

# THE ROLE OF DISPUTE SETTLEMENT PROCEDURES IN INTERNATIONAL TRADE AGREEMENTS \*

Giovanni Maggi

Yale University, NBER and CEPR

Robert W. Staiger

Stanford University and NBER

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## Abstract

While disputes are typically treated as synonymous with concerns about enforcement in economic models of trade agreements, in reality most WTO disputes seem to concern the interpretation of vague provisions, or instances where the agreement is silent. And some have suggested that the WTO's Dispute Settlement Body (DSB) could usefully grant exceptions to rigid contractual obligations. These activist DSB roles could help "complete" an incomplete contract. But how activist should the DSB be? And should DSB rulings set precedent? We address these questions by characterizing the optimal choice of contract form and DSB mandate under various contracting conditions.

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# 1. Introduction

Formal economic analysis of trade agreements typically treats disputes as synonymous with concerns about enforcement.<sup>1</sup> But at least in the World Trade Organization (WTO), observed disputes seem to be more about interpreting the agreement where it is vague and filling gaps in the agreement where it is silent than about enforcing clearly-stated obligations.<sup>2</sup> And it is sometimes suggested that the WTO's Dispute Settlement Body (DSB) might serve a useful purpose by granting exceptions to rigid contractual obligations. In each of these three cases, the *activist* role played by the DSB has the potential to “complete” various dimensions of an incomplete contract.

These distinctions are of more than passing interest: the dispute settlement system in the WTO – as well as in many of the major regional trade agreements – is still evolving, and there is on-going debate about the role that it should serve. How activist a role should the DSB play? And if the DSB is allowed to play an activist role, should it have authority to set precedent for future rulings? These questions have attracted considerable attention from scholars in international law, political science and economics, but the literature in this area is still largely informal in nature.

In this paper, we bring formal economic analysis to bear on the questions posed above. We evaluate the possible role that a DSB might play in helping to complete an incomplete contract, and characterize the optimal choice of contract form and DSB mandate under various contracting conditions. More specifically, we ask whether it is desirable to allow the DSB to *interpret* ambiguous obligations, to *fill gaps* in the agreement, or to *modify* rigid obligations; and we evaluate the implications of allowing the DSB to set *precedent* for future rulings.

A distinctive and novel feature of our approach is that it highlights the interaction between the design of the contract and the design of the DSB mandate, and it views these as two components of a single over-arching institutional design problem. The WTO DSB is a natural reference point for our analysis, and it serves as the lead example throughout the paper, but we emphasize that our analysis applies to trade agreements more generally.<sup>3</sup>

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<sup>1</sup>See for example Bagwell and Staiger (2002), Chapter 6, and the literature cited therein.

<sup>2</sup>The distinction between gaps and vagueness in a contract is often emphasized by legal scholars. For example, Jackson (2006, p. 184) describes the distinction in these terms: “In some cases, there are actual gaps in the treaty, in other words, the treaty is totally silent with regard to how it should apply in some circumstances. In other cases, there is treaty language that is applicable, but the treaty language is sufficiently ambiguous that it could reasonably be interpreted in several different ways.”

<sup>3</sup>For example, most preferential trade agreements have their own dispute settlement procedures, and our

We consider a two-country setting where governments design an institution (write a contract and define the role of the DSB) to maximize their ex-ante joint surplus, and subsequently the importing country selects a trade policy in a given industry and the exporting country can then file a complaint, in which case the DSB issues a ruling. The environment is uncertain and the efficient policy varies with the state of the world. We assume that the relevant contingencies are too costly to describe in a crisp way, and this can give rise to two forms of contractual incompleteness: *rigidity* and *discretion* (as in Battigalli and Maggi, 2002). We then introduce a contracting language which is vague in nature and gives rise to a third form of contractual incompleteness, which we label *vagueness*. Our analysis naturally pairs the three possible activist roles of the DSB described above with our three forms of contract incompleteness: the DSB can interpret vague provisions; it can fill gaps where the contract leaves discretion; and it can grant exceptions to rigid obligations. Or, the DSB can serve none of these functions and simply enforce clearly-stated obligations. Furthermore, for each of the activist roles, the DSB may or may not have precedent-setting authority. Finally, we assume that it is costly for both the complainant government and the defendant government to engage in a dispute, and this gives rise to non-trivial strategic interaction between them. Indeed, the performance of the various institutional arrangements depends crucially on how these arrangements affect the equilibrium occurrence of disputes.

As a first step of the analysis, we abstract from the issue of precedent and consider a static (one-period) setting. A key feature of our contracting environment is the accuracy of the DSB's information. We characterize the optimal institution as a function of the degree of DSB accuracy. When the DSB is sufficiently accurate, it is optimal to build discretion into the contract and provide the DSB with a mandate to fill the gaps. If the DSB is sufficiently inaccurate, it is optimal to write a contract that is either vague or rigid and to then bar the DSB from attempting to “complete” the contract. Finally, if the accuracy of the DSB falls in an intermediate range, it is optimal to write a vague contract and provide the DSB with a mandate to interpret the contract when disputes arise.

Interestingly, our analysis does not offer support for the “modification” role of the DSB: it is never optimal to allow the court to void obligations that are clearly stated in the agreement.

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analysis can help shed light on the role and design of these dispute procedures as well. We believe that our model can also be applied to dispute settlement mechanisms in international agreements and organizations more broadly, not just trade agreements. In the Conclusion, we comment briefly on the features of our model that might make it less-well suited for the analysis of domestic legal systems.

Also notable is our finding that, if the DSB is sufficiently accurate, the first-best outcome can be achieved even though the contract is highly incomplete, the use of the DSB is costly and the DSB rulings are imperfect. The reason is that the threat of invoking the DSB and the expectation of a sufficiently precise DSB ruling is sufficient to induce governments to act efficiently. Therefore, our model suggests that the imperfection in the DSB information does not necessarily impair the performance of the institution; the presence of an activist DSB can potentially generate dramatic efficiency gains in spite of its (inevitable) information limitations.

At the same time, our analysis offers a warning. We find that, if litigation costs are not too high, the equilibrium policy tends to be efficient when the DSB is *not* invoked in equilibrium. Moreover, we find that equilibrium disputes are more frequent when the DSB is *less* accurate. Thus, in effect the motives that trigger a DSB filing are inefficient, and the efficiency-enhancing effect of the DSB is associated with its *off-equilibrium* impacts. This is because, anticipating the possibility of error by the DSB, governments are tempted to game the system within the leeway offered by the incompleteness of the contract: the importer is tempted to protect when it should not, hoping to get away with it; and the exporter is tempted to force free trade by filing a dispute when it should not. One implication of these findings is that the intensity of DSB use is not a reliable indicator of the performance of the institution.

Our model can also shed light on the issue of “bias” in observed DSB rulings: both under the GATT and the WTO, complainants have mostly won their cases. What accounts for this observed pro-trade bias? Our model suggests that this can be the result of a selection bias in the filing of disputes, and in particular this occurs when the costs of dispute fall sufficiently on the exporter relative to the importer. We also address a related question: When DSB rulings exhibit a pro-trade bias, does the equilibrium *policy outcome* exhibit a pro-trade bias as well, in the sense that trade protection is under-utilized relative to the first-best outcome? Perhaps surprisingly, we find that there is an inverse relationship between the two biases: if there is a pro-trade bias in DSB rulings there tends to be an anti-trade bias in policy outcomes, and vice-versa.

We next extend the static model to a dynamic (two-period) setting to examine whether DSB rulings should set legal precedent for future rulings. There is a growing discussion in the legal literature as to whether and to what extent the actual WTO DSB operates on a precedent system.<sup>4</sup> Given that the role of precedent in the WTO is very much an open issue of

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<sup>4</sup>Jackson (2006, page 177) argues that “there is quite a powerful precedent effect in the jurisprudence of the

institutional design, it seems important to examine the implications of precedent from a formal perspective. We believe our framework is well-suited for this kind of analysis.

Our two-period model highlights a basic tradeoff concerning the effects of precedent. On one hand, precedent reduces the probability of second-period disputes by removing uncertainty about the rights and obligations that will apply should the same state of the world occur again, and this leads to beneficial savings in litigation costs. On the other hand, we find that precedent increases the frequency of first-period disputes and thereby leads to more waste in litigation costs and a less efficient policy selection (because the DSB is imperfectly informed); this effect of precedent is to our knowledge novel in the literature (as we discuss in section 3), and it *diminishes* the performance of the institution.

When we examine how the resolution of these opposing effects of precedent varies with key parameters of the model, we find two results. First, the introduction of precedent is more likely to enhance the performance of the institution when the accuracy of DSB rulings is lower. And second, precedent is more likely to be beneficial when governments discount the future more heavily. Interpreted broadly, this last result suggests that legal precedent should be *less* prominent in organizations where the relevant players are more likely to interact repeatedly in the legal system.

Our paper is related to Horn, Maggi and Staiger (2010), which also views trade agreements as incomplete contracts, but the two papers have a very different focus. In addition to the notion of vagueness which is novel to the present paper, the focus of the present paper is on the potential role of the courts in helping to complete the incomplete contract, a feature that is absent from Horn, Maggi and Staiger.<sup>5</sup>

A second related paper is Bustos (2007), who extends Battigalli and Maggi (2002) to include a notion of “vagueness.” There are two main differences between our paper and Bustos’: first, the way in which Bustos defines vagueness – a clause that demands “best effort” in performing the action – is very different from our concept of vagueness (which we believe permeates the

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WTO, but ... it is not so powerful as to require panels or the Appellate Body considering new cases to follow prior cases,” and concludes that “the ‘flavor’ of the precedent effect in the WTO is still somewhat fluid.” In a recent report (see WTO, 2008), the Appellate Body sought to clarify the role of precedent in the WTO with the following statement: “Ensuring ‘security and predictability’ in the dispute settlement system, as contemplated in Article 3.2 of the DSU, implies that, absent cogent reasons, an adjudicatory body will resolve the same legal question in the same way in a subsequent case.”

<sup>5</sup>An early attempt to formalize the potential role of the DSB for completing an incomplete agreement is the paper by Battigalli and Maggi (2003), who focus on issues of product standards. However, the structure adopted and the questions addressed in their paper are very different from our paper.

language used in trade agreements); and second, unlike our paper, Bustos is not concerned with the interplay between the form of contracts and the nature of the ex-post court activity, and indeed the court in Bustos' model plays only a contract-enforcement role.

In addition to the papers discussed above, there are several others that relate to various themes in our paper. In particular, a number of authors have begun to explore the interplay between the form of written contracts and the nature and degree of ex-post activities performed by the court. Shavell (2006) and Schwartz and Watson (2010), for example, emphasize how the possible methods of contract interpretation can affect the writing of contracts, and characterize the optimal method of interpretation. Anderlini, Felli and Postlewaite (2006, 2007) similarly analyze the role of active courts in contracting environments where the ex-ante contracts are incomplete, and characterize optimal court behavior (see also Fon and Parisi, 2007). These papers and our paper have a broadly similar focus, but the questions addressed and the formal modeling are quite distinct.

Finally, there is a large literature on the role of legal precedent, but this literature is mostly concerned with domestic court systems, rather than international agreements. We will review this literature in section 3.

The rest of the paper proceeds as follows. Section 2 presents our basic static model. Section 3 extends the model to a dynamic setting and considers the role of precedent. Section 4 concludes. An Appendix contains proofs not provided in the text.

## 2. The Basic Model

We consider a very simple partial-equilibrium setup to develop our points. We focus on a single industry in which an importing government chooses a binary import policy  $\tau \in \{FT, P\}$  (Free Trade or Protection) to maximize the payoff  $\omega(\tau; s)$ , where  $s \equiv (s_1, s_2, \dots, s_N)$  is a vector of state variables. Each state variable  $s_i$  represents a binary event, such as “there is/is not an import surge” or “the domestic industry does/does not shut down.” We will often refer to the random vector  $s$  simply as the “state.” We let  $p(s)$  denote the probability that state  $s$  occurs, and we let  $\Sigma$  denote the set of possible states. The exporting government is assumed to remain passive in this industry (i.e., there is no exporter policy), and its payoff is given by  $\omega^*(\tau; s)$ .

