Optimal Design of Trade Agreements in the Presence of Renegotiation*

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Abstract

We study the optimal design of trade agreements in a setting where governments can renegotiate the agreement ex-post subject to a key transaction cost, namely that compensation between governments is inefficient. The model delivers predictions concerning the optimal form of the agreement, the conditions under which the agreement will be renegotiated in equilibrium, and the form that such renegotiation will take. A key question on which we focus is whether the agreement should be structured as a system of “property rules” or “liability rules,” and in this respect we forge a link between the theory of trade agreements and the law-and-economics theory of optimal legal rules.

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1. Introduction

When governments make international commitments, what form should their contract take? This question is at the heart of a growing debate among scholars of international trade agreements, both in the field of economics and in the field of international law. Broadly speaking, there are two alternative contract forms that are relevant for a trade agreement. One type of contract assigns *rights* concerning trade policy to the contracting parties. To illustrate, consider a two-country world where the country that imports a good can either practice free trade or engage in protection: this first type of contract either assigns the right to protect to the importing country, or it assigns the right of free trade to the exporting country, and subsequently these rights can be transferred from one government to another only through a voluntary transaction – a renegotiation – between the two governments. In effect, this type of contract assigns *ownership* of rights concerning trade policy, and as a consequence it is commonly referred to in the legal literature as a *property rule*. This contrasts with a second type of contract, where the importer has the option to practice free trade, or to engage in protection and compensate the exporter with a certain amount of *damages*. In other words, this second type of contract assigns the entitlement of free trade to the exporter, and while a voluntary renegotiation between the two governments can always occur, the importer can also remove this entitlement unilaterally by paying damages; in the legal literature, this type of contract is referred to as a *liability rule*. As emphasized by many scholars, the choice between these two contract forms is an issue of fundamental importance for the design of a trade agreement (see for instance Jackson, 1997, Schwartz and Sykes, 2002, Lawrence, 2003 and Pauwelyn, 2008).¹

Looking across the range of real-world trade agreements, there is evidence that both liability rules and property rules are at work. For example, Pauwelyn (2008) argues that property rules provide the “default” approach in both the WTO (applying for example to the WTO prohibitions against quantitative restrictions, discriminatory tariffs, export subsidies and some forms of domestic subsidies) and NAFTA, but for certain specific issues a liability-rule approach has instead been taken. The clearest examples of liability rules in the GATT/WTO are the escape clause provisions in GATT Article XIX and the provisions for permanent tariff modifications

¹There is a semantic distinction in the law-and-economics literature according to which, if a trade agreement is viewed as a piece of international law then the property-rule/liability-rule terminology would be used, whereas if a trade agreement is viewed as a contract then the analogous distinction is between a contract that requires “specific performance” and one that specifies “damages for breach.” We will use these terms interchangeably.
in Article XXVIII.² And in NAFTA (as well as in many bilateral investment treaties), investor protection against expropriation is set up as a liability rule. In addition to this variation across issues, there is evidence that the contract forms featured in a given institution evolve over time. For instance, there is broad agreement that in the early years, GATT operated as a system of liability rules (see Jackson, 1969, p. 147, Schwartz and Sykes, 2002, and Lawrence, 2003, p. 29); however, many legal scholars argue that in more recent times the GATT/WTO has evolved toward a property-rule system (see, for example, Jackson, 1997, Charnovitz, 2003, Pauwelyn, 2008 and Pelc, 2009). Our paper aims at contributing toward an understanding of the forces that explain these choices.

The intuitive appeal of a liability rule over a property rule is that a liability rule may help governments cope with a key problem they face when entering into trade agreements, namely, the incompleteness of the contract. If governments could write a complete contingent contract, the efficient outcome could be achieved without the need of any liability rule. But if writing such a contract is not possible, for example because any of a number of key contingencies (such as political pressures in the importing country) are not verifiable, then a liability rule can facilitate the efficient adjustment of contractual obligations without the need to specify contingencies in the contract. The simple logic is that a liability rule can help induce the importer to internalize the externalities that it imposes on its trading partner(s) through its trade policy choices. But a liability-rule approach has its limitations. One limitation that stands out in the context of trade agreements is that international lump-sum transfers are generally not available; rather, compensation between governments is typically accomplished by “self-help” and takes the form of tariff retaliation, which is inefficient. This transaction cost (inefficient transfers) creates a nontrivial tradeoff between property-rule and liability-rule approaches. Formalizing and evaluating this tradeoff is a key focus of the paper.³ Our analysis

²Other examples of liability rules in the GATT/WTO can be found in the General Agreement on Trade in Services (Article XXI, which provides for the renegotiation of specific commitments in services trade), in the Agreement on Trade-Related Aspects of Intellectual Property Rights (Article 31, which sets conditions under which compulsory licenses may be issued), and in the Agreement on Subsidies and Countervailing Measures (Part III, which describes subsidies which are “actionable” though not prohibited). The non-violation nullification-or-impairment clause of the GATT can also be interpreted along the lines of a liability rule, as it permits countries to in effect escape their market access commitments with changes in domestic policies and pay damages to injured parties as a remedy. See Pauwelyn (2008, pp. 134-136) for further discussion.

³An additional limitation of a liability-rule approach is that it requires verifiability of the harm inflicted by a country’s trade policy on its trading partner(s), which is typically very imperfect. This limitation is often emphasized in the informal law-and-economics literature. We discuss this limitation briefly in the Conclusion, but we abstract from it in our basic model in order to focus more sharply on the role of inefficient transfers. It is also important to note that we focus on damages as a device to facilitate efficient adjustment of contractual
applies to trade agreements generally, but we will pay particular attention to the GATT/WTO, which is a natural institution on which to focus given its prominence in the world trading system.

In evaluating the desirability of these two types of contract it is important to allow for the possibility of renegotiation, especially given the empirical significance of renegotiation in real-world trade agreements. With renegotiation possible, the contract does not directly determine the policy outcome, but in the presence of transaction costs it does so indirectly by shaping the disagreement point for the ex-post negotiations. And the design of the contract can then have important efficiency consequences even when, as in the GATT/WTO, there are ample possibilities for renegotiation. In this light, it is surprising that virtually all existing models of trade agreements abstract from renegotiation (with the few partial exceptions discussed below). Our paper advances this literature by studying the optimal design of trade agreements in the presence of renegotiation.

In recent years there has been considerable research more generally on the optimal design of contracts in the presence of renegotiation, a leading example being Segal and Whinston (2002). Our approach broadly follows this literature, by considering an environment with nonverifiable information where the contract is designed ex-ante but can be renegotiated ex post through Nash bargaining. However, we depart from this literature by introducing some new features that are motivated by the international trade context, and we also impose some restrictions to make the model tractable. The main feature we add is that government-to-government transfers involve a deadweight loss, hence utility is nontransferable, whereas the typical models of contracting with renegotiation assume transferable utility. The main restriction we introduce, on the other hand, is that we focus on a binary policy choice. This buys us tractability, and as we later describe this focus captures many trade-related policies that are discrete in practice. 

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4 On the empirical significance of renegotiation in real-world trade agreements, see for example Busch and Reinhardt (2006) for an account of the many instances in which WTO members have engaged in renegotiation of their trade policy commitments.

5 A further restriction is that we focus on menu contracts, that is, contracts based on the choice of just one player (in our case the importer). In principle, one could design a more sophisticated mechanism that is based on messages sent by both players. As Segal and Whinston (2002) explain, a mechanism that is based on two-sided messages may or may not improve upon a menu contract, depending on the contracting environment; Segal and Whinston derive sufficient conditions for the optimality of menu contracts within the specific application of a hold-up problem (which is very different from our application). In our setting, it is an open question whether and to what extent more elaborate mechanisms can improve upon menu contracts. This is a question that we
As a consequence of the additional structure we impose, our model delivers sharp results on
the structure of the optimal contract, in particular on the desirability of property rules versus
liability rules, and on the nature and pattern of equilibrium renegotiation.\footnote{Use of the property-
and liability-rule terminology is less common outside of the law-and-economics liter-
ature, and so it may be helpful to note that our property rules correspond to what Segal and Whinston (2002)
call “noncontingent contracts,” and our liability rules correspond to what they refer to as “option contracts.”}

More specifically, we consider a two-country setting where governments contract over trade
policy in the presence of uncertainty about the joint benefits of free trade, which could be
positive or negative, due for example to political economy factors. These joint benefits are not
verifiable, so a complete contingent agreement cannot be written. The agreement can take the
form of a property rule (that either assigns the right of free trade to the exporter or assigns
the right to protect to the importer), or of a liability rule (which gives the importer a choice
between free trade and protection-cum-compensation). Importantly, we assume that transfers
between governments are costly, so that utility is not transferrable; and we allow governments
to renegotiate their contract through Nash bargaining once the state of the world is realized.

The model yields several predictions concerning the pattern and direction of renegotiation.
First, if the contract is designed optimally, renegotiation (when it occurs) will result in trade
liberalization, not protection. More specifically, equilibrium renegotiations must take a par-
ticular form, in which the exporter agrees to compensate the importer in exchange for trade
liberalization, against the importer’s (credible) threat to impose protection and pay damages.

Second, while it might be expected that renegotiation would be triggered in extreme states
of the world (where the joint benefits of free trade are either very large and positive or very
large and negative), we find that in equilibrium renegotiation can only occur for intermediate
states of the world. Thus, at a broad level, in our model renegotiation is not an “extraordinary”
event, but rather occurs in “ordinary” circumstances.

A third and key prediction concerning the pattern of renegotiation is that, if a property rule
is optimal, it is never renegotiated in equilibrium. We discuss this finding in light of evidence
that the use of compensation/counter-retaliation in the GATT/WTO has diminished through
time, and we suggest that this diminished role for compensation may be a consequence of the
shift from liability to property rules that, in the view of GATT/WTO legal scholars as we have
described above, has occurred over time.

We then examine whether the optimal contract takes the form of a property rule or a liability

leave for future research.
rule. In the standard setting where parties cannot renegotiate the contract, the tradeoff between property rules and liability rules is conceptually simple: property rules involve no ex-post transfers but imply inflexible policy outcomes, while liability rules allow more policy flexibility but entail costly transfers. But the ability to renegotiate the contract ex-post changes the nature of the tradeoff in significant ways: first, property rules no longer imply inflexible policy outcomes; and second, there is a new consideration that plays an important role, namely how the rule specified in the contract affects the amount of transfers that occur when the contract is renegotiated. Perhaps surprisingly, we show that even though the tradeoff is more subtle, the predictions of the model are sharper when renegotiation is allowed.

We find that a property rule is optimal if ex-ante uncertainty is sufficiently low, whereas a liability rule is optimal when ex-ante uncertainty is high. This suggests that the use of liability (property) rules should be prevalent for issue areas where uncertainty about the joint economic/political benefits of free trade is large (small). Moreover we show that, if a liability rule is desirable, it is never optimal to set damages high enough to make the exporter “whole.” This runs counter to the so-called “efficient breach” argument in the law-and-economics literature, according to which damages should be set at a level that makes the injured country whole.

One of the key parameters of the model is the relative bargaining power of the two governments. In our setting, bargaining powers have efficiency consequences, not just distributional consequences, because utility is not transferrable. We find that increasing the bargaining power of the importing country tends to favor property rules over liability rules. This follows from the combination of two results we mentioned above: first, if the importer is stronger the equilibrium transfer is larger, because equilibrium renegotiations always entail the exporter compensating the importer; and second, an optimal property rule is never renegotiated in equilibrium and hence entails no equilibrium transfers.

Finally, we compare our setting with renegotiation to the benchmark scenario in which renegotiation is not feasible. We find that introducing the possibility of renegotiation tends to favor liability rules over property rules. This is another consequence of the result mentioned above, that when a property rule is optimal it is never renegotiated in equilibrium: this result, together

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7Note that the reason why bargaining powers have efficiency consequences in our setting (the fact that transferring utility is costly) is very different from the reason this happens in the well-known hold-up models, where bargaining powers affect efficiency through equilibrium ex-ante investments (see for example Segal and Whinston, 2002).
with the fact that renegotiation can only increase joint surplus, implies that the possibility of renegotiation can only increase the relative attractiveness of a liability rule.

The scenario in which renegotiation is not feasible can be viewed as capturing an extreme form of frictions in ex-post bargaining, which is a distinct transaction cost from the one we focus on more directly (the cost of transfers). From this perspective, the comparison we just mentioned suggests that property rules are more likely to be optimal when there are frictions in ex-post bargaining. As we discuss further below, this suggestion is at odds with a central conclusion of the law-and-economics literature, namely, that bargaining frictions tend to favor liability rules over property rules (Calabresi and Melamed, 1972, and Kaplow and Shavell, 1996).\textsuperscript{8} Interestingly, if transfers were costless, the effect of introducing frictions in ex-post bargaining into our model would be reversed, that is, liability rules would be favored. This last observation explains why our result diverges from the conclusion of the law-and-economics literature: the reason is that, unlike that literature, we focus on a world with costly transfers, which as we argued are a key transaction cost in the international trade context.

