Dispute Settlement with Second-Order Uncertainty: The Case of International Trade Disputes

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Abstract

The literature on pretrial dispute settlement has studied the effect of first-order uncertainty on pre-trial settlement bargaining while assuming away any uncertainty about higher-order beliefs. We propose a settlement bargaining model in which one player receives a private and noisy signal of another player’s private type, thereby generating second-order uncertainty. We find that a private signal improves the efficiency of settlement bargaining. However, if the noisy signal of types is publicly observable, thereby eliminating the second-order uncertainty, the informational value associated with the signal of types completely disappears.

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1 Introduction

Pre-trial dispute settlement has been often studied in the economics literature as a bargaining game under asymmetric information. The information asymmetry considered in the literature is limited to the uncertainty about the first-order beliefs, while higher-order beliefs are assumed to be common knowledge. In particular, it is commonly assumed that each disputing party possesses private information about its type (determining its belief of court outcomes) while the distribution of types is commonly known to both parties.  

Our objective in this paper is to propose a model of pre-trial dispute settlement bargaining under higher-order uncertainty. To this end, we analyze a settlement bargaining game in which one player receives a private and noisy signal of another player’s private type, thereby generating second-order uncertainty. In particular, we study a game of bilateral bargaining over actions in which (i) the outcome of litigation depends on the private type of one the parties and (ii) the uninformed party receives a noisy private signal about the informed party’s type.

The Dispute Settlement Process (DSP) of the World Trade Organization is an example of bargaining under asymmetric information with higher-order uncertainty. The obligations of an importing country under the WTO are contingent on its domestic political economy conditions, which are likely to be the private information of the importing government. Other governments, however, could also conduct their own investigations and receive informative signals about the importing country’s political economy conditions. These signals, which are potentially the private information of the investigating governments, creates second-order uncertainty in the pre-trial dispute settlement game.

We model the pretrial settlement negotiation of a WTO trade dispute as a signaling game between a complaining government and a defending government.

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1There is a growing literature, including Bergemann and Morris (2009), Chen et al. (2017), Morris et al. (2016), that analyzes the effect of higher order beliefs and associated uncertainty on games and mechanism design problems. The literature on pretrial settlement, however, has not explored such an issue. For a comprehensive review of the literature on litigation and pretrial settlement see Daughety and Reinganum (2017) and Spier (2007).

2Our study is distinct from the literature on two-sided private information. Schweizer (1989) assumes that each disputing party receives an independent signal about the probability of its success in the court. Daughety and Reinganum (1994) also propose a dispute settlement model with two-sided imperfect information under which the complainant is privately informed about the extent of damages incurred, and the defendant is privately informed about the likelihood of being found liable for damages in the court. In both of these studies, the distribution of types is common knowledge and thus no second-order uncertainty exists.
with the following structure.\(^3\) At the beginning of the game the defendant observes its type (i.e., facing either high or low protectionist pressure) and the complainant receives a noisy signal about the defendant’s type. The defendant then proposes a settlement offer, which may be accepted or rejected by the complainant. In the case of rejection, the case is litigated, with the outcome of court ruling being uncertain: The defendant with high protectionist pressure would expect a more favorable outcome than the one with low protectionist pressure but the court outcome is still uncertain as the court ruling is based on its own noisy signal of the defendant’s protectionist pressure.

We follow the literature on trade agreements by assuming that intergovernmental transfers are usually in the form of policy adjustments, such as a bilateral change in the level of protection, rather than cash transfers. This assumption reflects some realities about international relations. First, transferring cash among governments involves both political and public finance costs, which reduces its appeal as a compensation mechanism. Moreover, in response to violation of their rights in an international agreement, governments normally seek compensations through withdrawal of concessions previously granted to the defecting government.\(^4\) This self-help method of receiving compensation may reflect the fact that the defecting country, being a sovereign state, cannot be coerced to compensate the injured government.\(^5\)

This paper is closely related to the recent literature on dispute settlement in the WTO. In particular, Beshkar (2010b, 2016), Park (2011), and Maggi and Staiger (2015, ming, 2017) study the role of the WTO as a public signaling device that reveals some useful—albeit imperfect—information about the type or action of the defending party.\(^6\) A question has been hovering over these studies: How would the value of the court as a public signaling device change if we consider

\(^3\)We also model the settlement negotiations as a screening game under which the uninformed party (i.e., the complainant in our model) makes a settlement offer. We find that in a screening game, the second-order uncertainty does not play any role. The best offer strategy of the complainant depends only on the probability that the defendant is a strong type conditional on its signal, which is unaffected by whether its signal is private or public.

\(^4\)In section 2, we discuss a case from the WTO in which a party withdrew its concessions in response to an initial violation by a trading partner.

\(^5\)Bagwell and Staiger (2005) show that when cash transfer is possible, the governments could implement the first-best outcome by requiring a proper amount of cash transfers as a price for imposing a contingent tariff.

\(^6\)Another related paper is Maggi and Staiger (2011) in which the DSB is modeled as an arbitrator that interprets ambiguous obligations, fills gaps in the agreement, and modifies rigid obligations. See Park (2016) for a comprehensive review of the recent literature on trade disputes and settlement.
the ability of the uninformed parties to conduct their own investigations to obtain an independent signal about the state of the world or the other party’s actions? This question is particularly interesting given that the disputing parties are most likely better equipped than the WTO arbitrators to monitor and extract information about the private type or actions of each other. Our study advances this line of research by shedding light on the impact of private monitoring conducted by the disputing parties.

Our main finding is related to the role of uncertainty about second-order beliefs on the likelihood and efficiency of settlement. Uncertainty about second-order beliefs depends on whether the noisy signal that the complaining party receives is publicly observable or not. If the signal is public—implying no uncertainty in second-order beliefs—then the signal has no bearing on the equilibrium of the game. The noisy signal becomes useful (by way of reducing the likelihood of litigation) if it is privately observed by the complaining party. This result is reminiscent of the anti-transparency result of Morris and Shin (2002), which will be discussed below.

For a general intuition for this result, note the difference between litigation strategy of the complaining party under private and public signals: If the signal is public, the defending country perceives the same risk of litigation regardless of its type. Put differently, a public signal only changes the common prior of the parties and, thus, have no impact on the set of separating equilibria. In contrast, if the defending country does not observe the signal received by the complaining party, then a low-type defending country faces a higher likelihood of litigation than a high-type defending country. This is precisely why a private signal could change (and improve) the equilibrium while a public signal has no effect on the equilibrium.

Our anti-transparency (i.e., anti-publicization of signals) result on the settlement of trade disputes contrasts with Park (2011)’s pro-public-monitoring result on the enforcement of international trade agreements. Using a repeated-game framework with imperfect monitoring of the potential use of concealed trade barriers, Park (2011) demonstrates that publicizing the imperfect private signal of potential deviations may facilitate a higher level of cooperation by relaxing the incentive constraint associated with utilizing imperfect private signals in invoking punishments.7

7Using a repeated game framework with incomplete information of potentially persistent political pressure for protection, Bagwell (2009) analyzes enforcement issues in trade agreements, demonstrating that a government facing a low political pressure may “pool” and apply its tariff at the bound rate, which is inefficiently high for her.
We find that a government with high protectionist pressure will propose tariff levels that are higher than the Pareto-efficient protection levels. Choosing such an inefficient action combination is more costly for a weak type than for a strong one, which enables the strong type to signal its type through such an offer, generating a fully separating equilibrium. The proposed tariff levels are possibly even higher than the ones that the Dispute Settlement Body (DSB) of the WTO would recommend when it finds evidence in favor of the defending government. This finding provides a new perspective on the observation that the DSB often rules against a defending government, recommending reduction or removal of the contingent protection. Our analysis suggests that even if the DSB finds that the prevailing situations legitimizes an increase in protection, it would order a cut in the protection level proposed by the defendant.

Our analysis also predicts that an improvement in the quality of the signal received by the complaining country will reduce the probability of litigation. In the extreme case where the complainant’s signal is completely accurate, pretrial bargaining always leads to a settlement. This theoretical finding is consistent with the evidence provided by Ahn, Lee, and Park (2014) who find a positive correlation between a proxy for information asymmetry and rate of litigation. The fact that the rate of the WTO disputes have decreased over time may also reflect a reduction in information asymmetry between the parties (i.e., an improved signal) after years of partnership.

Outside the literature on disputes and settlement, our anti-transparency result is related to that of Morris and Shin (2002) who show that an increase in the precision of public information may generate a detrimental effect on the overall welfare of the participants in a coordination game when each participant has access to private information. The public information in Morris and Shin (2002) serves as a coordination device among participants, creating the possibility of inducing a weight on the public information that is higher than the socially optimal level. In our signaling game of settlement bargaining, the public information eliminates

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8 As the receiver’s private signal of the sender’s type becomes increasingly accurate, the strong type’s equilibrium offer will approach a Pareto efficient action combination.
9 Sykes (2003) points out that the DSB has always ruled against the defending party in litigation regarding safeguard measures.
10 The number of WTO dispute cases decreased from 335 during its first 10 years (1995-2005) to 165 during the next 10 years (2006-2015). This decrease in the WTO disputes is even more surprising once we consider the steady expansion of the WTO membership from to 123 countries in 1995 to 162 countries in 2015, including major ones, such as China (2001) and Russia (2012). As trading partners interact for a longer period, informational asymmetry between them will naturally decrease.
second-order uncertainty that enables the receiver to make its rejection threat contingent upon the information about fundamentals (i.e., the sender’s type), which in turn completely eliminates its informational value.

Our result that a public signal has no impact on the equilibrium is related to the analysis of Bagwell (1995). He shows that any level of noise in a follower’s observation of a first mover’s action can induce the follower to completely ignore its imperfect information in a pure strategy equilibrium, which in turn eliminates the first mover advantage. Public information without any noise will induce the players to utilize such information in our settlement bargaining game, eliminating the need for inefficient litigation in the equilibrium. In contrast to the game analyzed by Bagwell (1995), the noisy information of the follower (settlement offer recipient) retains its informational value as long as it generates second-order uncertainty to the first mover (settlement offer maker).

Applying mechanism design to international conflict resolution, Hörner, Morelli, and Squintani (2015) demonstrate how a mediator without enforcement power can replicate the welfare outcome of an optimal settlement mechanism that utilizes an arbitrator with enforcement power. Under their model, the mediator overcomes its lack of enforcement power by choosing a recommendation strategy that does not reveal the type of a weak player to a strong player. This restrains the strong player’s incentive for fighting against the weak one. One could interpret the optimality of uncertainty in the mediator’s recommendation as optimality of second order uncertainty as we find in this paper.

In terms of informational structure, Feinberg and Skrzypacz (2005) analyze a similar bargaining game in which a seller has private information about his beliefs about the buyer’s private valuation (i.e., type), thus entailing second-order uncertainty. This second-order uncertainty creates a surprising result that delay in bargaining occurs even when a rational seller makes frequent offers to a rational buyer with common knowledge of gains from trade, thus generating a result that does not follow the “Coase property.”

Section 2 provides a brief description of the WTO’s dispute settlement system and a WTO dispute case. Section 3 describes the basic setup of our model.

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11Maggi (1999) demonstrates that the strategic value of commitment (e.g., moving first) is restored even with imperfect observability of commitment when a leader has private type information. As the optimal leader action depends on her type, the follower has an incentive to utilize even its imperfect information of the leader’s action, restoring at least a certain value of commitment. Although our settlement bargaining game also analyzes the situation in which the first mover (a defendant who makes a take-or-leave offer) has private type information, the follower’s noisy information is not about the first mover’s action but about her type.
In Section 4, we analyze the pretrial settlement bargaining as a signaling game with private noisy signals. In Section 5, we analyze the signaling game under the assumption that the noisy signal received by the complaining party is publicly observable. In Section 6, we analyze the pretrial settlement bargaining as a screening game. We provide some concluding remarks in Section 7.

2 WTO Dispute Settlement System and a Dispute Case

WTO gives its member governments the right to raise their protection level contingent upon realizing a certain condition that warrants protection.\textsuperscript{12} With regard to the condition that justifies the need for protection, however, trading partners may disagree, thus, leading to a trade dispute. If disputing parties fail to settle, then the DSB of WTO provides its ruling on the disputed case and possibly authorizes a complainant’s compensatory/retaliatory protection against a defendant who refuses to follow its ruling. When a defending government has private information of her condition, i.e., her type, and a complaining government receives a noisy private signal of the defendant’s type, then their trade dispute becomes the settlement bargaining game with second-order uncertainty described above.

WTO underscores the rule of law by requiring unanimous voting of all member countries to overturn the recommendation of a third-party panel (and possibly the report of the Appellate Body on the appealed recommendation of a panel). By contrast, WTO also strongly emphasizes settling disputes through consultations as its priority. As stated in the WTO’s official website, “... the point is not to pass judgment. The priority is to settle disputes, through consultations if possible. By January 2008, only about 136 of the nearly 369 cases had reached the full panel process. Most of the rest have either been notified as settled ‘out of court’ or remain in a prolonged consultation phase - some since 1995.” Of the economic importance of trade disputes filed to the WTO dispute settlement procedure, Bown and Reynolds (2015) find that the value of imported goods subject

\textsuperscript{12}Various types of contingent protection are allowed under the WTO regime. They can be safeguard measures, anti-dumping measures, countervailing duties against export subsidies, or even general exceptions to General Agreement of Tariffs and Trade (GATT, the agreement prior to the WTO, that remains a central part of the WTO regime) obligations. These general exceptions are given based on two articles, Article XX to protect public morals, human, animal, or plant life or health, international intellectual property rights, and etc., and Article XXI to protect national security. Sykes (2016) provides a comprehensive description of these contingent protection measures and other aspects of legal obligations of WTO.
to the WTO disputes from 1995 to 2011 is almost $1 trillion, an average of $55 billion per year, or equivalently about 0.5 percent of world imports in 2011. Given that only a small portion of trade disputes ends up being filed to WTO, a much bigger percentage of world imports must be under trade disputes, implying that trade disputes and settlements affect a sizable portion of the world trade.

