Pretrial Settlement with Imperfect Private Monitoring

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Abstract

We model pretrial settlement bargaining in the WTO trade disputes as a signaling game with nontransferable utility. In this pretrial bargaining with the DSB's judgement being subject to errors, a defendant government knows the probability of winning the DSB ruling by observing the realized contingency that determines protection desirability, but a complainant government only receives an imperfect private signal of the contingency. A truth-telling equilibrium arises regardless of the accuracy of the complainant's private signal: the defendant never exaggerates its desirability for protection. Despite this truth-telling behavior, the complainant assigns a positive probability for litigation (no settlement), which decreases in its signal's accuracy but remains positive even when the signal becomes almost perfect. When the accuracy of the complainant's signal improves, the defendant's take-it-or-leave-it tariff combination offer decreases toward a Pareto efficient tariff combination.

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1 Introduction

As a part of the post-World-War-II international economic institutions, the General Agreement on Tariffs and Trade (GATT), which later became the World Trade Organization (WTO) in 1995, has facilitated its member countries negotiating multilateral trade liberalization and enforcing the negotiated trade agreements. In enforcing the commitments under the WTO, its dispute settlement procedure (DSP) plays a central role. Any member government may file a petition to the WTO's Dispute Settlement Body (DSB) against its trading partner's measures that are suspected of voilating anticipated commitments under the WTO. Although the WTO's DSP 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), the WTO strongly emphasizes settling disputes through consultations among disputing parties. As stated in the WTO's official website, "..., the point is not to pass judgement. 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."

To understand the role that pretrial settlement plays in enforcing trade agreements, we develop a simple model of pretrial bargaining in which a defendant government proposes a take-it-or-leave-it tariff combtination offer after observing the realized contingency that determines the desirability of protection. In particular, we analyze the role of a complainant government's imperfect private signal about a potential violation by a defendant government in trade disputes. For example, the complainant government may file a petition to DSB of the WTO against the defending government's potential abuse of escape-clause protection, based on its exporting firms' allegation that the defendant government's import competing sector is not sufficiently injured by imports to warrant such protection. The complainant government's information about the potential abuse of escape-clause protection can be more accurate than the judgment of a third-party panel of the WTO because of its (exporting sectors') repeated economic and political interactions with the defendant country. Such information, however, is still imperfect and also private in the sense that public disclosure of such information can be highly costly to the exporting firms of the complainant country.[1]

Our analysis of a pre-trial settlement game with such an imperfect private signal of a potential violation generates the following results, particularly about the consequence of improving the accuracy of the complaining government's signal on the likelihood of violations and terms of settlement. Surprisingly, a truth-telling equilibrium arises as the outcome of the game regardless of the accuracy of the complainant government's signal: the defendant government never exaggerates its desirability for protection as an attempt to abuse the escape-clause protection. Despite this truth-telling behavior of the defendant government, the complainant government assigns a positive probability to its litigation (no settlement) against the denfendant government's claim for escape-clause protection (i.e., a tariff combination offer that signals such claim). When its signal's accuracy improves, the litigation probability of the complainant government decreases but remains positive even when the signal becomes almost perfect. In response to the improvement of the complainant government's signal, the defendant government's pretial tariff combination offer decreases toward a Pareto efficient tariff combination, in which the complainant government is indifferent between litigation and settlement.

"A literature review to be added."

[1] It is easy to find examples that firms choose not to reveal their private information even in the situation that such nondisclosure would lead to a costly consequence. For example, there exist many U.S. antidumping cases in which foreign companies under investigation decide not to provide "private" costs- and sales-related information despite the fact that such nondisclosure often leads to excessive dumping duties based on "best information available."

2 Basic setup

The basic setup of our model of trade disputes and settlement is as follows. There are two countries, country C and country D, that trade two products, x and y, on which each country may impose an import tariff. Country D's government is subject to its import competing sector's pressure for protection, denoted by θ, which can be either high ($\overline{\theta}$) or low ($\underline{\theta}$). This random domestic pressure for protection is the private information of country D's government (denoted by D, henceforth), of which the government of country C (denoted by C) receives an imperfect private signal, denoted by θ^C, which can be either high ($\overline{\theta}$) or low ($\underline{\theta}$).

In addition to C and D, there is a third party, namely DSB of the WTO, that may generate its ruling on a disputed case upon request. The DSB ruling is an announcement of its yet another imperfect signal of D's domestic pressure for protection. As discussed later in more details, we introduce a minimum specification for the DSB ruling: we assume that C and D can obtain higher expected payoffs with DSB than the ones without DSB given that C has no information about D's contingency on its pressure for protection.[2]

The focus of our analysis is on the use of C's imperfect private signal against D's potential misrepresentation of its domestic pressure for protection before the DSB ruling. We model the pretrial settlement game as a signaling game in which D signals its type (whether its domestic protection pressure is high or low) by proposing a take-it-or-leave-it tariff combination offer, which

[2] In the absence of C's signal of D's domestic pressure for protection, Beshkar (forthcoming) characterizes an optimal dispute settlement mechanism that induces the governments to implement tariff combinations that maximize the ex-ante joint payoff given the incentive constraint for truth-telling and the informational constraint of DSB. Such an optimal dispute settlement mechanism enables the governments to obtain higher expected payoffs than the ones that the governments can attain by themselves with C having no information about D's political pressure for protection. While our assumption allows a less-than optimal dispute settlement mechanism, we do assume that the DSB ruling and the resulting outcome of litigation neither depend on the accuracy of C's private signal nor depend on the governments' pretrial behaviors.

C can either accept (and settle) or litigate based on its imperfect private signal.