These themes are virtually unexplored in the existing economics literature on trade agreements, in part because those models do not accommodate the possibility of renegotiation in a meaningful way.\textsuperscript{9} For example, a number of papers (such as Bagwell and Staiger, 2005, Martin and Vergote, 2008, Bagwell, 2009, Park, 2009 and Beshkar, 2010a) consider the optimal design of trade agreements with privately observed political pressures, but none of these papers considers the possibility of renegotiation of the agreement. Howse and Staiger (2005) investigate whether the GATT/WTO reciprocity rule might be interpreted as facilitating efficient breach, but they do not consider the possibility of renegotiation either. One partial exception is Beshkar (2010b): he considers the optimal design of a trade agreement with non-verifiable political pressures and costly transfers, but only allows for a limited form of renegotiation, and furthermore the contract is not optimized to take into account the possibility of (partial) renegotiation.\textsuperscript{10} Another is Bagwell and Staiger (1999), who study the properties of a limited

\textsuperscript{8}This is widely seen as a fundamental result in law-and-economics. Wikipedia for example states: “With the opportunity to use either liability or property-based rules to protect entitlements, the academic community soon concluded that the key to figuring out which rule to use turned on the transaction costs. Therefore, if there were low transaction costs, then property rules should be used. If the transaction costs were high, then liability rules should be used.” (see the entry “Property Rules, Liability Rules and Inalienability”).

\textsuperscript{9}Lawrence (2003) provides a lucid treatment of these themes as they relate to international trade agreements at an informal level, and Srinivasan (2007) contains a related discussion.

\textsuperscript{10}More specifically, Beshkar (2010b) considers a setting in which the WTO court can observe a noisy signal of the state of political pressures, damages for breach can be contingent on this signal, and governments can
form of renegotiation that is restricted to satisfy the GATT/WTO principle of reciprocity, but they abstract from private information and their focus is very different from ours. Finally, the possibility of renegotiation is emphasized in the papers by Ludema (2001) and Klimenko et al. (2008), but their focus is on the renegotiation of punishment strategies in repeated-game models of self-enforcing agreements.

By contrast, in the law and economics literature analogous issues have been extensively studied in a domestic context. There are two related literatures. A fundamental question in the literature concerned with domestic contracts (see, for example, Schwartz, 1979, Shavell, 1984 and Ulen, 1984) is when contracting parties would want specific performance as a remedy for contract breach and when they would instead prefer damage payments. There is also a vast literature (the seminal contributions are Calabresi and Melamed, 1972, and Kaplow and Shavell, 1996) that is concerned with the related question of when property rules are preferred to liability rules in the design of domestic law. But all of this literature maintains the assumption that cash transfers are available (as seems appropriate given the literature’s domestic-context focus). By introducing costly transfers, our paper forges a link between the law-and-economics theory of optimal legal rules and the economic theory of trade agreements.

The rest of the paper proceeds as follows. Section 2 lays out the basic model. Section 3 considers a simple benchmark case where no renegotiation is possible. Section 4 characterizes the optimal agreement in the presence of renegotiation. Section 5 considers a more general class of contracts that allows not only for a “stick” associated with protection, but also for a “carrot” associated with free trade. Section 6 concludes. The Appendix contains proofs not presented in the text.

2. The Model

We focus on a single industry in which the Home country is the importer and the Foreign country is the exporter. The government of the importing country chooses a binary level of trade policy intervention for the industry, which we denote by $T \in \{FT, P\}$: “Free Trade” or “Protection.”\(^{11}\) We assume that the exporting government is passive in this industry.

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\(^{11}\)The assumption of a binary policy instrument helps to keep our analysis tractable, and it captures reasonably well a variety of non-tariff policy choices that are discrete in practice, such as regulatory regimes or product standards, on which many of the trade disputes in the GATT/WTO have focussed.
At the time that the Home government makes its trade policy choice, a transfer may also be exchanged between the governments, but at a cost. Here we seek to capture the feature that cash transfers between governments are seldom used for settling trade disputes or providing compensation to trading partners, while indirect (non-cash) transfers, such as tariff adjustments in other sectors or even non-trade policy adjustments, are more easily available.\textsuperscript{12} To allow for this possibility in a tractable way, we let $b$ denote a (positive or negative) transfer from Home to Foreign, and we let $c(b) \geq 0$ denote the deadweight loss associated with the transfer level $b$. The transfer cost $c(b)$ is (weakly) convex and smooth everywhere, with the natural features that $c(0) = 0$ and $c(b) > 0$ for $b \neq 0$. For simplicity, we assume that the importing country bears the deadweight loss $c(b)$, and that the total cost of the transfer inclusive of deadweight loss, $b + c(b)$, is increasing for all $b$.

The importing government’s payoff is given by

$$\omega(T, b) = v(T) - b - c(b),$$

(2.1)

where $v(T)$ is the importing government’s valuation of the domestic surplus associated with policy $T$ in the sector under consideration. We have in mind that $v(T)$ corresponds to a weighted sum of producer surplus, consumer surplus and revenue from trade policy intervention, with the weights possibly reflecting political economy concerns (as in, e.g., Baldwin, 1987, and Grossman and Helpman, 1994). As we noted above, the exporting government is passive in this industry; its payoff is therefore

$$\omega^*(T, b) = v^*(T) + b,$$

(2.2)

where $v^*(T)$ is the exporting government’s valuation of the foreign surplus associated with policy $T$.

Using (2.1) and (2.2), the joint payoff of the two governments is denoted as $\Omega$ and given by

$$\Omega(T, b) = v(T) + v^*(T) - c(b).$$

(2.3)

We assume that Home always gains from protection, and we denote this gain as

$$\gamma \equiv v(P) - v(FT).$$

\textsuperscript{12}For example, there are no known cases of cash compensation being provided within the context of the escape clause provisions in GATT Article XIX or the provisions for permanent tariff modifications in Article XXVIII, and the resolution of GATT/WTO disputes has, with two exceptions, never involved cash transfers either (the two exceptions to date are the \textit{US-Copyright} case – see WTO, 2007, pp. 283-286 – and the \textit{Brazil-Cotton} case – see Schnepf, 2010). However, countries do sometimes achieve indirect payment of compensation through the GATT/WTO “self-help” method of counter-retaliation in other sectors.
This gain may be interpreted as arising from some combination of terms-of-trade and political considerations. On the other hand, we assume that Foreign always loses from protection, and we denote this loss as
\[ \gamma^* \equiv v^*(FT) - v^*(P). \]
The joint (positive or negative) gain from protection is then \( \Gamma \equiv \gamma - \gamma^*. \)

Below we will refer to the outcome that maximizes joint surplus as the “first best” outcome. This outcome 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 \( b \) always equals zero under the first best, because transfers are costly to execute.

We assume that governments are ex-ante uncertain about the joint gains from protection (or equivalently the joint benefits from free trade, \( -\Gamma \)), but they observe \( \Gamma \) ex post. We also assume that \( \Gamma \) is not verifiable, i.e. not observed ex post by the court/dispute-settlement-body (DSB), so that governments are not able to write a complete contingent contract.\(^{13}\) We consider the simplest environment of this kind that allows us to make the relevant points. We assume that \( \gamma^* \) is known ex-ante, so that all the uncertainty in \( \Gamma \) originates from \( \gamma \), and that \( \gamma \) is not verifiable.\(^{14}\) In the Conclusion we briefly discuss the case in which \( \gamma^* \) is also uncertain (and not verifiable). But there is also a further motivation – besides simplicity – for considering the case in which \( \gamma^* \) is known ex ante. This is the case that is most favorable to the so-called “efficient breach” argument, according to which efficiency can be induced if Foreign is made whole with a damage payment of \( \gamma^* \) in the event of breach. We will show that, even in this most-favorable case, the standard argument for a liability rule must be qualified in our setting along a number of important dimensions.

We denote by \( h(\gamma) \) the ex-ante distribution of \( \gamma \), which we assume to be common knowledge (to the governments as well as the DSB). The density \( h(\gamma) \) is defined over the positive real line, \( \gamma \in [0, \infty) \). We let \( \underline{\gamma} \) and \( \bar{\gamma} \) denote the bounds of the support of \( \gamma \), or more formally, \( \underline{\gamma} = \inf\{\gamma : h(\gamma) > 0\} \) and \( \bar{\gamma} = \sup\{\gamma : h(\gamma) > 0\} \). To make things interesting, we assume that

\(^{13}\)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). We will use the expressions “court” and “DSB” interchangeably. Note that in our model the role of the court/DSB is simply that of an external enforcer of the contract, as in standard models of contracting.

\(^{14}\)These informational assumptions, namely that uncertainty is one-dimensional and that the uncertain parameter is not verifiable by the court but is observed by both parties, are relatively standard in the literature on mechanism design with renegotiation (see for example Segal and Whinston, 2002). Also, whether the uncertainty over \( \gamma \) reflects underlying uncertainty about \( v(FT) \) or \( v(P) \) or both is immaterial for our results.
\(\gamma^*\) is strictly positive and that the value \(\gamma = \gamma^*\) is in the interior of the support of \(\gamma\), 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 \(\Gamma < 0\)).

The fact that governments cannot write a complete contingent contract does not necessarily imply inefficiencies. If international transfers were costless (no deadweight loss), then governments could always achieve the first best by engaging in ex-post (i.e., after observing \(\gamma\)) negotiations over policies and (costless) transfers. When international transfers are costly, on the other hand, the first best cannot be achieved in general, but ex-ante joint surplus may be enhanced by writing a contract ex ante (before \(\gamma\) is realized). We look for the contract that maximizes ex-ante joint surplus.\(^{15}\)

The contract can be of two different types. The first type of contract is a property rule, which either assigns the right of free trade to the exporter (we will sometimes refer to this as a “prohibitive” property rule), or assigns the right to protect to the importer (we refer to this as a “discretionary” property rule). The second type of contract is a liability rule, which is a menu contract that gives the Home country a choice between (i) setting \(FT\) and (ii) setting \(P\) and compensating the Foreign country with a payment \(b_D\). Using slightly different terminology, this type of contract specifies a baseline commitment \((FT)\) but allows Home to escape this commitment by paying a certain amount of damages.\(^{16}\)

Note that a prohibitive property rule is outcome-equivalent to an extreme liability rule in which \(b_D\) is set prohibitively high (i.e. such that the importer never chooses to protect and pay \(b_D\) for any state of the world), and a discretionary property rule is outcome-equivalent to a liability rule at the other extreme in which \(b_D = 0\). Therefore, at a formal level we can focus without loss of generality on the family of liability contracts described above and simply optimize the level of \(b_D\). However, with a slight abuse of language we will call the contracts at the two extremes \((b_D = 0\) and \(b_D\) prohibitively high\) “property rules”: we choose to emphasize

\(^{15}\)There are three ways to justify this emphasis on the maximization of the governments’ ex-ante joint surplus. One possibility is to allow for costless ex-ante transfers, i.e., transfers at the time the institution is created. This justification is not in contradiction with our assumption of costly ex-post transfers, if it is interpreted as reflecting the notion that the cost of transfers can be substantially eliminated in an ex-ante setting such as a GATT/WTO negotiating round where many issues are on the table at once (see, for example, the discussion in Hoekman and Kostecki, 1995, Ch. 3). A second possibility would be to keep the single-sector model and introduce a veil of ignorance, so that ex-ante there is uncertainty over which of the two governments will be the importer and which the exporter. And a third possibility would be to introduce a second mirror-image sector.

\(^{16}\)In section 5 we will consider a more general type of contract that may specify a transfer also for the \(FT\) choice; in the basic model we focus on the simpler type of contract because it makes the main insights more transparent.
the property-rule interpretation rather than the extreme-liability-rule interpretation in order to connect with the ongoing debate on the optimal design of trade agreements that we described in the Introduction.\footnote{In our simple contracting environment, property rules and liability rules are noncontingent in nature. But in a richer model where some contingencies are uncertain ex-ante but verifiable ex-post, property and liability rules could be made (partially) contingent. It is useful to keep this in mind because in real-world trade agreements we do observe contingent property and liability rules. Consider, for instance, the WTO. An example of a contingent liability rule is given by the provisions for tariff modifications in GATT Article XXVIII, where the compensation due to the exporting country in case of a tariff increase is contingent on the trade effects of such a tariff change. And an example of a contingent property rule is given by the MFN obligation, which applies strictly as a default, but does not apply at all under certain “exceptional” contingencies (see GATT Article I).}

We allow the governments to renegotiate the initial contract after the state of the world $\gamma$ is realized. More specifically, we assume that the ex-post negotiation is a Nash bargaining game with the initial contract serving as the disagreement point. We let $\sigma$ (resp. $1 - \sigma$) denote the bargaining power of the Home (resp. Foreign) government. We abstract from underlying issues of enforcement and simply assume that bargaining outcomes between the two governments are enforced (we return to this assumption briefly in the Conclusion).