For concrete understanding of trade disputes and settlements, we provide a detailed discussion of the WTO dispute case number 235. (For empirical analyses of the WTO dispute settlement process, see Beshkar and Majbouri 2016; Bown 2004; Bown and Reynolds 2017.) Poland filed a consultation request on July 11, 2001, claiming that Slovakia had imposed a safeguard measure on imports of sugar in a manner inconsistent with the obligations under the Agreement on Safeguards, with the following statement as one of her key claims in the consultation request document:

“No document presented, including notifications to the SG Committee under Article 12, contained analyses on causal link between increased imports and serious injury to the domestic industry or factor other than imports which might have caused injury.”

A safeguard measure is justifiable if a causal link between increased imports and serious injury to the domestic industry exists, upon which disputing parties may disagree.\(^\text{13}\) With regard to the strength of this case, the defending government is likely to have some private information, such as assessment of the degree of damages to her domestic firms’ profitability caused by increased imports. Public revelation of such private information can be costly, as discussed in the introduction. A complaining government may also have a noisy and private signal of the causal link that is provided by her own domestic exporting firms to persuade her to file a dispute case to the WTO. As reported by the WTO, the outcome of this dispute was a mutually agreed solution as follows:

“On 11 January 2002, the parties notified the DSB that they have reached a mutually agreed solution within the meaning of Article 3.6 of the DSU. Accordingly, Slovakia agreed to a progressive increase of the level of its quota of imports of sugar from Poland between 2002 and 2004, and Poland agreed to remove its quantitative restriction on imports of butter and margarine. Both parties agreed to implement the above by 1 January 2002.”

This report demonstrates that a settlement is achieved by exchanging desired

\(^{13}\)Beshkar and Bond (2016) provide a literature review of studies on safeguard measures in the WTO and other trade agreements.
trade policies among disputing parties. We may interpret this settlement as an exchange of temporary protection policies.

3 Basic Setup

To analyze a settlement bargaining game between a defendant (D) and a complaint (C) that occurs before proceeding to litigation with uncertain outcomes, this section describes general properties of payoff functions, distribution of D’s types (θ), and C’s noisy signal of D’s types (θC).

Payoff Functions

Defendant’s payoff function, \( W_D((\tau, r); \theta) \), is increasing (decreasing) in \( \tau \) (\( r \)) at \( \tau = 0 \) (\( r = 0 \)), and is concave in \( \tau \). Moreover, \( W_{D\theta} > 0 \).

Complainant’s payoff function, \( W_C((\tau, r)) \), is decreasing (increasing) in \( \tau \) (\( r \)) at \( \tau = 0 \) (\( r = 0 \)), and is concave in \( r \).

The joint payoff, \( W_J((\tau, r); \theta) = W_D((\tau, r); \theta) + W_C((\tau, r)) \), is increasing in \( \tau \) at \( \tau = 0 \) iff \( \theta > 0 \). For \( \theta = 0 \), \( W_{J\theta}((\tau, r); \theta) < 0 \). Moreover, \( W_{J\theta} > 0 \).

In the context of trade disputes, the above payoff functions reflect a situation in which D and C bilaterally trade goods in two competitive sectors, of which each country has a comparative advantage in one of two sectors. Each government can impose an import tariff to manipulate its terms of trade in its favor and/or to protect her import-competing sector due to her domestic pressure for protection. In such a case, \( \tau \) and \( r \) denote D’s and C’s import tariff, respectively. \( \theta \) represents a random domestic for protection that D faces, of which C receives a noisy signal, \( \theta^C \). \(^{14}\) \( W_{D\theta} > 0 \) reflects that that D’s incentive to raise \( \tau \) increases as it is subject to a higher pressure protection (a higher \( \theta \)). Although raising \( \tau \) is a costly way to transfer payoff from D to C (by changing the term of trade with some distortionary

\(^{14}\)An increase in domestic pressure for protection may come from various random factors, such as public concerns about safety of imported products and a sudden import increase that threatens injury to domestic import-competing firms. In modeling such random pressure for protection, existing studies on contingent protection often assume, à la Baldwin \( (1987) \), that each government maximizes a weighted sum of its producer surplus, consumer surplus, and tariff revenues, possibly with a higher weight on the surplus of its import-competing sector. Grossman and Helpman \( (1994) \) demonstrate that the higher weight given to the import-competing sector may be the result of political pressure, through lobbying for example, that a government faces. \( \theta \) may denote the political weight on the import-competing sector. Although we utilize such a political economy model in our numerical analysis of Section 4, \( \theta \) can be any factor representing domestic pressure for protection that may necessitate contingent protection, of which a foreign government a noisy signal, \( \theta^C \).
losses) with $W^J_t((\tau, r); \theta = 0) < 0$, $W^J_{\tau \theta} > 0$ reflects the desirability of allowing a higher import tariff in response to a higher pressure for protection, even from the joint-payoff point of view. The absence of non-costly transfers, which we assume here, is common in inter-governmental agreements or settlement. This non-transferable utility assumption naturally leads to incentives to settle a dispute due to risk aversion against uncertain outcomes of litigation, which we assume below.

Regarding a possible protectionist pressure that may affect $C$’s import tariff choice, $r$, we assume that it is constant and known across governments. This assumption enables us to focus on uncertain types of $D$ as the source of informational asymmetry across countries, which in turn may block governments from choosing collectively efficient actions. $r$ may play a role in settlement bargaining because it enables $C$ to affect $D$’s payoff as well as its own, thus possibly affecting the settlement outcome, especially based on her noisy signal of $D$’s type.

**Distribution of $\theta$ and the noisy signal received by $C$**

$\theta$ can take one of two values, low ($l$) and high ($h$) with probability of $1 - \rho$ and $\rho$, respectively. Let $t^N(\theta)$ and $t^E(\theta)$ represent a Nash tariff pair $(\tau^N(\theta), r^N(\theta))$ and an efficient (joint-payoff-maximizing) tariff pair $(\tau^E(\theta), r^E(\theta))$ given $\theta$, respectively. We assume that $\tau^N(l) > \tau^E(h)$.\(^{15}\) $D_{\theta}$ denotes $D$ with $\theta \in \{l, h\}$.

$C$ receives a noisy signal of $\theta$, denoted by $\theta^C$, which is accurate with a probability of $\gamma$, namely,

$$\Pr\left(\theta^C = l | \theta = l\right) = \Pr\left(\theta^C = h | \theta = h\right) = \gamma.$$  

$C_{\theta^C}$ denotes $C$ with $\theta^C \in \{l, h\}$.

**DSB**

We assume that the disputing parties can resort to arbitration by the DSB if they fail to reach a mutually accepted solution in the consultation stage. We treat the DSB as a black-box that, if used, will result in outcomes that satisfy a set of conditions to be laid out below. We let $P_\theta$ denote the set of Pareto efficient tariff pairs, and $W^L_i(\theta)$ denotes the expected welfare of country $i = \{D, C\}$ from litigation if the true state of the world is $\theta$. Moreover, we define $t^\text{min}_l, t^\text{max}_l \in P_l$ and

\(^{15}\)This assumption simplifies the analysis by eliminating the possibility of tariff binding overhang under an optimal agreement. For an analysis of tariff binding overhang, see Beshkar et al. (2015); Beshkar and Bond (2017).
\( t^\text{min}_h, t^\text{max}_h \in P_h \) such that

\[
W^D(t^\text{min}_l; l) \equiv W^D_L(l), \quad W^C(t^\text{max}_l) \equiv W^C_L(l), \\
W^D(t^\text{min}_h; h) \equiv W^D_L(h), \quad W^C(t^\text{max}_h) \equiv W^C_L(h).
\]

We assume that the DSB rulings satisfy the following conditions:

1. \( C \) will strictly prefer an expected DSB ruling when \( \theta = l \) to an expected DSB ruling when \( \theta = h \). \( W^C_L(l) > W^C_L(h) \) or

\[
t^\text{max}_l \succ_C t^\text{max}_h.
\] (1)

2. \( D \) of any type will strictly prefer an expected court ruling when \( \theta = h \) to an expected court ruling when \( \theta = l \).

\[
t^\text{min}_l \preceq D_l t^\text{min}_h, \quad t^\text{min}_l \preceq D_l t^\text{min}_h.
\] (2)

3. Consider any incentive-compatible mechanism, \( t(\theta) \) such that \( t(l) \approx t(h) \) in the absence of \( C \)'s information of \( D \)'s type with \( \gamma = 0.5 \). The expected joint payoff is greater under litigation than under any such mechanism. Namely,

\[
(1 - \rho) \left[ W^C_L(l) + W^D_L(l) \right] + \rho \left[ W^C_L(h) + W^D_L(h) \right] >
\]

\[
(1 - \rho) \left[ W^C(t(l)) + W^D(t(l); l) \right] + \rho \left[ W^C(t(h)) + W^D(t(h); h) \right].
\] (3)

4. For any realization of \( \theta \), there are mutual gains from settlement in lieu of litigation, that is,

\[
\left( t^\text{min}_l \prec D_l t^\text{max}_l \right) \land \left( t^\text{min}_l \prec_C t^\text{max}_l \right),
\] (4)

and,

\[
\left( t^\text{min}_h \prec D_h t^\text{max}_h \right) \land \left( t^\text{min}_h \prec_C t^\text{max}_h \right).
\] (5)
Figure 1, in which $T^C(t)$ and $T^{D\theta}(t)$ denote the indifference curves of $C$ and $D_{\theta}$ that cross $t$ respectively, demonstrates the nature of settlement bargaining that we analyze. First, the efficient contractual arrangement is to assign $t = t^E(l)$ ($= t^E(h)$) if $\theta = l$ ($= h$). However, such arrangement is not incentive compatible because $D_l$ has an incentive to mimic $D_h$ with $W^{D}(t^E(h); l) > W^{D}(t^E(l); l)$. Figure 1 also demonstrates players’ incentives for settlement to avoid uncertain litigation outcomes. If $C$ knows that $\theta = h$, then any settlement that belongs to $\text{Conv}(T^{D_h}(t^\min_h), T^C(t^\max_h))$ is preferred by both $C$ and $D$, and similarly they prefer settlement in $\text{Conv}(T^{D_l}(t^\min_l), T^C(t^\max_l))$ if $C$ knows that $\theta = l$. Despite these incentives for settlement, the equilibrium of a pretrial settlement game may entail a positive probability of litigation due to the existence of asymmetric information, as demonstrated in the following analysis.

4 Signaling Game with a Private Noisy Signal

This section, along with Section 5, analyzes the settlement bargaining between $C$ and $D$ prior to litigation as a signaling game by assuming that $D$ proposes a settlement offer to $C$. Specifically, the sequence of events in the pretrial bargaining is as follows:

**Sequence of Events**

1. State of the world, $\theta$, is realized and observed privately by $D$.
2. $C$ receives a private noisy signal, $\theta^C$, such that $\Pr(\theta^C = \theta | \theta) = \gamma$. $D$ may not have access to this information (private noisy signal) or may have (public noisy signal).
3. $D$ proposes a tariff pair, $t^S \in (R^+, R^+)$, for settlement.
4. $C$ either accepts $t^S$, in which case a settlement is achieved and $t^S$ is implemented, or rejects $t^S$ and the dispute escalates to the DSB.

A strategy for $D_{\theta}$ prescribes a probability distribution $\alpha_{\theta}(t^S)$ over action $t^S$ for each type $\theta \in \{l, h\}$. A strategy for $C_{\theta^C}$ prescribes the probability that $C$ assigns for litigation in response to the offered action $t^S$ of $D$, denoted by $\beta_{\theta^C}(t^S) \in [0, 1]$ with $\theta^C \in \{l, h\}$. Given these notations for a strategy profile, we can define a Perfect Bayesian equilibrium (PBE) of this pretrial settlement game as follow:
**Definition 1.** The strategy profile \((\alpha_l(\cdot), \alpha_h(\cdot), \beta_l(\cdot), \beta_h(\cdot))\) is a PBE iff

1. [Incentives of \(C_j\)]
   
   (a) If \(0 < \beta_j(t^S) < 1\), then \(C_j\) is indifferent between settlement at \(t^S\) and litigation.
   
   \[
   0 < \beta_j(t^S) < 1 \\
   \Rightarrow W^C(t^S) = \Pr(\theta = l|\theta^C = j, t^S) W^C_L(l) + \Pr(\theta = h|\theta^C = j, t^S) W^C_H(h).
   \]

   (b) If \(\beta_j(t^S) = 1\) (\(\beta_j(t^S) = 0\)), then \(C_j\) at least weakly prefers litigation (settlement at \(t^S\)).

2. [Incentives of \(D_j\)] For any \(t^S\) for which \(0 < \alpha_j(t^S) < 1\), we should have
   
   \[
   t^S = \arg \max_i \left( [\gamma (1 - \beta_j(t)) + (1 - \gamma) (1 - \beta_i(t))] W^D(t; \theta = j) + [\gamma \beta_j(t) + (1 - \gamma) \beta_i(t)] W^D_L(j) \right),
   \]
   
   where \(i \neq j \in \{l, h\}\).