Let  $\gamma(s) \equiv \omega(P; s) - \omega(FT; s)$  denote the importing government's gain from protection. This gain may be thought of as arising from some combination of terms-of-trade and political

considerations. We assume that  $\gamma(s) > 0$  for all states  $s$ . Similarly, let  $\gamma^*(s) \equiv \omega^*(P; s) - \omega^*(FT; s)$ . We assume that  $\gamma^*(s) < 0$  for all  $s$ : the exporting government always dislikes import barriers. Finally, we assume that there cannot be transfers between governments at the ex-post stage (after the state  $s$  is realized).<sup>6</sup> For future reference, we define the “first-best” policy for a given state  $s$  as the policy that maximizes the governments’ joint payoff  $\Omega(\tau; s) \equiv \omega(\tau; s) + \omega^*(\tau; s)$ .

Let  $\Gamma(s) \equiv \gamma(s) + \gamma^*(s) = \Omega(P; s) - \Omega(FT; s)$  denote the joint (positive or negative) gain from protection for the two governments. We let  $\sigma^{FT}$  and  $\sigma^P$  denote the sets of states for which the first-best policy is respectively  $FT$  and  $P$ , or equivalently,  $\Gamma(s) \leq 0$  for  $s \in \sigma^{FT}$  and  $\Gamma(s) > 0$  for  $s \in \sigma^P$ . We assume that the realized state  $s$  is observed by the governments and by the DSB. On the other hand, we assume that  $\Gamma$  is observed by the governments but not by the DSB. That payoff levels are not verifiable is a standard assumption in contracting models; if  $\Gamma$  were verifiable, the first-best outcome could be trivially achieved with a contract that requires  $FT$  if and only if  $\Gamma < 0$ .

We next describe the language that is available to write a contract and the possible contracts that can be written. The first-best outcome could in principle be implemented by a contract that specifies in detail the contingencies  $\sigma^{FT}$  and  $\sigma^P$ , by describing precisely all the relevant state variables  $(s_1, s_2, \dots, s_N)$ , but such a contract would likely be very costly to write.<sup>7</sup> We focus instead on a *vague* language that provides an imprecise but inexpensive short-hand to describe the circumstances under which  $P$  is desirable. The language is vague in the sense that its meaning is partially defined.

Formally, we consider a sentence  $\nu$  with the following *truth function*:

$$\text{Sentence } \nu \text{ is } \begin{cases} \textit{True} & \text{if } s \in \mathbf{T} \\ \textit{False} & \text{if } s \in \mathbf{F} \\ \textit{Undefined} & \text{otherwise,} \end{cases}$$

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<sup>6</sup>In practice, direct transfers are rarely used in trade negotiations, but indirect transfers may be feasible (e.g., agreed-upon adjustments in intellectual property rights protection). We could allow for *ex-ante* transfers (i.e., transfers that occur at the stage of writing the contract), and need only rule out *ex-post* transfers (i.e., transfers that occur at the time of a dispute). The resolution of WTO disputes almost never involve direct transfers (the two exceptions to date are the US-Copyright case – see WTO, 2007, pp. 283-286 – and the Brazil-Cotton case – see Schnepf, 2010), and indirect transfers of the sort described above are typically not feasible in the context of dispute resolution. Nevertheless, a more realistic assumption might be that transfers can be enacted ex-post at some cost. For a model of trade agreements that allows for costly ex-post transfers see Maggi and Staiger (2009).

<sup>7</sup>See Dye (1985) and Battigalli and Maggi (2002) for two examples of models that formalize the costs of writing contracts.

where  $\mathbf{T}$  is a set of “extreme” states where sentence  $\nu$  is clearly true,  $\mathbf{F}$  is a set of states (disjoint from  $\mathbf{T}$ ) at the opposite extreme where  $\nu$  is clearly false; and the remaining states constitute a “grey area” where  $\nu$  is neither clearly true nor clearly false – in other words, in these states the meaning of  $\nu$  is ambiguous.<sup>8</sup>

We illustrate this formalism with a simple example. The vague sentence  $\nu$  could sound for example like “there is substantial injury to the domestic industry due to increased imports.” To exemplify the truth function of this sentence, suppose there are only three relevant state variables, with  $s_1 = 1$  ( $s_1 = 0$ ) indicating that there is (is not) an import surge,  $s_2 = 1$  ( $s_2 = 0$ ) that the domestic industry does (does not) shut down, and  $s_3 = 1$  ( $s_3 = 0$ ) that the majority of workers in the domestic industry are (are not) unemployed. Suppose also that the set  $\mathbf{T}$  includes only the state  $s = (1, 1, 1)$  and the set  $\mathbf{F}$  only includes the state  $s = (0, 0, 0)$ , while all other states fall in the “grey area.” Thus, in this example, sentence  $\nu$  is clearly true if there is an import surge, the domestic industry shuts down and the majority of workers in the industry are unemployed; sentence  $\nu$  is clearly false if none of these events has occurred; but in the remaining states it is not defined whether or not sentence  $\nu$  is true.

We assume that if  $\nu$  is clearly true then  $P$  is desirable, and if  $\nu$  is clearly false then  $FT$  is desirable, or more formally,  $\mathbf{T} \subset \sigma^P$  and  $\mathbf{F} \subset \sigma^{FT}$ . In our previous example, if it is clearly true that there is substantial injury (i.e. if  $s = (1, 1, 1)$ ) then  $P$  is desirable, while if there is clearly no substantial injury (i.e. if  $s = (0, 0, 0)$ ) then  $FT$  is desirable. We also assume that the truth function of sentence  $\nu$  is common knowledge to the governments and the DSB, so the governments anticipate perfectly what truth function the DSB will assign to  $\nu$ .

Our formalization of vagueness captures a key feature of many real-world contracts, namely, that “off-the-shelf” phrases (such as “substantial injury”) are commonly employed to convey the gist of contingencies. When it is very costly to describe precisely whether or not a certain action is allowed in each possible state of the world, the use of such phrases in a contract seems natural, even given the knowledge that with such phrases there will be some states of the world where it is a matter of interpretation whether or not the action is allowed.<sup>9</sup> What our model

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<sup>8</sup>The type of logic we are using here is known as three-valued (or “ternary”) logic, a simple form of multi-valued logic, which extends the classical propositional logic by allowing for more than two truth values. Ternary logic was first introduced by Łukasiewicz (1920). Notice also that we use the word “vague” to refer to a contract or sentence, while we use the word “ambiguous” when the contract/sentence has undefined meaning for a given state  $s$ .

<sup>9</sup>Notice that it could be very costly to achieve such partial state-contingency in a contract *directly* – rather than with the use of a vague sentence – by describing precisely what the “extreme” states are. Indeed, it is the use of an “off-the-shelf” language that gives vague sentences their possible appeal for inclusion in contracts, as



does not capture is the possibility of disagreement over the truth value of a vague sentence, which may also be an important consideration for real-world contracts. On balance, though, we view our formalization of vagueness as a useful starting point, and in our online Appendix we consider a richer model of language that allows for further possibilities in writing vague contracts.

The vague language can be used to write the *vague* ( $V$ ) contract: “ $P$  allowed if and only if  $\nu$ .” This contract specifies a crisp right to choose the trade policy in states  $s \in \mathbf{T}$ , it specifies a crisp obligation to practice free trade in states  $s \in \mathbf{F}$ , and it is ambiguous in all other states.<sup>10</sup>

In addition to the vague contract  $V$ , we also allow for a *rigid* contract ( $R$ ), which imposes  $FT$  in all states: “ $P$  never allowed.” And we allow for the empty contract ( $D$ ), which is silent in all states, thus leaving full *discretion* to the importing country.

Note that, under the feasible contracts, there are four possibilities for each state  $s$ : (1) the contract may impose a clear  $FT$  obligation, (2) it may assign a clear right to choose  $P$ , (3) it may be ambiguous, or (4) it may be silent (and therefore leave a gap).<sup>11</sup> Importantly, if the DSB only enforces crisp obligations, then the possibilities (2), (3) and (4) induce the same outcome, namely  $\tau = P$  (since in the absence of constraints the importer will always choose  $P$ ). But, as we describe more fully below, if the DSB has an activist role the three possibilities above may induce different outcomes.

We assume that the silent contract  $D$  is costless to write, while the non-silent contracts  $R$  and  $V$  entail a small writing cost. This seems like a reasonable assumption, since even the most basic of contract clauses needs to specify the policy ( $P$  or  $FT$ ), and so it is likely to cost *something* to write, whereas leaving a gap costs nothing. The role of this small cost will be essentially to break ties between contracts, and for this reason we do not introduce it explicitly in the notation, but will simply invoke it at the appropriate juncture of the analysis.

Notice that the  $R$  and  $D$  contracts represent in a stylized way two forms of contractual incompleteness that have been highlighted by the literature: rigidity and discretion (see for

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compared to describing precisely a list of state variables that apply to the particular situation at hand.

<sup>10</sup>One could consider alternative ways to utilize the vague sentence  $\nu$  in the contract. For example, the contract could specify just a necessary condition for  $FT$ , as in “If  $\neg\nu$  then  $FT$ ”; or it could *force* protection (e.g. “ $P$  if and only if  $\nu$ ”); but it is easy to see that these alternative contracts cannot improve on the contract  $V$  in our basic model.

<sup>11</sup>In our basic single-policy setting, a silent contract is the same as no contract at all, but in a richer setting with multiple policy instruments the contract could be silent on one policy but not on other policies (see also footnote 20). We discuss the extension to multiple policy instruments in our working paper (Maggi and Staiger, 2008).

example Battigalli and Maggi, 2002). The  $V$  contract, on the other hand, can be viewed as capturing a third form of contractual incompleteness, which we label simply *vagueness*.

We now discuss the potential roles played by the DSB. A first, basic, role is to oversee enforcement of the obligations that are specified unambiguously in the contract. To the extent that the DSB is able to ensure enforcement, this role is clearly desirable; we therefore take enforcement for granted and keep it in the background of the model. In particular, we assume that any crisp obligation is automatically enforced.<sup>12</sup> Our analysis will thus focus on whether and to what extent it is desirable for the DSB to go beyond a pure enforcement role.

Beyond the enforcement role, the DSB can play three potential roles: (1) Interpret obligations or rights that are ambiguous in the contract; (2) Fill gaps in the contract (that is, introduce obligations or rights that are not specified in the contract); and (3) Modify obligations or rights that are clearly stated in the contract.

It is important to be clear about our notion of “interpretation.” In principle one can distinguish between two levels of interpretation. A first level is the process by which the DSB reads and analyzes the text of the contract to deduce what the contract prescribes for the given state of the world (a crisp provision, an ambiguous provision, or silence). If the first level of interpretation determines that the contract is ambiguous, then the second (“higher”) level of interpretation may kick in: this is the process by which the DSB chooses a meaning for that state of the world. The distinction between these two levels of interpretation is important because, as we discuss below, it is the higher level of interpretation, not the lower level, that is at the center of ongoing debate concerning the role of the WTO DSB. In the richer model of vague language that we consider in the online Appendix, where multiple elementary vague sentences can be combined into composite sentences and the logical analysis of the text is non-trivial, these two levels of interpretation can be captured in a meaningful way. The basic model we develop in the present section captures the higher level of interpretation, but with its single vague sentence it is too simple to capture the first level of interpretation. Thus, when we speak of “interpretation,” we mean the higher level of interpretation just described.<sup>13</sup>

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<sup>12</sup>To be more precise, we are assuming that crisp obligations are automatically enforced unless the DSB has a modification mandate (to be introduced just below) and is invoked under this mandate. We could dispense with the automatic-enforcement assumption and assume instead that crisp obligations are enforced “on demand,” in which case compliance with these obligations would be ensured by the *threat* of invoking the DSB, provided litigation costs are not too high.

<sup>13</sup>One might wonder whether there is any real distinction between silence/gap-filling and vagueness/interpretation. First, from an ex-ante point of view, vagueness has different implications from silence, because a vague sentence does assign crisp rights/obligations in some states. This is true regardless of the role

We denote the interpretive, gap-filling and modification roles of the DSB with the labels  $i$ ,  $g$  and  $m$ , respectively. These three roles in effect entail DSB efforts to “complete” the ex-ante contract. We sometimes refer to a DSB with an  $i$ ,  $g$  or  $m$  mandate as an *activist* DSB, and to a DSB whose mandate is confined to the enforcement of crisp obligations as a *non-activist* DSB, denoted with the label  $n$ . Henceforth, when we make reference to a “dispute,” this always refers to one of the three activist DSB roles.