To summarize, the timing of events is as follows: (0) Governments write the contract; (1) $\gamma$ is realized and observed by the governments; (2) governments can renegotiate the terms of the contract ($b$ and $T$).

We conclude this section by highlighting an alternative interpretation of the contract-design problem described above. The literal interpretation is that governments write a contract that specifies two options for the importer (choosing $FT$, or choosing $P$ and compensating the exporter with the payment $b^D$), and the DSB simply enforces the contract. The alternative interpretation is that governments design an institution consisting of two parts: (i) a simple \{FT\} contract with no contractually specified means of escape; and (ii) a mandate for the DSB to implement a certain remedy for breach (the payment $b^D$). Our analysis applies equally well under either of these interpretations (i.e., whether the contract includes an escape provision, or rather a remedy for breach is specified in the DSB mandate), and both of these interpretations are relevant for the GATT/WTO: some WTO clauses take the form of explicit option contracts, for example the escape clause in GATT Article XIX and the provisions for tariff modifications in Article XXVIII; but there are also many contractual commitments for which, when they apply, there is no escape provision (e.g., the requirement of national treatment on internal taxation and regulation, and the ban on export subsidies), and in this case the relevant question is what should be the appropriate remedy applied by the DSB in case of breach. Under either
interpretation, the level of the breach remedy is important for the same reason: it serves to define the disagreement point provided by the legal system should ex-post negotiations fail.

3. The No-Renegotiation Benchmark

Before characterizing the optimal agreement in the presence of renegotiation, it is instructive first to consider the simpler setting where ex-post negotiation is not possible. When there is no ex-post negotiation, governments can be viewed as simply designing a contract ex ante (to maximize ex-ante joint surplus) and then implementing it ex post, and choosing a level of damages $b^D$ amounts to stipulating the actual level of damages that must be paid by Home if it chooses $P$.

We start by noting that, given $b^D$, the importer will choose $FT$ if and only if its gain from protection, $\gamma$, is below some threshold level $\hat{\gamma}$. The threshold level $\hat{\gamma}$ is the value of $\gamma$ for which the importer is indifferent between $FT$ and $P$-plus-damages-$b^D$, and is given by $\hat{\gamma} = b^D + c(b^D)$. The threshold $\hat{\gamma}$ summarizes the policy “allocation” induced by the contract, and we say that $\hat{\gamma}$ is “implemented” by the level of damages $b^D$ if $\hat{\gamma} = b^D + c(b^D)$.

It is useful to highlight how the notions of property rules and liability rules map into values of $\hat{\gamma}$. For this purpose, we define the “prohibitive” level of damages $b^{prohib}$ as the minimum value of $b^D$ such that the importer chooses $FT$ for all $\gamma$ in the support $(\underline{\gamma}, \bar{\gamma})$, which is defined implicitly by $b^D + c(b^D) = \bar{\gamma}$. Clearly, then, setting a discretionary property rule ($b^D = 0$) corresponds to setting $\hat{\gamma} = 0$; a prohibitive property rule ($b^D \geq b^{prohib}$) corresponds to $\hat{\gamma} \geq \bar{\gamma}$; and a liability rule ($b^D \in (0, b^{prohib})$) corresponds to a value $\hat{\gamma}$ that is strictly between 0 and $\bar{\gamma}$.

It is convenient to think about the optimal contracting problem as one of choosing the transfer $b^D$ and the policy allocation $\hat{\gamma}$ to maximize the ex-ante joint surplus, subject to the “implementation constraint” $b^D + c(b^D) = \hat{\gamma}$. Letting $E\Omega_\varphi(b^D, \hat{\gamma})$ denote the ex-ante joint surplus given $b^D$ and $\hat{\gamma}$ when no ex-post negotiation is possible, we can state the optimal contracting problem as follows:

$$\max_{b^D, \hat{\gamma}} E\Omega_\varphi(b^D, \hat{\gamma}) = V(FT) + \int_{\underline{\gamma}}^{\infty} (\gamma - \gamma^*)dH(\gamma) - c(b^D)[1 - H(\hat{\gamma})]$$

$$\text{s.t. } b^D + c(b^D) = \hat{\gamma},$$

(3.1)

(3.2)

where $V(FT) \equiv v(FT) + v^*(FT)$. The expression for $E\Omega_\varphi(b^D, \hat{\gamma})$ in (3.1) is composed of the
sum of three terms. The first term is the joint surplus under a rigid FT policy and no transfers; the second term captures the gains in joint surplus associated with allowing the policy $P$ for $\gamma > \hat{\gamma}$; and the third term reflects the deadweight loss associated with the transfer $b^D$ and policy allocation $\hat{\gamma}$.

Note that, if there is no cost of transfers ($c(\cdot) \equiv 0$), the objective in (3.1) is clearly maximized by $\hat{\gamma} = \gamma^*$, the first best allocation; but if $c(\cdot) > 0$, it may be optimal to deviate from this allocation. Next note that, if $c(\cdot) > 0$, implementing the first best allocation implies a deadweight loss, which is given by $c(b^D)[1 - H(\gamma^*)]$; this can be interpreted as the “sorting cost.” This cost is incurred for all states higher than $\gamma^*$, which explains why it is weighted by $[1 - H(\gamma^*)]$. Thus, in the absence of renegotiation, the tradeoff in choosing $\hat{\gamma}$, and hence the optimal level of damages, can be understood in very simple terms: the choice of $\hat{\gamma}$ hinges on the comparison between the efficiency cost of deviating from the first best allocation and the savings in sorting costs that can be achieved by doing so.

To maximize the objective in (3.1), we can use the implementation constraint to solve for the value of $b^D$ that implements $\hat{\gamma}$, plug this into the objective function and optimize $\hat{\gamma}$. We let $b^D_\hat{\gamma}(\hat{\gamma})$ denote the value of $b^D$ that implements $\hat{\gamma}$. Differentiating $E\Omega_\varphi$ with respect to $\hat{\gamma}$, and noting that $\frac{dc(b^D(\hat{\gamma}))}{d\hat{\gamma}} = \frac{c(\cdot)}{1+c(\cdot)}$, we obtain

$$\frac{dE\Omega_\varphi(b^D_\hat{\gamma}(\hat{\gamma}), \hat{\gamma})}{d\hat{\gamma}} = (\gamma^* - \hat{\gamma}) \cdot h(\hat{\gamma}) + c(\cdot) \cdot h(\hat{\gamma}) - \frac{c(\cdot)}{1+c(\cdot)} \cdot [1 - H(\hat{\gamma})].$$

(3.3)

The first term of $\frac{dE\Omega_\varphi}{d\hat{\gamma}}$ captures the marginal efficiency gain of increasing $\hat{\gamma}$: this is positive if $\hat{\gamma} < \gamma^*$ and negative otherwise. The second term and third term together capture the marginal savings in sorting costs (positive or negative) from increasing $\hat{\gamma}$: the second term is positive because increasing $\hat{\gamma}$ reduces the range of states for which the importer government chooses to pay the transfer, while the third term is negative because increasing $\hat{\gamma}$ requires an increase in the transfer, which will be paid for all states higher than $\hat{\gamma}$.

At this point one might proceed with a “local” approach, and ask how the objective can be improved starting from the first best allocation $\hat{\gamma} = \gamma^*$: Does improvement require increasing or decreasing $\hat{\gamma}$? Or formally, what is the sign of $\frac{dE\Omega_\varphi}{d\hat{\gamma}}$ at $\hat{\gamma} = \gamma^*$? Clearly, the sign is positive if and only if sorting costs are saved by increasing $\hat{\gamma}$ slightly from $\gamma^*$, but this is ambiguous because, as explained above, the marginal savings in sorting costs are composed of two effects that go in opposite directions. More specifically, it is direct to verify that the sign of $\frac{dE\Omega_\varphi}{d\hat{\gamma}}$ at $\hat{\gamma} = \gamma^*$ is positive if and only if $\frac{d\ln c}{d\hat{\gamma}} > \frac{b(\hat{\gamma})}{1 - H(\hat{\gamma})}$: thus the answer hinges on a comparison between
the proportional change in the deadweight loss and the (inverse of) the hazard rate at \( \hat{\gamma} \), and a local approach cannot therefore take us very far.

Partly because of the feature we just highlighted, the predictions about the nature of the optimal rules in the no-renegotiation case are somewhat ambiguous. The only sharp prediction obtains under the scenario in which uncertainty about \( \gamma \) is small, in the sense that the support of \( \gamma \) around \( \gamma^* \) is small: in this case, a property rule must be optimal. To see why, consider a liability rule, that is a value of \( \hat{\gamma} \) within \((0, \hat{\gamma})\). It is easy to see that such a value of \( \hat{\gamma} \) is dominated by \( \hat{\gamma} = 0 \): the key is to notice from (3.3) that \( \frac{dE\Omega\gamma}{d\gamma} = -\frac{c'(\hat{\gamma})}{1+c'(\hat{\gamma})} < 0 \) for all \( \hat{\gamma} \) between 0 and \( \hat{\gamma} \) (because \( h = 0 \) for all these values). This implies that \( \hat{\gamma} = 0 \) dominates all values of \( \hat{\gamma} \) between 0 and \( \hat{\gamma} \), and moreover \( \hat{\gamma} = 0 \) dominates \( \hat{\gamma} = \gamma \) by a discrete margin, and by continuity will dominate any \( \hat{\gamma} \) within the support \((\gamma, \hat{\gamma})\) provided that this support is sufficiently small.

Intuitively, a liability rule can achieve a contingent, and hence more efficient, policy allocation, but the associated gain is small when the support of \( \gamma \) is small, and it is overwhelmed by the deadweight loss from the transfer.

Let us focus now on the opposite case, in which uncertainty is large. We find that, if the support of \( \gamma \) is sufficiently large, a prohibitive property rule \( \hat{\gamma} \geq \gamma \) is necessarily suboptimal, but the discretionary property rule cannot be ruled out. To understand the first of these two claims, start by noting that the first two terms in (3.3) collapse to \((\gamma^* - b_D^p(\hat{\gamma})) \cdot h(\hat{\gamma})\) (using the definition of \( b_D^p(\hat{\gamma}) \)). Next note that \( b_D^p(\hat{\gamma}) > \gamma^* \) for \( \hat{\gamma} \) large enough, and hence \( \frac{dE\Omega\gamma}{d\gamma} < 0 \) for \( \hat{\gamma} \) in a left neighborhood of \( \hat{\gamma} \). This implies that \( \hat{\gamma} \geq \gamma \) is dominated by setting \( \hat{\gamma} \) slightly lower than \( \gamma \). On the other hand, the discretionary property rule \( \hat{\gamma} = 0 \) can under some conditions be a maximum. To see why, notice that, since \( b_D^p(0) = 0 \) and \( c'(0) = c(0) = 0 \), we have \( \frac{dE\Omega\gamma}{d\gamma} \big|_{\gamma=0} = \gamma^* \cdot h(0) \). If \( h(0) = 0 \) then \( \hat{\gamma} = 0 \) is a stationary point, and in this case one can show that if \( h'(0) \) is sufficiently small then \( \hat{\gamma} = 0 \) is a local maximum, and it is straightforward to construct examples in which \( \hat{\gamma} = 0 \) is a global maximum. Intuitively, when uncertainty is large and renegotiation is not possible, it may be best to allow full discretion (\( P \) always), because inducing \( FT \) even for just the lowest levels of \( \gamma \) – i.e. those states where \( FT \) is most desirable for joint surplus – requires a transfer that will occur in equilibrium for all higher levels of \( \gamma \).

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18 Recall that \( \gamma^* > 0 \), and so when the support of \( \gamma \) around \( \gamma^* \) is sufficiently small we must have that \( \gamma > 0 \).
19 It can be shown that a liability rule is dominated also by the prohibitive property rule \( \hat{\gamma} \geq \gamma \). This cannot be seen easily from (3.3), but one way to see it intuitively is to focus on the symmetric case where \( E\Omega\gamma = \gamma^* \): in this case the two property rules yield the same expected joint surplus, and hence if a liability rule is dominated by one property rule it is also dominated by the other.
i.e. those states in which the importer will choose $P$ – and the resulting transfer costs may be too high to be worthwhile.

To summarize our analysis thus far, in the no-renegotiation scenario the key tradeoff is conceptually simple. A liability rule can insure against extreme realizations of $\gamma$ but it entails transfer costs, while a property rule avoids transfer costs but it entails downside risk associated with extreme realizations of $\gamma$. However, the predictions about the optimal rules are somewhat ambiguous, at least in the case of large uncertainty. As we will show in the next section, introducing renegotiation complicates the trade-offs, but perhaps surprisingly, leads to sharper predictions about the optimal rules.