3. [Consistency of beliefs] If \(\alpha_l(t^S) > 0\) or \(\alpha_h(t^S) > 0\), then
   
   \[
   \Pr(\theta = l|\theta^C = l, t^S) = \frac{\Pr(t^S|\theta^C = l, \theta = l) \Pr(\theta^C = l, \theta = l)}{\Pr(\theta^C = l, t^S)} = \frac{\alpha_l(t^S) \gamma (1 - \rho) \alpha_l(t^S) \gamma (1 - \rho) + \alpha_h(t^S) (1 - \gamma) \rho}{\alpha_l(t^S) \gamma (1 - \rho) + \alpha_h(t^S) (1 - \gamma) \rho}
   \]

As in other signaling games, a set of PBEs of our pretrial bargaining game exist. We adopt Universal Divinity of Banks and Sobel (1987) as the refinement concept.

**Definition 2.** Denote \(D_h\)'s (\(D_l\)'s) expected equilibrium payoff by \(EW^{D_h}(EW^{D_l})\). Define \(B_h(t')\) and \(B_l(t')\) as a subset of best-response litigation strategies, \((\beta_l(t'), \beta_h(t'))\) of \(C\) on \(D\)'s of the-equilibrium settlement proposal, \(t'\), that respectively satisfies the following inequalities:

\[
[\gamma \beta_h(t') + (1 - \gamma) \beta_l(t')] W^D_L(h) + \{\gamma [1 - \beta_h(t')] + (1 - \gamma) [1 - \beta_l(t')]\} W(t', h) > EW^{D_h},
\]

\[
[(1 - \gamma) \beta_h(t') + \gamma \beta_l(t')] W^D_L(l) + [(1 - \gamma) [1 - \beta_h(t')] + \gamma [1 - \beta_l(t')]] W(t', l) > EW^{D_l},
\]
with $\bar{B}_h(t')$ and $\bar{B}_l(t')$ defined as a subset of best-response strategies of $C$ on $D$’s proposal, $t'$, that respectively satisfies the above inequalities with weak inequalities. For any off-the-equilibrium settlement proposal, $t'$, $C$ believes that $D_h$ ($D_l$) proposed $t'$ iff $B_h(t') \supset \bar{B}_l(t')$ ($B_l(t') \supset \bar{B}_h(t')$). A PBE of our dispute settlement game is universally divine iff it is supported by such belief of $C$ about any off-equilibrium proposal.

Although universal divinity defined above is a stronger refinement concept than divinity, we will refer a universally divine equilibrium as a divine equilibrium for simplicity.

In this section we assume that $C$ receives a noisy private signal of $D$’s type (thus, $C$’s signal remains private). Section 4.1 proves the existence of a Divine PBE of the pretrial bargaining game, in which a fully separating behavior by $D$ arises with $D_h$’s expected payoff being maximized. Then, Section 4.2 characterizes how the divine PBE changes in response to a change in the accuracy of $C$’s signal, $\gamma$.

### 4.1 Divine PBE

Prior to characterizing a Divine PBE, the two following lemmas limit the possible PBE strategies of $D$ and $C$.

**Lemma 1.** Under any separating PBE, i.e., $\exists t^S$ with $\alpha_l(t^S) > 0$ and $\alpha_h(t^S) = 0$, $t^S = t^{\text{max}}_l$ and $\beta_l(t^{\text{max}}_l) = \beta_h(t^{\text{max}}_l) = 0$.

*Proof.* See Appendix.

**Lemma 2.** Under any separating PBE, any $t^S (\neq t^{\text{max}}_l)$ with $\alpha_h(t^S) > 0$ and a positive settlement probability (i.e., $\beta_l(t^S)$ or $\beta_h(t^S) < 1$) belongs to $\text{Conv}(T^{D_h}(t^{\text{min}}_h), T^{C}(t^{\text{max}}_h))$.

*Proof.* See Appendix.

Among all possible separating PBEs, Lemmas 1 and 2 enable us to focus on separating PBEs in which $t^S = t^{\text{max}}_l$ with $\alpha_l(t^{\text{max}}_l) > 0$, $\alpha_h(t^{\text{max}}_l) = 0$, and $\beta_l(t^{\text{max}}_l) = \beta_h(t^{\text{max}}_l) = 0$, and $t^S (\neq t^{\text{max}}_l)$ with $\alpha_h(t^S) > 0$ belongs to $\text{Conv}(T^{D_h}(t^{\text{min}}_h), T^{C}(t^{\text{max}}_h))$ in Figure 1.16

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16Although Lemma 2 does not rule out the possibility of having a separating PBE in which
In any separating PBE, $D_l$ weakly prefers proposing $t_l^{\max}$ over proposing $t^S \in \text{Conv} \left( T^D_h \left( t_h^{\min} \right), T^C_h \left( t_h^{\max} \right) \right)$ with $\alpha_h \left( t^S \right) > 0$ according to Lemma 1; otherwise, $D_l$ engages in a pooling behavior with $\alpha_l \left( t_l^{\max} \right) = 0$. Under a separating PBE, the following incentive constraint of $D_l$ should hold:

\[
W^D \left( t_l^{\max}, l \right) \geq \left[ \gamma \beta_l \left( t^S \right) + (1 - \gamma) \beta_h \left( t^S \right) \right] W^D_L \left( l \right) + \left[ 1 - \gamma \beta_l \left( t^S \right) - (1 - \gamma) \beta_h \left( t^S \right) \right] W^D \left( t^S; l \right).
\]

(6)

In addition, $\beta_l \left( t^S \right) \in [0, 1]$ implies $\beta_h \left( t^S \right) > 0$, and $\beta_h \left( t^S \right) \in (0, 1]$ implies $\beta_l \left( t^S \right) = 1$ in any PBE equilibrium. This relationship between $\beta_l \left( t^S \right)$ and $\beta_h \left( t^S \right)$ comes from the following incentive conditions for $C$: for any $t^S$ with $\alpha_h \left( t^S \right) > 0$, if $C_l$ weakly prefers settlement over litigation, then $C_h$ will prefer settlement; if $C_h$ weakly prefers litigation over settlement, then $C_l$ will prefer litigation.

A divine PBE is a separating equilibrium that maximizes $D$’s expected payoff, as shown later. The following lemma narrows down the set of $t^S (\neq t_l^{\max})$ with $\alpha_h \left( t^S \right) > 0$ under such a separating PBE:

**Lemma 3.** Under a separating PBE that maximizes $D_h$’s expected payoff, any $t^S (\neq t_l^{\max})$ with $\alpha_h \left( t^S \right) > 0$ belongs to $T^C_h \left( t_h^{\max} \right)$.

**Proof.** See Appendix.

With Lemmas 2 and 3, finding $t^S (\neq t_l^{\max})$ with $\alpha_h \left( t^S \right) > 0$ under a separating PBE that maximizes the expected payoff of $D_h$ is reduced to solving the following

\[
t^S \notin \text{Conv} \left( T^D_h \left( t_h^{\min} \right), T^C_h \left( t_h^{\max} \right) \right) \text{ with } \alpha_h \left( t^S \right) > 0 \text{ and a zero settlement probability } (\beta_l \left( t^S \right) = \beta_h \left( t^S \right) = 1), \text{ a separating PBE exists, yielding } D_h \text{’s expected payoff that is strictly higher than } W^D_L \left( h \right), \text{ as shown later. This implies that } t^S \notin \text{Conv} \left( T^D_h \left( t_h^{\min} \right), T^C_h \left( t_h^{\max} \right) \right) \text{ with } \alpha_h \left( t^S \right) > 0 \text{ and } \beta_l \left( t^S \right) = \beta_h \left( t^S \right) = 1 \text{ will not be a part of a separating PBE strategy of } D_h \text{ that maximizes its expected payoff. Among PBEs, we are interested in characterizing a Divine PBE, and it is the one that maximizes } D_h \text{’s expected payoff among separating PBEs, as shown later.}

\footnote{This statement is not valid for $t^S \in T^C_h \left( t_h^{\max} \right)$ with $\alpha_h \left( t^S \right) > 0$ and $\alpha_l \left( t^S \right) = 0$ because $C$ is indifferent between litigation and settlement for such $t^S$ regardless of her private signal. However, there is no loss of generality in focusing on $\beta_l \left( t^S \right)$ and $\beta_h \left( t^S \right)$ that satisfy these conditions for our analysis of a divine PBE. As shown below, a Divine PBE is a PBE that maximizes the expected payoff of $D_h$, and such a Divine PBE needs to satisfy these conditions even for $t^S \in T^C_h \left( t_h^{\max} \right)$ with $\alpha_h \left( t^S \right) > 0$ and $\alpha_l \left( t^S \right) = 0.$}
maximization problem:

\[
    t^S \in \text{Argmax}_{t \in T_C(t_h^{max})} \left\{ \gamma [1 - \beta_h(t)] + (1 - \gamma) [1 - \beta_l(t)] \right\} W^D(t; h) \\
    + \left[ \gamma \beta_h(t) + (1 - \gamma) \beta_l(t) \right] W^D_l(h) \right\}
\]

subject to:

\[
    W^D(t^I_{l}; l) = [\gamma \beta_l(t) + (1 - \gamma) \beta_h(t)] W^D_l(l) + [1 - \gamma \beta_l(t) - (1 - \gamma) \beta_h(t)] W^D(t; l)
\]

where \( \beta_l(t) \in [0, 1) \) implies \( \beta_h(t) = 0 \), and \( \beta_h(t) \in (0, 1] \) implies \( \beta_l(t) = 1 \).

Although this maximization problem involves choosing over a pair of tariffs \((\tau, r)\) instead a single variable, we can (and will) treat \( t \equiv (\tau, r) \in T_C(t_h^{max}) \) as if it is a single variable in the following use of derivatives for solving the maximization problem. Given that any change in the choice of \( t \) occurs along a line, \( T_C(t_h^{max}) \), let \( \partial t \) represent a change in \( t \) such that \( \partial \tau = \partial t \) with \( \partial r \) being defined by \((\tau + \partial \tau, r + \partial r) \in T_C(t_h^{max})\). Then, the first order derivative associated with the maximization problem in (7) is

\[
    - \left[ \gamma \frac{\partial \beta_h(t)}{\partial t} + (1 - \gamma) \frac{\partial \beta_l(t)}{\partial t} \right] \left[ W^D(t; h) - W^D_l(h) \right] + \\
    \{ \gamma [1 - \beta_h(t)] + (1 - \gamma) [1 - \beta_l(t)] \} \frac{\partial W^D(t; h)}{\partial t}.
\]

Definition 3. \( t_h^{max} \equiv \text{max} \{ T_C(t_h^{max}) \cap T^{D_h}(t_h^{min}) \} \) and \( t_b \in T_C(t_h^{max}) \) denotes \( t^S \) that solves the maximization problem in (7) subject to (8).

Given the first order condition in (9) with \( t_h^{max} \) and \( t_b \) being defined as above, we can show that \( t_b \in (t_h^{max}, t_h^{max}) \) as follows. The first multiplicative part in (9) is strictly positive, except on the highest possible value of \( t \in T_C(t_h^{max}) \), denoted by \( t_h^{max} \), on which it equals 0. The first bracketed term is strictly negative, which equals either \( \gamma \frac{\partial \beta_h(t)}{\partial t} \) or \( (1 - \gamma) \frac{\partial \beta_l(t)}{\partial t} \) respectively depending on whether \( \beta_h(t) \leq 0 \) (with \( \beta_l(t) = 1 \)) or \( \beta_l(t) < 1 \); the second bracketed term is strictly positive and decreases in \( t \), except becoming 0 at \( t = t_h^{max} \). The second multiplicative part in (9) is continuous and strictly negative (positive) for all possible values of \( t > t_h^{max} \).

\[\text{Footnote 18: Without loss of generality, we can focus on the range of } T_C(t_h^{max}) \text{ that is positively sloped in the space of } (\tau, r).\]
(t < t_{h}^{\text{max}}) and t \in T^{C}(t_{h}^{\text{max}}), except at t = t_{h}^{\text{max}} on which it equals 0. The first (and curly) bracketed term is strictly positive, which equals either \(\gamma [1 - \beta_{h}(t)]\) or \(\gamma + (1 - \gamma) [1 - \beta_{l}(t)]\), respectively, depending on whether \(\beta_{h}(t) \geq 0\) (with \(\beta_{l}(t) = 1\)) or \(\beta_{l}(t) < 1\); the second term is strictly positive (negative) for \(t < t_{h}^{\text{max}}\) and 0 when \(t = t_{h}^{\text{max}}\). Given these characteristics of the first and the second multiplicative parts in (9), \(t_{b} \in (t_{h}^{\text{max}}, t_{h}^{\text{max}})\).

The following lemma then characterizes the strategy profile of a separating PBE that maximizes \(D_{h}\)'s expected payoff:

**Lemma 4.** There exists a separating PBE that maximizes the expected payoff of \(D_{h}\), in which having \(t^{S} = t_{b}(> t_{h}^{max}) \in T^{C}(t_{h}^{max})\) with \(\alpha_{h}(t_{b}) = 1, \alpha_{l}(t_{l}^{max}) = 1, \beta_{l}(t_{b})\) and \(\beta_{h}(t_{b})\) being uniquely determined by 8.

**Proof.** See Appendix.

Although Lemma 4 allows the possibility of having multiple separating PBEs that maximize the expected payoff of \(D_{h}\), we will assume the uniqueness of such a PBE in the following analysis.\(^{19}\) In proving that the separating PBE characterized in Lemma 4 is the unique Divine PBE equilibrium, the following lemma about a pooling PBE (i.e., \(\alpha_{l}(t_{l}^{max}) = 0\) and \(\exists t^{S} \in \text{Conv}(T_{D_{h}}(t_{h}^{\text{min}}), T^{C}(t_{h}^{\text{max}}))\) with \(\alpha_{l}(t^{S}) > 0\) and \(\alpha_{h}(t^{S}) > 0\)), is helpful.

