small because the support of \( \gamma \) around \( \gamma^* \) is small. On the other hand, the cost of achieving this state-contingency is not small, because it requires a non-negligible level of transfer payments in equilibrium. To see this, recall that, given \( b^C \), the policy outcome is \( FT \) for \( \gamma < R(b^C) \) and \( P \) for \( \gamma > R(b^C) \). Thus, when the support of \( \gamma|\gamma^{dsb} \) is small around \( \gamma^* \), if we want to induce a state-contingent policy outcome the transfer \( b^C \) needs to be close to \( R^{-1}(\gamma^*) = \frac{\gamma^*}{2} \). Clearly, this transfer level does not become negligible as the support shrinks. Note that for \( \gamma > R(b^C) \) the equilibrium transfer will be exactly \( b^C \), while for \( \gamma < R(b^C) \) the contract will be renegotiated, and the equilibrium transfer will be \( b^e = \frac{2(b^C - \frac{\gamma^*}{2}) + c(\gamma^* - \gamma)}{2(1 - c)} - \frac{\gamma^*}{2} \). This renegotiated transfer \( b^e \) may be smaller in magnitude than \( \frac{\gamma^*}{2} \), but is unrelated to the size of the support of \( \gamma \) and hence does not become small as the support shrinks. The claim then follows. QED

Proof of Proposition 7:

Recall from the proof of Proposition 5 that it can never be strictly optimal to have \( b^C < \gamma^* \). If \( b^C(\gamma^{dsb}) \) is a liability rule (with or without escape), then \( b^C(\gamma^{dsb}) \) must be below the prohibitive level for all \( \gamma^{dsb} \). Next recall that we have defined \( b^C \) as “prohibitive” given \( \gamma^{dsb} \) if it is such that Home would choose \( T = FT \) for all \( \gamma \) in its conditional support \( (\tilde{\gamma}(\gamma^{dsb}), \tilde{\gamma}(\gamma^{dsb})) \), which implies \( S(b^C) > \tilde{\gamma}(\gamma^{dsb}) \). Hence, it follows that if \( \tilde{\gamma}(\gamma^{dsb}) > S(\gamma^*) \) for all \( \gamma^{dsb} \), then the optimal \( b^C(\gamma^{dsb}) \) must be below the prohibitive level for all \( \gamma^{dsb} \). And with \( \tilde{\gamma}(\gamma^{dsb}) \) below \( \gamma^* \) for at least some \( \gamma^{dsb} \) by our assumption that the empty contract is not optimal, it follows that if \( \tilde{\gamma}(\gamma^{dsb}) \) and \( \gamma(\gamma^{dsb}) \) are sufficiently far apart for all \( \gamma^{dsb} \), the optimum must be a liability rule (with or without escape). QED
References


Staiger, Robert W. and Alan O. Sykes (2013), “How Important can the Non-Violation Clause be for the GATT/WTO?,” unpublished manuscript, The University of Wisconsin, August.


Figure 1: possible types of contract
**Figure 2: bargaining frontier**

Region I: \( \gamma < (1 - c)\gamma^* \)

Region II: \( (1 - c)\gamma^* < \gamma < (1 + c)\gamma^* \)

Region III: \( \gamma > (1 + c)\gamma^* \)
Figure 3: stage - 2 and stage - 4 bargaining outcomes

Region II: \((1 - c)\gamma^* < \gamma < (1 + c)\gamma^*\)
Figure 4

Note: Bars represent the claim-weighted average rates of early settlement in a given era for claims that are classified as property ($ES_{P,WTO}$) and liability ($ES_{L,WTO}$) rules in the WTO era; see text for precise definitions.
Figure 5: stage - 4 bargaining outcome
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Note: See Data Appendix for specific GATT/WTO Articles associated with each claim.
### Table 2: Logit Coefficients

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<td>WTO-era property rules:</td>
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<td>National treatment</td>
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<td>Antidumping/countervailing duty</td>
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<td>-1.2446</td>
<td>-1.1916</td>
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<td>Admin of trade regs/fees/formalities</td>
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<td>0.5043</td>
<td>-0.9701</td>
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<td>Escape clause</td>
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<td>0.7641</td>
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<td>(0.4150)</td>
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<td>(0.8677)</td>
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<td>Export subsidies</td>
<td>-0.8442**</td>
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<td></td>
<td>(0.4193)</td>
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<td>-1.7484***</td>
<td>-1.7622***</td>
<td>2.3497***</td>
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<td>(0.5706)</td>
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<td>(0.7246)</td>
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**Observations**

- Early Settlement: 348
- Early Settlement: 109
- Early Settlement: 457
- Early Settlement: 916

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**Note:**

Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1

"a" denotes claim omitted due to lack of use.

1: interaction terms represent the product of the associated base group variable and an indicator variable that takes value 1 if the dispute was a WTO-era