4. The Optimal Agreement in the Presence of Renegotiation

We now turn to the central task of characterizing the optimal agreement in the presence of renegotiation. In part we can build on the analysis of the no-renegotiation case in the previous section, because for any level of damages $b^D$ the contract characterized there provides the disagreement (threat) point for any renegotiation in the present setting. But to characterize where governments will actually end up for any realization of $\gamma$ given a level of $b^D$, we must consider the incentives to renegotiate the initial contract, and this necessitates some new notation and a somewhat more involved analysis.

The first question we need to address is the following: Given a contract that specifies damages $b^D$, when does renegotiation occur (i.e., for what realizations of $\gamma$), and in what direction does it occur (i.e., from $P$ to $FT$ or from $FT$ to $P$)? As we observed just above, the threat point in the renegotiation is given by the initial contract, which gives the importer the option to choose between ($T = FT, b = 0$) and ($T = P, b = b^D$). Clearly, the importer is indifferent between these two options if $\gamma = b^D + c(b^D) \equiv S(b^D)$. In words, $S(b^D)$ is the total cost of the transfer $b^D$ inclusive of deadweight loss, and it is the level of $\gamma$ at which the threat point “switches”: under disagreement, for $\gamma < S(b^D)$ the importer chooses ($T = FT, b = 0$), while for $\gamma > S(b^D)$ it chooses ($T = P, b = b^D$). We depict the curve $S(b^D)$ in Figure 1. As Figure 1 reflects, $S(b^D)$ is increasing and convex and goes through the origin, and the threat point is ($T = FT, b = 0$) below $S(b^D)$ and ($T = P, b = b^D$) above it.

Having characterized how the threat point varies with $\gamma$ for a given $b^D$, we can now proceed to identify the realizations of $\gamma$ for which the initial contract will be renegotiated, and determ-
ine as well the direction of the renegotiation. Note that the analysis of renegotiation is not straightforward because utility is not transferrable, due to the cost of transfers, and for this reason we cannot simply focus on the governments’ ex-post joint surplus to determine whether the contract will be renegotiated.

Let us focus first on the case $\gamma < S(b^D)$, where the threat point is $(T = FT, b = 0)$. Clearly, the governments will renegotiate to the policy $P$ if and only if there exists a transfer $b^e$ such that both governments gain by switching from $(T = FT, b = 0)$ to $(T = P, b = b^e)$, which requires $\gamma > S(b^e)$ (for the importer) and $b^e > \gamma^*$ (for the exporter). Using the definition of $S(\cdot)$, the equilibrium $b^e$ will then fall somewhere in the interval $[\gamma^*, S^{-1}(\gamma)]$, depending on bargaining powers.\(^{20}\) Furthermore, it is clear that there is a Pareto improvement over the threat point if and only if the interval $[\gamma^*, S^{-1}(\gamma)]$ is nonempty, or $\gamma > S(\gamma^*)$. Thus, we can conclude that the contract is renegotiated toward policy $P$ for values of $\gamma$ such that $S(\gamma^*) < \gamma < S(b^D)$. This condition identifies a region in $(\gamma, b^D)$ space, which is highlighted in Figure 1 by the vertical shading (and labeled $P_R$).\(^{21}\)

It is useful at this juncture to observe that it can never be strictly optimal to set $b^D > \gamma^*$. To see why, notice from Figure 1 that setting $b^D > \gamma^*$ induces the same policy allocation as setting $b^D = \gamma^*$ (namely $FT$ for $\gamma < S(\gamma^*)$ and $P$ for $\gamma > S(\gamma^*)$). Therefore, any $b^D > \gamma^*$ is weakly dominated by $b^D = \gamma^*$ because the latter implies a weakly lower expected transfer.\(^{21}\) A consequence of this observation is that it will never be the case that in equilibrium the contract is renegotiated towards $P$: this follows because renegotiation from $FT$ to $P$ is only possible in the case where $\gamma < S(b^D)$ and the threat point is $FT$, and as Figure 1 depicts when $\gamma < S(b^D)$ the contract is renegotiated toward $P$ only when $b^D > \gamma^*$, which we have just observed can never be strictly optimal. Instead, as we will confirm and discuss further below, the only kind of renegotiation that can occur in equilibrium is from $P$ to $FT$.

Let us now focus on the case $\gamma > S(b^D)$, where the threat point is $(T = P, b = b^D)$. In this case, the governments will renegotiate toward the policy $FT$ if and only if there exists a

\(^{20}\)Note that the function $S(\cdot)$ is invertible, because we assumed that $b + c(b)$ is increasing everywhere.

\(^{21}\)To see this, fix a level of $b^D$ above $\gamma^*$, say $b^D = \bar{b}^D > \gamma^*$, and replace it with $b^D = \gamma^*$. This decreases the expected equilibrium transfer (weakly) for two reasons: (1) if $\gamma > S(b^D)$, so that the importer chooses $(T = P, b = b^D)$ without renegotiating, the transfer obviously decreases, and (2) if $\gamma \in (\gamma^* + c(\gamma^*), S(b^D))$, so that the contract is renegotiated, the equilibrium transfer $b^e$ is higher than $\gamma^*$, as we showed in the text. We also note the reason for the qualifier that $b^D > \gamma^*$ is “weakly” dominated by $b^D = \gamma^*$: if the support of $\gamma$ around $\gamma^*$ is small, the expected equilibrium transfer is the same in the two cases, because all states $\gamma > \gamma^* + c(\gamma^*)$ have zero density. But note that, if this is the case, even if $b^D > \gamma^*$ renegotiation from $FT$ to $P$ cannot occur with positive probability. This explains the sentence that follows in the text.
(negative) transfer $b^e$ such that both governments gain by switching from $(T = P, b = b^D)$ to $(T = FT, b = b^e)$, which requires $S(b^D) - S(b^e) > \gamma$ (for the importer) and $\gamma^* > b^D - b^e$ (for the exporter). Again using the definition of $S(\cdot)$, the equilibrium $b^e$ will then fall somewhere in the interval $[b^D - \gamma^*, S^{-1}(S(b^D) - \gamma)]$, depending on bargaining powers. Clearly, there exists a Pareto improvement over the threat point if and only if this interval is nonempty, or $\gamma < S(b^D) - S(b^D - \gamma^*) \equiv R(b^D)$, hence we can conclude that the contract is renegotiated toward policy FT when $S(b^D) < \gamma < R(b^D)$. This condition identifies a region in $(\gamma, b^D)$ space that is highlighted in Figure 1 by the horizontal shading (and labeled FT$_R$).\footnote{Note that $R(0) = -S(-\gamma^*) > 0$, so this region is guaranteed to be nonempty, and note also that $R''(b^D) < S''(b^D)$ for all $b^D$, which ensures that the point of intersection between the $R$ curve and the $S$ curve is unique.}

Finally we note that the two renegotiation regions highlighted in Figure 1 are themselves independent of the bargaining-power parameter $\sigma$. Bargaining powers only affect the exact amount of transfer $b^e$ that will be exchanged inside these regions.

Figure 1 summarizes the analysis thus far, and is of central importance for understanding the results that follow. The two key curves are $S(b^D)$ and $R(b^D)$. The curve $\gamma = S(b^D)$ is the locus of points where the importer’s threat point switches between $P$ and $FT$. If $b^D < \gamma^*$ (which as we argued is the relevant case), this curve also marks the lower boundary of the region where governments renegotiate the contract (in the direction of free trade), while the curve $\gamma = R(b^D)$ marks the upper boundary of the renegotiation region.

Our findings on the pattern of renegotiation are recorded in the following:

\textbf{Proposition 1.} (i) If $b^D < \gamma^*$, the contract is renegotiated for $\gamma \in (S(b^D), R(b^D))$, in which case the governments agree on FT and the exporter compensates the importer. (ii) If $b^D > \gamma^*$, the contract is renegotiated for $\gamma \in (S(\gamma^*), S(b^D))$, in which case the governments agree on P and the importer compensates the exporter; however, setting $b^D > \gamma^*$ is weakly dominated, and this kind of renegotiation does not happen in equilibrium.

Proposition 1 provides a key step in the analysis of the optimal agreement in the presence of renegotiation. But it is worthwhile to note in passing that Proposition 1 also implies a pair of predictions that are of some independent interest.

The first prediction is that, as long as damages are set optimally, any observed ex-post renegotiation of the ex-ante contract must result in liberalization (from $P$ to FT), not protection (from FT to $P$). That is, according to Proposition 1, equilibrium renegotiations all take
a particular form in which the importer agrees to liberalize and the exporter agrees to pay something for this. What should not occur in equilibrium according to Proposition 1 is a renegotiation wherein the importer’s threat point is FT but the governments agree to a policy of P and a level of damages to the exporter that is less than the contractually-specified level \( b^e < b^D \). Intuitively, if renegotiation took this form it would imply that the contractually-specified damages \( b^D \) are suboptimally high, because for the exporter government to agree to such a renegotiation would require \( \gamma^* < b^e \), and hence \( \gamma^* < b^D \); but this cannot be optimal, as we have explained previously.\(^{23}\)

The second prediction is that, if \( b^D > 0 \), renegotiation can occur in equilibrium only for intermediate values of \( \gamma \). Broadly speaking, then, our model predicts that renegotiation is not an “extraordinary” event that occurs only in extreme states of the world, but instead can occur only for “ordinary” states of the world.\(^{24}\) This is perhaps surprising, since intuition might suggest that renegotiation should occur in exceptional circumstances where the ex-ante contract turns out to be highly inefficient ex-post. The reason this intuition is not correct in our model is that, in extreme states of the world, the initial contract performs well, in the sense that it induces the importer to make the correct policy choice. Instead, in our model governments may have incentive to renegotiate (for the relevant range of \( b^D \)) only if the importer government is relatively close to indifferent between the options placed before it by the initial contract, and this indifference occurs for an intermediate state of the world (\( \gamma = S(b^D) \)): if the importer prefers P and is far from this indifference point, the exporter will have to pay a large transfer to convince the importer to switch its policy choice to FT, and this will entail a large dead weight loss. In this sense, the reason the contract may be renegotiated in equilibrium in our model reflects the inefficiencies of the transfers more than the inefficiencies of the policy itself.

Having characterized the pattern and direction of renegotiation, the next question is: What allocations \( \hat{\gamma} \) can be implemented in the presence of renegotiation, and what is the level of damages \( b^D \) that implements a given \( \hat{\gamma} \)?

This question is immediately answered by looking at Figure 1. First note that there exists no

\(^{23}\)Whether or not renegotiations of this latter form are observed in (e.g., GATT/WTO) practice is an interesting empirical question that is suggested by Proposition 1, but we are unaware of any evidence from existing empirical studies that is directly relevant in this regard.

\(^{24}\)Note that this result makes no reference to the probabilities of different realizations of \( \gamma \). Thus, in principle, intermediate values of \( \gamma \) could be less likely than extreme values of \( \gamma \), and in this sense the former could be more “exceptional” than the latter. But this can happen only for very non-standard distributions, so we feel justified in stating broadly that in our model renegotiation can occur only for “ordinary” states of the world.
level of damages $b^D$ that can implement values of $\hat{\gamma}$ outside the interval $[R(0), S(\gamma^*)]$; regardless of $b^D$, the policy outcome for $\gamma > S(\gamma^*)$ is always $P$, and the policy outcome for $\gamma < R(0)$ is always $FT$. This is an important difference relative to the case of no renegotiation: in the absence of renegotiation, any allocation $\hat{\gamma}$ can be implemented by an appropriate choice of $b^D$. But when renegotiation is feasible, it is impossible to induce $FT$ for values of $\gamma$ above $S(\gamma^*)$, or $P$ for values of $\gamma$ below $R(0)$. Notice also that the range of implementable values of $\hat{\gamma}$ is smaller when the cost of transfer is lower (it can be verified that decreasing $c(\cdot)$ leads to an increase in $R(0)$). This feature is very intuitive in the limiting case where transfers are costless: then the parties will always renegotiate to the efficient outcome regardless of $b^D$, and hence only the allocation $\hat{\gamma} = \gamma^*$ is implementable. When transfers are quite costly, on the other hand, the renegotiation outcome is very sensitive to the level of damages $b^D$ specified in the initial contract, and hence the range of implementable allocations is wider. Thus renegotiation limits the scope of implementation, and the more so the lower the transfer cost. We let $IM_{\hat{\gamma}} = [R(0), S(\gamma^*)]$ denote the set of implementable values of $\hat{\gamma}$.