It is possible to envision a ranking among the DSB roles in terms of *degrees of DSB activism*. The pure enforcement role ( $n$ ) embodies the lowest degree of activism; the interpretation role ( $i$ ) can be thought of as an intermediate degree of DSB activism; and the modification ( $m$ ) and gap-filling ( $g$ ) roles can be thought of as embodying the highest degree of activism, since they give the DSB authority to add to or diminish the rights/obligations specified in the contract.

In this regard, the language of the WTO Agreement provides explicitly for some kind of an interpretive role for the DSB, while this language would seem to rule out the possibility that the DSB could serve a gap-filling or modification role. As Article 3, paragraph 2 of the WTO Understanding on Rules and Procedures Governing the Settlement of Disputes indicates: “The dispute settlement system of the WTO ... serves to preserve the rights and obligations of Members under the covered agreements, and to clarify the existing provisions of those agreements in accordance with customary rules of interpretation of public international law. Recommendations and rulings of the DSB cannot add to or diminish the rights and obligations provided in the covered agreements.”

Nevertheless, there is debate among legal scholars and policy makers on what the DSB mandate is exactly, and what it should be from a normative perspective. Some voices in this debate argue that the mandate of the DSB should be limited to an enforcement role and the “lower” level of interpretation defined above (see, for example, USTR, 2005); others argue that the DSB in practice engages in “higher-level” interpretation and gap-filling (see, for example, Goldstein and Steinberg, forthcoming); and there has been some discussion of the potential benefits of allowing the DSB to introduce exceptions to rigid contractual obligations

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of the DSB. And second, if one focuses on a given state  $s$ , there is a more subtle distinction between silence and vagueness. In our model we cannot have a contract that includes both ambiguity and silence, but in a richer multiple-policy setting where this is possible, these could have different implications if the DSB has a mandate to interpret but not to fill gaps (or vice-versa). In such a setting it might be a good idea, for example, to include vague clauses for policies where the DSB is likely to be accurate, leave silence over policies for which the DSB is likely to be uninformed, and allow the DSB to interpret but not fill gaps.

(see WTO, 2007a, pp. 279-281).<sup>14</sup> For these reasons we think it is important to evaluate the whole spectrum of possible DSB roles, from enforcement-only to gap-filling and modification, in addition to the interpretation role.

We next describe our assumptions regarding disputes. We assume that it is feasible for a government to invoke the DSB only when the DSB’s mandate is relevant, or more concretely, that it is feasible to invoke the DSB in state  $s$  only under the following circumstances: (a) the contract is silent in state  $s$  and the DSB has a gap-filling role; (b) the contract has undefined meaning in state  $s$  and the DSB has an interpretation role; or (c) the contract is crisp in state  $s$  and the DSB has a modification role. If invoked, we assume that the DSB operates in accordance with its mandate.<sup>15</sup>

Recall that the DSB is assumed to observe the realized state  $s$  but not the value of  $\Gamma$ ; thus, the DSB does not know what the “best” (joint-payoff-maximizing) policy is for the realized state  $s$ . We assume that, if invoked, the DSB observes a noisy signal of  $\Gamma$ , which can be interpreted as the outcome of an independent investigation. The DSB then issues a *ruling* – that is a policy determination  $\tau^{DSB}$ , which we assume to be automatically enforced – with the objective of maximizing the expected joint payoff of the governments given the signal.<sup>16</sup>

We let  $q(s)$  denote the probability that the DSB issues the “wrong” ruling in state  $s$ . We assume that  $q(s)$  is bounded above by  $1/2$ , that is, the DSB cannot do worse than a coin flip. We could model the probability of DSB error in a more “structural” way as resulting from a process of Bayesian updating, whereby the DSB uses the signal to update its prior beliefs on  $\Gamma$  and

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<sup>14</sup>We note as well that in domestic settings there exist several examples of courts playing a modification-type role. See Anderlini, Felli and Postlewaite (2006, 2007), who describe examples in which courts may void certain obligations in contracts.

<sup>15</sup>The assumption that the DSB operates according to its mandate is essential, but the assumption that it is feasible to invoke the DSB only when its mandate is relevant is just for simplicity. We could allow a government to invoke the DSB also when the DSB has no applicable activist mandate, but anticipating that the DSB will not over-step its mandate, the governments would not invoke it in equilibrium. For example, suppose the contract is silent and the DSB has no mandate to fill gaps; then if a government were to invoke the DSB, the DSB would simply dismiss the complaint, and so the government would have no incentive to file in the first place. Recall also that we have assumed that the enforcement of crisp obligations is automatic.

<sup>16</sup>Our assumption that the DSB seeks to maximize the governments’ joint payoff – and therefore attempts to complete the contract as the governments would have done *ex ante* – is broadly in line with the rules set out by the Vienna Convention (and adhered to by the WTO). In WTO (2005), the Appellate Body states: “We recall that Article 31(1) of the Vienna Convention stipulates that: ‘A treaty shall be interpreted in good faith in accordance with the ordinary meaning to be given to the terms of the treaty in their context and in the light of its object and purpose.’... Importantly, the ordinary meaning of a treaty term must be seen *in the light of the intention of the parties...*” (emphasis added). Even for domestic legal settings, Posner (2005, p.8) writes: “Gap filling and disambiguating are both ‘interpretive’ in the sense that they are efforts to determine how the parties would have resolved the issue that has arisen had they foreseen it when they negotiated their contract.”

then maximizes the expected joint surplus given the updated beliefs; but in the analysis that follows,  $q(s)$  is all that matters, so we keep the DSB’s updating process in the background.<sup>17</sup>

For the purposes of comparative-static analysis, we will consider equi-proportional changes in the precision of the DSB signal, letting  $q(s) \equiv q \cdot k(s)$ , where  $k(s) \in [0, 1/2]$  for all  $s$  and  $q \in [0, 1]$  is a parameter that captures (inversely) the overall quality of the DSB information. We will vary  $q$  while keeping  $k(s)$  fixed. The case  $q = 0$  corresponds to the case in which the DSB has perfect information.

Finally, we assume that disputes are costly. In particular, whenever the exporter (complainant) invokes the DSB, the exporter incurs cost  $c^* > 0$  and the importer (defendant) incurs cost  $c > 0$ . We have in mind the costs of litigation, which may reflect administrative costs, the costs of lawyers, the burden of proof, etc., but in the model we treat these costs as parameters.<sup>18</sup>

We start with a game that is essentially static. In the next section we consider a repeated version of this game, where the issue of precedent can be explored. But many of the main points are best illustrated in a static setting.

In what follows, we refer to a combination of contract and DSB mandate as an *institution*. We assume that the institution is designed to maximize the governments’ ex-ante joint payoff, and we will refer to such an institution as an “optimal” institution.<sup>19</sup>

We consider the following timing:

Stage 0. The institution is designed;

Stage 1. The state  $s$  is realized;

Stage 2. The importer government chooses  $\tau \in \{FT, P\}$ ;

Stage 3. The exporter government decides whether to file with the DSB;

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<sup>17</sup>We note that the assumption  $q(s) \leq 1/2$  would be satisfied in terms of the underlying process of Bayesian updating under plausible conditions. For example, one simple sufficient condition is that the signal of  $\Gamma$  is unbiased and the DSB’s prior beliefs are uninformative. But in any event, the condition  $q(s) \leq 1/2$  only serves to create a simple “worst case” benchmark in which the DSB has essentially no information and its ruling is equivalent to a coin toss ( $q(s) = 1/2$ ).

<sup>18</sup>We could allow these costs to be partly contingent on the outcome of the dispute (e.g., the loser of a dispute incurs an additional “reputation” cost) without affecting the logic of our results (see footnote 21).

<sup>19</sup>There are three ways to justify this emphasis on the maximization of the governments’ joint payoff: one possibility is to allow for ex-ante transfers, i.e., transfers at the time the institution is created (this is not in contradiction with the assumption of no ex-post transfers – see footnote 6); a second possibility would be to 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.

Stage 4. If invoked, the DSB issues a ruling  $\tau^{DSB} \in \{FT, P\}$ ;

Stage 5. Payoffs are realized.

We will focus on the subgame perfect equilibrium of the above game. We can allow governments to renegotiate, both after the state  $s$  is realized in *stage* 1, and after the DSB issues a ruling in *stage* 4 (these are the two relevant renegotiation nodes, because at each of these nodes governments receive some new information). But note that, since transfers between governments are not available, the possibility of renegotiation is irrelevant in this setting. This is because the interests of the two governments are directly in conflict and no Pareto improvement is possible ex-post; hence there is no room for renegotiation.

## 2.1. The optimal institution

We can now delve into the analysis. We start by describing the possible combinations of contract and DSB mandate that must be considered. First, the DSB may be given a non-activist mandate ( $n$ ), in conjunction with the  $D$  contract, the  $R$  contract or the  $V$  contract; we denote the corresponding institutions by  $D_n$ ,  $R_n$  and  $V_n$ , respectively. Alternatively, the DSB may be given any of the activist mandates we have described above. In the case of the silent contract ( $D$ ), only the role of gap-filling ( $g$ ) is relevant. In the case of the rigid contract ( $R$ ), only the role of modification of obligations ( $m$ ) is relevant. And in the case of the vague contract ( $V$ ), only the interpretation role ( $i$ ) is relevant.<sup>20</sup> Collecting these possibilities for the contract and the DSB mandate, we have the following six candidate institutions:

<u>Contract</u> <u>DSB Role</u>	<b>Silent</b>	<b>Rigid</b>	<b>Vague</b>
<b>Non-activist</b>	$D_n$	$R_n$	$V_n$
<b>Activist</b>	$D_g$ : DSB fills gaps	$R_m$ : DSB allows exceptions	$V_i$ : DSB interprets

Observe that the institution  $D_n$  delivers the noncooperative equilibrium outcome, and so it does nothing to prevent opportunistic behavior by governments. The institution  $R_n$  prevents opportunistic behavior but its rigid insistence on free trade implies that it sometimes gets

<sup>20</sup>We note that while the strict correspondence between contract form ( $D$ ,  $R$ ,  $V$ ) and DSB activist role ( $g$ ,  $m$ ,  $i$ ) is convenient for organizing our analysis, it reflects the fact that we have focused on a single policy, so this feature should not be taken literally. In a setting with multiple policies it might conceivably be optimal, for example, to give the DSB an interpretation mandate but regulate some policies in a rigid way and others in a vague way (see also footnote 11). Viewing the model from this broader perspective is important when comparing its predictions with a complex institution like the GATT/WTO, where some policies are regulated in a rigid way, others are regulated in a vague way, and still others are largely left to discretion.

the policy wrong. The institution  $V_n$  features a “grey area” of states in which the importer effectively has discretion and so the wrong policy may be chosen. Finally, the institutions  $D_g$ ,  $R_m$  and  $V_i$  entail DSB-use costs and potential errors in DSB rulings.

We focus first on the non-activist-DSB institutions  $D_n$ ,  $R_n$  and  $V_n$ . Recall that in each of these cases, the DSB has no mandate to “complete” the contract, and no disputes can arise. A first observation is that  $D_n$  is dominated by the vague contract  $V_n$ . This is because the latter contract imposes  $FT$  in some states within  $\sigma^{FT}$  and induces  $P$  in all other states, while  $D_n$  induces  $P$  in all states. Hence, within the non-activist-DSB institutions, the optimum can be either  $V_n$  or  $R_n$ , depending on parameters. Which of these contracts is optimal will be immaterial for our qualitative results.

We next turn to consider the institutions with an activist DSB:  $D_g$ ,  $R_m$ , and  $V_i$ . It is helpful to distinguish between two cases: (a) those states  $s$  where, for the given institution, the activist role of the DSB is not applicable; and (b) those states  $s$  where the activist mandate of the DSB is applicable. Note that, within the activist-DSB institutions, case (a) applies only for  $V_i$ , and only for those states where the contract specifies a crisp provision. For all other states and institutions, case (b) applies, and therefore we have to consider the possibility of disputes and derive the equilibrium outcome by backward induction.