2.1 Markets

Prior to analyzing the pretrial settlement game, we describe a simple and widely-used political-economy trade model, which can generate the charateristics of governments' payoff functions that we assume in our analysis. We assume competitive markets in which countries gain from trade because of different costs of production. The trade policy instrument at each governments' disposal is its import tariff. We also assume, à la Baldwin (1987), that each government maximizes a weighted sum of its producers' surplus (π), consumers' surplus (ψ), and tariff revenues (T), possibly with a higher weight on the surplus of its import-competing sector. As demonstrated by Grossman and Helpman (1994), the higher weight given to the import-competing sector may be the result of political pressure, through lobbying for example, that a government faces. Denoting the political weight on the import-competing sector by $\theta \geq 1$, each government's payoff drawn from its import-competing sector, m, is given as follows:

$$u(\tau;\theta) \equiv \psi_m(\tau) + \theta\pi_m(\tau) + T(\tau),$$

where, τ is the specific tariff on imports. The each government's payoff from its export sector, x, is given by

$$v(r) \equiv \psi_x(r) + \pi_x(r).$$

where, r is the other government's import tariff. Finally, let

$$W^D(t;\theta) \equiv W^D(\tau, r;\theta) = u(\tau;\theta) + v(r).$$

denote the total payoff of D as a function of $t \equiv (\tau, r)$. The total payoff of C, $W^C(t;\theta)$, can be defined in a similar manner.

Private political shocks

To capture fluctuations in political economy preferences, we assume that θ is subject to random shocks, i.e., the weight that D places on its import-competing sector may change over time. Formally, we assume that θ is drawn from a binary set $\{\underline{\theta}, \overline{\theta}\}$, such that $\theta = \overline{\theta}$ with probability ρ and $\theta = \underline{\theta}$ with probability $1-\rho$. For simplicity, we assume that C's political pressure parameter for its import-competing sector is fixed and equal to $\underline{\theta}$, thereby θ denotes only the contingency of D's domestic pressure for protection.

2.2 DSB's ruling

We assume that disputing parties could resort to the third-party ruling by DSB if they fail to reach a mutually accepted solution in the consultation stage. We treat the DSB ruling process, if used, as a black box that will result in outcomes that satisfy a set of conditions to be laid out below. Let T_θ denote the set of Pareto efficient tariff pairs and $W_L^i(\theta)$ denote the expected payoff of a government $i = \{D, C\}$ from litigation if the true state of the world is θ (of D). Moreover, define $t_l^{\min}, t_l^{\max} \in T_{\underline{\theta}}$ and $t_h^{\min}, t_h^{\max} \in T_{\overline{\theta}}$ such that

$$\begin{aligned} W^D\left(t_l^{\min}; \underline{\theta}\right) &\equiv W_L^D\left(\underline{\theta}\right), \\ W^C\left(t_l^{\max}\right) &\equiv W_L^C\left(\underline{\theta}\right), \\ W^D\left(t_h^{\min}; \overline{\theta}\right) &\equiv W_L^D\left(\overline{\theta}\right), \\ W^C\left(t_h^{\max}\right) &\equiv W_L^C\left(\overline{\theta}\right). \end{aligned}$$

We assume that the DSB ruling satisfies the following conditions:

1. C will strictly prefer an expected court ruling when $\theta = \underline{\theta}$ to an expected

court DSB when $\theta = \overline{\theta}$. In other words, $W_L^C(l) > W_L^C\left(\overline{\theta}\right)$, or

$$t_l^{\max} \underset{C}{\succ} t_h^{\max}. \tag{1}$$

2. C of any type will strictly prefer an expected court ruling when $\theta = \overline{\theta}$ to an expected DSB ruling when $\theta = \underline{\theta}$. In other words,

$$\begin{aligned} t_l^{\min} &\underset{D_h}{\prec} t_h^{\min}, \\ t_l^{\min} &\underset{D_l}{\prec} t_h^{\min}. \end{aligned} \tag{2}$$

3. Consider any incentive-compatible mechanism with $t(\theta)$ such that $t(\underline{\theta}) \underset{D_l}{\approx} t(\overline{\theta})$, which C and D can emply with no DSB and no information of C. The expected joint payoff under litigation is greater than the expected payoff under any such mechanism. Namely,

$$\begin{aligned} (1-\rho)\left[W_L^C(\underline{\theta}) + W_L^D(\underline{\theta})\right] + \rho\left[W_L^C(\overline{\theta}) + W_L^D(\overline{\theta})\right] > \\ (1-\rho)\left[W^C(t(\underline{\theta})) + W^D(t(\underline{\theta});\underline{\theta})\right] + \rho\left[W^C(t(\overline{\theta})) + W^D(t(\overline{\theta});\overline{\theta})\right]. \end{aligned} \tag{3}$$

Moreover, we assume that there is joint surplus from settlement under $\theta = \underline{\theta}$, i.e.,

$$\left(t_l^{\min} \underset{D_l}{\prec} t_l^{\max}\right) \wedge \left(t_l^{\min} \underset{C}{\succ} t_l^{\max}\right), \tag{4}$$

as well as under $\theta = \overline{\theta}$, i.e.,

$$\left(t_h^{\min} \underset{D_h}{\prec} t_h^{\max}\right) \wedge \left(t_h^{\min} \underset{C}{\succ} t_h^{\max}\right). \tag{5}$$

Proposition 1 *Conditions (1)-(5) imply the following preference ranking with regard to the four extreme-value tariff combinations associated with the DSB ruling.*

$$t_l^{\min} \underset{D}{\prec} t_l^{\max} \underset{D}{\prec} t_h^{\min} \underset{D}{\prec} t_h^{\max},$$
$$t_l^{\min} \underset{C}{\succ} t_l^{\max} \underset{C}{\succ} t_h^{\min} \underset{C}{\succ} t_h^{\max}.$$

Proof. To be added: [Sketch of the proof] We first show that conditions 3-5 imply

$$\left(t_l^{\max} \underset{D_l}{\prec} t_h^{\min}\right) \wedge \left(t_l^{\max} \underset{D_h}{\prec} t_h^{\min}\right) \wedge \left(t_l^{\max} \underset{C}{\succ} t_h^{\min}\right).$$

The remaining relationships are directly implied from the other conditions. ■

3 Pre-trial Settlement Game with a Take-or-Leave-it Offer

Having the DSB ruling characterized as in the preceding section, this section analyzes the pretrial settlement game between C and D before the DSB ruling. Recall that C receives a noisy private signal about D's domestic pressure for protection. Formally, C receives a signal, denoted by θ^C, that matches the true state of the world with probability $\gamma > \frac{1}{2}$, i.e.,

$$\Pr\left(\theta^C = \underline{\theta} | \theta = \underline{\theta}\right) = \Pr\left(\theta^C = \overline{\theta} | \theta = \overline{\theta}\right) = \gamma.$$

As discussed by Beshkar (forthcoming), the disputing parties have a collective incentive to settle without resorting to DSB's ruling because the joint payoff of the disputing parties is a concave function in t and the DSB ruling is uncertain. In addition to this incentive to settle because of the concavity of the joint payoff function, there may exist an additional incentive for settlement to avoid the transaction cost of litigation, which may include attorney fees, cost of gathering information, etc. In order to highlight the effect of uncertain DSB outcomes on the pattern of dispute settlement, we assume zero litigation cost and investigate whether C would invoke a formal dispute after observing certain tariff-setting behaviors by D.