In spite of the fact that renegotiation imposes bounds on implementation, renegotiation is beneficial for ex-ante joint surplus. To see this notice that, for each given $b^D$ and $\gamma$, governments renegotiate only if this leads to an ex-post Pareto improvement. Since renegotiation leads to a weak ex-post Pareto improvement for all $(b^D, \gamma)$, it follows that the ex-ante joint surplus must also be weakly higher. The following lemma summarizes:

**Lemma 1.** Renegotiation limits the range of allocations $\hat{\gamma}$ that can be implemented. The implementable range of $\hat{\gamma}$ is given by $IM_{\hat{\gamma}} = [R(0), S(\gamma^*)]$. However, renegotiation is (weakly) beneficial for the ex-ante joint surplus.

Lemma 1 indicates that, despite placing limits on what can be implemented, the ability to renegotiate (weakly) enhances the ex-ante joint surplus of the governments. We note that this feature contrasts with other mechanism design settings (e.g., the hold-up and risk-sharing environments studied in Segal and Whinston, 2002) where the ability to renegotiate ex-post can be harmful to ex-ante surplus, for the simple reason that our model abstracts from the sorts of ex-ante investment/risk-aversion issues that are the focus of those settings.\(^{25}\)

We next ask, what level of $b^D$ is required to implement a given $\hat{\gamma}$? From Figure 1 it is clear that implementing a given $\hat{\gamma}$ in $IM_{\hat{\gamma}}$ requires $b^D(\hat{\gamma}) = R^{-1}(\hat{\gamma})$. Note that $b^D(\hat{\gamma})$ is increasing in

\(^{25}\)It is also relevant to observe that efforts to renegotiate ex-post are actively encouraged (and even mandated) in the context of GATT/WTO disputes. Our finding that renegotiation is beneficial is consistent with this stance.
the relevant range; and, recalling that the definition of $b_D(\hat{\gamma})$ implies $b_D(\hat{\gamma}) = S^{-1}(\hat{\gamma})$, we note as well that $b_D(\hat{\gamma}) \leq b_D^{*}(\hat{\gamma})$ for all $\hat{\gamma} \in IM$, in spite of the fact that renegotiation limits the scope of implementation, it takes a lower level of contractually-specified damages to implement a given $\hat{\gamma}$ than in the absence of renegotiation (for $\hat{\gamma}$ in the implementable set).

Finally, it is important to recall that the level of damages $b_D(\hat{\gamma})$ specified in the contract is not necessarily the transfer that occurs in equilibrium, since the contract may be renegotiated, so Lemma 1 does not tell us the cost of implementing $\hat{\gamma}$. For $\gamma \in IM$, this cost includes two components: (1) the cost of the transfer $b^e(\cdot)$ made when the contract is renegotiated, which is the case for $\gamma \in (S(b_D(\hat{\gamma})), \hat{\gamma})$, and (2) the cost of the transfer $b_D$ made when the contract is not renegotiated and the importer chooses $(T = P, b = b_D)$, which is the case for $\gamma > \hat{\gamma}$.

Armed with the observations above, we can now write down the optimization problem in the presence of renegotiation. Recalling that we can focus on $b_D \leq \gamma^*$ and that for this range of $b_D$ we have $\hat{\gamma} = R(b_D)$, we can write the problem as follows:

$$\max_{b_D, \hat{\gamma}} E\Omega(b_D, \hat{\gamma}) = V(FT) + \int_{\gamma}^{\infty} (\gamma - \gamma^*)dH(\gamma) - c(b_D)[1 - H(\hat{\gamma})] - \int_{S(b_D)}^{\hat{\gamma}} c(b^e(b_D, \gamma))dH(\gamma)$$

s.t. $\hat{\gamma} = R(b_D), \ b_D \leq \gamma^*$

There are two main differences between this optimization problem and the optimization problem in (3.1) that applies when renegotiation is not possible: first, the expected cost of transfers now includes not only the cost of the transfer $b_D$ for states in which the contract is not renegotiated and the importer chooses $(T = P, b = b_D)$, but also the cost of the transfer $b^e$ that is paid by the exporter when renegotiation occurs; and second, the level of $b_D$ required to implement a given $\hat{\gamma}$ is lower than in the case of no renegotiation, as we highlighted above.

A key ingredient for finding the optimal level of contractually-stipulated damages $b_D$ is understanding how the level of $b_D$ affects the transfer $b^e$ paid by the exporter when renegotiation occurs. Intuitively, increasing $b_D$ strengthens the bargaining position of the exporter and hence decreases $b^e$ in absolute size. To see this more formally, note that in the $FT_R$ region $b^e$ solves the generalized Nash bargaining problem:

$$\max_b NB(b, b_D) = \left(\omega(FT, b) - \omega(P, b_D)\right)^{1-\sigma} \left(\omega^*(FT, b) - \omega^*(P, b_D)\right)^{1-\sigma}.$$ 

By standard monotone comparative-statics results, $\frac{\partial b^e}{\partial b_D}$ has the same sign as $\frac{\partial^2 NB(b, b_D)}{\partial b \partial b_D}|_{b = b^e}$, which, using the expression $NB(b, b_D) = \left(S(b_D) - S(b) - \gamma\right)^{1-\sigma} \left(\gamma^* + b - b_D\right)^{1-\sigma}$, is easily shown
to be positive. As \( b^e < 0 \) in the \( FT_R \) region, it follows that \( \frac{\partial |b^e|}{\partial b_D} < 0 \). We record this in

**Lemma 2.** For \((b^D, \gamma)\) in the \( FT_R \) region, where governments renegotiate to \( FT \) and \( b^e < 0 \), an increase in \( b^D \) leads to a decrease in (the absolute size of) the equilibrium transfer: \( \frac{\partial |b^e|}{\partial b_D} < 0 \).

We are now ready to study the optimal level of \( b^D \), and in particular compare property rules with liability rules in the presence of renegotiation. Recall that the discretionary property rule is defined as \( b^D = 0 \); the prohibitive property rule as \( b^D \geq b^{prohib} \) (where \( b^{prohib} \) is determined by \( S(b^{prohib}) = \gamma \)); and a liability rule as \( b^D \in (0, b^{prohib}) \).

Before proceeding, however, it is important to emphasize how the introduction of renegotiation changes the tradeoff involved in the choice between liability rules and property rules. Recall that, in the absence of renegotiation, the tradeoff is fairly simple: property rules avoid the cost of transfers but imply rigid policy outcomes, whereas liability rules can introduce policy flexibility but imply some waste associated with the use of transfers. If governments are able to renegotiate the contract, on the other hand, this tradeoff is complicated by the fact that the policy outcome is no longer rigid under property rules; by the fact that renegotiation imposes a limit on the policy allocations that can be implemented; and perhaps most importantly, by the fact that the level of \( b^D \) affects the equilibrium payments that are made when governments renegotiate. But as we now show, in spite of this more complicated tradeoff, the introduction of renegotiation actually sharpens the results of the model.

We focus first on the case of small uncertainty. In this case, a property rule must be optimal, and the logic is similar to the case of no renegotiation. Figure 2 depicts the relevant features of the small-uncertainty case. First note from Figure 2 that, if the support of \( \gamma \) around \( \gamma^* \) is sufficiently small, a property rule \((b^D = 0 \text{ or } b^D \geq b^{prohib})\) is not renegotiated for any \( \gamma \), and hence it induces zero transfers in equilibrium. A liability rule may achieve a more efficient policy allocation than a property rule, since the policy can be made contingent on \( \gamma \), 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 implementing a threshold \( \hat{\gamma} \) close to \( \gamma^* \) requires a level of damages \( b^D \) that is close to \( R^{-1}(\gamma^*) \) and hence does not become negligible as the support shrinks.\(^{26}\) In this case, it is straightforward to establish that the

\(^{26}\)To be more precise, if \( \hat{\gamma} \) is close to \( \gamma^* \) then for states above \( \hat{\gamma} \) the transfer \( b^D \) will be close to \( R^{-1}(\gamma^*) \), which is non-negligible; for states below \( \hat{\gamma} \) the contract will be renegotiated, and the equilibrium transfer may be lower, but this renegotiated transfer is unrelated to the size of the support of \( \gamma \) and hence does not become small as the support shrinks.
optimum is \( b^D = 0 \) if \( E\gamma > \gamma^* \) and \( b^D \geq \bar{b}_{\text{prohib}} \) if \( E\gamma < \gamma^* \).

Let us focus next on the case where uncertainty is sufficiently large. It is helpful to refer back to Figure 1 for this case. Suppose that \( \gamma < R(0) \) and \( \bar{\gamma} > S(\gamma^*) \). Recalling that the implementable range of \( \bar{\gamma} \) is \( IM_{\bar{\gamma}} = [R(0), S(\gamma^*)] \), this is the case in which the support includes high-\( \gamma \) states in which the policy outcome is \( P \) regardless of the initial contract, and it includes low-\( \gamma \) states in which the policy outcome is \( FT \) regardless of the initial contract. In this case, a liability rule must be optimal. To see why, first note that in this case \( \bar{b}_{\text{prohib}} > \gamma^* \), and recall from Proposition 1 that \( b^D > \gamma^* \) can never be optimal, so a prohibitive property rule cannot be optimal. Next consider the discretionary property rule \( b^D = 0 \). Note that, given \( b^D = 0 \), for all \( \gamma > R(0) \) the contract is not renegotiated and the outcome is \( (P, b = 0) \); for these states, increasing \( b^D \) slightly from zero entails only a second-order loss, since the marginal cost of the transfer is zero at \( b = 0 \). But for all \( \gamma < R(0) \), given \( b^D = 0 \) the contract is renegotiated and the exporter pays a sizable transfer \( b^e \), and recall from Lemma 2 that increasing \( b^D \) reduces the size of \( b^e \): this is a first-order benefit, and hence increasing \( b^D \) slightly from zero improves the objective. We can conclude that if the support of \( \gamma \) is sufficiently large, both property rules are dominated by a liability rule.

The following proposition summarizes:

**Proposition 2.** (i) If the support of \( \gamma \) is sufficiently small, a property rule is optimal (specifically, the optimum is \( b^D = 0 \) if \( E\gamma > \gamma^* \) and \( b^D \geq \bar{b}_{\text{prohib}} \) if \( E\gamma < \gamma^* \)). (ii) If the support of \( \gamma \) is sufficiently large (on both sides of \( \gamma^* \)), the optimum is a liability rule, and in particular the optimal \( b^D \) satisfies \( 0 < b^D < \gamma^* < \bar{b}_{\text{prohib}} \).

As Proposition 2 reflects, the introduction of renegotiation leads to sharper predictions about the optimal rules, despite the fact that the trade-offs involved become more subtle. In particular, when renegotiation is possible, with sufficiently large uncertainty a liability rule dominates both the prohibitive property rule and the discretionary property rule, whereas in the absence of renegotiation we have shown that the discretionary property rule can be optimal even when uncertainty is large. And as we have explained, the reasoning behind the sharper result is surprising: in the large uncertainty case it is the savings in transfer costs that comes with a small increase in \( b^D \) above zero which accounts for the fact that a liability rule dominates the discretionary property rule in the presence of renegotiation, while the policy allocation remains unaffected by this adjustment in \( b^D \).
We have used the support of $\gamma$ as a measure of ex-ante uncertainty. If uncertainty about $\gamma$ is small in the sense of small variance but with a large support, then the optimum will not be exactly a property rule, but the result will hold in an approximate sense, so the qualitative insight goes through. We note as well that the support of $\gamma$ need only shrink relative to $\gamma^*$, not in absolute size.

Proposition 2 states that a liability rule is optimal if uncertainty about $\gamma$ is sufficiently large, but in this case the optimal level of $b^D$ is lower than the level that makes the exporter “whole,” i.e. $\gamma^*$.\textsuperscript{27} This result qualifies the argument often made in the law-and-economics literature that the efficient level of damages makes the injured party whole; and this qualification arises even under the conditions that are most favorable to this argument, namely that $\gamma^*$ is verifiable. The source of this qualification comes from our assumption of costly transfers, and so it applies with particular force to international trade agreements. Specifically, in the context of the WTO, compensation often takes the form of counter-retaliation by the injured party, hence it entails inefficiencies, and therefore from an ex-ante perspective it should not be utilized to an extent that makes the injured party whole. This qualification gains special relevance in light of the emphasis placed on reciprocity in the GATT/WTO system of remedies: it is sometimes suggested that reciprocity falls short as a mechanism for inducing efficient outcomes because it does not make the injured party whole (see Charnovitz, 2002, Lawrence, 2003 and Pauwelyn, 2008), but Proposition 2 suggests that this may in fact be a desirable feature of reciprocity.

Moreover, as Proposition 2 indicates, if uncertainty about $\gamma$ is sufficiently small, any liability rule is suboptimal (let alone the specific liability rule with $b^D = \gamma^*$), and instead the optimum is a property rule. This suggests an empirical prediction: we should tend to observe more liability rules for issue areas where uncertainty about the joint economic/political benefits of free trade is larger; and conversely, the use of property rules should be more frequent for issue areas where this uncertainty is smaller.\textsuperscript{28}

We next highlight two interesting predictions of our model that derive from the underlying pattern of equilibrium renegotiation. One relates to a surprising feature of optimal property

\textsuperscript{27} A similar result has been shown by Beshkar (2010b).