**Lemma 5.** (i) Under a pooling PBE, \(\alpha_{l}(t^{S}) > 0\) only if \(\alpha_{h}(t^{S}) > 0\). (ii) Under a pooling PBE if \(t^{S} \in T^{C}(t_{h}^{\text{max}})\), then \(\alpha_{l}(t^{S}) = 0\). (iii) All pooling equilibrium actions for \(D_{j}\) generate the same expected payoff for \(D_{j}\), for \(j = l\) or \(h\).

**Proof.** See Appendix.

**Proposition 1.** A PBE is divine iff it is a separating equilibrium that maximizes \(D_{h}\)'s expected payoff.

**Proof.** See Appendix.

\(^{19}\)We believe that this assumption is not a strong one. This is because no systematic reason exists for the payoff functions (characterized in the preceding section) to yield multiple values of \(t_{b}\) that generate an identical maximized expected payoff of \(D_{h}\) under a separating PBE. Even in the presence of multiple separating PBEs that maximize the expected payoff of \(D_{h}\), the proof for characterizing a divine PBE in Proposition 1 remains the same, implying that only a separating PBE that maximizes the expected payoff of \(D_{h}\) can be supported as a divine PBE. In this subsection, the uniqueness assumption is mainly for expositional simplicity.
Proposition 1 enables us to focus on the separating PBE—characterized in Lemma 4—that maximizes $D_h$’s expected payoff. Using Figure 2, we can explain such an equilibrium bargaining outcome with $\alpha_l \big( t_l^{\text{max}} \big) = 1$ and $\alpha_h \big( t_b \big) = 1$ as follows. To maximize $D_h$’s expected payoff, her equilibrium tariff proposal, $t_b$, needs to be on $T_C \big( t_h^{\text{max}} \big)$, as shown in Figure 2, with $\alpha_h \big( t_b \big) = 1$. Comparing with $t_b \in T_C \big( t_h^{\text{max}} \big)$, any tariff proposal $t' \in T_D \big( t_h \big)$ that is not on $T_C \big( t_h^{\text{max}} \big)$ yields a strictly lower expected payoff to $D_h$ under a separating PBE. This outcome is because it entails the same litigation probability as the one for $t^S = t_b$, with $\beta_l \big( t' \big)$ and $\beta_h \big( t' \big)$ being uniquely determined by 8, and a strictly lower settlement payoff to $D_h$ with $W_D \big( t'; h \big) < W_D \big( t_b; h \big)$. Since $C$ is indifferent between settlement and litigation given that $t^S = t_b \in T_C \big( t_h^{\text{max}} \big)$ and $\theta = h$, $\alpha_l \big( t_b \big) = 0$ is necessary for $C$ to be indifferent between settlement and litigation. Under a separating PBE, $D_l$ proposes $t^S = t_l^{\text{max}}$ with $\alpha_l \big( t_l^{\text{max}} \big) = 1$ because it is $D_l$’s settlement proposal that maximizes her settlement payoff without invoking $C$’s litigation when she reveals her type by proposing $t^S \neq t_b$. Finally, $t_b > t_h^{\text{max}}$ because the marginal benefit of lowering $t_b$ is smaller than the marginal cost of doing so at $t_b = t_h^{\text{max}}$. On one hand, the marginal benefit associated with lowering $t_b$ toward $t_h^{\text{max}}$ (which reflects an increase in $D_h$’s settlement payoff) decreases to 0 as $t_b$ approaches $t_h^{\text{max}}$ as implied by the fact that $T_D \big( t_h^{\text{max}} \big)$ is tangent to $T_C \big( t_h^{\text{max}} \big)$. On the other hand, the marginal cost associated with lowering $t_b$ toward $t_h^{\text{max}}$ (which reflects an increase in the equilibrium litigation probability) remains positive even when $t_b$ approaches $t_h^{\text{max}}$ as implied by $T_D \big( t_h^{\text{max}} \big)$ not tangent to $T_C \big( t_h^{\text{max}} \big)$.

The result that $t_b > t_h^{\text{max}}$ demonstrates the signaling nature of this pretrial settlement game. To signal her type, $D_h$ offers a tariff pair, $t_b$, that is strictly higher than the Pareto efficient tariff combination, $t_h^{\text{max}}$ (which maximizes her settlement payoff given the constraint that $C$ is indifferent between litigation and settlement under a fully separating equilibrium). The reason for $D_h$ to offer such a tariff pair comes from her stronger preference toward more import protection (i.e., her willingness to accept $C$’s even higher protection against her export) than $D_l$’s, which in turn enable $D_h$ to signal her type by such an offer.

As discussed in the introduction, existing studies on trade dispute have not identified this signaling nature of pretrial settlement.\(^{20}\) $t_b > t_h^{\text{max}}$ leads to the following two new predictions. First, the settlement tariff pair may entail the protec-

\(^{20}\)Although Feenstra and Lewis (1991) emphasize the signaling nature of export restraint agreements, their analysis does not analyze the trade dispute and settlement under the WTO regime that prohibits the use of export restraint agreements as a contingent protection policy.
tion levels that are higher than the certainty equivalent (and Pareto-efficient) protection levels that are expected under the litigation for each party, with \( t_b > t_h^{\min} \) for \( D_h \) and \( t_b > t_h^{\max} \) for \( C \). In addition, \( t_b \) can be even greater than \( t^E(h) \equiv (\tau^E(h), r^E(h)) \), as demonstrated in Figure 2. Given that the DSB authorizes \( C \) to retaliate against \( D \)'s imposition of high protection by imposing the same protection level only when it rules against \( D \)'s claim of facing high protectionist pressure based on its own imperfect public signal of \( D \)'s pressure, Beshkar (2010b) shows that the joint-payoff maximizing DSB will recommend \( D \)'s protection level that is lower than \( \tau^E(h) \) even when it rules that \( D \) is subject to high protectionist pressure.\(^{21}\) If \( t_b \) is greater than \( t^E(h) \equiv (\tau^E(h), r^E(h)) \) and the DSB rulings follow the prediction of Beshkar (2010b), then the DSB will always recommend reducing contingent protection. Legal scholars identified such free trade bias in the WTO’s DSB rulings, as discussed in footnote ??.

The second prediction is about what will happen to \( C \)'s access into \( D \)'s market when they settle their dispute. Given that \( D_h \) sets her contingent protection level at \( \tau_b \) with \( (\tau_b, r_b) \equiv t_b \) prior to a trade dispute being filed to the WTO, allowing \( C \) to raise her own protection level up to \( r_b \), their settlement of a dispute will not lead to any increase in \( C \)'s access to \( D \)'s market of the product under dispute. This hypothesis can be tested, possibly using trade flow data related to mutually agreed settlements of the WTO trade disputes.

As emphasized by existing studies on trade dispute and settlement, governments can renegotiate their protection levels, potentially inducing them to renegotiate \( t_b (> t_h^{\max}) \) into lower and Pareto-efficient levels (which would increase both governments’ settlement payoffs). If such renegotiation is expected to take place immediately after settlement, then the “real” settlement should be Pareto efficient, and \( t_h^{\max} \) is the renegotiation-proof offer that maximizes \( D_h \)'s expected payoff under a fully separating equilibrium via Lemma 4. As discussed above, however, the renegotiation-proof settlement offer, \( t_h^{\max} \), entails a higher litigation probability, yielding a strictly lower expected payoff to \( D_h \) than \( t_b \) does. This gives \( D_h \) a strict incentive to commit to the settlement offer of \( t_b \), if possible. In practice, once a government explicitly sets her contingent protection level after

\(^{21}\) Although Beshkar (2010b) analyzes the issue of optimal safeguard protection in a model similar to ours, his model assumes that \( C \) has no information about \( D \)'s type except the prior distribution of it. Thus, how the presence of \( C \)'s informative signal of \( D \)'s type may affect the DSB’s ruling is a possible future research topic, of which the conclusion provides a brief discussion. However, it is reasonable to conjecture that the joint-payoff maximizing DSB will recommend \( D \)'s protection level that is lower than \( \tau^E(h) \) even in the presence of \( C \)'s signal of \( D \)'s type because recommending \( D \)'s protection level be higher than \( \tau^E(h) \) will reduce the joint-payoff of governments without relaxing \( D \)'s incentive to exaggerate her pressure for protection.
going through a domestic process to justify such protection, readjusting it will be (politically) costly in the absence of the DSB’s formal ruling against it because the domestic import-competing firms are entitled to such protection. This may render the initial contingent protection level fixed under settlement negotiation.

4.2 Signal’s Accuracy and Divine PBE

The Divinity refinement narrows PBEs of the pretrial settlement game down to the separating PBE that maximizes $D_h$’s expected payoff. This section characterizes how the Divine PBE changes as the accuracy of $C$’s signal ($\gamma$) improves. Prior to providing such characterization, we define some critical values of $\gamma$ as follows.

**Definition 4.** $\gamma^{III} \equiv \frac{[W^D (t^\text{max}_b; l) - W^D (t^\text{max}_l; l)]}{[W^D (t^\text{max}_b; l) - W^D_L (l)]}$, with $t^\text{max}_b$ being implicitly defined by $t$ solving

$$\frac{W^D (t; l) - W^D (l)}{W^D (t; h) - W^D_L (h)} = \frac{\partial W^D (t; l)}{\partial t} \frac{\partial W^D (t; h)}{\partial t}',$$

$\gamma^{II}$ is the minimum value of $\gamma$ that satisfies the following equality:

$$\frac{(1 - \gamma)}{\gamma^2} = \frac{\partial W^D (\hat{t}^S (\gamma); h)}{\partial t} \frac{W^D (\hat{t}^S (\gamma); l) - W^D (l)}{W^D (\hat{t}^S (\gamma); l) - W^D (l)} \left[ W^D (\hat{t}^S (\gamma); l) - W^D (l) \right]^2$$

with $\hat{t}^S (\gamma)$ being defined by $t$ that induces $\beta_h (t) = 0$ and $\beta_l (t) = 1$ under (8), and

$$\gamma^I \equiv \frac{[W^D (t^\text{max}_l; l) - W^D (t^\text{max}_b; l)]}{[W^D (t^\text{max}_l; l) - W^D_L (l)]} < 1.$$

$\gamma^{III} \in (0, 1)$ is defined so that $D_l$ is indifferent between proposing $t^\text{max}_b$ (thus, revealing her type) and proposing $t^\text{max}_b$ given that $\beta_l (t^\text{max}_b) = 1$ and $\beta_h (t^\text{max}_b) = 0$. If $\gamma < \gamma^{III}$, then $\beta_l (t^\text{max}_b) = 1$ and $\beta_h (t^\text{max}_b) > 0$ are necessary to make $D_l$ be indifferent between proposing $t^\text{max}_l$ and proposing $t^\text{max}_b$. Similarly, $\gamma^I \in (0, 1)$ is defined so that $D_l$ is indifferent between proposing $t^\text{max}_l$ and proposing $t^\text{max}_l$. If $\gamma \geq \gamma^I$, then $\beta_l (t^S) < 1$ and $\beta_h (t^S) = 0$ are sufficient to make $D_l$ be indifferent between proposing $t^\text{max}_l$ and proposing
\[ t^S > t_h^{\text{max}}. \] \[ t_b^{\text{max}} \] is the maximum Divine equilibrium tariff offer, as shown in the following proposition. \[ t_b^{\text{max}} > t_h^{\text{max}} \] implies that \( \gamma^I > \gamma^{III} \), and the following proposition also shows that \( \gamma^{III} \in (\gamma^I, \gamma^{III}) \).

**Proposition 2.** The Divine PBE has one of the following three types of litigation strategies on \( D_h \)'s settlement proposal, \( t_b \), with distinctive comparative statics, depending on the accuracy of C's private signal, \( \gamma \):

(a) If \( \gamma < \gamma^{III} \), \( t_b = t_b^{\text{max}} \), \( \beta_l (t_b) = 1 \) and \( \beta_h (t_b) > 0 \), with \( \frac{\partial t_h}{\partial \gamma} = 0 \) and \( \frac{\partial \beta_h (t_b)}{\partial \gamma} < 0 \);  
(b) If \( \gamma^{III} \leq \gamma < \gamma^{II} \), \( t_b = \hat{t}^S (\gamma) \), \( \beta_l (t_b) = 1 \) and \( \beta_h (t_b) = 0 \), with \( \frac{\partial t_h}{\partial \gamma} < 0 \) and \( \frac{\partial \beta_l (t_b)}{\partial \gamma} = 0 \);  
(c) If \( \gamma \geq \gamma^{II} \), \( t_b \leq \hat{t}^S (\gamma^{II}) \), \( \beta_l (t_b) \in (0, 1] \) and \( \beta_h (t_b) = 0 \), with \( \frac{\partial t_h}{\partial \gamma} < 0 \), and if \( \gamma \geq \gamma^I (\gamma^{II}) \), \( \beta_l (t_b) \in (0, 1) \) with \( \lim_{\gamma \to 1} t_b = t_h^{\text{max}} \) and \( \lim_{\gamma \to 1} \beta_l (t_b) > 0 \).

**Proof.** See Appendix. \( \square \)

Figure 3, a graphical representation of the first order condition of the maximization problem (7), is useful in explaining the results in Proposition 2. The litigation probabilities are defined by \( D_l \)'s incentive constraint for truth-telling in (8). \( D_h \)'s marginal benefit from raising \( t^S \), denoted by \( MB(t^S; \gamma) \), is the first multiplicative part in (9), representing the benefit from reducing the litigation probability with a higher \( t^S \). \( D_h \)'s marginal cost from raising \( t^S \), denoted by \( MC(t^S; \gamma) \), is the second multiplicative part in (9), representing the cost of offering \( t^S \) that is further away from \( t_h^{\text{max}} \), reducing \( D_h \)'s settlement payoff.