In analyzing the pretrial settlement game, we consider the game in which D makes a take-it-or-leave-it offer on tariffs prior to the DSB ruling process. More specifically, we study the following pretrial settlement game. Assume that after the realization of the state of the world, D proposes a tariff pair $t = (\tau, r)$. If C accepts this proposal after observing its noisy signal of the state of the world, there will be no litigation. Otherwise, the dispute escalates to the DSB, leading to the DSb outcome described in Section 2.2. This is a signaling game in which D is the *sender* and C is the *receiver*. The proposed tariff pair, t, is D's signaling of its type (i.e., level of its domestic pressure for protection) and the threat of litigation is the cost associated with this signaling.

We consider hybrid equilibria of this signaling game, which includes pooling and separating equilibria as special cases. On the one hand, a high-type D has a pure strategy of proposing t_h in the equilibrium. On the other hand, the strategy of a low-type D is to randomize between t_l and t_h with $t_l \leq t_h$. Let α denote the probability that a low-type D proposes t_h instead of t_l. C's equilibrium strategy is to accept a settlement proposal when $t = t_l$, to reject $t = t_h$ with probability $\underline{\beta}$ if $\theta^C = \underline{\theta}$, and to reject $t = t_h$ with probability $\overline{\beta}$ if $\theta^C = \overline{\theta}$.

$\left(\alpha, \underline{\beta}, \overline{\beta}, t_l, t_h\right)$ is a Perfect Bayesian Equilibrium (PBE) if and only if:

1. When $\theta = \underline{\theta}$,

   (a) D prefers to settle at t_l than to litigate, i.e.,

$$W^D\left(t_l; \underline{\theta}\right) \geq W_L^D\left(\underline{\theta}\right) \tag{6}$$

(b) if $\alpha \in (0,1)$, D is indifferent between proposing t_l and t_h, i.e.,

$$\begin{aligned} W^D(t_l;\underline{\theta}) &= W^D(t_h;\underline{\theta},\underline{\beta},\overline{\beta}) \\ &\equiv \gamma[\left(1-\underline{\beta}\right) W^D(t_h;\underline{\theta}) + \underline{\beta} W_L^D(\underline{\theta})] \\ &\quad + (1-\gamma)\left[\left(1-\overline{\beta}\right) W^D(t_h;\underline{\theta}) + \overline{\beta} W_L^D(\underline{\theta})\right], \end{aligned} \tag{7}$$

if $\alpha = 1$, $W^D(t_l;\underline{\theta}) \leq W^D(t_h;\underline{\theta},\underline{\beta},\overline{\beta})$, and
if $\alpha = 0$, $W^D(t_l;\underline{\theta}) \geq W^D(t_h;\underline{\theta},\underline{\beta},\overline{\beta})$.

2. When $\theta = \overline{\theta}$, D (weakly) prefers to settle at t_h than to litigate, i.e.,

$$W^D\left(t_h;\overline{\theta}\right) \geq W_L^D(\overline{\theta}). \tag{8}$$

3. C (weakly) prefers settlement to litigation when t_l is proposed, i.e.,

$$W^C(t_l) \geqslant W_L^C(\underline{\theta}). \tag{9}$$

4. When D proposes t_h

(a) and $\theta^C = \underline{\theta}$,

if $\underline{\beta} \in (0,1)$, C is indifferent between litigation and settlement, i.e.,

$$\begin{aligned} W^C(t_h) &= W_L^C(\theta^C = \underline{\theta};\alpha) \\ &\equiv \Pr\left(\theta = \underline{\theta} | \theta^C = \underline{\theta};\alpha\right) W_L^C(\underline{\theta}) \\ &\quad + \left[1 - \Pr\left(\theta = \underline{\theta} | \theta^C = \underline{\theta};\alpha\right)\right] W_L^C(\overline{\theta}), \end{aligned} \tag{10}$$

if $\underline{\beta} = 1$, $W^C(t_h) \leq W_L^C(\theta^C = \underline{\theta};\alpha)$,
if $\underline{\beta} = 0$, $W^C(t_h) \geq W_L^C(\theta^C = \underline{\theta};\alpha)$,

where

$$\Pr\left(\theta = \underline{\theta} | \theta^C = \underline{\theta}; \alpha\right) = \frac{\gamma\left(1-\rho\right)\alpha}{\left(1-\rho\right)\alpha\gamma + \rho\left(1-\gamma\right)}.$$

(b) and $\theta^C = \overline{\theta}$,

if $\overline{\beta} \in (0,1)$, C is indifferent between litigation and settlement, i.e.,

$$\begin{aligned} W^C\left(t_h\right) &= W_L^C(\theta^C = \overline{\theta}; \alpha) \\ &\equiv \Pr\left(\theta = \overline{\theta} | \theta^C = \overline{\theta}; \alpha\right) W_L^C\left(\overline{\theta}\right) \\ &\quad + \left[1 - \Pr\left(\theta = \overline{\theta} | \theta^C = \overline{\theta}; \alpha\right)\right] W_L^C(\underline{\theta}), \end{aligned} \tag{11}$$

if $\overline{\beta} = 1$, $W^C\left(t_h\right) \leq W_L^C(\theta^C = \overline{\theta}; \alpha)$, and

if $\overline{\beta} = 0$, $W^C\left(t_h\right) \geq W_L^C(\theta^C = \overline{\theta}; \alpha)$,

where

$$\Pr\left(\theta = \overline{\theta} | \theta^C = \overline{\theta}; \alpha\right) = \frac{\gamma\rho}{\gamma\rho + (1-\rho)\alpha\left(1-\gamma\right)}.$$

5. $0 \leq \alpha \leq 1$, $0 \leq \underline{\beta} \leq 1$, $0 \leq \overline{\beta} \leq 1$.