\textsuperscript{28} Whether or not this empirical prediction is consistent with the observed trade agreements is an open question, but there is little doubt that the degree of uncertainty was a key consideration in the discussions of GATT trade negotiators on the potential benefits of liability rules. As Pauwelyn (2008, p. 137) writes: “...trade negotiators cannot foresee all possible situations, nor can they predict future economic and political developments, both at home and internationally. As a result of this uncertainty, they wanted the flexibility of a liability rule.” This kind of consideration seems broadly in line with the message of our Proposition 2.
rules, while the other relates to the role of bargaining powers for the optimal choice of contract.

First, when a property rule is optimal, it is never renegotiated, and it therefore entails no equilibrium transfers. This can be seen as follows. Consider a prohibitive property rule \((b^D \geq b^{prohib})\). By definition, this entails a \(b^D\) high enough that for all \(\gamma\) in the support the importer’s threat point is \(FT\) (or \(S(b^D) > \gamma\)); but we know from Proposition 1 that under an optimal contract there can never be renegotiation from \(FT\) to \(P\), hence when a prohibitive property rule is optimal it is never renegotiated. Now consider a discretionary property rule \((b^D = 0)\). We have established previously that a necessary condition for this to be optimal is that when \(b^D = 0\) there is no renegotiation for any \(\gamma\) (or \(R(0) < \gamma\)). Our claim then follows immediately. We record this in

**Proposition 3.** When a property rule is optimal, it is never renegotiated, and therefore entails no equilibrium transfers.

Intuition might have suggested that the possibility of renegotiation should enhance the performance of property rules, because it insures the contracting parties against the intrinsic rigidity of such rules. Proposition 3 however tells us that this intuition is not really correct. The possibility of renegotiation can enhance the performance of a property rule only if such a rule is suboptimal. If a property rule if optimal, the possibility of renegotiation is immaterial.

In light of Proposition 3, it is relevant to observe that the frequency of renegotiation and compensation in the GATT/WTO has diminished through time.\(^{29}\) And as we mentioned in the Introduction, in the view of most legal scholars the GATT/WTO began as a liability-rule system but has developed over time into a system of property rules.\(^{30}\) Proposition 3 links these two observations, and suggests that the observed drop in the use of compensation might be a consequence of this shift in the GATT/WTO from liability to property rules. Finally, we have emphasized the implications of Proposition 3 for changes through time, but we note that Proposition 3 suggests an analogous cross-sectional prediction: there should be more renegotiation and compensation in issue areas regulated by liability rules.

\(^{29}\)This feature has been noted by, among others, Hoda (2001), Goldstein and Martin (2002), Pauwelyn (2008), and Pelc (2009). For example, Hoda (2001) notes that during the period 1995-1999 only eight tariff renegotiations took place, as opposed to fifty-six in the period 1980-89.

\(^{30}\)Representing this majority view, Jackson (1997, pp. 62-63), argues that the GATT/WTO has evolved from what was in effect a system of liability rules in the early GATT years to a system of property rules under the reforms introduced with the creation of the WTO and embodied in the DSB. On the dissenting view, see Hippler Bello (1996) and Schwartz and Sykes (2002), who view the changes in the DSB that were introduced with the creation of the WTO as serving instead to return the system to one based squarely on liability rules.
We turn now to the role of bargaining powers for the optimal choice of contract. We find that an increase in the importing government’s bargaining power $\sigma$ unambiguously favors property rules over liability rules. The reason is simple. As $\sigma$ rises, the expected transfer as a result of renegotiations goes up, because by Proposition 1 equilibrium renegotiations always entail a transfer from the exporter to the importer. Next recall that $\sigma$ has no impact on the equilibrium policy. These observations, combined with the result of Proposition 3 that there are no equilibrium renegotiations when property rules are optimal, lead to the following implication:

**Proposition 4.** As $\sigma$ rises, the optimum can switch from a liability rule to a property rule, but it cannot switch from a property rule to a liability rule.

It is interesting to observe that, according to our model, bargaining powers are irrelevant under an optimal property rule (because by Proposition 3 an optimal property rule is never renegotiated), while an importing government with low bargaining power (small $\sigma$) will receive a relatively low payoff under a liability rule. Hence our model indicates that, where significant power imbalances exist between countries, moving between a liability rule system and a property rule system will not be distributionally neutral, suggesting in turn that developed and developing countries might naturally have differing preferences with regard to reforms that would move an institution in one direction or the other.\(^{31}\)

Finally, we examine how the possibility of renegotiation impacts the choice between property rules and liability rules. In our model, the possibility of renegotiation tends to favor liability rules over property rules. The key observation is again the finding in Proposition 3. When a property rule is optimal, it is never renegotiated, while as we have established above, when renegotiation occurs it increases joint surplus. Hence, the introduction of renegotiation can only increase the relative attractiveness of a liability rule, and therefore it can cause a switch from a property rule to a liability rule, but not vice-versa.\(^{32}\) We record this in

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\(^{31}\)In the case of the GATT/WTO, one might expect based on our results that developing countries would take a skeptical view of reforms that had the impact of moving the system away from property rules and toward liability rules. This prediction is broadly in line with bargaining positions taken by member governments over proposed institutional reforms that would have elevated the role of compensation as a “buy out” of one’s obligations in the GATT/WTO (see, for example, the discussion in Pelc, 2009, and the references cited therein, as well as the complementary discussion in Pauwelyn, 2008, pp. 90-93).

\(^{32}\)It is easily established that the switch from a property rule to a liability rule can indeed occur. Consider for example a case where uncertainty is large but without renegotiation a discretionary property rule is optimal, along the lines described in section 3. In this large uncertainty case, a liability rule must become optimal once the possibility of renegotiation is introduced, as indicated by Proposition 2.
Proposition 5. As the possibility of renegotiation is introduced, the optimum may switch from a property rule to a liability rule, but not vice-versa.

Proposition 5 highlights how introducing renegotiation impacts the optimal contract. But it actually serves a second purpose as well: if the case where renegotiation is not feasible is viewed as capturing an extreme form of frictions in ex-post negotiations, then Proposition 5 can help illuminate the impact of this type of transaction cost, which is distinct from the transaction cost that we have focused on more directly – the cost of transfers. Viewed from this perspective, Proposition 5 suggests that property rules are more likely to be optimal when there are frictions in ex-post negotiations.

It is interesting to observe that, if transfers were costless, the introduction of frictions in ex-post negotiations would have the opposite effect, that is, it would favor liability rules.33 This suggests that these different forms of transaction costs interact in nontrivial ways, and it points to the importance of accounting for transfer costs when evaluating the effects of bargaining frictions. It also explains why our result is at odds with the conclusion of the law-and-economics literature, namely, that bargaining frictions favor liability rules over property rules (Calabresi and Melamed, 1972, Kaplow and Shavell, 1996).34 Relative to that literature, our novel finding arises because we focus on a world with costly transfers, which as we have indicated are an important transaction cost in the international government-to-government setting.

Notice finally that Propositions 3 and 5 taken together suggest a kind of complementarity between liability rules and renegotiation when transfers are costly. In this environment, the possibility of renegotiation makes liability rules more attractive, and the adoption of liability rules makes renegotiation more likely in equilibrium.

5. A More General Class of Contracts

Thus far we have considered a family of menu contracts that, as we have observed, admits a natural partition into contracts that operate as liability rules and contracts that operate as

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33To see this, suppose that transfers are costless (i.e., \( c(b) = 0 \)). In this case, with frictionless ex-post bargaining, liability rules are equivalent to property rules, because the first best is achieved in all cases; while if ex-post bargaining is not feasible, it is easy to show that the unique optimum is a liability rule with \( b^D = \gamma^* \) (i.e. the exporter must be made “whole”). Hence, if transfers are costless, removing the possibility of ex-post bargaining tends to favor liability rules, in contrast with the case of costly transfers.

34It is this conclusion, applied to the GATT/WTO context, that leads Pauwelyn (2008, p. 66) to the following statement: “On balance, one can therefore expect that Calabresi and Melamed’s third reason for liability rules (high transaction costs) can find particular application in the international context.”
property rules. While a property rule amounts to granting the right of \( P \) to the importer (when damages are set to zero) or the right of \( FT \) to the exporter (when damages are set at a prohibitive level), a liability rule can be thought of as introducing a “stick” \( b^D \) attached to the choice of \( P \) (when \( b^D \) is strictly positive but set at a non-prohibitive level).

We now ask whether it is desirable in the presence of a liability rule to introduce as well a “carrot” \( b^{FT} \) attached to the choice of \( FT \). We accomplish this by considering a more general class of menu contracts of the type \( \{(P, b^D), (FT, b^{FT})\} \), where in principle \( b^D \) and \( b^{FT} \) could be positive or negative. Notice that there is no role for a carrot in a property rule, because by definition a property rule simply assigns property rights without specifying any ex-post transfers. But the introduction of a carrot might be optimal as a complement to a stick/liability rule. And if it is optimal, the question then arises whether a property rule can still be optimal when a carrot is available for use with a liability rule.

We find that the performance of a liability rule can always be enhanced by the use of an appropriately chosen carrot \( b^{FT} < 0 \). The reason for this can be understood as follows. Under a liability rule, there will be some states of the world (some \( \gamma \)'s) where the importer would be willing to select \( FT \) for a very small transfer from the exporter, but the importer can exploit its bargaining power (i.e., \( \sigma > 0 \)) to extract a sizable transfer \( b^e \) from the exporter in order to be induced away from the threat point \( (P, b^D) \) to a policy of \( FT \). Introducing a small carrot \( b^{FT} < 0 \) for \( FT \) flips the importer’s threat point for these \( \gamma \)'s from \( (P, b^D) \) to \( (FT, b^{FT}) \) and thereby undercuts the ability of the importer to hold out for a bigger transfer from the exporter, ensuring that for these \( \gamma \)'s the importer will then select \( FT \) and be paid the contractually specified \( b^{FT} \). And from the point of view of ex-ante efficiency, the elimination of large transfers \( (b^e) \) that would have to be paid in a few states of the world is worth the addition of a very small transfer \( (b^{FT}) \) to be paid in (possibly) many states of the world. The upshot, then, is that introducing a small carrot for “good behavior” can be helpful in the presence of a liability rule, even when that carrot is a costly/inefficient means of transferring surplus between governments, because the presence of a small carrot can destroy the ability of the importer to hold out for a big carrot for good behavior (which would be even more costly/inefficient) in some states of the world.

As noted above, this raises a second question: Can a property rule still be optimal when a carrot is available for use with a liability rule? Here we find that the answer is “Yes,” and in particular that the availability of a carrot for use with a liability rule does not alter our previous
finding that a property rule (liability rule) is optimal if uncertainty is sufficiently small (large).

The following proposition (proved in the Appendix) summarizes the discussion thus far:

**Proposition 6.** Consider menu contracts of the type \(\{(P, b^D), (FT, b^{FT})\}\): (i) If the support of \(\gamma\) is sufficiently small, a property rule is optimal; (ii) If the support of \(\gamma\) is sufficiently large (on both sides of \(\gamma^*\)), it is optimal to use a carrot \((b^{FT} < 0)\) together with a liability rule/stick \((b^D > 0)\), and in particular the optimal \(b^D\) satisfies \(0 < b^D < \gamma^* < \tilde{b}_{prohib}\).

Notice that if a liability rule is not optimal in the restricted class of menu contracts that we considered in previous sections, it might become optimal in the more general class considered here, because the use of a carrot can enhance the value of a stick/liability rule as we have observed. What Proposition 6 shows is that, while the quantitative thresholds will therefore change, it is nevertheless true that the qualitative findings reported in Proposition 2 extend to this more general class of contracts.

We have focused above on establishing that Proposition 2 extends to the more general class of contracts considered here, but it is straightforward to check that each of our other Propositions extend to this setting as well.\(^{35}\) In particular, Proposition 1 extends with modification only in the critical levels of \(b^D\) and \(\gamma\), while Propositions 3-5 extend without modification.

It is interesting to consider whether the kind of carrot mechanism described in Proposition 6 is observed in actual trade agreements such as the WTO. On the one hand, when a government agrees to reduce its tariffs as a result of a trade negotiation, it typically considers this to be a concession that is only valuable to it in exchange for similar concessions from other governments. So it is clearly the norm for a government to receive some form of compensation from other governments when it agrees to a policy of free trade. According to this observation, the findings recorded in Proposition 6 could potentially be interpreted as suggesting a novel role played by the compensations for trade liberalization that we observe. But when interpreting the carrot \(b^{FT}\), it must be remembered that this is an ex-post transfer, which is contractually specified to be executed after the state of the world \(\gamma\) has been observed as an additional (ex post) reward for contract performance. When put this way, it is less clear that the “carrot” device represented in Proposition 6 can be found in existing trade agreements.