Let us focus on case (b), that is, on states where the activist role of the DSB is applicable under the given institution. For these states, the behavior of the DSB will be the same under  $D_g$ ,  $R_m$  or  $V_i$ , so the following discussion applies to all three institutions. Consider first the exporter government’s filing behavior. This government files a complaint if and only if  $\tau = P$  and the expected benefit to the exporter government of filing exceeds the exporter government’s cost of filing, that is

$$\Pr(\text{DSB ruling is } FT \mid s) \cdot |\gamma^*(s)| > c^*. \quad (\text{F})$$

Condition (F) is the “filing” condition for the exporter government to invoke the DSB in response to a policy choice by the importer government of  $\tau = P$ .

Next consider the importer government’s policy choice. This government chooses  $\tau = P$  if either (F) fails – because then the importer government can set  $\tau = P$  without triggering a dispute – or if (F) holds and the expected benefit to the importer government from trade protection exceeds the cost to the importer government of a DSB dispute:

$$\Pr(\text{DSB ruling is } P \mid s) \cdot \gamma(s) > c. \quad (\text{P})$$

To reduce the number of cases and focus on the more interesting ones, we assume that for each disputant the cost of a dispute is relatively small. More specifically, we assume that even in the benchmark case of maximal DSB noise, i.e. even if the DSB flips a coin, the (F) and (P) conditions are both satisfied for all  $s$ , or:

$$\frac{1}{2}|\gamma^*(s)| > c^* \text{ and } \frac{1}{2}\gamma(s) > c \text{ for all } s. \quad (2.1)$$

Condition (2.1) implies that  $c^*$  and  $c$  are sufficiently small so that, for any level of DSB noise, (i) if the first-best policy is  $P$ , the importer government chooses  $P$  whether or not this triggers a complaint by the exporter government, and (ii) if the first-best policy is  $FT$  but the importer government still chooses  $P$ , the exporter government files a complaint.

We can now examine more closely each of the activist-DSB institutions  $D_g$ ,  $R_m$ , and  $V_i$ . Consider first the institution  $D_g$ . It is direct to derive the equilibrium actions of the governments for each state:

1. In states  $s \in \sigma^{FT}$ : if  $qk(s) < \frac{c}{\gamma(s)}$  then  $\tau = FT$  and the DSB is not invoked; if instead  $qk(s) > \frac{c}{\gamma(s)}$  then  $\tau = P$  and the DSB is invoked.
2. In states  $s \in \sigma^P$ : if  $qk(s) < \frac{c^*}{|\gamma^*(s)|}$  then  $\tau = P$  and the DSB is not invoked; if instead  $qk(s) > \frac{c^*}{|\gamma^*(s)|}$  then  $\tau = P$  and the DSB is invoked.

Notice an interesting feature of the  $D_g$  institution: the accuracy of DSB rulings has a perverse effect on the equilibrium utilization of the DSB, in the sense that *the DSB is invoked more frequently when its accuracy is low*. Specifically, in states  $s \in \sigma^{FT}$ , the importing government chooses the inefficient policy  $P$  and induces a DSB filing by the exporting government if and only if the probability of DSB error  $qk(s)$  is sufficiently high. Similarly, in states  $s \in \sigma^P$ , the exporting government chooses to file and challenge the importing government's efficient policy choice  $P$  if and only if  $qk(s)$  is sufficiently high. Note also that, *for a given state  $s$ , the first-best outcome is achieved if and only if the DSB is not invoked*. These two observations play a central role in the analysis to follow, and indeed they are at the heart of the main results of this section. Together they imply that the equilibrium motives that trigger a DSB filing are inefficient from an ex-ante perspective, and it is the off-equilibrium impacts of the activist role of the DSB that are efficiency-enhancing.<sup>21</sup>

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<sup>21</sup>As mentioned in footnote 18, our qualitative results would not change if the loser of a dispute incurred an



We can write down the expected efficiency loss associated with the institution  $D_g$  relative to the first-best outcome. This loss is given by:

$$L(D_g) = \sum_{s \in \hat{\sigma}^{FT} \cup \hat{\sigma}^P} p(s)[qk(s)|\Gamma(s)| + c^{all}]. \quad (2.2)$$

Here,  $\hat{\sigma}^{FT}$  denotes the set of states for which  $FT$  is efficient, the importing government chooses  $P$ , and the exporting government files a complaint (i.e.,  $s$  such that  $s \in \sigma^{FT}$  and  $qk(s) > \frac{c}{\gamma(s)}$ ). Similarly,  $\hat{\sigma}^P$  denotes the set of states for which  $P$  is efficient, the importing government chooses  $P$ , and the exporting government files a complaint (i.e.,  $s$  such that  $s \in \sigma^P$  and  $qk(s) > \frac{c^*}{|\gamma^*(s)|}$ ). And finally,  $c^{all} \equiv c + c^*$ .

As (2.2) makes clear, the institution  $D_g$  entails two inefficiencies relative to the first best: one arising from the probability of DSB error and the other arising from the cost of the dispute. The expected loss  $L(D_g)$  is given by this double inefficiency summed over two sets of states: the set of states  $\hat{\sigma}^{FT}$ , where it is the importer government who acts opportunistically and exploits the incompleteness of the contract, thereby triggering a dispute; and the set of states  $\hat{\sigma}^P$ , where it is the exporter government who acts opportunistically and exploits the incompleteness of the contract, thereby triggering a dispute. And as a consequence,  $L(D_g)$  is increasing in  $q$ , for two reasons: first, a higher  $q$  implies a higher expected cost of DSB error if the DSB is invoked,  $qk(s)|\Gamma(s)|$ ; and second, a higher  $q$  increases the number of states in which the DSB is invoked in equilibrium, and therefore increases the size of the sets  $\hat{\sigma}^{FT}$  and  $\hat{\sigma}^P$ .

Also note from (2.2) that no loss arises ( $L(D_g) = 0$ ) if  $q$  is lower than a critical level. This is the level of  $q$  below which the DSB is not invoked in any state ( $\hat{\sigma}^{FT}$  and  $\hat{\sigma}^P$  are empty). Intuitively, if  $q$  is small then the governments, expecting the DSB to make the right decision with high probability, will act efficiently and avoid the DSB intervention to save on the dispute cost (the importer will always choose the first-best policy and the exporter will never file complaints). This reflects the off-equilibrium impacts of the DSB described above.

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additional cost  $\tilde{c}$ , because then the filing condition (F) becomes  $qk(s)|\gamma^*(s)| > c^* + (1 - qk(s))\tilde{c}$ , yielding  $qk(s) > (c^* + \tilde{c})/(|\gamma^*(s)| + \tilde{c})$ , and condition (P) becomes  $qk(s)\gamma(s) > c + (1 - qk(s))\tilde{c}$ , yielding  $qk(s) > (c + \tilde{c})/(\gamma(s) + \tilde{c})$ , and hence the presence of the extra cost  $\tilde{c}$  would only modify the exact thresholds for the equilibrium occurrence of disputes without affecting the qualitative results. On the other hand, results might change if  $c$  and  $c^*$  are so large that condition (2.1) did not hold. In this case, inefficient policies would arise also for states where the DSB is not invoked in equilibrium, because the threat of invoking the DSB may not be credible if the cost of doing so is high. This would tend to weaken the efficiency-enhancing effects associated with the off-equilibrium impacts of the activist DSB role, but these effects would still be present, provided that  $c$  and  $c^*$  are not so high that they shut down the impact of the DSB altogether.

Consider next the institution  $R_m$ . Under this institution, the contract specifies a rigid free trade rule, but the DSB can allow exceptions if invoked. Notice, though, that the DSB is unconstrained by the (rigid) contract under the  $m$  mandate, and hence if invoked, it issues the same ruling as it would under the  $D$  contract. And since the DSB rules in the same way in both cases, the governments will make the same decisions in both cases. As a consequence, the equilibrium outcome under  $R_m$  is the same as under  $D_g$ . Based on this observation, and recalling that  $R_m$  entails a small contracting cost whereas  $D_g$  does not, we conclude that  $R_m$  is dominated by  $D_g$ .

Finally consider institution  $V_i$ . Clearly, in all states where the contract is ambiguous, the governments' equilibrium actions are the same as under  $D_g$ . On the other hand, in the states where the contract specifies a crisp provision, the activist DSB mandate does not apply, and hence the policy outcome is directly determined by the contract.

We now compare the performance of the  $V_i$  and  $D_g$  institutions. First recall from our discussion above that if  $q$  is small enough,  $D_g$  will induce the first-best outcome in all states, and as it costs nothing to write,  $D_g$  is then strictly preferable to  $V_i$  for small  $q$ . Next, letting  $\mathbf{s}^{crisp} = \mathbf{T} \cup \mathbf{F}$  denote the set of states for which the contract  $V$  specifies a crisp provision, note that for  $s \in \mathbf{s}^{crisp}$  the loss of surplus associated with  $D_g$  is increasing in  $q$ , while the loss of surplus associated with  $V_i$  is independent of  $q$ ; and for the remaining states  $s \in \Sigma \setminus \mathbf{s}^{crisp}$  the institutions  $D_g$  and  $V_i$  induce exactly the same outcome. It follows that  $L(D_g) - L(V_i)$  is increasing in  $q$ , and hence we can conclude that  $V_i$  is preferred to  $D_g$  if and only if  $q$  is above a certain threshold level.

We may also compare  $V_i$  with the candidate non-activist-DSB institutions, namely  $V_n$  and  $R_n$ . Clearly, an increase in  $q$  damages the performance of  $V_i$ , while it does not affect the performance of the non-activist-DSB institutions. Putting together this consideration with the ones above, it is a small step to prove the following:

**Proposition 1.** *There exist critical levels  $q_1$  and  $q_2$  (with  $0 < q_1 \leq q_2 \leq 1$ ) such that: (i) for  $q < q_1$ , the optimum is a silent contract with a gap-filling mandate for the DSB ( $D_g$ ); (ii) for  $q_1 < q < q_2$ , the optimum is a vague contract with a mandate for the DSB to interpret ( $V_i$ ); (iii) for  $q > q_2$ , it is optimal to have a non-activist DSB, and the optimal contract may be vague or rigid ( $V_n$  or  $R_n$ ).*

At a broad level, Proposition 1 suggests that the optimal degree of DSB activism is de-

creasing in the level of DSB noise ( $q$ ), moving from a gap-filling role to an interpretive role and finally to a non-activist role as  $q$  increases (although note that each of the intervals  $(q_1, q_2)$  and  $(q_2, 1)$  may be empty). This in turn suggests a pair of empirical implications. First, if the accuracy of the DSB changes over time, then the optimal degree of activism should change in the same direction.<sup>22</sup> And second, we should tend to observe a higher degree of court activism in those agreements (or in those issue areas within a given agreement) where the informational requirements for the court are less demanding.

Proposition 1 carries with it a number of further implications. We highlight three of these.

First, Proposition 1 implies that, if  $q$  is sufficiently small, the first-best outcome can be achieved under  $D_g$  and  $V_i$  even though (i) the contract is highly incomplete, (ii) the use of the DSB is costly, and (iii) the DSB rulings are imperfect. The reason is that the threat of invoking the DSB and the expectation of a sufficiently precise DSB ruling is enough to induce governments to act efficiently. But notice that the first-best cannot be achieved if the DSB is not given an activist mandate.

Second, Proposition 1 implies that there is no modification role for the DSB in the optimal institution, contrary to the suggestions of some legal scholars. Intuitively, rather than placing a rigid obligation into the contract and then endowing the DSB with a mandate to modify the obligation ex post, it is always better to simply leave a gap in the contract to begin with and then endow the DSB with a mandate to fill the gap ex post.

And finally, a corollary of Proposition 1 is that the probability of a DSB dispute – and hence the expected cost of disputes – is non-monotonic in  $q$ , and in particular it is increasing for low levels of  $q$  and decreasing for high levels of  $q$  (provided the interval  $(q_2, 1)$  is nonempty). The reason is that when  $q$  is sufficiently low the DSB is not invoked at all in equilibrium, and when  $q$  is sufficiently close to 1 it is optimal to have a non-activist DSB. Notice as well that, because the efficiency achieved by the optimal institution is decreasing in  $q$ , there is a nonmonotonic relationship between the equilibrium frequency of DSB use and the performance

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<sup>22</sup>More specifically, in the context of the GATT/WTO one can identify three relevant developments in this regard, two pointing toward an increase in  $q$ , and the third pointing to a decrease in  $q$ . On one hand, the addition of new members has resulted in an increasingly heterogeneous membership, and this might suggest diminishing accuracy in DSB rulings; moreover, in the evolution from GATT to the WTO, a number of new issue areas were taken on, again suggesting an overall diminishment in the DSB accuracy. On the other hand, some new features of the DSB introduced with the WTO (e.g., the possibility of appealing the lower court/“panel” rulings to a higher court/“appellate body”) have likely resulted in greater accuracy of DSB rulings. Which of these forces is dominant is of course an empirical question, but our model points to these developments as likely candidates for determining the evolution of the optimal degree of DSB activism in the GATT/WTO.

of the optimal institution. Therefore, our model implies that one cannot rely on information about the equilibrium frequency of DSB use alone to gain information about the performance of the optimal institution in terms of how close it gets to the first best.