Lemma 1 *There exists the following two types of mutually exclusive equilibria: Type I equilibrium with the low-type C ($\theta^C = \underline{\theta}$) being indifferent between litigation and settlement, having $\overline{\beta} = 0$ and $\underline{\beta} \in (0,1]$; Type II equilibrium with the high-type C ($\theta^C = \overline{\theta}$) being indifferent between litigation and settlement, having $\overline{\beta} \in (0,1]$ and $\underline{\beta} = 1$.*

Proof. "to be added." ■

We can rule out $\overline{\beta} = \underline{\beta} = 0$ and $\overline{\beta} = \underline{\beta} = 1$ from equilibrium values of our interest. If $\overline{\beta} = \underline{\beta} = 0$, the low-type D will always offer t_h (thus, $\alpha = 1$), generating a pooling equilibrium, strictly dominated by an equilibrium with an informative DSB ruling. If $\overline{\beta} = \underline{\beta} = 1$, then it will be identical to the litigation case with no information of C. Thus, we can focus on the two types of equilibrium specified in Lemma 1.

3.1 Divine PBE

As in other signaling games, there exists multiple Perfect Bayesian equilibria that satisfy the above conditions 1 - 5. As refinement, we use the solution concept of "divine equilibrum," developed by Banks and Sobel (1987):

Definition 2 *"to be added."*

By applying this equilibrium concept, we can show the following lemmas about the divine PBE of the signal game specified above:

Lemma 2 *The divine PBE value of t_l is $t_l^{\max}$ uniquely determined by*

$$W^C\left(t_l^{\max}\right) = W_L^C\left(\underline{\theta}\right) \text{ and } t_l^{\max} \in T_{\underline{\theta}}.$$

Proof. "to be added." ■

Given Lemma 2, now we need to characterize divine PBE values of $\left(\alpha, \underline{\beta}, \overline{\beta}, t_l^{\max}, t_h\right)$ that depend on the value of γ:

Lemma 3 *The only divine PBE, $\left(\alpha, \underline{\beta}, \overline{\beta}, t_l^{\max}, t_h\right)$, is the one that maximizes the expected payoff of the high-type D.*

Proof. A complete proof to be added: Let $\left(\alpha^*, \underline{\beta}^*, \overline{\beta}^*, t_l^{\max}, t_h^*\right)$ denote the PBE under which the expected welfare of the high-type D is the highest among all PBE. Now consider a PBE, $\left(\alpha, \underline{\beta}, \overline{\beta}, t_l^{\max}, t_h\right) \neq \left(\alpha^*, \underline{\beta}^*, \overline{\beta}^*, t_l^{\max}, t_h^*\right)$. To prove this lemma, we need to show that a PBE with $\left(\alpha, \underline{\beta}, \overline{\beta}, t_l^{\max}, t_h\right)$ does not satisfy the divinity criterion, but $\left(\alpha^*, \underline{\beta}^*, \overline{\beta}^*, t_l^{\max}, t_h^*\right)$ does.

To show that $\left(\alpha, \underline{\beta}, \overline{\beta}, t_l^{\max}, t_h\right)$ does not satisfy the divinity criterion, we first show that $D(l, \Theta, t_h^*) \cup D^\circ(l, \Theta, t_h^*) \subset D(h, \Theta, t_h^*)$,thus, $\Theta^{**}(t_h^*) = \{h\}$. Because the expected payoff of the high-type D under $\left(\alpha, \underline{\beta}, \overline{\beta}, t_l^{\max}, t_h\right)$ is strictly lower than its expected payoff under $\left(\alpha^*, \underline{\beta}^*, \overline{\beta}^*, t_l^{\max}, t_h^*\right)$ by definition:

$$\begin{aligned} & \left[(1-\underline{\beta})(1-\gamma) + (1-\overline{\beta})\gamma\right] W^D(t_h; h) + \left[\underline{\beta}(1-\gamma) + \overline{\beta}\gamma\right] W_L^D(h) \\ < & \left[(1-\underline{\beta}^*)(1-\gamma) + (1-\overline{\beta}^*)\gamma\right] W^D(t_h^*; h) + \left[\underline{\beta}^*(1-\gamma) + \overline{\beta}^*\gamma\right] W_L^D(h), \end{aligned}$$

$(\underline{\beta}^/, \overline{\beta}^/)$ that satisfies

$$\begin{aligned} & \left[(1-\underline{\beta}^/)(1-\gamma) + (1-\overline{\beta}^/)\gamma\right] W^D(t_h^*; h) + \left[\underline{\beta}^/(1-\gamma) + \overline{\beta}^/\gamma\right] W_L^D(h) \\ = & \left[(1-\underline{\beta})(1-\gamma) + (1-\overline{\beta})\gamma\right] W^D(t_h; h) + \left[\underline{\beta}(1-\gamma) + \overline{\beta}\gamma\right] W_L^D(h) \end{aligned}$$

is greater than $(\underline{\beta}^*, \overline{\beta}^*)$ with $W^D(t_h^*; h) > W_L^D(h)$. This implies that $D^\circ(h, \Theta, t_h^*) = \{(\underline{\beta}^/, \overline{\beta}^/)\}$ and $D(h, \Theta, t_h^*) = \{(\underline{\beta}, \overline{\beta}) \mid 0 < \underline{\beta} \leq \underline{\beta}^/$ and $0 < \overline{\beta} \leq \overline{\beta}^/$ with at least one of the weak inequalities holds with a strong inequality$\}$. Because the expected payoff of the low-type D under $\left(\alpha, \underline{\beta}, \overline{\beta}, t_l^{\max}, t_h\right)$ is identical its expected payoff under $\left(\alpha^*, \underline{\beta}^*, \overline{\beta}^*, t_l^{\max}, t_h^*\right)$:

$$\begin{aligned} & \left[(1-\underline{\beta})\gamma + (1-\overline{\beta})(1-\gamma)\right] W^D(t_h; l) + \left[\underline{\beta}\gamma + \overline{\beta}(1-\gamma)\right] W_L^D(l) \\ = & \left[(1-\underline{\beta}^*)\gamma + (1-\overline{\beta}^*)(1-\gamma)\right] W^D(t_h^*; l) + \left[\underline{\beta}^*\gamma + \overline{\beta}^*(1-\gamma)\right] W_L^D(l) = W^D(t_l^{\max}; l), \end{aligned}$$