\(^{35}\)Lemma 2 also extends to this setting. In fact, the only result from earlier sections that does not extend to the more general class of contracts considered here is Lemma 1: when a carrot is available, renegotiation does not limit the range of allocations that can be implemented.
Finally, we close our discussion of this more general class of contracts by emphasizing that, while it is optimal under some circumstances to include a carrot $b^F_T$ in the contract, its inclusion does not alter in any substantive way our results from the previous section, and indeed as we have observed, all of our Propositions extend to this setting as well.

6. Conclusion

We have characterized the optimal design of trade agreements in a model where governments can renegotiate the agreement ex-post subject to a key transaction cost, namely that compensation between governments is inefficient. We have argued that these two features, renegotiation and inefficient government-to-government transfers, figure prominently in the GATT/WTO and other trade agreements. Our model delivers predictions concerning the optimal form of the agreement, the conditions under which the agreement will be renegotiated in equilibrium, and the form that such renegotiation will take. A key question on which we have focused is whether the agreement should be structured as a system of “property rules” or “liability rules.” In this respect our paper forges a link between the theory of trade agreements and the law-and-economics theory of optimal legal rules. We have shown that answers to this question diverge from those provided by the law and economics literature once the inefficiency of transfers is introduced, indicating that the inefficiency of government-to-government transfers distinguishes the trade-agreement setting from domestic legal environments in important ways.

To preserve tractability and focus on the main points, we have made a number of strong assumptions. For example, as we mentioned earlier, one important limitation of a liability-rule approach from which our model abstracts and which is often emphasized in the informal law-and-economics literature is that a liability rule requires verifiability of the harm inflicted by a country’s trade policy on its trading partner(s), and in practice this can often be difficult to come by. In ongoing work, we allow that the level of harm is not perfectly verifiable, and the DSB (if invoked) can observe a noisy signal of this harm. We find that, in itself, imperfect verifiability of the level of harm makes liability rules relatively less attractive, which is not surprising. But an advantage of studying this noisy-verification setting is that it can generate positive predictions regarding the propensity of governments to settle early versus “going to court” (i.e., invoking the DSB to generate a noisy signal and issue a ruling), and more generally regarding the outcome of trade disputes.

We have also assumed that neither government possesses private information, an assumption
that has helped to bring the distinctive features of our analysis into sharp relief. As a general matter, allowing for private information would introduce an additional transaction cost in the form of a bargaining friction; unlike the transfer costs that we have emphasized, such bargaining frictions are not specific to the international setting which is our focus, but they are surely important in real-world trade agreements. A bargaining friction of more specific interest is the “hold-out” problem that could arise for the government of an importing country when there are many exporting governments that hold an entitlement to its markets and have private valuations. These considerations may be particularly relevant for the GATT/WTO in light of its nondiscrimination rules, and Schwartz and Sykes (2002) and Pauwelyn (2008, pp. 56-59) apply results from the law-and-economics literature to argue that the transaction costs associated with this hold-out problem weigh in favor of a liability-rule interpretation of GATT/WTO commitments. As we have emphasized, however, in the presence of costly transfers it is property rules rather than liability rules that are more likely to be optimal when bargaining frictions are high, and this suggests that these considerations might weigh in favor of a property-rule interpretation of GATT/WTO commitments once the cost of transfers is acknowledged. Of course, a formal analysis of this issue within our framework would require extending the model to a multi-country setting where the nondiscrimination rules could be meaningfully introduced. This is an important extension that we leave for future work.

As we have discussed, our assumption of a binary policy choice buys us tractability and captures many trade-related policies that are discrete in practice, but extending our analysis to the case of continuous policies is a logical next step. In the absence of renegotiation this extension is straightforward, but with renegotiation this extension becomes non-trivial.

And finally, we have assumed that contracts between governments can be perfectly enforced. While we have already noted that enforcement issues are logically distinct from our main focus here (see note 3), this is nevertheless a strong assumption, since in reality trade agreements must be self-enforcing;\(^\text{36}\) and it leaves unanswered subtle questions about the interplay between the nature of enforcement mechanisms on the one hand and the nature of legal rules (liability or property rules) on the other (see Pauwelyn, 2008, pp. 148-197 for a discussion of some of these questions from a legal perspective). We leave these questions as well to future work.

\(^{36}\)For papers that model the self-enforcing nature of trade agreements, see for example Bagwell and Staiger (1990), Maggi (1999) and Ederington (2001) in addition to those cited in note 10.
7. Appendix

Proof of Proposition 6

In this extended family of contracts, we can think of a pair \((b^D, b^{FT})\) as representing a contract. For each contract and state of the world, \((b^D, b^{FT}; \gamma)\), there will be one of four possible equilibrium outcomes: (i) the importer chooses \(P\) without renegotiating; (ii) the importer’s threat point is \(P\) but the governments renegotiate to policy \(FT\); (iii) the importer chooses \(FT\) without renegotiating; (iv) the importer’s threat point is \(FT\) but the governments renegotiate to policy \(P\). The first step of the analysis is to characterize the mapping from \((b^D, b^{FT}; \gamma)\) to these four possible outcomes. One way to proceed is to build on the graphical apparatus of Figure 1: we continue working within the \((b^D, \gamma)\) space and think of \(b^{FT}\) as a parameter that shifts the key curves in this space.

As we will show later, it can never be optimal to set \(b^{FT} > 0\) or \(b^D < 0\). Since proving this claim involves a tedious and taxonomic argument, we postpone this argument to a later part of this proof, and here we focus on the intuitive case where \(b^{FT} \leq 0\) and \(b^D \geq 0\).

Let us start by characterizing the locus of points where the importer is indifferent between the two threat points \((P\) and \(FT)\), for a given \(b^{FT}\). Clearly, the importer is indifferent between the two threat points when \(\gamma = S(b^D) - S(b^{FT})\). This threat-point-indifference curve is depicted in Figure 3. Note that introducing \(b^{FT} < 0\) in the contract shifts the threat-point-indifference curve upwards relative to Figure 1.

Next we ask: given \(b^{FT}\), what are the regions of the \((b^D, \gamma)\) space in which governments renegotiate the contract? Let us first derive the region in which the threat point is \(P\) but governments renegotiate toward \(FT\) (which we continue to label \(FT_R\)). It is immediate to verify that the threat point is \(P\) iff \(\gamma > S(b^D) - S(b^{FT})\), and that in this case governments will renegotiate to \(FT\) iff \(\gamma < S(b^D) - S(b^D - \gamma^*) = R(b^D)\). Notice that this latter condition is exactly the same as in the case of \(b^D\)-only contracts. Intuitively, conditional on the threat point being \(P\) the level of \(b^{FT}\) does not affect the outcome. The \(R(b^D)\) curve is depicted in Figure 3, and is the same as the \(R(b^D)\) curve in Figure 1. Thus, the region \(FT_R\) is the region above the \(\gamma = S(b^D) - S(b^{FT})\) curve and below the \(R(b^D)\) curve. Note for future reference that these curves intersect for \(b^D = \gamma^* + b^{FT}\), and note also that if \(b^{FT}\) is sufficiently large and negative the \(FT_R\) region will be empty. In Figure 3 we depict the case in which the \(FT_R\) region overlaps with the positive quadrant, which (as we show below) must be the case at an optimal contract.
We next characterize the region where the threat point is $FT$ but governments renegotiate toward $P$ (which we continue to label $P_R$). Clearly the threat point is $FT$ iff $\gamma < S(b^D) - S(b^{FT})$, and it is easy to show that in this case governments will renegotiate toward $P$ iff $\gamma < S(b^{FT} + \gamma^*) - S(b^{FT})$. It can be easily verified that $\gamma = S(b^{FT} + \gamma^*) - S(b^{FT})$ is just the horizontal line that goes through the point of intersection between the $\gamma = S(b^D) - S(b^{FT})$ curve and the $R(b^D)$ curve. The $P_R$ region is therefore the region that lies above this horizontal line and below the $\gamma = S(b^D) - S(b^{FT})$ curve, as depicted in Figure 3.

Having characterized the mapping from $(b^D, b^{FT}; \gamma)$ to the four possible outcomes, we can now turn to the characterization of the optimal contract.

We start by extending the result of Proposition 1, which is an intermediate step toward proving Proposition 6. We argue that it can never be strictly optimal to set $b^D > \gamma^* + b^{FT}$, and the optimal contract never induces renegotiation toward $P$, while it does induce renegotiation toward $FT$ for an intermediate range of $\gamma$.

We will suppose by contradiction that it is strictly optimal to set $b^D > \gamma^* + b^{FT}$ and will show that the initial contract can be (weakly) improved upon. We can write the expected joint surplus as

$$E\Omega(b^D, b^{FT})|_{b^D \geq \gamma^* + b^{FT}} = V(FT) + \int_{S(b^D) - S(b^{FT})}^{\infty} [\gamma - \gamma^* - c(b^D)]dH(\gamma)$$

$$+ \int_{S(b^{FT} + \gamma^*) - S(b^{FT})}^{S(b^{FT} + \gamma^*) - S(b^{FT})} [\gamma - \gamma^* - c(b^e(b^{FT}; \gamma))]dH(\gamma) - \int_0^{c(b^{FT})} c(b^{FT})dH(\gamma)$$

(7.1)

where (with a slight abuse of notation) $b^e(b^{FT}; \gamma)$ denotes the equilibrium transfer in region $P_R$; note that $b^e$ depends only on $b^{FT}$ and not on $b^D$. To understand this expression, refer to Figure 3 and notice that if $b^D > \gamma^* + b^{FT}$ there are three relevant intervals of $\gamma$: for $\gamma > S(b^D) - S(b^{FT})$, we are in region $P$ and the joint surplus is $V(FT) + \gamma - \gamma^* - c(b^D)$; for $S(b^{FT} + \gamma^*) - S(b^{FT}) < \gamma < S(b^D) - S(b^{FT})$, we are in region $P_R$ and the joint surplus is $V(FT) + \gamma - \gamma^* - c(b^e(b^{FT}; \gamma))$; and for $\gamma < S(b^{FT} + \gamma^*) - S(b^{FT})$ we are in region $FT$ and hence the joint surplus is $V(FT) - c(b^{FT})$.

We can now write down the partial derivatives of $E\Omega$:

$$\frac{\partial E\Omega}{\partial b^D} \bigg|_{b^D \geq \gamma^* + b^{FT}} = -c'(b^D)[1 - H(S(b^D) - S(b^{FT}))] + (1 + c'(b^D))[c(b^D) - c(b^e(\cdot))][h(S(b^D) - S(b^{FT}))]$$

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\[
\frac{\partial E\Omega}{\partial b^{FT}} \bigg|_{b^D \geq \gamma^* + b^{FT}} = -(1 + c'(b^{FT})) [c(b^D) - c(b^e(\cdot))] h(S(b^D) - S(b^{FT}))
\]

(7.2)

where we have used the fact that \( \Omega \) is continuous at the border between the P region and the PR region (i.e. at \( \gamma = S(b^{FT} + \gamma^*) - S(b^{FT}) \)).

We also note for future reference that, in analogy with the result of Lemma 2, one can show that \( b^e(b^{FT}; \gamma) \) is increasing in \( b^{FT} \); intuitively, a higher \( b^{FT} \) worsens the threat point for the importer and hence the importer gets a worse deal in the renegotiation. Finally, recall that in the PR region \( \gamma^* + b^{FT} < b^e < S^{-1}(\gamma + S(b^{FT})) \).

There are two cases to consider, depending on whether \( b^D > 0 \) or \( b^D = 0 \).

Suppose first that \( b^D > 0 \) at the initial contract. In this case we can improve over the initial contract by lowering \( b^D \) to \( \max\{0, \gamma^* + b^{FT}\} \). From expression 7.1 it is clear that this will increase \( E\Omega \), because it induces no change in the policy and (i) for states \( \gamma \) that lie above \( S(b^D) - S(b^{FT}) \) before and after the change, the transfer \( b^D \) is reduced, and (ii) for states \( \gamma \) that lie below \( S(b^D) - S(b^{FT}) \) before the change but above \( S(b^D) - S(b^{FT}) \) after the change, the transfer goes from \( b^e \) to \( b^D \), which is an improvement since \( b^e > \gamma^* + b^{FT} \).