For any level of \( \gamma \), \( MB(t^S; \gamma) \) and \( MC(t^S; \gamma) \) are divided into two parts in Figure 3: one denoted by a bold line and the other by a thin line. The bold-line part corresponds to the case with \( \beta_l (t^S) = 1 \) and \( \beta_h (t^S) \in (0, 1) \), and the thin-line part corresponds to the case with \( \beta_l (t^S) \in (0, 1) \) and \( \beta_h (t^S) = 0 \), with \( \hat{t}^S (\gamma) \) denoting \( t \) that induces \( \beta_h (t) = 0 \) and \( \beta_l (t) = 1 \) under the requirement of (8). When \( \gamma = 0.5 \), for example, reducing \( t^S \) from \( t_h^{\text{max}} \) toward \( t_h^{\text{max}} \) requires the litigation probability that satisfies (8) to rise, having \( \beta_h (t^S) = 0 \) and \( \beta_l (t^S) = 1 \) at \( t^S = \hat{t}^S (0.5) \), and \( \beta_l (t^S) = 1 \) and \( \beta_h (t^S) \in (0, 1) \) for \( t^S < \hat{t}^S (0.5) \). In addition, \( \hat{t}^S (\gamma) \) decreases as \( \gamma \) increases, having \( \hat{t}^S (\gamma^I) = t_h^{\text{max}} \), thus \( \beta_l (t^S) \in (0, 1) \) and \( \beta_h (t^S) = 0 \) for all \( \gamma \in [t_h^{\text{max}}, t_h^{\text{max}}] \) if \( \gamma > \gamma^I \).
Using Figure 3, we can explain the result (a) as follows: The value of $t^S$ that maximizes the expected payoff of $D_h$ given $\gamma = 0.5$, $t_b \ (\gamma = 0.5)$, is equal to $t_b^{\max}$ with $\beta_l (t^S) = 1$ and $\beta_h (t^S) \in (0, 1)$. When $\gamma$ increases, the bold-line parts of $MB(t^S; \gamma)$ and $MC(t^S; \gamma)$ shift up by the same amount. As a result, $t_b \ (\gamma)$ remains at $t_b^{\max}$ as long as $\beta_h (t^S) \in (0, 1)$ is required to satisfy the incentive constraint of $D_l$ for not imitating $D_h$'s proposal of $t^S = t_b^{\max}$, i.e. as long as $\gamma < \gamma^{III}$.

With regard to the result (b), if $\gamma = \gamma^{III}$, then $\hat{t}^S (\gamma) = t_b^{\max}$, thus $t_b \ (\gamma)$ continues to be equal to $t_b^{\max}$, but $\beta_l (t^S) = 1$ and $\beta_h (t^S) = 0$. An increase in $\gamma$ shifts down the thin-line part of $MB(t^S; \gamma)$ although it shifts up the thin-line part of $MC(t^S; \gamma)$. This creates discontinuity in $MB(t^S; \gamma)$ on $t^S = \hat{t}^S (\gamma)$ for any $\gamma > 0.5$, as shown in Figure 3. If $\beta_h (t^S) > 0$, then an increase in $\gamma$ raises $MB(t^S; \gamma)$, because a higher $\gamma$ raises the weight on the marginal benefit from a higher $t^S$ with $-\gamma [\partial \beta_h (t^S) / \partial t^S] [W^D (t^S) - W^L (t^S)]$ in (9). If $\beta_l (t^S) < 1$, then an increase in $\gamma$ reduces $MB(t^S; \gamma)$, because a higher $\gamma$ decreases the weight on the marginal benefit from a higher $t^S$ with $- (1 - \gamma) [\partial \beta_l (t^S) / \partial t^S] [W^D (t^S) - W^L (t^S)]$ in (9). This discontinuity in $MB(t^S; \gamma)$ at $t^S = \hat{t}^S (\gamma)$ implies that an increase in $\gamma$ from $\gamma = \gamma^{III}$ leads to having $MB(t^S; \gamma) > MC(t^S; \gamma)$ for $t^S < \hat{t}^S (\gamma)$ and $MB(t^S; \gamma) < MC(t^S; \gamma)$ for $t^S > \hat{t}^S (\gamma)$, which in turn implies $t_b \ (\gamma) = \hat{t}^S (\gamma)$ for $\gamma < \gamma^{II}$ ($\gamma^{III}$). Thus, $\beta_l (t^S) = 1$ and $\beta_h (t^S) = 0$, and $t_b \ (\gamma) = \hat{t}^S (\gamma)$ decreases as $\gamma$ increases for $\gamma \in [\gamma^{III}, \gamma^{II}]$.

Regarding the result (c), an increase in $\gamma$ from $\gamma = \gamma^{II}$ leads to either having $\beta_l (t^S) < 1$ and $\beta_h (t^S) = 0$ or having $\beta_l (t^S) = 1$ and $\beta_h (t^S) = 0$ with $t_b \ (\gamma)$ continuing to be equal to $\hat{t}^S (\gamma)$. In both cases, an increase in $\gamma$ leads to a decrease in $t_b \ (\gamma)$. In the former case, $MB(t^S; \gamma)$ gets smaller and $MC(t^S; \gamma)$ gets bigger, creating an incentive to reduce $t^S$. If $\gamma \geq \gamma^{I}$, then $\beta_l (t^S) \in (0, 1)$ and $\beta_h (t^S) = 0$ for all $\gamma \in [t_h^{\max}, t^S]$ as discussed earlier, generating the former case. In the latter case in which $t_b \ (\gamma) = \hat{t}^S (\gamma)$, $\hat{t}^S (\gamma)$ decreases as $\gamma$ increases.

The graphs on the left side in Figure 4 demonstrate the results in Proposition 2 based on a numerical analysis. Three distinctive regions of $\gamma$ exist, and they differ from each other on how an increase in $\gamma$ affects $D_h$’s equilibrium tariff offer and $C$’s litigation probabilities. Although we cannot theoretically rule out the possibility of having $\beta_l (t_b) = 1$ for $\gamma \in (\gamma^{II}, \gamma^{I})$, the numerical analysis does show that having $\beta_l (t_b) < 1$ is possible for $\gamma > \gamma^{II}$. The analysis also demonstrates that $\beta_l (t_b)$ may strictly decrease as $\gamma$ increases for $\gamma > \gamma^{II}$.

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22 In the Appendix we discuss how we constructed the numerical analysis shown in Figure 4.
The top graphs on the right side in Figure 4 demonstrate how the litigation likelihood (i.e., probability of litigation) against D_l’s potential choice of mimicking D_h’s equilibrium tariff offer, denoted by LL (l), changes as the quality of C’s information improves. As shown in Figure 4, this probability of litigation stays constant until γ reaches γ^{III} then monotonically increases in response to a further increase in γ. Such a change in the potential (not observed in the equilibrium) litigation likelihood is necessary to deter D_l from mimicking D_h’s equilibrium tariff offer (t_b) that is constant until γ reaches γ^{III}, then monotonically decreases toward t_h^{max} in response to a further increase in γ. In contrast to this potential litigation likelihood, LL (h) represents the equilibrium litigation likelihood (i.e. probability of litigation) against D_h’s equilibrium tariff offer, t_h. As the theory predicts, LL (h) monotonically decreases in response to an increase in γ up to γ^{II}. For a further increase in γ beyond γ^{II}, the numerical simulation shows that LL (h) may monotonically decrease toward 0 as C’s signal gets almost perfect.

The bottom graphs on the right side in Figure 4 demonstrate how each party’s expected payoff from the pretrial bargaining game changes as the quality of C’s signal improves. As the theory predicts, all the informational rent from an improvement in C’s signal accrues to D_h as she takes all the surplus from the pretrial settlement bargaining game (through her take-or-leave offer), having the expected payoffs of D_l and C be constant in response to an increase in γ.

5 Signaling Game with a Noisy Public Signal

In this section, we study the pretrial settlement game under the assumption that the complaining party receives a public signal about the type of the defending party. All other assumptions remain the same as the game under private signals discussed in the previous section.

Assuming that C’s signal is public rather than private changes the incentive compatibility constraint for the low-type D. Recall that when C’s signal is private, D_l perceives the likelihood of litigation given t^S to be γβ_l (t^S) + (1 − γ) β_h (t^S). In contrast, when C’s signal is public, D_l’s perceived likelihood of litigation given t^S is β_l (t^S) and β_h (t^S) if θ^C = l and θ^C = h, respectively. Therefore, under the public signal, the incentive compatibility constraint for D_l given t^S and θ^C may be written as

\[ W^D (t_l^{max}; l) \geq β_{θ^C} (t^S) W^D_L (l) + (1 − β_{θ^C} (t^S)) W^D (t^S; l) \] for \( θ^C = l, h \).

The left-hand side of this condition is the welfare of D_l if it reveals its type by
proposing \( t_l^{\text{max}} \). The right-hand side of this condition is the \( D_l \)'s expected welfare if it mimics \( D_h \) by proposing \( t^S \) given the realized public signal \( \theta^C \). However, the public signal has no effect on this condition because these incentive compatibility constraints imply that \( \beta_l (t^S) = \beta_h (t^S) \). Intuitively, to make \( D_l \) indifferent between revealing its true type (by proposing \( t_l^{\text{max}} \)) and mimicking \( D_h \) (by proposing \( t^S \)), \( C \) has to choose the same rate of litigation regardless of the realized public signal. Therefore,

**Proposition 3.** The separating PBEs of the settlement bargaining game are independent of a noisy public signal about \( D \)'s private information.

This proposition implies that if we focus on separating PBEs, the introduction of a noisy public signal is completely innocuous.

**Pooling Equilibria**

We now investigate the impact of a public signal on pooling equilibria. With a public signal at the pretrial stage, the common prior belief of the parties is updated. Let \( \rho^* \) denote the updated common belief of the parties about the likelihood of a high type after observing the public signal. Moreover, let \( t_{\text{pool}} (\rho^*) \in P_h \) denote a tariff pair that makes \( C \) indifferent between settlement and litigation when all types of \( D \) pool, namely,

\[
(1 - \rho^*) \, W^C_L (l) + \rho^* \, W^C_L (h) \equiv W^C (t_{\text{pool}} (\rho^*)) .
\]

\( t_{\text{pool}} (\rho) \prec t_{h}^{\text{min}} \) by our assumption about the quality of the court.\(^{23}\) Moreover, as \( \rho^* \) increases, the expression on the left-hand side of \( 10 \) decreases, which implies that \( t_{\text{pool}} (\rho^*) \) moves monotonically toward \( t_{h}^{\text{max}} \) on \( P_h \). If \( \rho^* \) is sufficiently high such that \( t_{\text{pool}} (\rho^*) \succ t_{h}^{\text{min}} \), then \( t_{\text{pool}} (\rho^*) \) is part of a pooling PBE in which both types of \( D \) propose \( t_{\text{pool}} (\rho^*) \) and \( C \) accepts with certainty. Therefore,

**Lemma 6.** Let \( t_{\text{pool}} (\rho^*) \) and \( \hat{\rho}_1 \) be defined by \( 10 \) and the following condition, respectively:

\[
(1 - \hat{\rho}_1) \, W^C_L (l) + \hat{\rho}_1 \, W^C_L (h) \equiv W^C (t_{h}^{\text{min}}) .
\]

If \( \rho^* \geq \hat{\rho}_1 \), then any \( t^S \in \text{Conv} (t_{h}^{\text{min}}, t_{\text{pool}} (\rho^*)) \) constitutes a pooling PBE where both types of \( D \) propose \( t^S \) for settlement and \( C \) accepts the proposal.

\(^{23}\) By assumption, if the common prior belief about the likelihood of high type is \( \rho \), full settlement cannot be an equilibrium. The court is assumed to be “good enough” so that if the common prior belief of the parties is the same as the belief based on which the court is designed, the parties cannot jointly improve their welfare by adopting an alternative mechanism that exclude the court.
Therefore, although a public signal has no impact on the set of separating PBEs, a pooling PBE can arise with a sufficiently informative public signal. Nevertheless,

**Lemma 7.** Pooling PBEs are not universally divine.

*Proof.* See Appendix. □

Moreover, applying the Universal Divinity criterion to separating PBEs kills all but one equilibrium:

**Lemma 8.** Under public signaling, a PBE is universally divine iff it is a separating PBE that maximizes the expected payoff of $D_h$.

*Proof.* See Appendix. □

As we showed that a private signal improves the expected payoff of the high-type $D$ as well as the expected joint welfare of the parties, this proposition implies that

**Corollary 1.** An informative signal about $D$’s private information improves the expected payoffs of the parties in the signaling game iff it is privately observed by $C$.

The following thought experiment provides some perspective on the result that a signal is useful only if it is private. Consider a tariff pair $t^S \in \text{Conv}(t^h_{\text{min}}, t^h_{\text{max}})$, and the equilibrium strategies that support it as a separating PBE under public signaling and private signaling respectively. Letting $\beta$ denote the likelihood of litigation if $t^S$ is proposed under public signaling, the incentive compatibility constraint for $D_l$ is given by

\[
W^D(t^\text{max}_l, l) \geq \beta W^D_L(l) + (1 - \beta) W^D(t^S_l).
\]

Solving for $\beta$ that makes $D_l$ indifferent yields

\[
\beta = \frac{W^D(t^S_l) - W^D(t^\text{max}_l)}{W^D(t^S_l) - W^D_L(l)}.
\]

The value of $\beta$ indicates the likelihood that $D_h$, as well as untruthful $D_l$, will face litigation in the equilibrium of a public signaling game.