$(\underline{\beta}^/, \overline{\beta}^/)$ that satisfies

$$\begin{aligned} & \left[(1-\underline{\beta}^/)\gamma + (1-\gamma)\right] W^D(t_h^*; l) + \underline{\beta}^/\gamma W_L^D(l) \\ = & \left[(1-\underline{\beta})\gamma + (1-\gamma)\right] W^D(t_h; l) + \underline{\beta}\gamma W_L^D(l) \end{aligned}$$

is identical to $(\underline{\beta}^*, \overline{\beta}^*)$. This implies that $D^\circ(l, \Theta, t_h^*) = \{(\underline{\beta}^*, \overline{\beta}^*)\}$ and $D(l, \Theta, t_h^*) = \{(\underline{\beta}, \overline{\beta}) \mid 0 < \underline{\beta} \leq \underline{\beta}^*$ and $0 < \overline{\beta} \leq \overline{\beta}^*$ with at least one of the weak inequalities holds with a strong inequality}. Therefore, $D^{\circ}(l,\Theta,t_h^*)\cup D(l,\Theta,t_h^*) = \{\underline{\beta} \mid 0<\underline{\beta}\leq\underline{\beta}^* \text{ and } 0<\overline{\beta}\leq\overline{\beta}^*\}\subset D(h,\Theta,t_h^*) = \{(\underline{\beta},\overline{\beta}) \mid 0<\underline{\beta}\leq\underline{\beta}^{/}$ and $0<\overline{\beta}\leq\overline{\beta}^{/}$ with at least one of the weak inequalities holds with a strong inequality} with $(\underline{\beta}^*,\overline{\beta}^*)<(\underline{\beta}^{/},\overline{\beta}^{/})$. This implies that $\Theta^{**}(t_h^*)=\{h\}$. If the deviation message from $\left(\alpha,\underline{\beta},\overline{\beta},t_l^{\max},t_h\right)$ is t_h^*, then the receiver (C) would believe that such a deviation is done by a high-type D by the divinity criterion. Given this belief the optimal action of C is settlement ($\underline{\beta}=0$ and $\overline{\beta}=0$), having

$$\begin{aligned}
&\min_{(\underline{\beta},\overline{\beta})\in A^*(\Theta^{**}(t_h^*),t_h^*)}\left\{\left[(1-\underline{\beta})\gamma+(1-\overline{\beta})(1-\gamma)\right]W^D(t_h^*;l)+\left[\underline{\beta}\gamma+\overline{\beta}(1-\gamma)\right]W_L^D(l)\right\}\\
=\ & W^D(t_h^*;l)>W^D(t_l^{\max};l),
\end{aligned}$$

and

$$\begin{aligned}
&\min_{(\underline{\beta},\overline{\beta})\in A^*(\Theta^{**}(t_h^*),t_h^*)}\left\{\left[(1-\underline{\beta})(1-\gamma)+(1-\overline{\beta})\gamma\right]W^D(t_h^*;h)+\left[\underline{\beta}(1-\gamma)+\overline{\beta}\gamma\right]W_L^D(h)\right\}\\
=\ & W^D(t_h^*;h)>\left[(1-\underline{\beta}^*)(1-\gamma)+(1-\overline{\beta}^*)\gamma\right]W^D(t_h^*;h)+\left[\underline{\beta}^*(1-\gamma)+\overline{\beta}^*\gamma\right]W_L^D(h)\\
>\ & \left[(1-\underline{\beta})(1-\gamma)+(1-\overline{\beta})\gamma\right]W^D(t_h;h)+\left[\underline{\beta}(1-\gamma)+\overline{\beta}\gamma\right]W_L^D(h).
\end{aligned}$$

Thus, a PBE with $\left(\alpha,\underline{\beta},\overline{\beta},t_l^{\max},t_h\right)$ does not satisfy the divinity criterion.

On the other hand, the equilibrium $\left(\alpha^*,\underline{\beta}^*,\overline{\beta}^*,t_l^{\max},t_h^*\right)$ satisfies the divinity criterion. To see this, consider a situation where D proposes an off-equilibrium tariff pair $t_h'\neq t_h^*$ where $t_h^{/}\in T_h^c$. Let $(\underline{\beta}^{/},\overline{\beta}^{/})$ denote $(\underline{\beta},\overline{\beta})$ that together with $t_h^{/}$ constitutes a PBE. By definition of t_h^* we know that the expected payoff of the high type D under $(t_h^{/},\ \underline{\beta}^{/},\overline{\beta}^{/})$ is strictly lower than its expected payoff under $\left(t_h^*,\underline{\beta}^*,\overline{\beta}^*\right)$. Nevertheless, the low-type D is indifferent between $(t_h^{/},\ \underline{\beta}^{/},\overline{\beta}^{/})$ and $\left(t_h^*,\underline{\beta}^*,\overline{\beta}^*\right)$. Therefore, due to the continuity of D's expected payoff with respect to $(\underline{\beta},\overline{\beta})$ and t_h, there must exist $(\underline{\beta}^{//},\overline{\beta}^{//})>(\underline{\beta}^{/},\overline{\beta}^{/})$ for which the low-type D strictly prefers the deviation outcome, $(t_h^{/},\ \underline{\beta}^{//},\overline{\beta}^{//})$, to the equilibrium, $\left(t_h^*,\underline{\beta}^*,\overline{\beta}^*\right)$, while the high-type D is strictly worse off by the deviation. Therefore, $D(h, \Theta, t_h^{/}) \cup D^{\circ}(h, \Theta, t_h^{/}) \subset D(l, \Theta, t_h^{/})$,thus, $\Theta^{**}(t_h^{/}) = \{l\}$. This means that when a deviation from the equilibrium $\left(\alpha^*, \underline{\beta}^*, \overline{\beta}^*, t_l^{\max}, t_h^*\right)$ is observed, C would think that such a deviation is carried out by a low-type D. Given this belief, the optimal action of C is litigation ($\underline{\beta} = 1$ and $\overline{\beta} = 1$), having