As already mentioned, in the online Appendix we consider a richer model of language that allows for further possibilities in writing vague contracts. In that extended environment, we establish conditions under which the optimal vague contract has the same qualitative features as in our basic model, but we also show that there is a parameter region in which the optimal vague contract specifies fewer conditions for trade protection than the first-best contract and/or imposes free trade unduly in some states; in this sense, our extended model reveals the possibility that “vagueness begets rigidity.” Further, our extended model suggests a novel reason why a contract might be left deliberately vague: in a situation where it would be costless to remove vagueness along some dimensions of the contract but not others, we show that it may nevertheless be optimal to leave all dimensions of the contract vague.

## 2.2. Selection of disputes and pro-trade bias

It has been pointed out in the literature on WTO disputes that there is an apparent “pro-trade bias” in DSB rulings. For example, according to the WTO (WTO, 2007a, p. 273), “...both under the GATT (82 per cent) and the WTO (88 per cent) complainants have mostly won their cases (counting the ones that went through to an adopted report and ‘decisive’ ruling respectively).” We now show that a pro-trade bias in DSB rulings arises in our model when disputes are mostly triggered as a result of the importer – rather than the exporter – acting opportunistically and exploiting the incompleteness of the contract, and we show that this occurs when the exporter faces relatively high dispute costs as compared to the importer.<sup>23</sup>

We also raise a related question: Under what conditions do the equilibrium *policy outcomes* skew in favor of free trade relative to the first-best outcome, and in this sense exhibit a pro-trade bias? One might conjecture that the two dimensions of bias – the bias in rulings and the bias in policy outcomes – would go in the same direction, but in fact we will show that the two biases are inversely related: if there is a pro-trade bias in DSB rulings, then there tends to be

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<sup>23</sup>In offering an interpretation of this bias which derives from high costs of dispute for the exporter *relative* to those borne by the importer, our model points to an interpretation that is somewhat different from that put forward by Goldstein and Steinberg (forthcoming). They suggest that a high absolute *level* of dispute costs faced by the exporter might induce a pro-trade (selection) bias in DSB rulings, because the exporter will file only when there is a high probability of success.

an anti-trade bias in policy outcomes, and vice versa.

We first consider the bias in DSB rulings. In order to highlight selection as a source of bias, we assume that if disputes were initiated randomly, the outcome of disputes would be unbiased. Formally, we assume

$$\sum_{s \in \sigma^{FT}} p(s) = \sum_{s \in \sigma^P} p(s) = \frac{1}{2} \text{ and } \sum_{s \in \sigma^{FT}} q(s)p(s) = \sum_{s \in \sigma^P} q(s)p(s), \quad (2.3)$$

where to avoid unnecessary notation we now use  $q(s)$  rather than  $qk(s)$  as our (inverse) measure of the quality of DSB information. The first condition in (2.3) says that the first-best policy is  $FT$  or  $P$  with equal probability; and given the first condition, the second says that the conditional mean of  $q$  is independent of the first-best policy.

For simplicity we consider only the  $D_g$  institution, but similar results apply to the  $V_i$  institution. Recalling that  $\hat{\sigma}^{FT}$  denotes the subset of  $\sigma^{FT}$  in which a dispute is filed under the  $D_g$  institution and similarly  $\hat{\sigma}^P$  denotes the subset of  $\sigma^P$  in which a dispute is filed under the  $D_g$  institution, it is direct to derive:

$$\Pr(\tau^{DSB} = FT \mid \text{file}) = \frac{\sum_{s \in \hat{\sigma}^{FT}} (1 - q(s))p(s) + \sum_{s \in \hat{\sigma}^P} q(s)p(s)}{\sum_{s \in \hat{\sigma}^P} p(s) + \sum_{s \in \hat{\sigma}^{FT}} p(s)}. \quad (2.4)$$

It follows from (2.4) that there is a pro-trade bias in DSB rulings (i.e.,  $\Pr(\tau^{DSB} = FT \mid \text{file}) > 1/2$ ) if and only if

$$\sum_{s \in \hat{\sigma}^{FT}} (1 - 2q(s))p(s) > \sum_{s \in \hat{\sigma}^P} (1 - 2q(s))p(s). \quad (2.5)$$

Our goal now is to identify the region in  $(c, c^*)$ -space where (2.5) holds. First note that, if  $c < \min_{s \in \sigma^{FT}} q(s)\gamma(s)$  and  $c^* < \min_{s \in \sigma^P} q(s)|\gamma^*(s)|$ , filing occurs in equilibrium in every state  $s$ . In this case, given (2.3), there is clearly no bias. Next focus on the case in which  $c > \min_{s \in \sigma^{FT}} q(s)\gamma(s)$  or  $c^* > \min_{s \in \sigma^P} q(s)|\gamma^*(s)|$ , so that filing occurs in some but not all states. Recall that, by our small-cost assumption (2.1), the number of states in  $\hat{\sigma}^{FT}$  depends only on  $c$  (and is weakly decreasing in  $c$ ) and the number of states in  $\hat{\sigma}^P$  depends only on  $c^*$  (and is weakly decreasing in  $c^*$ ). This implies that the left hand side of (2.5) is a weakly decreasing function of  $c$  and the right hand side of (2.5) is a weakly decreasing function of  $c^*$ . It follows immediately that (2.5) is satisfied if and only if  $c^* > y(c)$ , where  $y(\cdot)$  is a weakly increasing function. Thus, at a broad level we find that DSB rulings tend to have a pro-trade bias if the dispute costs incurred by the exporter are high relative to the dispute costs incurred by the importer.

We next characterize the bias in the policy outcomes under the  $D_g$  institution (again, similar results apply to the  $V_i$  institution). Since we are assuming here that the first-best policy is  $FT$  or  $P$  with equal probability, it is natural to say that the policy outcome exhibits a pro-trade bias if  $\Pr(\hat{\tau}(D_g) = FT) > 1/2$ , where  $\hat{\tau}(D_g)$  denotes the equilibrium policy that emerges under institution  $D_g$ .

A key observation is that, in the sets of states where no dispute occurs (i.e.  $\sigma^P \setminus \hat{\sigma}^P$  and  $\sigma^{FT} \setminus \hat{\sigma}^{FT}$ ), the equilibrium policy is the first-best policy. Using this observation, and with some straightforward algebra, we find:

$$\Pr(\hat{\tau}(D_g) = FT) = \frac{1}{2} - \sum_{s \in \hat{\sigma}^{FT}} q(s)p(s) + \sum_{s \in \hat{\sigma}^P} q(s)p(s).$$

This implies that  $\Pr(\hat{\tau}(D_g) = FT) > 1/2$  if and only if

$$\sum_{s \in \hat{\sigma}^{FT}} q(s)p(s) < \sum_{s \in \hat{\sigma}^P} q(s)p(s). \quad (2.6)$$

Intuitively, there is no bias in policy outcomes under the  $D_g$  institution if no disputes ever arise, because as we have shown in that case the equilibrium policy is always the first-best policy; and so, as (2.6) indicates, the extent of anti- or pro- trade bias in policy outcomes depends on the relative size of the sets  $\hat{\sigma}^{FT}$  and  $\hat{\sigma}^P$ .

Using arguments analogous to those above for the analysis of bias in DSB rulings, it is straightforward to show that (2.6) is satisfied if and only if  $c^* < z(c)$ , where  $z(\cdot)$  is a weakly increasing function. Thus, in sharp contrast with our finding concerning the bias in DSB rulings, we find that the policy outcomes tend to exhibit a pro-trade bias if the dispute costs incurred by the exporter are *low* relative to the dispute costs incurred by the importer. This result becomes even more stark in the special case where  $q(s)$  and  $p(s)$  are both independent of  $s$ . In that case, it is direct to see that the two curves  $y(c)$  and  $z(c)$  coincide, and hence (2.6) is satisfied if and only if (2.5) is violated.

The following proposition summarizes these results:

**Proposition 2.** *Consider the  $D_g$  and  $V_i$  institutions: (i) There is a pro-trade bias in DSB rulings if and only if  $c^* > y(c)$ , where  $y(\cdot)$  is a (weakly) increasing function. (ii) There is a pro-trade bias in policy outcomes if and only if  $c^* < z(c)$ , where  $z(\cdot)$  is a (weakly) increasing function. (iii) In the symmetric case where  $q(s) = q$  for all  $s$  and  $p(s) = p$  for all  $s$ ,  $y(c) = z(c)$ , and hence there is a pro-trade bias in DSB rulings if and only if there is an anti-trade bias in policy outcomes.*

Figure 1 conveys the main message of Proposition 2 for the symmetric case where  $q(s) = q$  for all  $s$  and  $p(s) = p$  for all  $s$ :<sup>24</sup> the conditions leading to a *pro-trade bias* in the DSB *rulings* are essentially the same as those leading to an *anti-trade bias* in the *policy outcomes*. Evidently, our model suggests that when  $c^*$  is high relative to  $c$ , the joint behavior that is induced by both the importer government and the exporter government under the  $D_g$  and  $V_i$  institutions means that the most common reason for a dispute to arise is because the importer government is trying to exploit the incompleteness of the contract and “get away with protection” (rather than the alternative that the exporter government is trying to exploit the incompleteness of the contract and “get away with forcing free trade”); and this ensures that the policy outcomes tend to be biased toward Protection relative to the first-best policies even though the DSB, when invoked, will usually find in favor of the complainant and rule for Free Trade.

### 3. Precedent Setting

We next develop a dynamic extension of the static model described in the previous section. With this dynamic extension, we consider a further important issue of DSB design: whether or not DSB rulings should set legal *precedent* for future rulings.

There is a large literature in law and economics on the role played by precedent in domestic legal systems. This literature is primarily concerned with the role of precedent in the creation of legal rules through the litigation process (common law) as distinct from the creation of law through legislation (civil law).<sup>25</sup> In effect, precedent is the means by which the legal decisions in individual disputes contribute to the formation of rules which in turn bind legal decisions in future disputes. Having considered the optimal degree of DSB activism in a static setting, an examination of the role of precedent is a natural next step, as this feature of DSB design dictates whether or not DSB rulings will be enshrined in a body of common law, or in other words, whether or not DSB rulings will serve to complete the incomplete ex-ante contract or rather simply provide ex-post resolution to disputes on a case-by-case basis.

A legal system can rely on precedent to differing degrees. At one extreme is the complete

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<sup>24</sup>In Figure 1, we define  $c_1 \equiv \min_{s \in \sigma^{FT}} q(s)\gamma(s)$ ,  $c_1^* \equiv \min_{s \in \sigma^P} q(s)|\gamma^*(s)|$ ,  $c_2 \equiv \max_{s \in \sigma^{FT}} q(s)\gamma(s)$  and  $c_2^* \equiv \max_{s \in \sigma^P} q(s)|\gamma^*(s)|$ . Note that by our assumption (2.1) we can focus on the region where  $c < c_2$  and  $c^* < c_2^*$ . Also note that the “No-Bias” locus is technically not a function but a correspondence, due to the discrete nature of the state space. If the state space were continuous this locus would be a curve.

<sup>25</sup>In our model, civil law can be thought of as the ex-ante contract agreed by the governments, and DSB disputes then have the potential to create a body of common law through precedent.

absence of precedent: in this case the legal decisions in individual disputes have no bearing on the outcomes of future disputes, and so these legal decisions do not contribute to the formation of legal rules. At the other extreme is strict adherence to precedent: in this case the legal decision in an initial dispute determines the rule for all future disputes of this kind, and future legal decisions are bound against deviating from this legal rule. In between these two extremes are legal systems in which precedent plays a role but is nonetheless “malleable” to some degree. Here the legal decisions in individual disputes are to varying degrees bound by/influenced by the precedent set by past legal decisions but can also deviate from precedent and hence alter precedent for future disputes.