In the case of private signaling, the probability of litigation for an untruthful $D_l$ is given by $\gamma \beta_l + (1 - \gamma) \beta_h$, and the incentive compatibility constraint is given by
\(W^D(t_{l}^{\max}; l) \geq (\gamma \beta_l + (1 - \gamma) \beta_h) W^D_L(l) + (1 - (\gamma \beta_l + (1 - \gamma) \beta_h)) W^D(t^S; l).\)

Solving for \(\gamma \beta_l + (1 - \gamma) \beta_h\) yields

\[
\gamma \beta_l + (1 - \gamma) \beta_h = \frac{W^D(t^S; l) - W^D(t_{l}^{\max}; l)}{W^D(t^S; l) - W^D_L(l)}.
\]

Therefore, the incentive compatibility constraint implies the same likelihood of litigation for the low type under private and public signaling.

Now consider the likelihood of litigation for \(D_h\) under private signaling, which is given by \(\gamma \beta_h + (1 - \gamma) \beta_l\). To check that for \(\gamma > \frac{1}{2}\), we have

\[
\gamma \beta_h + (1 - \gamma) \beta_l < \gamma \beta_l + (1 - \gamma) \beta_h,
\]

which implies that \(D_h\) faces a lower likelihood of litigation under private signaling than under public signaling.

This comparison clarifies the source of efficiency improvement under private signaling: when the signal is unobservable to \(D\), \(C\) can condition its litigation strategy on the private signal and litigate different types with different probabilities. In particular, under private signaling, \(D_h\) is less likely to be litigated than untruthful \(D_l\).

6 Settlement Bargaining as a Screening Game

In this section, we reformulate our settlement bargaining game as a screening game in which the uninformed party (i.e., the complainant) makes a settlement proposal and the informed party (i.e., the defendant) decides whether to accept the proposal and settle, or reject the proposal and litigate. We assume the following sequence of events. First, \(C\) receives a signal of \(D\)'s type and proposes a tariff pair for settlement. \(D\) can either drop the case and adopt the status quo, \(t_{l}^{\min}\), accept the proposal and settle, or litigate. \(D\) will accept the proposal if \(W(t^S; \theta) \geq W^D_L(\theta)\). \(D\) will drop the case and implement the status quo, \(t_{l}^{\min}\), iff \(\theta = l\) and \(W^D(t^S; l) < W^D_L(l)\). Finally, \(D\) will litigate if \(D\)'s expected payoff under litigation is greater than the payoff under the status quo and the proposed settlement, i.e., \(W^D_L(\theta) > W^D(t_{l}^{\min}; \theta)\) and \(W^D(\theta) > W^D(t^S; \theta)\).
Proposition 4. i) For $\text{Pr}(\theta = h | \theta^C) > \frac{W^C(t^\text{min}_h) - W^C(t^\text{min}_l)}{W^C(t^\text{min}_l) - W^C(t^\text{min}_h)}$, the unique PBE is a pooling equilibrium in which $C$ proposes $t^\text{min}_l$ for settlement and both types of $D$ will accept this proposal.

ii) For $\text{Pr}(\theta = h | \theta^C) < \frac{W^C(t^\text{min}_l) - W^C(t^\text{min}_h)}{W^C(t^\text{min}_l) - W^C(t^\text{min}_h)}$, the unique PBE is a separating equilibrium in which $C$ proposes $t^\text{min}_l$ for settlement, which will be accepted (rejected) by $D_l(D_h)$.

Proof. See Appendix.

Proposition 4 does not depend on whether $C$’s signal is private or public. The above result shows that the player with her private type information should be the one to make an offer for the second-order uncertainty to drastically affect the equilibrium of a settlement bargaining game. $C$’s best offer strategy depends only on the probability of $D$ being a strong type conditional on her signal, which is unaffected by whether $C$’s signal remains private or becomes public, and $D$’s decision to accept the offer depends only on her type and the offer.

With regard to predicting the role that second order uncertainty may play in a settlement bargaining game, one needs to determine whether the bargaining game should be modeled as a signaling or a screening game. For the imposition of contingent protection under the WTO regime, a defending government has the right to impose such protection as long as she goes through a domestic process to determine its legitimacy. A complaining government then has the choice over whether to accept such protection (possibly together with her own protection offered to be tolerated by the defendant) or litigate it. Therefore, our pretrial settlement game over contingent protection should be analyzed as a signaling game.

7 Conclusion

We consider a game of bilateral bargaining over actions in which (i) the cost of disagreement depends on the private type of one of the parties and (ii) the uninformed party receives a noisy signal about this private type before the actual bargaining. We analyze the role of uncertainty about higher-order beliefs in this bargaining game and establish an anti-transparency result. That is the efficiency of the settlement bargaining outcome is higher if the signal that the uninformed party receives is private rather than public.

The anti-transparency result can be generalized by considering an extension of our model in which the signal is partially public, i.e., if public but noisy information
about the signal is available. In that case, we can show that the more public is the signal that the un-informed party receives, the lower is the efficiency of the settlement bargaining outcome. Therefore, our result is not a feature of the extreme assumption of public vs. private signaling.

Our anti-transparency result in pretrial negotiations may be contrasted to the pro-transparency result in arbitration models proposed by Beshkar (2010b) and Park (2011). In these studies, publicizing the private information of the defending party relaxes the self-enforceability condition and reduces the level of inefficient punishment that is required to induce truthfulness. Beshkar (2010b) and Park (2011) find the pro-transparency result in a repeated-game framework in which enforceability of the agreement is improved by introducing an informative public signal.24

Understanding caveats associated with our anti-transparency result is important. First, the noisy signal of a defendant’s type is “secondary information” in the sense that it does not affect the players’ expectation about the court ruling (or the outcome of hostile engagement resulting from failing to settle) for a given type of the defendant. If the signal can change the expected court ruling conditional on a specific type of the defendant, thus having its own informational value independent from the defendant’s type, then our anti-transparency result may not hold.25 Second, we do not explore the possibility that the court utilizes such secondary information once it is revealed, possibly affecting the ruling. As reviewed by Spier (2007), litigation literature on “evidence” studies how various institutional requirements on evidence affect pretrial settlement and ruling.26 Given that the nature of noisy signals that we analyze here is different from those explored by existing studies, extending our paper toward this direction may lead to new results.

24The main difference between Beshkar (2010b) and Park (2011) lies in the analysis of no public signal case. The former assumes no private signal, but the latter analyzes the case with a noisy private signal of potentially deviatory actions.

25The studies that explore how two-sided private information affects litigation in the law and economics literature assume that both sides of private information have independent informational value on the expected court outcome (Schweizer, 1989; Daughety and Reinganum, 1994).

26The institutional requirements include the burden of proof, disclosure and discovery as well as admissibility of settlement negotiations at trial. See Spier (2007) for the review of studies on these issues.
Appendix

Proof. for Lemma 1) Consider a tariff proposal under a separating PBE, \( t^S \neq t^\alpha_{\max} \) with \( \alpha_l (t^S) > 0 \) and \( \alpha_h (t^S) = 0 \): if \( t^S \) is located to the left of \( T^C (t^\alpha_{\max}) \) in the space of \((\tau, r)\), \( \beta_l (t^S) = \beta_h (t^S) = 0 \); if \( t^S \in T^C (t^\alpha_{\max}) \), \( \beta_l (t^S), \beta_h (t^S) \in [0,1] \); if \( t^S \) is located to the right of \( T^C (t^\alpha_{\max}) \) in the space of \((\tau, r)\), \( \beta_l (t^S) = \beta_h (t^S) = 1 \). Note that the expected payoff of \( D_l \) from proposing such \( t^S \neq t^\alpha_{\max} \) is strictly smaller that its payoff from proposing \( t^S = t^\alpha_{\max} \) with \( \beta_l (t^\alpha_{\max}) = \beta_h (t^\alpha_{\max}) = 0 \) because \( W^D(t^\alpha_{\max};l) > W^D_l(l) \) and \( W^D(t^\alpha_{\max};l) > W^D(t^S;l) \) for \( t^S \neq t^\alpha_{\max} \). Then, there exists \( t^\prime \neq t^S \in P_l \) located to the left of \( T^C (t^\alpha_{\max}) \) and that is sufficiently close to \( t^\alpha_{\max} \) such that the expected payoff of \( D_l \) from proposing \( t^\prime \) with \( \beta_l (t^\prime) = \beta_h (t^\prime) = 0 \) is strictly greater than the expected payoff of \( D_l \) from proposing \( t^S(\neq t^\alpha_{\max}) \). Because \( C \) strictly prefers settling with \( t^\prime \) to litigating it regardless of \( D^l \)’s types, \( \beta_l (t^\prime) = \beta_h (t^\prime) = 0 \) will result from proposing \( t^\prime \). This implies that a tariff proposal, \( t^S \neq t^\alpha_{\max} \) with \( \alpha_l (t^S) > 0 \) and \( \alpha_h (t^S) = 0 \) cannot be a part of a PBE. For a tariff proposal, \( t^S = t^\alpha_{\max} \) with \( \alpha_l (t^S) > 0, \alpha_h (t^S) = 0, \) and \( \beta_l (t^\alpha_{\max}) > 0 \) or \( \beta_h (t^\alpha_{\max}) > 0 \), the same logic can be applied to show that it cannot be a part of a separating PBE.

\[ \square \]

Proof. for Lemma 2) If \( t^S \) does not belong to \( \text{Conv} \left( T^D_h (t^\alpha_{\min}), T^C (t^\alpha_{\max}) \right) \), then either \( D_h \) or \( C \) will strictly prefer litigating over settlement with \( t^S \). If \( D_h \) strictly prefers litigating over settlement with \( t^S \) that entails a positive probability of settlement, then proposing such \( t^S \) is strictly dominated by a proposal that will surely invoke litigation. If \( C \) strictly prefers litigation over settlement with \( t^S \), then such \( t^S \) will entail zero probability of settlement.

\[ \square \]

Proof. for Lemma 3) Under a separating PBE, consider \( t^S(\neq t^\alpha_{\max}) \) with \( \alpha_h (t^S) > 0 \) that does not belong to \( T^C (t^\alpha_{\max}) \). For such \( t^S \), first note that \( \beta_l (t^S) \) and \( \beta_h (t^S) \) (with \( \beta_l (t^S) > 0 \)) need to satisfy \( D_l^l \)’s incentive constraint in (6) with equality: if \( D_l^l \)’s incentive constraint in (6) holds with a strictly inequality, then \( \alpha_l (t^S) = 0 \), implying that \( C \), who correctly believes that only \( D_h \) would propose such \( t^S \), will settle for sure with \( W^C (t^S) > W^C_l (h) \), which in turn contradicts with \( D_l^l \)’s incentive constraint in (6) holding with a strictly inequality.

If \( \beta_l (t^\prime) = \beta_l (t^S) \) and \( \beta_h (t^\prime) = \beta_h (t^S) \), \( D_h \)’s proposing \( t^\prime \in T^D_l (t^S) \) continues to satisfy \( D_l^l \)’s incentive constraint in (6) with an equality, and \( t^\prime \in T^D_l (t^S) \)
\( \cap T^C (t^\max_h) \) yields the highest (and strictly higher than other \( t' \in T^D_l (t^S) \)) expected payoff to \( D_h \), and a strategy profile with \( \alpha_h \left( t' \right) = 1, \beta_l \left( t' \right) = \beta_l (t^S) \) and \( \beta_h \left( t' \right) = \beta_h (t^S) \) is a separating PBE as long as \( \alpha_l \left( t' \right) = 0 \). This proves that any \( t^S \neq t^\max_l \) with \( \alpha_h (t^S) > 0 \) belongs to \( T^C (t^\max_h) \).

**Proof.** for Lemma 4) First, note that (8) uniquely defines a pair of \( \beta_l (t^S) \) and \( \beta_h (t^S) \) for any \( t^S \in T^C (t^\max_h) \). Because \( W^D (t^S; l) > W^D (t^\max_l; l) > W^D_l (l) \) for \( t^S \in T^C (t^\max_h) \) and \( \partial W^D (t^S; l) / \partial t^S < 0 \), an increase in \( t^S \) requires a corresponding decrease in \( \gamma \beta_l (t^S) + (1 - \gamma) \beta_h (t^S) \). Since \( \beta_l (t) \in [0, 1] \) implies \( \beta_h (t) = 0 \), and \( \beta_h (t) \in (0, 1] \) implies \( \beta_l (t) = 1 \), as discussed earlier in relation with \( C \)'s incentive compatibility condition associated with (6), this means that either only a decrease in \( \beta_l (t^S) \) or only a decrease in \( \beta_h (t^S) \), which in turn proves that \( \beta_l (t^S) \) and \( \beta_h (t^S) \) are uniquely determined by (8).

If there is a unique value of \( t_b \), then a separating PBE that maximizes the expected payoff of \( D_h \) should entail \( \alpha_h (t_b) = 1 \). Even if there exist multiple values of \( t_b \), a separating PBE with \( \alpha_h (t_b) = 1 \) is one of such PBEs that maximizes the expected payoff of \( D_h \). It remains to show that \( \alpha_l (t^\max_l) = 1 \). This results from the fact that \( t_b \in T^C (t^\max_h) \), implying that \( W^C (t_b) = W^C_L (h) \). This means that \( C \) is indifferent between accepting \( t_b \) and litigating with the belief of \( D \) being high-type with probability 1. Any (equilibrium) behavior of \( \alpha_l (t^\max_l) < 1 \) with \( \alpha_l (t_b) > 0 \) will invoke litigation against \( t_b \in T^C (t^\max_h) \) with probability one. Thus, a separating PBE having having \( t^S = t_b (> t^\max_l) \in T^C (t^\max_h) \) with \( \alpha_h (t_b) = 1 \) and \( \alpha_l (t^\max_l) = 1 \) is a PBE that maximizes the expected payoff of \( D_h \).