$$\begin{aligned} & \underset{(\underline{\beta},\overline{\beta}) \in A^*(\Theta^{**}(t_h'),t_h')}{min} \left\{ \left[(1-\underline{\beta})\gamma + (1-\overline{\beta})(1-\gamma)\right] W^D(t_h'; l) + \left[\underline{\beta}\gamma + \overline{\beta}(1-\gamma)\right] W_L^D(l) \right\} \\ = \; & W_L^D(l) < W^D(t_l^{\max}; l), \end{aligned}$$

and

$$\begin{aligned} & \underset{(\underline{\beta},\overline{\beta}) \in A^*(\Theta^{**}(t_h'),t_h')}{min} \left\{ \left[(1-\underline{\beta})(1-\gamma) + (1-\overline{\beta})\gamma\right] W^D(t_h'; h) + \left[\underline{\beta}(1-\gamma) + \overline{\beta}\gamma\right] W_L^D(h) \right\} \\ = \; & W_L^D(h) < \left[(1-\underline{\beta}^*)(1-\gamma) + (1-\overline{\beta}^*)\gamma\right] W^D(t_h^*; h) + \left[\underline{\beta}^*(1-\gamma) + \overline{\beta}^*\gamma\right] W_L^D(h). \end{aligned}$$

Therefore, a PBE with $\left(\alpha^*, \underline{\beta}^*, \overline{\beta}^*, t_l^{\max}, t_h^*\right)$ does satisfy the divinity criterion.

Note that the above proof focuses on the PBE in which $\alpha > 0$ so that the low-type D is indifferent between offering $t_l^{\max}$ and offering t_h. Now, consider the PBE in which $\alpha = 0$, thus $t_h = t_h^{\max}$. ■

Note that Lemma 2 and 3 come from the assumption that D makes a take-it-or-leave-it offer on tariffs prior to the DSB ruling process, which in turn provide D with all the bargaining power in the pretrial settlement game.

3.2 Characterization of Divine PBE

Proposition 3 *For all values of $\gamma \in [0.5, 1)$, the divine PBE entails a truth-telling equilibrium with $\alpha = 0$, having t_h belong to $\{t \mid W^C(t) = W^C(t_h^{\max}) \equiv W_L^C\left(\overline{\theta}\right)\}$ and $(\underline{\beta}, \overline{\beta})$ be defined by the following*

LD condition that makes a low-type D be indifferent between $t_l^{\max}$ and t_h

$$W^D\left(t_l^{\max};\underline{\theta}\right) = \left[\gamma\underline{\beta} + (1-\gamma)\overline{\beta}\right] W_L^D\left(\underline{\theta}\right) + (1-\gamma\underline{\beta})(1-\overline{\beta})W^D\left(t_h;\underline{\theta}\right),$$

where $\underline{\beta} \in (0,1)$ implies $\overline{\beta} = 0$, and $\overline{\beta} \in (0,1)$ implies $\underline{\beta} = 1$.
Proof. "to be added" ■

Figure 1 can graphically demonstrate the above proposition. According to Proposition 3, the divine PBE is on C's indifference curve, on which C is indifferent between litigation and settlement given that D's type is high with $W^C(t) = W_L^C\left(\overline{\theta}\right)$. These tariff combinations define the settlement offers that are least favorable to C among the potentially acceptable offers: C would be willing to accept such tariff combination offers if C knows that D is under a high domestic pressure for protection. Also note that a high-type D's indifference curve with $W^D\left(t;\overline{\theta}\right) = W_L^D(\overline{\theta})$ in Figure 1 defines the settlement offers that are least favorable to a high-type D. Thus, the equilibrium settlement offer must entail a tariff combination that belongs to the oval-shaped area in-between these two extreme-value indifference curves.

There is another indifference curve that is important in characterizing the divine PBE in Figure 1: a low-type D's indifference curve, on which it is indifferent between revealing its type by offering $t_l^{\max}$ and exaggerating its domestic pressure for protection by offering t_h with $W^D\left(t;\underline{\theta}\right) = W^D\left(t_l^{\max};\underline{\theta}\right)$. If the settlement offer is on this indifference curve, then a low-type D would be indifferent between $t_l^{\max}$ and t_h (even) when $\underline{\beta} = \overline{\beta} = 0$: the only values of $\underline{\beta}$ and $\overline{\beta}$ that satisfy the LD condition in Proposition 1 are zero when t_h is on this indifference curve. For a given value of $\gamma \in [0.5, 1)$, note that the tariff combinations on a low-type D's higher indifferent curve with $W^D\left(t;\underline{\theta}\right) > W^D\left(t_l^{\max};\underline{\theta}\right)$ uniquely defines $\underline{\beta}$ and $\overline{\beta}$ with a positive probability of litigation through the LD condition. Also note that the higher a low-type D's indifference curve is, the higher the probability that C assigns for litigation.

Now, consider the problem of choosing a settlement offer (t_h) that maximizes the expected payoff of a high-type D (the criterion for divine PBE) among tariff combinations on a low-type D's indifference curve with $W^D(t;\underline{\theta}) = W^D(t_l^{\max};\underline{\theta})$. Because $\underline{\beta} = \overline{\beta} = 0$ for any settlement offer on this indifference curve, a high-type D simply needs to choose t_h that maximizes $W^D\left(t;\overline{\theta}\right)$. Also note that the indifference curve of a high-type D always cuts the indifference curve of a low-type D from below, which in turn implies that t_h that maximizes $W^D\left(t;\overline{\theta}\right)$ on the low-type D's indifference curve with $W^D(t;\underline{\theta}) = W^D(t_l^{\max};\underline{\theta})$ is $t_h^{O\max}$ as any tariff offer that goes beyond this will be rejected (thus litigated) by C. This proves that only $t_h^{O\max}$ on the C's indifference curve with $W^C(t) = W_L^C\left(\overline{\theta}\right)$ is a possible candidate for a divine PBE for the case with $\underline{\beta} = \overline{\beta} = 0$. For any other values of $\underline{\beta}$ and $\overline{\beta}$, there exists a corresponding indifference curve of a low-type D that satisfies the LD condition. Given these specific values for $\underline{\beta}$ and $\overline{\beta}$, once again, one simply needs to choose t_h that maximizes $W^D\left(t;\overline{\theta}\right)$ on the corresponding indifference curve to find t_h that maximizes the expected payoff of a high-type D. On such a corresponding indifference curve, t_h that maximizes $W^D\left(t;\overline{\theta}\right)$ is the one that intersects with the C's indifference curve with $W^C(t) = W_L^C\left(\overline{\theta}\right)$. This proves that the divine PBE is on C's indifference curve with $W^C(t) = W_L^C\left(\overline{\theta}\right)$.