A central focus of the law and economics literature concerned with the role of precedent is the question of whether common law evolves toward efficient law when precedent is malleable, treating the strength of precedent as a given. One branch of the literature takes the occurrence of disputes as exogenous, and asks whether precedent can lead to the creation of efficient legal rules over time even when individual judges operate with bias and/or imperfect information and learning. Another branch emphasizes the endogenous selection of disputes, and asks whether inefficient laws are more likely to be litigated than efficient laws, so that precedent leads to an increase in the average efficiency of legal rules through time.<sup>26</sup>

Some papers in this literature also consider precedent from a more normative perspective: Do the benefits of precedent outweigh the costs, and what is the *optimal* strength of precedent? Broadly speaking, these papers emphasize a basic tradeoff: stricter adherence to precedence creates the benefit of predictability of legal rulings in future disputes, but it comes at the cost of less adaptability of the law to changing environment and preferences.<sup>27</sup>

We abstract from the question of how common law evolves under a given malleable system of precedent to focus instead on the question, Is precedent better than no precedent? We emphasize a tradeoff that has some similarities to that emphasized in the law and economics literature but also important differences. In our model, the benefit of precedent is that it removes uncertainty about the rights and obligations that will apply for the given state  $s$  in the future, and hence no disputes will occur again under state  $s$ , with associated savings in future

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<sup>26</sup>Key papers that adopt the former focus include Cardozo (1921), Cooter, Kornhauser, and Lane (1979), Gemaioli and Shleifer (2007) and Ponzetto and Fernandez (2008), while notable papers that reflect the latter focus are Rubin (1977), Priest (1977), Goodman (1978) and Landes and Posner (1979).

<sup>27</sup>Ponzetto and Fernandez (2008) provide a formal analysis of these normative considerations, but these considerations are discussed informally in much of the law and economics literature on precedent.



dispute costs. This can be viewed as akin to the benefit of “predictability” emphasized in the law and economics literature. But the cost of precedent that we emphasize is very different. We will show that introducing precedent leads initially to a higher frequency of litigation, by raising the future stakes associated with litigation. This in turn implies more waste in litigation costs and a less efficient policy outcome. This effect is novel in the literature, and as will become clear it arises solely because contracting parties interact repeatedly in court; and for this reason we view it as relatively more important in an international setting.<sup>28</sup>

For simplicity, we consider a two-period version of the static model developed above, with a prior period (*Period 0*) in which the institution is created. *Period 1* and *Period 2* then each proceed as in (stages 1 through 5 of) the static model of the previous section.

We assume that the state  $s$  is *iid* across the two periods, and we let  $\delta \geq 0$  denote the weight attached by governments to the *Period-2* payoff: because “the future” is collapsed into *Period 2*, we allow  $\delta$  to be larger than one. Finally, we denote by  $\tau_t$  and  $\tau_t^{DSB}$  ( $t \in \{1, 2\}$ ) the *Period-t* importer-government policy choice and DSB ruling, respectively. Given that *Period 2* is the repetition of *Period 1*, and given the *iid* assumption, there is nothing truly dynamic in the contracting environment. The dynamic aspect of the analysis will arise from the presence of the DSB institution, *if* the DSB has precedent-setting authority.

As in our static model we do not allow the governments to renegotiate the contract. But it can easily be shown that, given our assumptions, the governments would never renegotiate even if they could.

We next describe the formal meaning of “precedent” within our model. When DSB rulings set precedent, we assume that a *Period-1* ruling  $\tau_1^{DSB}(s')$  for state  $s'$  implies henceforth that the contract specifies  $\tau(s') = \tau_1^{DSB}(s')$  and cannot be further modified. Therefore, if the DSB operates under precedent and the DSB is invoked in *Period 1* for state  $s'$ , then in *Period 2* the contract is “completed” for state  $s'$ .<sup>29</sup>

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<sup>28</sup>The law and economics literature also discusses the possible importance of repeat interaction of disputants in creating incentives to initiate disputes for the purpose of creating precedent (see, for example, the discussion of “future stakes” in Landes and Posner, 1979, p.160). Our point is not that such considerations never arise in the domestic setting, but simply that these considerations are likely to be far more central in an international setting where the disputants are governments of member countries.

<sup>29</sup>We are implicitly assuming that describing the realized state  $s'$  – which the DSB must do if its ruling is to set a precedent for the future – is costless. In reality, the cost of describing a state ex-post is probably non-negligible but significantly lower than the cost of describing a state *ex-ante*. This makes the difference between ex-ante and ex-post description costs rather extreme in our model, but it would be easy to allow for a positive cost of ex-post description; intuitively, this would make precedent less attractive, other things equal.

We assume for simplicity that, if the same state occurs in both periods and the DSB is invoked in both periods (which is possible in the absence of precedent), then the DSB uses only the *Period-2* signal when making its *Period-2* ruling.<sup>30</sup> Under this assumption, it is clear that the DSB behaves exactly as it did in the static model of the previous section, whether it is invoked in *Period 1* or in *Period 2*, and in each case the probability of a wrong ruling is given by  $q(s)$ .

With these preliminaries established, we can now delve into the analysis. In the absence of legal precedent, it is straightforward to see that our dynamic model behaves exactly as (a twice-repeated version of) the static model, and our analysis from the previous section carries over. Moreover, it is immediate that introducing precedent has no impact on the performance of any of the institutions with a non-activist DSB, that is, on the institutions  $(D_n, R_n, V_n)$ . Also,  $R_m$  is again outcome-equivalent to  $D_g$ , and hence dominated. Therefore, to evaluate the role of legal precedent in the optimal institution, we need only derive the impact of precedent on the performance of the institutions  $V_i$  and  $D_g$ .

Again to reduce the number of cases and focus on the more interesting ones, we impose for the dynamic model a slight strengthening of the static-model condition (2.1). We assume that  $c^*$  and  $c$  are sufficiently small so that (i) if the first-best policy is  $P$ , the importer government chooses  $P$  in *Period 1* whether or not this triggers a complaint by the exporter government, and (ii) if the first-best policy is  $FT$  but the importer government chooses  $P$  in *Period 1*, the exporter government files a complaint. This is ensured (it can be shown) by the following condition:

$$\frac{1}{2}(1 - \delta p(s))|\gamma^*(s)| > c^* \quad \text{and} \quad \frac{1}{2}(1 - \delta p(s))\gamma(s) > c \quad \text{for all } s. \quad (3.1)$$

We now make an important observation:

**Remark 1.** *If the DSB plays an activist role ( $g$  or  $i$ ), the frequency of Period-1 disputes rises (weakly) with the introduction of precedent.*

The broad intuition for Remark 1 is that the introduction of precedent raises the future stakes associated with litigation. More specifically, for  $s \in \sigma^{FT}$ , precedent magnifies the gain

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<sup>30</sup>This might be a reasonable assumption if DSB judges change over time. But the reason we make this assumption is only to focus more sharply on the main points. It is clear that allowing the DSB to use the period-1 signal in a period-2 ruling would introduce another cost of precedent, because under precedent the DSB cannot then reduce the noise of its signal with repeated draws over time for the same state. Notice, though, that our assumptions stack the deck in favor of precedent, and yet we will show that precedent still performs less well than one might expect.

that the importer anticipates if it provokes a DSB filing by setting  $\tau = P$  and the DSB rules in error.<sup>31</sup> And similarly, for  $s \in \sigma^P$ , precedent magnifies the gain that the exporter can anticipate if it files against  $\tau = P$  and the DSB rules in error.

As in the static model, the occurrence of disputes in equilibrium is associated with a double inefficiency, namely a waste in litigation costs and (with some probability) an inefficient policy selection by the DSB. Thus, the effect that precedent has on the *Period-1* filing frequency by itself tends to *diminish* the efficiency of the institution. However, weighing against this negative effect of precedent is the benefit of reducing expected future litigation costs.<sup>32</sup> The next step is to assess the net impact of these effects.

We focus first on the  $D_g$  institution. Let  $D_g^P$  denote the  $D_g$  institution with precedent-setting, and  $L(D_g^P)$  the associated loss relative to the first best. The differential loss implied by the introduction of precedent can be written as:

$$L(D_g^P) - L(D_g) = \sum_{s \in \hat{\Delta}} p(s)[qk(s)|\Gamma(s)| + c^{all}] + \delta \sum_{s \in \hat{\Delta}} p^2(s)qk(s)|\Gamma(s)| - \delta \sum_{s \in \hat{\sigma}} p^2(s)c^{all} \quad (3.2)$$

where  $\hat{\sigma}$  is the set of states where *Period-1* filing occurs under the  $D_g$  institution and  $\hat{\Delta}$  is the set of states for which *Period-1* filing occurs under  $D_g^P$  but not under  $D_g$  (see the proof of Proposition 3 in the Appendix for a formal derivation of  $\hat{\Delta}$ ).

The first term on the right-hand-side of (3.2) represents the *Period-1* efficiency loss generated by precedent, coming from the additional equilibrium filing behavior and associated DSB error and litigation cost. The second term on the right-hand-side of (3.2) represents the discounted *Period-2* efficiency loss generated by precedent when the DSB rules in error: this can be understood by observing that  $p^2(s)$  is the probability that state  $s$  will occur in both *Period 1* and *Period 2*, and therefore that the precedent set from a *Period-1* ruling in state  $s$  will be relevant in *Period 2*. Finally, the third term on the right-hand-side of (3.2) is the discounted *Period-2* savings in litigation cost over the states in which *Period-2* filing would have occurred

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<sup>31</sup>Of course, if the DSB ruling is *FT*, precedent also extends this (correct) ruling into the future, and so it might be thought that precedent magnifies the loss from a correct ruling as well. But this is the policy that the importer would have to choose for  $s \in \sigma^{FT}$  in order *not* to provoke a DSB filing, and so relative to that alternative a correct DSB ruling imposes no loss from filing (in either period). A similar statement applies to the exporter for  $s \in \sigma^P$ .

<sup>32</sup>Our assumption (3.1) on litigation costs serves to highlight this basic tradeoff. If (3.1) is violated, further effects of precedent will arise, because there will then be states in which the threat of invoking the DSB is not credible and so the DSB is not invoked in equilibrium but the choice of policy is inefficient. For these states, it can be shown that the introduction of precedent has ambiguous effects. Such states are ruled out if condition (3.1) is satisfied, and this then isolates the novel effect of precedent that we emphasize in the text.

in the absence of precedent (i.e.,  $s \in \hat{\sigma}$ ).

Evidently,  $L(D_g^{\mathcal{P}}) < L(D_g)$  – and hence the introduction of precedent enhances the performance of the  $D_g$  institution – only if the savings in expected *Period-2* litigation costs outweighs the inefficiencies associated with the additional *Period-1* filing behavior.

We turn next to the  $V_i$  institution. Let  $V_i^{\mathcal{P}}$  denote the  $V_i$  institution with precedent-setting, and  $L(V_i^{\mathcal{P}})$  the associated loss relative to the first best.

If the *Period-1* realized state is not in  $\mathbf{s}^{crisp}$ , so that the activist role of the DSB is applicable, then the statements made above apply, with  $V_i^{\mathcal{P}}$  and  $V_i$  taking the place respectively of  $D_g^{\mathcal{P}}$  and  $D_g$ . If instead the *Period-1* realized state is in  $\mathbf{s}^{crisp}$ , then there is no activist role for the DSB under the  $V_i$  or the  $V_i^{\mathcal{P}}$  institution, and *Period 2* behaves exactly like the static model under  $V_i$ . Hence, we can write the differential loss implied by the introduction of precedent as:

$$L(V_i^{\mathcal{P}}) - L(V_i) = \sum_{s \in \tilde{\Delta}} p(s)[qk(s)|\Gamma(s)| + c^{all}] + \delta \sum_{s \in \tilde{\Delta}} p^2(s)qk(s)|\Gamma(s)| - \delta \sum_{s \in \tilde{\sigma}} p^2(s)c^{all} \quad (3.3)$$

where  $\tilde{\sigma}$  is the set of states where *Period-1* filing occurs under institution  $V_i$  and  $\tilde{\Delta}$  is the set of states for which *Period-1* filing occurs under  $V_i^{\mathcal{P}}$  but not under  $V_i$ . Clearly, introducing precedent into the  $V_i$  institution involves identical trade-offs to those described above for the  $D_g$  institution, except that the states in  $\mathbf{s}^{crisp}$  are excluded from this tradeoff for the  $V_i$  institution.