**Proof.** for Lemma 5) First, consider a pooling PBE does entail \( t^S \) with \( \alpha_l (t^S) > 0 \) and \( \alpha_h (t^S) = 0 \) in the equilibrium strategy profile. Once such \( t^S \) is played, then \( C \) will litigate it with probability one because \( W^C (t^S) > W^C_L (l) \) for all \( t^S \in Conv (T^D_h (t^\min_h), T^C (t^\max_h)) \). Given that \( D_l \)'s expected payoff from playing the pooling PBE is greater than \( W^D_L (l) \), then \( \alpha_l (t^S) > 0 \) cannot be a part of the pooling PBE because it will violate the incentive constraint of \( D_l \) of the PBE.

Second, assume \( \exists t^S \in T^C (t^\max_h) \) with \( \alpha_l (t^S) > 0 \) and \( \alpha_h (t^S) > 0 \). Once such \( t^S \) is played, then \( C \) will litigate it with probability one because \( W^C (t^S) = W^C_L (h) \) is strictly smaller than \( C \)'s expected payoff from litigation. Given that \( D_l \)'s expected
payoff from playing the pooling PBE is greater than $W^D_L (l)$, then, $\alpha_l (t^S) > 0$ cannot be a part of the pooling PBE because it will violate the incentive constraint of $D_l$ of the PBE.

Third, $D_j$’s expected payoff from offering a specific tariff proposal, $t^S$ with $\alpha_j (t^S) > 0$, is identical to $D_j$’s expected payoff from the pooling equilibrium because otherwise, it will violate the incentive constraint of $D_j$ of the PBE.

Proof: for Proposition 1) The proof is divided into two parts: first, proving that the only separating PBE (including semi-separating ones) that satisfies the universal divinity criterion is the fully separating equilibrium that maximizes the expected payoff of $D_h$ (characterized in Lemma 4); second, proving that no pooling PBE satisfies the universal divinity criterion.

First, consider a separating PBE that is not maximizing $D_h$’s expected payoff. The expected payoff of $D_l$ under such a PBE (or any separating PBE), denoted by $EW^{D_l}$, is equal to $W^D (t^l_{\text{max}}; l)$; if $EW^{D_l} > W^D (t^l_{\text{max}}; l)$, $D_l$ has a strict incentive to assign $\alpha_l (t^l_{\text{max}}) = 0$, thus invalidating the separating behavior in such an equilibrium; if $EW^{D_l} < W^D (t^l_{\text{max}}; l)$, $D_l$ has a strict incentive to assign $\alpha_l (t^l_{\text{max}}) = 1$, thus having $EW^{D_l} = W^D (t^l_{\text{max}}; l)$. Denote the expected payoff of $D_h$ from playing such a separating PBE by $EW^{D_h} (t^h_{\tau_b})$, where $EW^{D_h} (t^h_{\tau_b})$ represents the maximized expected payoff of $D_h$. Now consider a possible off-the-equilibrium deviation in which $t^S = t' = (\tau', r') \in T^{D_l} (t_b)$ with $\tau' < \tau_b$, where $\tau_b$ is defined by $(\tau_b, r_b) \equiv t_b$. In particular, $t'$ is close enough to $t_b$ so that the expected payoff of $D_h$ from playing $\alpha_h (t'_{\tau}) = 1$ with $\beta_l (t')$ and $\beta_h (t')$ being respectively equal to $\beta^+_l (t')$ and $\beta^+_h (t')$ that are uniquely determined by 8, which we denote by $EW^{D_h} (t')$, satisfies the following inequalities: $EW^{D_h} (t') < EW^{D_h} (t_b)$. 

Recall that $\beta_l (t) \in [0, 1]$ implies $\beta_h (t) = 0$, and $\beta_h (t) \in (0, 1]$ implies $\beta_l (t) = 1$. This enables us to represent the strategy of $C$ by a single variable, $\beta_S (t^S) \equiv \beta_l (t^S) + \beta_h (t^S) \in [0, 2]$. In a similar manner, define $\beta^*_S (t') \equiv \beta^+_l (t') + \beta^+_h (t')$. Also, define $\hat{\beta}_S (t') \equiv \hat{\beta}_l (t') + \hat{\beta}_h (t')$ as the value of $\beta_S (t')$ that makes the expected payoff of $D_h$ from playing $\alpha_h (t') = 1$ with $\hat{\beta}_S (t')$ be equal to $EW^{D_h}$. Thus, $B_h (t') = \{ \beta_S (t') < \hat{\beta}_S (t') \}$. $B_l (t') = \{ \beta_S (t') \leq \beta^*_S (t') \}$.
because the expected payoff of $D_l$ from playing $\alpha_l(t^l_b) = 1$ with $\beta_S = \beta_S^*(t^l)$, denoted by $EW_{D_l}(t^l)$, is equal to $W^D(t^l_{i_{\text{max}}};l)$, thus $EW_{D_l}(t^l) = EW_{D_l}$. Because $\hat{\beta}_S(t^l_b) > \beta_S^*(t^l)$, $B_l(t^l) \supset B_l(t^l)$, inducing $C$ to believe that $D_h$ has deviated to proposing $t^l$. Because $W^C(t^l) > W^E_l(h)$, $C$ will accept such a deviation proposal $t^l$, creating a deviation incentive for $D$. This proves that a separating PBE that is not maximizing $D_h$'s expected payoff is not a Divine equilibrium.

For the first part, it remains to show that the fully separating equilibrium that maximizes the expected payoff of $D_h$, characterized in Lemma 4, does satisfy the Divinity criterion against any off-the-equilibrium action of $t^S = t^l(\neq t_b) \in \text{Conv}(T^{D_h}(t^l_{\text{min}}), T^C(t^l_{\text{max}}))$. With respect to an off-the-equilibrium action of $t^S = t^l(\neq t_b) \in \text{Conv}(T^{D_h}(t^l_{\text{min}}), T^C(t^l_{\text{max}}))$, define $\beta_S^*(t^l)$ be the value of $\beta_S(t^l)$ that makes the expected payoff of $D_l$ from $t^S = t^l$ being equal to $W^D(t^l_{i_{\text{max}}};l)$. Note that $\beta_S^*(t^l)$ is uniquely determined by 8 with $t = t^l$.

Now, define $\hat{\beta}_S(t^l)$ as the value of $\beta_S(t^l)$ that makes the expected payoff of $D_h$ from playing $\alpha_h(t^l) = 1$ with $\beta_S(t^l) = \hat{\beta}_S(t^l)$ be equal to $EW_{D_h}(t_b)$. Note that $\hat{\beta}_S(t^l) < \beta_S^*(t^l)$ because the expected payoff of $D_h$ from playing $\alpha_h(t^l) = 1$ with $\beta_S(t^l) = \beta_S^*(t^l)$ is smaller than $EW_{D_h}(t_b)$. This implies $B_l(t^l) = \{\beta_S(t^l) < \beta_S^*(t^l)\} \supset \bar{B}_h(t^l) = \{\beta_S(t^l) \leq \hat{\beta}_S(t^l)\}$, which in turn induces $C$ to believe that $D_l$ deviates by proposing $t^l$. Thus, $C$ will litigate against $t^l$ with $\beta_S(t^l) = 2$, eliminating any incentive for $D$ to deviate from the fully separating equilibrium that maximizes the expected payoff of $D_h$.

For the second part, we need to prove that no pooling PBE does satisfies the universal divinity criterion (not even divinity criterion nor intuitive criterion). Given Lemma 5, we can consider a deviation from a pooling equilibrium as if it is a deviation from a specific tariff proposal, $t^S$ with $\alpha_l(t^S) > 0$ and $\alpha_h(t^S) > 0$, because $D_j$'s expected payoff from offering a specific tariff proposal, $t^S$ with $\alpha_j(t^S) > 0$, is identical to $D_j$'s expected payoff from the pooling equilibrium with $j = l$ or $h$. Denote such $t^S$ by $t_{\text{pool}}$ and denote the expected payoffs of $D_l$ and $D_h$ in a pooling PBE by $EW_{D_l}^{\text{pool}}$ and $EW_{D_h}^{\text{pool}'}$ respectively. Now consider a possible off-the-equilibrium deviation in which $t^S = t^l \equiv (\tau^l, r^l)$
\( \in T_{D_i}(t_{pool}) \) with \( \tau^p < \tau_{\max}^{\text{pool}} \), where \( \tau_{\max}^{\text{pool}} \) is defined by \( (\tau_{\max}^{\text{pool}}, r_{\max}^{\text{pool}}) \equiv t_{\max}^{\text{pool}} \) \( \equiv T_{D_i}(t_{pool}) \cap T_C(t_{h_{\max}}) \). In particular, \( \tau^p \) is close enough to \( \tau_{\max}^{\text{pool}} \) so that the expected payoff of \( D_h \) from playing \( \alpha_h(t^p) = 1 \) with \( \beta_S(t^p) = \beta_S(t_{pool})(\geq 0) \), the probability of litigation associated with \( t_{pool} \) in the pooling equilibrium, denoted by \( EW_{D_h}^{\text{pool}}(t^p) \), satisfies the following inequality: \( EW_{D_h}^{\text{pool}} < EW_{C_{\max}}(t) \).

Finally, define \( \tilde{\beta}_S(t^p) \) as the value of \( \beta_S(t^p) \) that makes the expected payoff of \( D_h \) from playing \( \alpha_h(t^p) = 1 \) with \( \beta_S(t^p) = \tilde{\beta}_S(t_{pool}) \) be equal to \( EW_{D_h}^{\text{pool}} \). Note that \( B_h(t^p) = \{ \beta_S(t_{pool}) < \tilde{\beta}_S(t_{pool}) \} \) and \( \bar{B}_l(t^p) = \{ \beta_S(t^p) \leq \tilde{\beta}_S(t^p) \} \). Because \( \tilde{\beta}_S(t^p) > \beta_S(t^p) \), \( B_h(t^p) \supset \bar{B}_l(t^p) \) inducing \( C \) to believe that \( D_h \) has deviated to proposing \( t^p \). Because \( W_C(t^p) > W_L(h) \), \( C \) will accept such a deviation proposal \( t^p \), creating a deviation incentive for \( D \). This proves that any pooling PBE is not a Divine equilibrium. \( \square \)

**Proof.** for Proposition 2)

(a) We show this result in the following two steps: first, assume that the equilibrium litigation strategy profile embodies \( \beta_l(t_b) = 1 \) and \( \beta_h(t_b) > 0 \), establishing the associated comparative static results; second, the equilibrium litigation strategy profile embodies \( \beta_l(t_b) = 1 \) and \( \beta_h(t_b) > 0 \), if \( \gamma < \gamma^{III} \). If the divine PBE embodies \( \beta_l(t_b) = 1 \) and \( \beta_h(t_b) > 0 \), it implies that the first order derivative associated with the maximization problem in (7) takes the following form and equals to zero:

\[
-\gamma \frac{\partial \beta_h(t)}{\partial t} \left[ W^D(t; h) - W^L_L(h) \right] + \gamma [1 - \beta_h(t)] \frac{\partial W^D(t; h)}{\partial t} = 0. \quad (11)
\]

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with

\[
\frac{\partial \beta_h(t)}{\partial t} = \frac{1}{(1 - \gamma)} \frac{\partial W^D(t; l)}{\partial t} \left[ W^D(t_{l_{\text{max}}}; l) - W^D_l(l) \right] ,
\]

\[
1 - \beta_h(t) = \frac{1}{(1 - \gamma)} \left[ W^D(t; l) - W^D_l(l) \right]^2 ,
\]

\[
\frac{\partial \beta_h(t)}{\partial \gamma} = -\frac{\partial W^D(t_{l_{\text{max}}}; l) - W^D_l(l)}{(1 - \gamma)^2 \left[ W^D(t; l) - W^D_l(l) \right]} < 0 .
\]

The first two equalities in (12) implies that (11) is not affected by \( \gamma \), which in turn implies that \( \frac{\partial \beta_h(t)}{\partial \gamma} = 0 \). In fact, (11) implicitly define \( t_{b_{\text{max}}} \) in Definition 4, having \( t_b = t_{b_{\text{max}}} \). Given this result, the last inequality in (12) implies \( \frac{\partial \beta_h(t_b)}{\partial \gamma} < 0 \). It remains to show that the divine PBE embodies \( \beta_l(t_b) = 1 \) and \( \beta_h(t_b) > 0 \) if \( \gamma < \gamma_{III} \).

If \( \gamma = \gamma_{III} \), then \( \beta_l(t) = 1 \) and \( \beta_h(t) = 0 \) to make \( D_l \) is indifferent between proposing \( t_{l_{\text{max}}} \) and proposing \( t = t_{b_{\text{max}}} \), which in turn implies that \( \beta_l(t) = 1 \) and \( \beta_h(t) > 0 \) are required to make \( D_l \) is indifferent between proposing \( t_{l_{\text{max}}} \) and \( t = t_{b_{\text{max}}} \) if \( \gamma < \gamma_{III} \).