Given that the divine PBE is on C's indifference curve with $W^C(t) = W_L^C\left(\overline{\theta}\right)$, it is easy understand why the divine PBE entails a truth-telling equilibrium with $\alpha = 0$. If having $\alpha > 0$ with a settlement offer being on C's indifference curve with $W^C(t) = W_L^C\left(\overline{\theta}\right)$, will make C strictly prefer litigating over settling.

Proposition 4 *D's settlement offer, t_h, declines toward a more efficient one as C's signal improves with $t_h \to t_h^{\max}$ as $\gamma \to 1$.*

Proof. "to be added" ■

To understand the above proposition, one needs to know the trade-off that a high-type D faces when it choose t_h on C's indifference curve with

$W^C(t) = W_L^C\left(\overline{\theta}\right)$. As D's settlement offer, t_h, declines toward $t_h^{\max}$ along C's indifference curve with $W^C(t) = W_L^C\left(\overline{\theta}\right)$, the settlement payoff for a high-type D, $W^D\left(t_h; \overline{\theta}\right)$, strictly increases. However, a lower tariff combination on this C's indifference curve also implies a higher probability of litigation with a higher value for either $\underline{\beta}$ or $\overline{\beta}$, that is determined by the LD condition in Proposition 3. To maximize the expected payoff of a high-type D, thus one needs to balance the benefit of lowering the settlement tariff offer toward $t_h^{\max}$ against the cost of raising the probability of litigation associated with lowering the tariff combination offer. As C's signal improves with a higher value for γ, the probability of litigation associated with any tariff combination offer decreases, changing the above mentioned trade-off in favor of lowering the settlement tariff offer further toward $t_h^{\max}$.

Proposition 5 *The divine PBE entails only a type I equilibrium with* $\overline{\beta} = 0$ *and* $\underline{\beta} \in (0,1)$ *for* $\gamma > \gamma^I$ *with:*

$$\gamma^I = [W^D\left(t_h^{\max}; \underline{\theta}\right) - W^D\left(t_l^{\max}; \underline{\theta}\right)]/[W^D\left(t_h^{\max}; \underline{\theta}\right) - W_L^D\left(\underline{\theta}\right)] < 1,$$

where the last inequality comes from $W^D\left(t_l^{\max}; \underline{\theta}\right) > W_L^D\left(\underline{\theta}\right)$.

Proof. "to be added" ■

Figure 2 graphically illustrates the above proposition. On the vertical axis of Figure 2, we have t_h on C's indifference curve with $W^C(t) = W_L^C\left(\overline{\theta}\right)$ with a slight abuse of the notation t_h: although t_h is (τ, r) instead of being a variable with a single value, both τ and r moves in the same direction along the C's indifference curve with $W^C(t) = W_L^C\left(\overline{\theta}\right)$. This enable us to represent a change in t_h by a change in a single variable, for example, such as a corresponding change in τ in $t_h = (\tau, r)$. On the horizontal axis, we have the accuracy of C' imperfect private signal, γ. Although Figure 2 shows γ for the values from 0 to 1, the only relevant range of γ is $[0.5, 1)$.

Each LD curve in Figure 2 corresponds to a specific value pair of $\underline{\beta}$ and $\overline{\beta}$, with a lower LD curve being associated with a higher probability of litigation.

Also note that each LD curve decreases in γ, implying that a lower settlement tariff offer is compatible with a higher value for γ, keeping a low-type D to be indifferent between offering t_h and offering $t_l^{\max}$. For $\gamma > \gamma^I$, only a type I equilibrium with $\overline{\beta} = 0$ and $\underline{\beta} \in (0, 1)$ is possible for t_h that is greater than $t_h^{\max}$, as shown in Figure 2.

Corollary 6 *Even when C's private signal is almost accurate with $\gamma \to 1$, the probability that C assigns for litigation remains strictly positive with $\underline{\beta} = \underline{\beta}^{\max} > 0$.*

4 Conclusion

"to be added."

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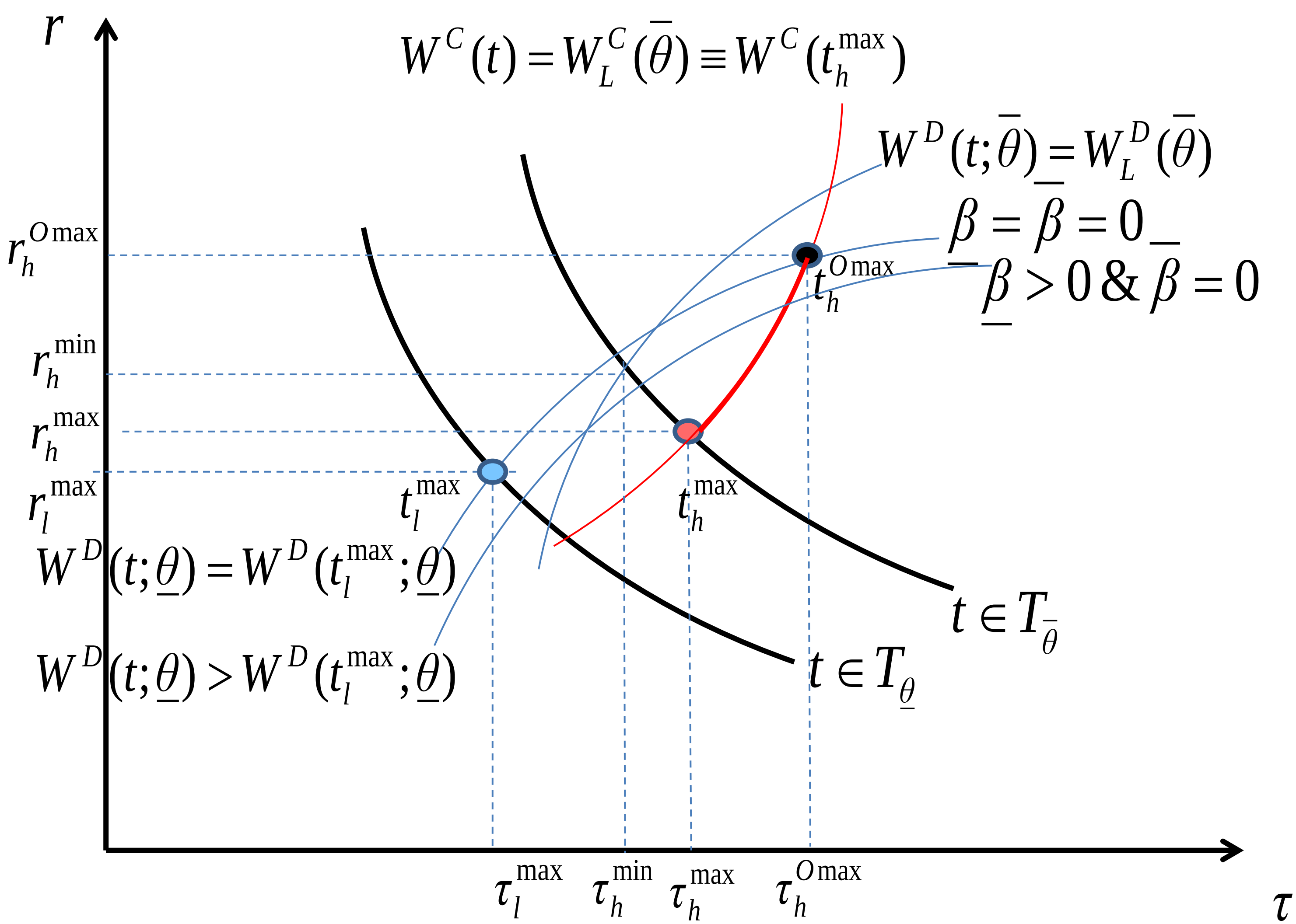