We can now examine the optimal choice of institution. In this setting, we need to consider six types of institution, namely the four that we showed could be optimal in the static model ( $R_n, V_n, V_i$  and  $D_g$ ) plus the two with precedent ( $D_g^{\mathcal{P}}$  and  $V_i^{\mathcal{P}}$ ). In general, any of these institutions can be optimal depending on parameter values, but we can say something about how changes in  $q$  and  $\delta$  affect the optimal choice of institution.

Consider first the impact of changes in the DSB noise  $q$ . In analogy with the previous section, an increase in  $q$  clearly favors non-activist-DSB institutions over activist-DSB institutions, so that as  $q$  increases the optimal institution can only switch from one of the latter to one of the former. Also, it continues to be true that an increase in  $q$  favors institutions where the DSB interprets a vague contract ( $V_i$  and  $V_i^{\mathcal{P}}$ ) over institutions where the DSB fills gaps ( $D_g$  and  $D_g^{\mathcal{P}}$ ), so that as  $q$  increases the optimal institution can only switch from one of the latter to one of the former. Thus, the result of Proposition 1 generalizes to this dynamic setting: as  $q$  increases, the optimal institution switches from a discretionary contract with a gap-filling DSB to a vague contract with a contract-interpreting DSB to a vague or rigid contract with a non-activist DSB (possibly “skipping over” one or more of these).

But how does an increase in  $q$  affect the desirability of precedent? For the purposes of addressing this question, we assume for simplicity that  $k(s) = 1/2$  for all  $s$ , so that as  $q$  goes from zero to one, the DSB signal goes from perfect to uninformative. We find that the introduction of precedent is more likely to be desirable when the accuracy of DSB rulings is low. Formally, we have the following result:

**Proposition 3.** *Consider a given activist DSB role ( $g$  or  $i$ ). As  $q$  increases from zero, initially the introduction of precedent has no effect, then it becomes strictly undesirable, and finally it becomes strictly desirable as  $q$  approaches one.*

Proposition 3 is somewhat surprising, but it reflects a simple logic. Consider the  $D_g$  and  $D_g^P$  institutions (analogous arguments hold for  $V_i$  and  $V_i^P$ ). In the case where the DSB is sufficiently uninformed, the DSB will be invoked in every state realization under the  $D_g$  institution, and so when precedent is introduced the equilibrium *Period-1* frequency of filings cannot rise: the only effect of moving from  $D_g$  to  $D_g^P$  in this case is then to reduce expected litigation costs in *Period 2*, which is efficiency enhancing. For this reason, precedent is desirable when the DSB operates with sufficiently little information. Now consider the case where the DSB is sufficiently informed so that the DSB will not be invoked in any state: introducing precedent in this case will either (i) preserve the absence of DSB filings in all states, in which case introducing precedent has no effects, or (ii) lead to a *Period-1* filing in some state, in which case the equilibrium *Period-1* frequency of filings is increased while there is no reduction of litigation costs in *Period 2*, and therefore efficiency must be reduced. For this reason, introducing precedent is undesirable when the DSB is sufficiently informed.

Next we consider the impact of changes in the discount factor  $\delta$ . For the purposes of this exercise we assume that  $c^{all}$  is sufficiently small.<sup>33</sup> We find that, if  $q$  lies in an intermediate range, precedent-setting is desirable if governments are sufficiently impatient, but that it is harmful if governments are sufficiently patient:

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<sup>33</sup>This assumption serves to rule out “pathological” cases due to the discreteness of the state space. An alternative way to ensure the result would be to assume that the dimensionality of the state space is sufficiently large (or that the state space is continuous). More explicitly, the condition we need is  $c^{all} < \frac{1}{p^2(\tilde{s})} \sum_{s \neq \tilde{s}} p^2(s) q k(s) |\Gamma(s)|$ , where  $\tilde{s}$  is the first state in which a dispute arises as  $q$  increases from zero. Note that this condition may well be less restrictive than (and hence implied by) condition (3.1); and this will certainly be the case if the dimensionality of the state space is sufficiently large.

**Proposition 4.** *There exists an intermediate range of  $q$  such that, for a given activist DSB role ( $g$  or  $i$ ), it is optimal to give the DSB precedent-setting authority if  $\delta$  is sufficiently low, while it is preferable not to do so if  $\delta$  is sufficiently high.*

The intuition for the finding reported in Proposition 4 is simple. If  $q$  is either sufficiently low or sufficiently high, we know from Proposition 3 that introducing precedent is respectively undesirable or desirable regardless of the level of  $\delta$ . What Proposition 4 indicates is that, when  $q$  lies in an intermediate range, the level of  $\delta$  becomes decisive. In particular, when  $\delta$  is small, introducing precedent adds little additional impetus to initiate a dispute in *Period* 1, and hence the implied savings in future litigation costs dominate, making precedent attractive. On the other hand, a large  $\delta$  magnifies the additional impetus to initiate a dispute with the DSB that comes from the introduction of precedent, and this accentuates the efficiency-reducing impacts of a precedent-setting DSB to a sufficient degree that precedent becomes unattractive.

At a broad level, Proposition 4 suggests an interesting prediction. If  $\delta$  is viewed as incorporating the probability that the contracting parties will interact again in the future, our model suggests that legal precedent should be *less* prominent in settings where the relevant players are more likely to interact repeatedly in the legal system. We return briefly to this point in the Conclusion when we discuss the extent to which the insights of our model extend to a domestic legal setting.

In our working paper version we consider also the case of persistent shocks. We argue there that an increase in the degree of persistence has the same qualitative impact as an increase in  $\delta$ . Intuitively, when persistence is higher, the probability that the Period-1 state will occur again in Period 2 is higher, hence under a system of precedent it is more likely that today's DSB ruling will apply tomorrow as well. This amplifies the expected impact of today's actions on tomorrow's payoffs, and hence it has similar effects as increasing  $\delta$ .

## 4. Conclusion

In this paper we examine the potential roles that an international court such as the WTO-DSB can play in a trade agreement. In particular, we analyze the implications of different degrees of court activism, and whether the court should have authority to set precedent for future rulings. Our main findings are the following: (i) The optimal DSB mandate moves from a non-activist role to an interpretive role to a gap-filling role as the quality of the DSB's information

increases. A “modification” role is never optimal in our framework. The beneficial impacts of the DSB tend to arise when DSB disputes remain off-equilibrium, whereas the occurrence of disputes tends to be associated with inefficient outcomes; as a consequence, the intensity of DSB use is not a good indicator of the performance of the institution. (ii) Selection effects can explain the observed “pro-trade bias” in WTO DSB rulings, if the litigation costs incurred by the complainant are high relative to those of the defendant. But the same conditions imply an “anti-trade bias” in policy outcomes. (iii) We highlight a novel, harmful effect of precedent, namely that it increases the frequency of disputes in the early stages of the institution. When trading off this effect with the more standard one that precedent leads to savings in expected future litigation costs, we find that precedent tends to be beneficial when the quality of the DSB’s information is low, and when governments have a high discount rate.

We conclude with a brief discussion of three issues from which our model has abstracted.

We have abstracted from two possible ways in which the DSB might extract further information about the joint gains from protection  $\Gamma(s)$ . First, the DSB might try to infer the value of  $\Gamma(s)$  from the governments’ choice of contract. But we note here that the governments’ choice of contract can convey little information about the sign of  $\Gamma$  for the specific state of the world *ex post* when the dispute arises, since the contract is chosen *ex-ante*, before the state of the world is observed. Also, the governments’ filing behavior is likely to reveal little information about the sign of  $\Gamma$ , because as we have shown, filing occurs both when  $s \in \sigma^P$  and when  $s \in \sigma^{FT}$ . Consequently, the scope for this kind of inference on the part of the DSB is likely to be limited. Second, the DSB could in principle extract information from the governments through some form of “hearing” game, as for example in the models by Krishna and Morgan (2001) and Battaglini (2002). The results of these papers suggest that, if the governments have conflicting interests, as in our model, the DSB may be able to elicit some information from them, but is unlikely to learn the state with certainty. This suggests a reinterpretation of the signal observed by the DSB in our model: the signal can be thought of as incorporating the information that the DSB is able to extract from the hearings, and  $q$  can be interpreted as capturing the DSB’s residual uncertainty about  $\Gamma$  after the hearings.

A second issue concerns the enforcement of agreements. We have assumed that the DSB is able to enforce the obligations stipulated in the agreement, as well as its own rulings in case of a dispute. But in reality the DSB does not have direct enforcement power. This raises a natural question: Can there still be a contract-completing role for the DSB in a world of self-

enforcing agreements? And can the results of the model be re-interpreted in a meaningful way within such a world? We believe that the main ideas of our paper are relevant even from the perspective of self-enforcing agreements, provided that they are re-interpreted in the broader context of a multi-country setting in which the DSB serves to muster enforcement power from third countries by transmitting information to them.

To see why, consider a world with  $N$  countries, and focus on a given bilateral relationship, say the one between countries A and B. The standard way to think about self-enforcing agreements is to consider a repeated game played by two or more governments. If A and B are sufficiently patient, they will be able to enforce the first-best outcome simply by the threat of bilateral retaliation, without the need for a formal (complete or incomplete) contract of any kind. But if A and B are relatively impatient, so that they are not able to enforce the first-best policies with bilateral retaliation alone, they may benefit from the involvement of third countries in the enforcement process: to the extent that third countries can credibly threaten to inflict some punishment in case of violation, A and B may be able to sustain more efficient policies. Is there a potential contract-completing role for the DSB in this setting? Not necessarily. If all  $N$  countries have symmetric information, then again there is no clear role for a formal contract, let alone a DSB that fills gaps or interprets this contract. But suppose now that, while A and B know the first-best levels for their bilateral policies, third countries do not. In this case, a role for a formal (written) contract and for a contract-completing institution *can* arise. A formal contract that stipulates obligations between A and B is a way to inform third parties of what A and B would like to enforce – which third countries are not otherwise able to infer because they do not know A and B’s true preferences. And if it is too costly to write a complete contract, then a role for a DSB that helps complete the incomplete contract may arise: the DSB’s role would be to transmit its own (imperfect) guess of the first-best policy to third countries, so that third countries can lend (off-equilibrium) enforcement power to countries A and B.

The final issue is whether our model of trade agreements can be interpreted to apply more broadly to other legal settings. Do the same insights extend to the optimal design of the role of courts more generally? We believe that a similar model could be applied to other types of *international* agreements, but it is less clear whether the insights of the paper can be applied directly to the design of domestic legal institutions, for two main reasons. First, our assumption that ex-post transfers are not available is not realistic in a domestic setting; the use of monetary compensation as both a settlement tool and a legal remedy is pervasive in domestic settings.



Second, trade agreements involve a small number of players (the governments) who interact repeatedly, while in most domestic settings there are many “small” players (the individuals), who utilize the court system only rarely. This difference can itself produce very different implications. Consider for example the role of precedent. A key insight of our model is that precedent has the harmful effect of increasing the frequency of litigation early on, and this effect arises because of the repeated nature of the interaction among governments. As we discuss in section 3, in a domestic setting this consideration is likely to have less weight. This suggests that legal precedent would be more likely to be desirable in a domestic setting than in an international setting. For these reasons, we believe that our model would have to be substantially modified before it can be fruitfully applied to the analysis of domestic legal systems. We see this as an ambitious and important area for future research.

## 5. Appendix

**Proof of Remark 1:** We will prove that the equilibrium frequency of disputes is (weakly) higher under  $D_g^P$  than under  $D_g$ . The proof of the statement concerning  $V_i^P$  and  $V_i$  is analogous.

We work backwards through time. Denote the *Period-1* realized state by  $s'$ . Observe first that, if there is no *Period-1* filing, then *Period 2* behaves like the static model under  $D_g$  for all  $s$ . If instead there is a *Period-1* filing with associated *Period-1* DSB ruling  $\tau_1^{DSB}(s')$ , then in *Period 2* the contract specifies  $\tau_2(s') = \tau_1^{DSB}(s')$  and the DSB has no active role for  $s = s'$ , while for  $s \neq s'$ , *Period 2* behaves exactly like the static model under  $D_g$ .