(b) Given \( \gamma = \gamma_{III} \), the first order derivative associated with the maximization problem in (7) takes the following form, being strictly smaller than zero for \( t \geq t_{b_{\text{max}}} \) in the neighborhood of \( t_{b_{\text{max}}} \):}

\[
-(1 - \gamma) \frac{\partial \beta_l(t)}{\partial t} \left[ W^D(t; h) - W^D_l(h) \right] + [1 - (1 - \gamma) \beta_l(t)] \frac{\partial W^D(t; h)}{\partial t} < 0 .
\]

with

\[
\frac{\partial \beta_l(t)}{\partial t} = \frac{1}{\gamma} \frac{\partial W^D(t; l)}{\partial t} \left[ W^D(t_{l_{\text{max}}}; l) - W^D_l(l) \right] < 0 ,
\]

\[
1 - (1 - \gamma) \beta_l(t) = 1 - \frac{(1 - \gamma)}{\gamma} \left[ W^D(t; l) - W^D(t_{l_{\text{max}}}; l) \right] ,
\]

\[
\frac{\partial \beta_l(t)}{\partial \gamma} = -\frac{\partial W^D(t; l) - W^D(t_{l_{\text{max}}}; l)}{\gamma^2 \left[ W^D(t; l) - W^D_l(l) \right]} < 0 .
\]

First, note that (8) requires \( \beta_h(t_{b_{\text{max}}}) = 0 \) and \( \beta_l(t_{b_{\text{max}}}) = 1 \) by definition of \( \gamma_{III} \), and \( \beta_h(t) = 0 \) and \( \beta_l(t) < 1 \) for \( t > t_{b_{\text{max}}} \). The strict inequality in (13) for \( t > t_{b_{\text{max}}} \) comes from the definition of \( t_{b_{\text{max}}} \) (being the unique value of \( t \) that maximizes the
expected payoff of $D_h$ with $\gamma = \gamma^{III}$). The strict inequality in (13) holds even at $t = t^{max}_b$ because the first term in (13) is strictly smaller than the first term in (11) at $t = t^{max}_b$ with $\gamma = \gamma^{III} > 0.5$.

This strict inequality in (13) at $t = t^{max}_b$ implies $\beta_l(t_b) = 1$ and $\beta_h(t_b) = 0$ with $\frac{\partial \beta_l(t_b)}{\partial \gamma} = 0$ for $\gamma > \gamma^{III}$ in the neighborhood of $\gamma^{III}$. On the one hand, an increase in $\gamma$ raises the absolute value of the second term both in (11) and (13), thus raising the negative effect from raising $t$ in maximizing the expected payoff of $D_h$. An increase in $\gamma$ also decreases $\hat{t}_b(\gamma)$ with $\gamma$. On the other hand, an increase in $\gamma$ decreases the first term in (13) but increases the first term in (11). These comparative static results implies that a small increase in $\gamma$ at $\gamma = \gamma^{III}$ will lead to a decrease in $t_b$ (thus, $\partial t_b/\partial \gamma < 0$) so that $t_b = \hat{t}_b(\gamma)$. This is because the first order derivative associated with the maximization problem in (7) is positive for $t_b < \hat{t}_b(\gamma)$ and it is negative for $t_b > \hat{t}_b(\gamma)$. For $\gamma \geq \gamma^{III}$, therefore, $\beta_l(t_b) = 1$ and $\beta_h(t_b) = 0$ with $\partial t_b/\partial \gamma < 0$ and $\frac{\partial \beta_l(t_b)}{\partial \gamma} = 0$ in the neighborhood of $\gamma^{III}$.

Recall that we define $\gamma^{II}$ as the minimum value of $\gamma$ such that the left hand side of the inequality in (13) becomes zero with $t_b = \hat{t}^S(\gamma)$, thus $\gamma^{II} > \gamma^{III}$. Note that such a value of $\gamma$ exists and it is strictly smaller than $\gamma^I$. Because $\hat{t}^S(\gamma) = t^{max}_h$ if $\gamma = \gamma^I$, having the left hand side of the inequality in (13) is greater than zero at $t = \hat{t}^S(\gamma) = t^{max}_h$, $\gamma^{II}$ does exist and it is smaller than $\gamma^I$.

(c) If $\gamma \geq \gamma^{II}$, then $\beta_h(t_b) = 0$ because the first order derivative associated with the maximization problem in (7) is strictly greater than zero for any $t < \hat{t}^S(\gamma)$. This implies that $\beta_l(t_b) = 1$ with $t_b = \hat{t}^S(\gamma)$ or $\beta_l(t_b) < 1$ with $t_b > \hat{t}^S(\gamma)$, if $\gamma \geq \gamma^{II}$, which in turn implies that $\partial t_b/\partial \gamma < 0$: $\partial t_b/\partial \gamma < 0$ for the case in which $\beta_l(t_b) < 1$ is shown in what follows.

If $\gamma \geq \gamma^I$, first note that $\beta_h(t) = 0$ and $\beta_l(t) < 1$ under the requirement of (8) for all $t \in T^C(t^{max}_h)$ with $t^S > t^{max}_h$ by the definition of $\gamma^I$. This implies that the first derivative associated with the maximization problem in (7) takes the same form as the one in (13), and it equals to zero at $t_h$. When $\gamma$ increases, the first term in (13) decreases, reflecting a reduced benefit from raising $t$, and the (negative) second term $\gamma$ decreases, reflecting an increased cost from raising $t$. These changes in (13) in response to an increase in $\gamma$ implies $\partial t_b/\partial \gamma < 0$. To show that $\partial t_b/\partial \gamma < 0$ for any divine PBE with $\beta_l(t_b) \in (0, 1)$ and $\beta_h(t_b) = 0$, we can apply the same logic. This is because the first derivative associated with the maximization problem in (7) takes the same form as the one in (13) in the neighborhood of $t = t_b$ if $\beta_l(t_b) \in (0, 1)$ and $\beta_h(t_b) = 0$.

$\lim_{\gamma \to 1} (t^S) = t^{max}_h$ because the limit of the firm term in (13) approaches
to zero with $\gamma \to 1$ while the second term in (13) remains negative, except at $t = t_b$. Finally, the requirement of (8) implies $\beta_l(t) = [W^D(t^S; l) - W^D(t_i^{\text{max}}; l)]/\gamma [W^D(t^S; l) - W^D_L(l)]$ for $\beta_l(t) < 1$, thus

$$\lim_{\gamma \to 1} \beta_l(t^S) = \frac{W^D(t_i^{\text{max}}; l) - W^D_L(l)}{W^D(t_i^{\text{max}}; l) - W^D_L(l)} > 0$$

\[ \square \]

**Numerical Analysis in Figure 4**

The numerical analysis in Figure 4 uses the following political-economy model in defining governments’ payoff functions.\(^{27}\) It is a two-good ($m$ and $x$) two-country ($D$ and $C$) model with linear demand and supply. The demand functions of each country are as follows:

$$D^D_m(p^D_m) = 1 - p^D_m, \quad D^D_x(p^D_x) = 1 - p^D_x, \quad D^C_m(p^C_m) = 1 - p^C_m, \quad D^C_x(p^C_x) = 1 - p^C_x,$$

where $p^g_i$ denotes the price of goods $g$ in country $i$. Specific import tariffs $\tau$ and $r$ are chosen by $D$ and $C$, respectively. These are assumed to be the only trade policy instruments. In particular, $p^D_m = p^C_m + \tau$ and $p^D_x = p^C_x - r$.

$D$ and $C$ produce $m$ and $x$ using the following supply functions:

$$Q^D_m(p^D_m) = p^D_m, \quad Q^D_x(p_x) = b p^D_x, \quad Q^C_m(p^C_m) = b p^C_m, \quad Q^C_x(p_x) = p^C_x.$$

Assuming $b > 1$, $D$ becomes a natural importer of $m$ and a natural exporter of $x$.

Under this specification, the politically-weighted government payoff from the importing sector in $D$ is given by

$$u(\tau; \theta_D) = \frac{1}{(3 + b)^2} \left\{ \frac{1}{2} (1 + b)^2 + 2\theta_D(1 + b) - 4\| \tau \\
+ \left[ \frac{1 + \theta_D}{2} (1 + b)^2 - 2(3 + b)(1 + b) \right] \tau^2 \right\},$$

\(^{27}\)Many studies use this simple political-economy model to analyze various issues of trade agreements that arise from private political pressure for protection, including Bagwell and Staiger (2005) and Beshkar (2010a, 2016). The following representation of such a political-economy model directly comes from Beshkar (2016).
where $\theta_D \geq 1$ denotes $D$’s political pressure from the import competing industry. $D$’s payoff from the exporting sector is a function of $C$’s import tariff $r$:

$$v(r) = \frac{1}{(3+b)^2} \left\{ \frac{(1+b)^2}{2} + 2b + 2(1-b)r + 2(1+b)r^2 \right\}.$$  \hspace{1cm} (18)

For the derivation of equations (17) and (18), see Appendix A of Beshkar (2016).

$C$’s politically-weighted payoff from the importing industry $u(r, \theta_C)$ and her payoff from the exporting industry $v(\tau)$ can be defined symmetrically.

Using $u$ and $v$ constructed above, the payoff function of each government can be defined as follows:

$$W^D(\tau, r; \theta = \theta_D) = u(\tau; \theta) + v(r), \quad W^C(\tau, r; \theta_C) = u(r; \theta_C) + v(\tau).$$ \hspace{1cm} (19)

The parameter values used for the numerical analysis are as follows: $b = 15$, $l = 1.05$, $h = 1.35$. $\theta = h$ if the political pressure is high, and $\theta = l$, otherwise. $\theta_C$ is fixed at $l$ throughout the analysis.

Proof. for Lemma 7) Consider a pooling PBE under which both types of $D$ propose $t_{pool}$ and $C$ accepts it. Now consider an alternative tariff pair, $t'$, such that $t' \prec _{D_l} t_{pool} \prec _{D_h} t' \prec _h t_{pool}$ and $W^C_L(h) < W^C(t')$. Then a defection to $t'$ will certainly hurt $D_l$ compared to the equilibrium outcome regardless of $C$’s reaction. Therefore, $C$ would believe that the defection to $t'$ has been committed by $D_h$, in which case $C$ will accept the proposal. Knowing this, $D_h$ will defect to $t'$ with certainty. Thus, $t_{pool}$ cannot be supported by reasonable off-equilibrium belief. \hfill $\Box$

Proof. for Lemma 8) First, we show that a PBE that involves $\beta_0$ and $t_0 \in T^C_t (t_{max}^h), t_0 \neq t_b$ is not universally divine. To this end, note that there must exist $t'' \in T^D_I (t_b)$ such that $t'' \prec t_b$ and

$$(1 - \beta_0) W^D(t_0, h) + \beta_0 W^D_L(h) = (1 - \beta_b) W^D(t''; h) + \beta_b W^D_L(l).$$

Given continuity of welfare functions, there must also exist $t' \in T^D_I (t_b), t'' \prec t' \prec _{D_h} t_b, and \beta' > \beta_b$ such that

$$\beta' W^D_L(l) + (1 - \beta') W^D(t'; h) = (1 - \beta_b) W^D(t''; h) + \beta_b W^D_L(l).$$
Now suppose that under the PBE that involves $\beta_0$ and $t_0$, $D$ defects to $t'$. This defection will strictly reduce $D_l$'s expected welfare if $C$ responds with $\beta > \beta_b$. However, this defection will strictly increases $D_h$'s expected welfare if $C$ responds with any $\beta < \beta'$. Therefore, there for any $\beta \in (\beta_b, \beta')$, $D_h$ benefits (loses) from a defection to $t'$. Therefore, if a defection to $t'$ is observed (instead of observing one of possible equilibrium outcomes, $t_0$ or $t_l^{\max}$), $C$ will believe it is committed by $D_h$. Since $t'$ is strictly preferred by $C$ to litigation, $C$ cannot reject this proposal under any reasonable belief about $D$’s type.

To complete the proof, we need to show that the PBE that involves $t_b$ and $\beta_b$ is universally divine. To this end, note that $(t_b, \beta_b)$ is not universally divine if and only if there exist $(t', \beta')$ such that

\[(t', \beta') \succ (t_b, \beta_b),
(t', \beta') \prec (t_b, \beta_b) \equiv t_l^{\max}.
\]

However, this is not possible because these preference orderings imply that there exists a PBE involving $t'$ that is preferred to $(t_b, \beta_b)$ by $D_h$. Therefore, $(t_b, \beta_b)$ is universally divine.

Proof. For Proposition 4) First note that regardless of its information, $D$’s settlement proposal, $t^S$, must be either $t_l^{\min}$ or $t_h^{\min}$. To see this, first note that $t^S \succ t_h^{\min}$ is a suboptimal proposal for $C$ because proposing $t_h^{\min}$ will draw the same response from $D$, which is acceptance, but $t_l^{\min}$ will generate a higher welfare for $C$. Second, note that it is not optimal for $C$ to propose $t^S$ such that $t_l^{\min} \prec t^S \prec t_h^{\min}$. That is because the $D_l$ ($D_h$) will settle (litigate) whether $t_l^{\min}$ or $t^S$ that satisfies $t_l^{\min} < t^S < t_h^{\min}$ is proposed. But $C$ prefers $t_l^{\min}$ to $t^S$ that satisfies $t_l^{\min} < t^S < t_h^{\min}$. Therefore, the equilibrium proposal is either $t_l^{\min}$ or $t_h^{\min}$.

If $t^S = t_l^{\min}$, then $D_l$ will settle and $D_h$ will litigate. Therefore, given $\theta^C$, $C$’s expected payoff from proposing $t^S = t_l^{\min}$ is

\[
Pr(\theta = h|\theta^C)W^C_L(h) + \left[1 - Pr(\theta = h|\theta^C)\right] W^C(t_l^{\min}).
\]
If $t^S = t^\text{min}_h$, then both types of $D$ will accept the proposal in which case the payoff of $C$ is given by $W^C(t^\text{min}_h)$. Therefore, $C$ will propose $t^S = t^\text{min}_h$ if and only if

$$W^C(t^\text{min}_h) \geq \Pr(\theta = h|\theta^C) W^C_L(h) + \left[1 - \Pr(\theta = h|\theta^C)\right] W^C(t^\text{min}_l),$$

or, equivalently, iff

$$\Pr(\theta = h|\theta^C) \geq \frac{W^C(t^\text{min}_h) - W^C(t^\text{min}_l)}{W^C(t^\text{min}_l) - W^C_L(h)}.$$

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**References**


Figure 1. Potential Gains from Settlement
Figure 2. Divine Equilibrium Settlement Offer
Figure 3. Effect of $\gamma$ on the Divine Equilibrium