Figure 1

LD condition that makes a low-type D be indifferent between $t_l^{\max}$ and t_h

$$W^D\left(t_l^{\max};\underline{\theta}\right) = \left[\gamma\underline{\beta} + (1-\gamma)\overline{\beta}\right] W_L^D\left(\underline{\theta}\right) + (1-\gamma\underline{\beta})(1-\overline{\beta}) W^D\left(t_h;\underline{\theta}\right),$$

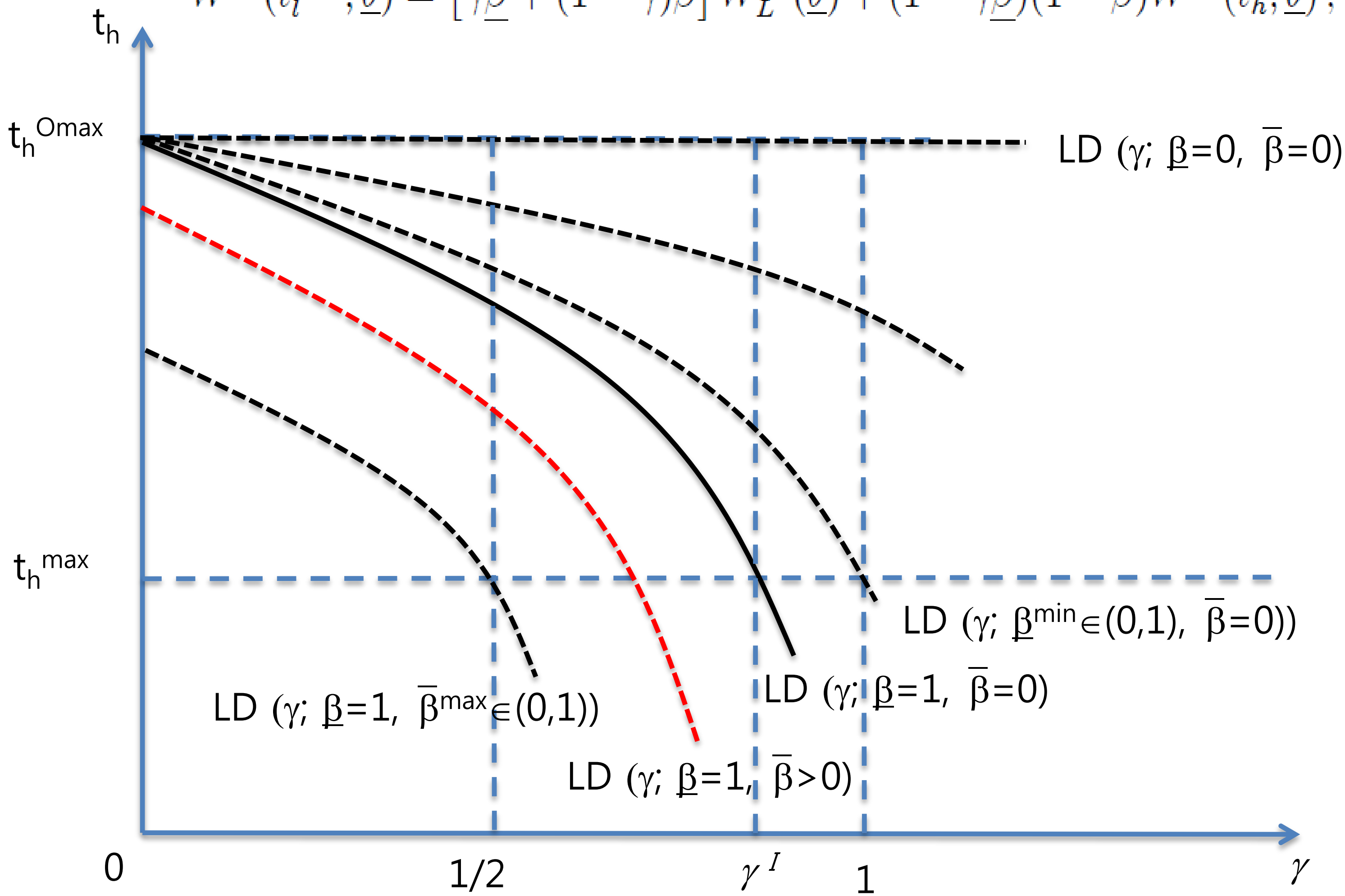

Figure 2