Next suppose \( b^D = 0 \) at the initial contract. In this case the initial contract can be dominated by increasing \( b^{FT} \) slightly toward zero. To see this, notice that (i) since we have supposed that \( b^D \geq \gamma^* + b^{FT} \), we have \( b^{FT} < 0 \) and hence \( c'(b^{FT}) < 0 \); and (ii) given \( b^D = 0 \), in region PR we have \( \gamma < -S(b^{FT}) \), and hence \( b^e < S^{-1}(\gamma + S(b^{FT})) < 0 \), and recalling that \( b^e \) is increasing in \( b^{FT} \), this in turn implies \( \frac{dc(b^{FT}; \gamma)}{db^{FT}} < 0 \). These two observations together imply that \( \frac{\partial E\Omega}{\partial b^{FT}} \bigg|_{b^D \geq \gamma^* + b^{FT}} > 0 \) when evaluated at \( b^D = 0 \).

To summarize, we have just shown that the result of Proposition 1 extends to this more general class of contracts, in the sense that we can focus without loss of generality on contracts with \( b^D < \gamma^* + b^{FT} \), and the optimal contract never induces renegotiation toward \( P \), while it does induce renegotiation toward \( FT \) for an intermediate range of \( \gamma \).

We can now turn to proving the claims made in Proposition 6. It is convenient to start with the case of large uncertainty (Proposition 6(ii)).

Large uncertainty.
For our purposes it suffices to focus on the case of full support, i.e. $\gamma \in (0, \infty)$. Recall that we are focusing on the case where $b_D \geq 0$ and $b_{FT} \leq 0$ (we show later that it can never be optimal to set $b_D < 0$ or $b_{FT} > 0$).

Let $b_D$ denote the optimal value of $b_D$ conditional on $b_{FT} = 0$. Given our results above and our focus on $b_D \geq 0$, it follows that $0 \leq b_D \leq \gamma^*$. We now argue that, starting from $(b_{FT} = 0, b_D = \tilde{b}_D)$, we can raise expected joint surplus by making $b_{FT}$ slightly negative. Decreasing $b_{FT}$ slightly has no impact on the policy allocation, but it has two effects on the expected equilibrium transfer. First, for $\gamma < S(b_D)$ there is now a small transfer $b_{FT}$, which introduces a cost, but this is a second order cost since $c(0) = 0$. Second, for $\gamma$ just above $\gamma = S(b_D)$ the threat point switches from $P$ to $FT$, so for these states, before the change governments renegotiate toward $FT$ and the equilibrium transfer is nonnegligible, and after the change the importer chooses $FT$ without renegotiating and the transfer is negligible (because $b_{FT}$ is close to zero); this is a first-order beneficial effect. Note that, within the renegotiation region $FT_R$, decreasing $b_{FT}$ has no impact on the threat point, hence it does not affect the equilibrium transfer.

To see this more formally, let us write down the expected joint surplus as a function of $b_D$ and $b_{FT}$. As we argued above we can focus on the case $b_D \leq \gamma^* + b_{FT}$. We can then write the expected joint surplus as

$$E\Omega(b_D, b_{FT})|_{b_D \leq \gamma^* + b_{FT}} = V(FT) + \int_{R(b_D)}^{\infty} [\gamma - \gamma^* - c(b_D)]dH(\gamma)$$

$$- \int_{S(b_D)-S(b_{FT})} c(\mathcal{E}(b_D; \gamma))dH(\gamma) - \int_{0}^{S(b_D)-S(b_{FT})} c(b_{FT})dH(\gamma)$$

Differentiating this expression with respect to $b_{FT}$ and evaluating at $(b_{FT} = 0, b_D = \tilde{b}_D)$ we obtain

$$\frac{\partial E\Omega}{\partial b_{FT}}|_{(b_{FT} = 0, b_D = \tilde{b}_D)} = -h(S(\tilde{b}_D))c(\mathcal{E}(\tilde{b}_D; S(\tilde{b}_D))) < 0$$

where we have used the facts that $S(b_{FT}) = b_{FT} + c(b_{FT})$ and $c(0) = c'(0) = 0$; it can easily be shown that $\mathcal{E}(\tilde{b}_D; S(\tilde{b}_D)) \neq 0$; and recall that we are assuming a large enough support of $\gamma$, hence $h(S(\tilde{b}_D)) > 0$. We can conclude that, when the support of $\gamma$ is large enough, $b_{FT} = 0$ cannot be optimal, and coupled with the fact that the optimal $b_{FT}$ cannot be positive (as we next argue), this implies that the optimal $b_{FT}$ is strictly negative.
We now rule out the possibility that $b^D = 0$ at an optimal contract. Given our results above, the only case we need to rule out is $b^D = 0 \leq \gamma^* + b^{FT}$. Letting $\tilde{b}^{FT}$ denote the optimal value of $b^{FT}$ conditional on $b^D = 0$, we can write

$$\frac{\partial E\Omega}{\partial b^D} \bigg|_{(b^D=0,b^{FT}=\tilde{b}^{FT})} = - \int_{-S(\tilde{b}^{FT})}^{R(0)} \frac{dc(b^D;\gamma)}{db^D} dH(\gamma) + h(-S(\tilde{b}^{FT}))[c(b^D(0); -S(\tilde{b}^{FT})) - c(\tilde{b}^{FT})]$$

In this case it is immediate to establish that in the FT$_R$ region $b^e \leq S^{-1}(\gamma) < 0$. It follows that at the lower border of the FT$_R$ region, where $\gamma = -S(\tilde{b}^{FT})$, it must be $b^e \leq \tilde{b}^{FT} \leq 0$. This implies $c(b^e(0); -S(\tilde{b}^{FT})) \geq c(\tilde{b}^{FT})$, so the second term of the expression above is nonnegative. Also recall that $\frac{\partial E\Omega}{\partial b^{FT}} > 0$, hence $\frac{dc(b^D;\gamma)}{db^D} < 0$. We can conclude that $\frac{\partial E\Omega}{\partial b^{FT}} \big|_{(b^D=0,b^{FT}=\tilde{b}^{FT})} > 0$, and hence $b^D = 0$ cannot be optimal. This, together with the fact that the optimal $b^D$ cannot be negative (as we argue below), implies that the optimal $b^D$ is strictly positive.

We now return to our earlier claim that it cannot be optimal to set $b^D < 0$ or $b^{FT} > 0$ (recall that we just ruled out the possibilities $b^D = 0$ and $b^{FT} = 0$, so we can focus on strict inequalities). To establish this claim, we need to rule out several possibilities:

(a) $b^D < 0$ and $b^{FT} < 0$. We need to distinguish two subcases:

(a$_i$) $b^D \geq \gamma^* + b^{FT}$. In this case it is easy to show that the equilibrium transfer $b^e$ in the renegotiation region (P$_R$) is negative. Our strategy to improve on the initial contract depends on whether $b^D$ is higher or lower than $b^e$ at the initial contract. If $b^D < b^e$, we can improve on the initial contract by increasing $b^D$ slightly; to see this, refer to expression 7.1 and note that in this case $c(b^D) > c(b^e)$ and $c'(b^D) < 0$, therefore $\frac{\partial E\Omega}{\partial b^{FT}} \big|_{b^D \geq \gamma^* + b^{FT}} > 0$. If $b^D > b^e$, then we can improve on the initial contract by increasing $b^{FT}$ slightly, because $\frac{\partial E\Omega}{\partial b^{FT}} \big|_{b^D \geq \gamma^* + b^{FT}} > 0$; to see this, note that in this case $c(b^D) - c(b^e) < 0$, $c'(b^{FT}) < 0$ and $\frac{dc(b^D;\gamma)}{db^{FT}} < 0$ (and recall the assumption that $1 + c'(\cdot) > 0$ for any transfer level).

(a$_{ii}$) $b^D < \gamma^* + b^{FT}$. Also in this case the equilibrium transfer $b^e$ in the renegotiation region (FT$_R$) is negative. Our strategy to improve on the initial contract depends on whether $b^{FT}$ is higher or lower than $b^e$ in absolute level. If $|b^e| > |b^{FT}|$, we can improve on the initial contract by increasing $b^D$ slightly toward zero. This has three first-order beneficial effects: (i) it reduces the transfer (in absolute value) for states $\gamma > R(b^D)$, where the importer chooses $P$ without renegotiating; (ii) it improves the threat point for the importer in the FT$_R$ region and hence it makes $b^e$ less negative; (iii) for states just above $\gamma = S(b^D) - S(b^{FT})$, before the change governments renegotiate toward $FT$ and after the change the importer chooses $FT$ without
renegotiating, thus the equilibrium transfer switches from \( b^e \) to \( b^{FT} \); since we are focusing on the case \(|b^e| > |b^{FT}|\), also this effect is beneficial.

If \(|b^e| < |b^{FT}|\), on the other hand, we can improve on the initial contract by increasing \( b^{FT} \) slightly toward zero. This has two beneficial first-order effects: (i) it reduces the transfer (in absolute value) for states \( \gamma < S(b^D) - S(b^{FT}) \), where the importer chooses \( FT \) without renegotiating, and (ii) for states just above \( \gamma = S(b^D) - S(b^{FT}) \), the equilibrium transfer switches from \( b^{FT} \) to \( b^e \); since we are focusing on the case \(|b^e| < |b^{FT}|\), this effect is beneficial.

(b) \( b^D < 0 \) and \( b^{FT} > 0 \).

It can be easily shown that we can lower \( b^{FT} \) to zero, and in fact we can make it slightly negative, without affecting the policy allocation or the equilibrium transfer for any \( \gamma \). This takes us back to the previous case where \( b^D < 0 \) and \( b^{FT} < 0 \), which we already ruled out.

(c) \( b^D > 0 \) and \( b^{FT} > 0 \). Here our strategy to improve on the initial contract depends on whether \( b^D \) is higher or lower than \( \gamma^* \). If \( b^D < \gamma^* \), we can improve on the initial contract by increasing \( b^{FT} \) to zero. And if \( b^D < \gamma^* \), the initial contract can be improved upon by increasing both \( b^D \) and \( b^{FT} \) toward zero in such a way that \( S(b^D) - S(b^{FT}) \) is kept constant. We leave the proof of these claims to the reader.

Finally, the claim that an optimal contract entails \( b^D < \gamma^* \) follows from the fact that an optimal contract entails \( b^D < \gamma^* + b^{FT} \) and \( b^{FT} < 0 \).

Small uncertainty.

We can now turn to the case of small uncertainty (Proposition 6(i)).

The first observation is that a noncontingent allocation (where the same policy is chosen for all \( \gamma \) in the support) can be implemented at zero cost (i.e. with no transfers occurring in equilibrium) with a property rule. Thus, conditional on a noncontingent allocation being optimal, a property rule is optimal. We next show that if the support of \( \gamma \) is sufficiently small, a noncontingent allocation is indeed optimal.

Let the support of \( \gamma \) be given by \( (\gamma^* - \varepsilon, \gamma^* + \varepsilon) \); note that we are considering a symmetric support, but the argument is easily extended to the case of an asymmetric support. Consider a contingent allocation with threshold \( \hat{\gamma}_\varepsilon \in (\gamma^* - \varepsilon, \gamma^* + \varepsilon) \) (we use the subscript \( \varepsilon \) because we need to allow this allocation to vary as we drive \( \varepsilon \) to zero). We have shown above that at an optimum it must be the case that for \( \gamma = \hat{\gamma}_\varepsilon \) the importer is indifferent between choosing \( P \) without renegotiating and renegotiating toward \( FT \). In other words, it must be \( \hat{\gamma}_\varepsilon = R(b^D) = S(b^D) - S(b^D - \gamma^*) \). This implies that for states \( \gamma \) just above \( \hat{\gamma}_\varepsilon \) the importer will pay a transfer
That is close to \( R^{-1}(\hat{\gamma}_\varepsilon) \); clearly, this transfer does not become small as \( \varepsilon \) goes to zero. For states \( \gamma \) just below \( \hat{\gamma}_\varepsilon \) the governments will renegotiate and the equilibrium transfer may be lower, but this transfer is unrelated to \( \varepsilon \) and hence does not become small as the support shrinks.

Now consider replacing this contingent allocation with a noncontingent allocation where policy \( FT \) is chosen in all states (and no transfers are incurred). As \( \varepsilon \to 0 \) this noncontingent allocation must dominate, because it implies a non-negligible savings in transfer costs for each state \( \gamma \), while the associated loss in terms of policy efficiency is at most of magnitude \( \varepsilon \) for each state \( \gamma \). Note that this argument holds even if the threshold \( \hat{\gamma}_\varepsilon \) approaches one of the bounds of the support as \( \varepsilon \to 0 \). We have thus shown that if the support is sufficiently small, a noncontingent allocation must be optimal, and therefore a property rule is optimal. **QED**
References


Figure 1

\[ \gamma \]

\[ b^D \]

P

\[ S(b^D) \]

\[ R(b^D) \]

\[ FTR \]

\[ FT_R \]

\[ FT \]
Figure 3

(bD)-S(bFT)

S(bD)-S(bFT)

R(bD)

FT

P

P_R

R(bD)

FT_R

S(bD)-S(bFT)

\gamma^* + b^{FT}

0

\gamma

\gamma

b^D