Now consider *Period 1*. The exporter government files a complaint if and only if  $\tau = P$  and the expected benefit of filing exceeds the cost of filing. Denote by  $B_P^E(s')$  the expected *Period-2* value to the exporter of the precedent that would be set by a DSB ruling, conditional on the realized *Period-1* state  $s'$  (but before the filing decision is made and the *Period-1* ruling is known). Then the exporter files a complaint in *Period 1* if and only if  $\tau = P$  and

$$\Pr(\text{DSB ruling is } FT \mid s') \cdot |\gamma^*(s')| + \delta B_P^E(s') > c^*. \quad (\text{F1})$$

It can be shown that the term  $B_P^E(s')$  can be written as

$$B_P^E(s') = \begin{cases} p(s') \cdot c^* & \text{if } s' \in \hat{\sigma}^P \cup \hat{\sigma}^{FT} \\ p(s') \cdot [qk(s')|\gamma^*(s')|] & \text{if } s' \in \sigma^P \setminus \hat{\sigma}^P \\ -p(s') \cdot [qk(s')|\gamma^*(s')|] & \text{if } s' \in \sigma^{FT} \setminus \hat{\sigma}^{FT}. \end{cases} \quad (5.1)$$

where the sets  $\hat{\sigma}^{FT}$  and  $\hat{\sigma}^P$  are as defined in the static model of section 2. To understand this expression, observe first that precedent is only relevant if the *Period-2* state realization is also  $s'$ , which occurs with probability  $p(s')$ . This explains why each term on the right-hand-side is multiplied by  $p(s')$ . For  $s' \in \hat{\sigma}^P \cup \hat{\sigma}^{FT}$ , the exporter would have filed in *Period 2* if not for the precedent created by the *Period-1* DSB ruling, and so the exporter saves the *Period-2* litigation cost  $c^*$ . For  $s' \in \sigma^P \setminus \hat{\sigma}^P$ , the exporter would not have filed in *Period 2* and the importer would have chosen  $\tau = P$ , so the exporter enjoys a *Period-2* benefit of  $|\gamma^*(s')|$  from the precedent created by the *Period-1* DSB ruling provided the ruling is in error, which happens with probability  $qk(s')$ . Finally, for  $s' \in \sigma^{FT} \setminus \hat{\sigma}^{FT}$ , the exporter would not have filed in *Period 2* and the importer would have chosen  $\tau = FT$ , so the exporter suffers a *Period-2* loss in the amount  $\gamma^*(s')$  from the precedent created by the *Period-1* DSB ruling if the ruling is in error, which happens with probability  $qk(s')$ .

Next consider the importer government's *Period-1* policy choice. Denote by  $B_{\mathcal{P}}^M(s')$  the expected *Period-2* value to the importer, given the realized *Period-1* state  $s'$ , of the precedent set by a DSB ruling. The importer chooses  $\tau = P$  if either (F1) fails or if (F1) holds and the expected benefit from choosing  $P$  exceeds the cost of a DSB dispute:

$$\Pr(\text{DSB ruling is } P \mid s') \cdot \gamma(s') + \delta B_{\mathcal{P}}^M(s') > c. \quad (\text{P1})$$

It can be shown that the term  $B_{\mathcal{P}}^M(s')$  can be written as

$$B_{\mathcal{P}}^M(s') = \begin{cases} p(s') \cdot c & \text{if } s' \in \hat{\sigma}^{FT} \cup \hat{\sigma}^P \\ p(s') \cdot [qk(s')\gamma(s')] & \text{if } s' \in \sigma^{FT} \setminus \hat{\sigma}^{FT} \\ -p(s') \cdot [qk(s')\gamma(s')] & \text{if } s' \in \sigma^P \setminus \hat{\sigma}^P. \end{cases} \quad (5.2)$$

This expression has an analogous interpretation to that described above for  $B_{\mathcal{P}}^E(s')$ .

We can now derive the equilibrium *Period-1* actions of the governments under  $D_g^{\mathcal{P}}$ :

1. For  $s \in \sigma^{FT}$ : if  $qk(s) < \frac{c}{(1+\delta p(s))\gamma(s)}$  then  $\tau_1 = FT$  and the DSB is not invoked in *Period 1*; if instead  $qk(s) > \frac{c}{(1+\delta p(s))\gamma(s)}$  then  $\tau_1 = P$  and the DSB is invoked in *Period 1*.
2. For  $s \in \sigma^P$ : if  $qk(s) < \frac{c^*}{(1+\delta p(s))|\gamma^*(s)|}$  then  $\tau_1 = P$  and the DSB is not invoked in *Period 1*; if instead  $qk(s) > \frac{c^*}{(1+\delta p(s))|\gamma^*(s)|}$  then  $\tau_1 = P$  and the DSB is invoked in *Period 1*.

It is now direct to compare the *Period-1* equilibrium actions under  $D_g^{\mathcal{P}}$  and under  $D_g$  (as described in section 2), and conclude that the number of states in which a dispute is triggered is (weakly) larger under  $D_g^{\mathcal{P}}$ . The claim follows. **QED**

### Proof of Proposition 3:

Let us first focus on the  $D_g$  and  $D_g^{\mathcal{P}}$  institutions. Using the assumption that  $k(s) = 1/2$  for all  $s$ , define  $\hat{\sigma}_{\mathcal{P}}^{FT}$  as the set of states  $s$  such that  $s \in \sigma^{FT}$  and  $\frac{q}{2}(1 + \delta p(s))\gamma(s) > c$ , and  $\hat{\sigma}_{\mathcal{P}}^P$  as the set of states  $s$  such that  $s \in \sigma^P$  and  $\frac{q}{2}(1 + \delta p(s))|\gamma^*(s)| > c^*$ . Thus,  $\hat{\sigma}_{\mathcal{P}}^{FT}$  is the set of states for which (i)  $FT$  is efficient and (ii) in *Period 1* there is a dispute in equilibrium under  $D_g^{\mathcal{P}}$ . And  $\hat{\sigma}_{\mathcal{P}}^P$  is the set of states for which (i)  $P$  is efficient and (ii) in *Period 1* there is a dispute in equilibrium under  $D_g^{\mathcal{P}}$ . The set of states where *Period-1* filing occurs under  $D_g$  is then  $\hat{\sigma} = \hat{\sigma}_{\mathcal{P}}^P \cup \hat{\sigma}_{\mathcal{P}}^{FT}$ , and the set of states for which *Period-1* filing occurs under  $D_g^{\mathcal{P}}$  but not under  $D_g$  is  $\hat{\Delta} = (\hat{\sigma}_{\mathcal{P}}^P \cup \hat{\sigma}_{\mathcal{P}}^{FT}) \setminus (\hat{\sigma}_{\mathcal{P}}^P \cup \hat{\sigma}_{\mathcal{P}}^{FT})$ .

Now refer to the expression (3.2) for  $L(D_g^{\mathcal{P}}) - L(D_g)$ , and note first that, if  $q = 0$ , the sets  $\hat{\Delta}$  and  $\hat{\sigma}$  are both empty, and hence  $L(D_g^{\mathcal{P}}) - L(D_g) = 0$ . As  $q$  increases from zero, the first of these two sets to become non-empty is  $\hat{\Delta}$ , and hence  $L(D_g^{\mathcal{P}}) - L(D_g) > 0$ . To see this, note

that  $\hat{\Delta}$  is the set of states  $s$  such that either (i)  $s \in \sigma^{FT}$  and  $\frac{c}{q(1+\delta p(s))} < \frac{\gamma(s)}{2} < \frac{c}{q}$ , or (ii)  $s \in \sigma^P$  and  $\frac{c^*}{q(1+\delta p(s))} < \frac{|\gamma^*(s)|}{2} < \frac{c^*}{q}$ , while the set  $\hat{\sigma}$  is the set of states  $s$  such that either (i)  $s \in \sigma^{FT}$  and  $\frac{\gamma(s)}{2} > \frac{c}{q}$ , or (ii)  $s \in \sigma^P$  and  $\frac{|\gamma^*(s)|}{2} > \frac{c^*}{q}$ . As  $q$  increases from zero, the thresholds  $\frac{c}{q(1+\delta p(s))}$  and  $\frac{c}{q}$  drop down from infinity. It is clear from inspection of the inequalities above that the first set to become nonempty is  $\hat{\Delta}$ .

Next note that, if  $q = 1$ , filing occurs for all states both in the presence and in the absence of precedent, and therefore  $\hat{\sigma}$  includes all states and  $\hat{\Delta}$  is empty, and hence  $L(D_g^P) - L(D_g) < 0$ . It is then a small step to prove that the introduction of precedent is beneficial if  $q$  is sufficiently close to one, while it is harmful (or has no effect) if  $q$  is sufficiently close to zero.

Next focus on the comparison between  $V_i$  and  $V_i^P$ . Let  $\tilde{\sigma}^{FT}$  be the set of states  $s$  such that  $s \in \sigma^{FT} \setminus \mathbf{s}^{crisp}$  and  $\frac{\gamma(s)}{2} > \frac{c}{q}$ , and  $\tilde{\sigma}^P$  the set of states  $s$  such that  $s \in \sigma^P \setminus \mathbf{s}^{crisp}$  and  $\frac{|\gamma^*(s)|}{2} > \frac{c^*}{q}$ . These are the analogs of the sets  $\hat{\sigma}^P$  and  $\hat{\sigma}^{FT}$  that we defined in section 2 for the  $D_g$  institution. Also, let  $\tilde{\sigma}_P^{FT}$  be the set of states  $s$  such that  $s \in \sigma^{FT} \setminus \mathbf{s}^{crisp}$  and  $\frac{q}{2}(1 + \delta p(s))\gamma(s) > c$ , and  $\tilde{\sigma}_P^P$  the set of states  $s$  such that  $s \in \sigma^P \setminus \mathbf{s}^{crisp}$  and  $\frac{q}{2}(1 + \delta p(s))|\gamma^*(s)| > c^*$ . Clearly, the set of states where *Period-1* filing occurs under  $V_i$  is  $\tilde{\sigma} = (\tilde{\sigma}^P \cup \tilde{\sigma}^{FT})$ , and the set of states for which *Period-1* filing occurs under  $V_i^P$  but not under  $V_i$  is given by  $\tilde{\Delta} = (\tilde{\sigma}_P^P \cup \tilde{\sigma}_P^{FT}) \setminus (\tilde{\sigma}^P \cup \tilde{\sigma}^{FT})$ . Following similar steps as the ones for  $D_g$  and  $D_g^P$ , one can establish again that the introduction of precedent is beneficial if  $q$  is sufficiently close to one, while it is harmful (or has no effect) if  $q$  is sufficiently close to zero. **QED**

#### Proof of Proposition 4:

We prove the claim for  $L(D_g^P) - L(D_g)$ ; an analogous argument applies for  $L(V_i^P) - L(V_i)$ . The key observations are: (i) when  $\delta = 0$ , the set  $\hat{\Delta}$  is empty; and (ii) the set  $\hat{\sigma}$  is independent of  $\delta$ , while the set  $\hat{\Delta}$  is weakly increasing in  $\delta$  and as  $\delta \rightarrow \infty$  the set  $\hat{\Delta}$  includes all states  $s$  that are not in  $\hat{\sigma}$ . Consider the case where  $q$  lies in an intermediate range, so that the set  $\hat{\sigma}$  is non-empty but sufficiently small (e.g. contains a single state). When  $\delta = 0$ , we have by (i) that  $\hat{\Delta}$  is empty, and so (3.2) implies  $L(D_g^P) = L(D_g)$ ; for  $\delta > 0$  but sufficiently small so that  $\hat{\Delta}$  remains empty, (3.2) implies  $L(D_g^P) < L(D_g)$ , because the first two terms on the right-hand-side of (3.2) are zero and the third term is strictly negative; and for  $\delta \rightarrow \infty$ , we have by (ii) that  $\hat{\Delta}$  includes all states  $s$  that are not in  $\hat{\sigma}$ , and so (3.2) implies  $L(D_g^P) > L(D_g)$  if  $c^{all}$  is sufficiently close to zero. We can conclude that introducing precedent is desirable if  $\delta$  is sufficiently low, but is undesirable if  $\delta$  is sufficiently high. **QED**

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# Figure 1

