Threats and Concessions in Tariff Settings

by

Taiji Furusawa[*] [†]

October 2001

Abstract

The paper analyzes a tariff-setting game between two large countries, in which one country, the sender, has initially selected a low tariff rate while the other country, the target, has selected a high Nash equilibrium tariff rate. The sender urges the target to lower the tariff by threatening to raise her own tariff rate to the Nash equilibrium level. We examine whether or not the threat is effective in inducing the target to comply. Although there always exists a non-cooperative equilibrium in which the sanction is carried out and the countries remain in selecting their individual Nash tariff rates thereafter, there also exist equilibria in which the countries attain the target cooperative tariff profile if both countries are "cooperative." The sanctions may actually be carried out to induce the target to comply in some of those equilibria.

[*]Department of Economics, Boston University, 270 Bay State Road, Boston, MA 02215. Email: furusawa@bu.edu Tel: 617-353-4125. Fax: 617-353-4449. Department of Economics, Yokohama National University, 79-3 Tokiwadai, Hodogaya-ku, Yokohama 240-8501 JAPAN. Email: furusawa@ynu.ac.jp. Tel/Fax: +81-45-339-3534.

[†]I am grateful to Pierre-Philippe Combes, Michael Conlin, Jonathan Eaton, Makoto Ikema, Hideo Konishi, Dilip Mookherjee, Vitor Trindade, and other seminar participants at Boston University, Syracuse University and Hitotsubashi University for helpful discussions and comments.

1 Introduction

In many occasions, countries threaten to carry out sanctions in order to influence other countries' policy making. Many sanctions have been imposed in reality to exercise political influence on other countries' governments. Countries also use threats to attain their economic goals. In most of such cases, they believe that the target countries have not carried out the past agreements or have violated common trade practices, etc.

The most notable example is Section 301 of the Trade Act of 1974, which legitimizes the U.S. government's unilateral sanctions that are aimed at eliminating foreign unfair trade practices.[1] Dispute settlement procedures in the World Trade Organization can also be considered as a framework that allows damaged countries to take punitive actions if the Dispute Settlement Bodies identified accused countries' violations of past agreements. Moreover, countries often take safeguards measures to temporarily protect their import-competing industries. However, there is a risk that those measures are used to influence other countries' trade policies.

There have been many trade disputes whose results vary significantly from one case to another. In many cases, threats of sanctions induce the target countries to comply. However, there are also many cases in which sanctions are actually carried out. Some of those cases are settled with the target's compliance after sanctions are carried out, and some other cases are not.

In the context of international trade negotiations, Dixit (1987) develops Schelling's (1960, 1966) idea as to how threats and promises are used to influence foreign countries' decision making on trade policies.[2] Threats can be used to induce the foreign country to lower the tariffs, since the foreign country may have incentive to reduce the tariff to avoid a sanction. Promises can also be effective in this context, since the foreign country may be willing to lower the tariff if she is promised that she obtains a comparable reduction of the tariff rate

[1] Bhagwati(1990) gives thorough discussion of Section 301.

[2] Eaton and Engers (1994) analyze how threats and promises are used to affect foreign party's decision to pollute the environment under asymmetric information.

imposed on her exports.

It is important to notice that threats and promises interact with each other. When promises are effective, threats are often used to ensure that promises are carried out. When threats are effective, promises to lift the threats are usually understood.

If carrying out a sanction is not credible, threats cannot be effective. Are they always effective if they are credible? They may not be effective if the promise to lift the sanction is not credible. In such cases, the target will not comply after the sanction is imposed. Of course, it is possible that the target complies before the sanction is imposed when the sanction hurts the target significantly. If both the threat of a sanction and the promise to lift it are credible, there may exit a path such that the sanction is actually imposed but is lifted after the target complies.

We investigate such interactions of threats and promises in a tariff-setting game between two large countries: the sender that threatens a sanction and the target that is urged to comply. We assume for simplicity that each country can only choose either a low tariff rate or a high Nash equilibrium tariff rate. In the basic model, we consider the situation in which only the sender has conceded, setting the low tariff rate. The sender threatens to withdraw her earlier concession in order to induce the target to lower the tariff. Notice that the sanction of withdrawing her earlier concession is beneficial to the sender since her initial tariff rate is lower than the Nash equilibrium tariff rate. We derive Markov perfect equilibria to see if the threat is effective in this context. We also ask if the target complies before or after the sanction is imposed in the case where (the threat of) the sanction is effective. In one equilibrium, the target complies before the sender carries out the sanction. We also find another equilibrium in which the sender actually carries out the sanction which then induces the target to comply.

Eaton and Engers (1992) analyze a closely related problem. In their model, the sender may impose a sanction, which is costly to both sender and target, to urge the target to comply. Instead of assuming that the sanction is costly to both parties, we consider a situation in which it is costly to the target but beneficial to the sender. Tariff-settings between two large countries usually have a structure of the prisoner's dilemma game, in which the sanction of withdrawing the sender's earlier concession benefits the sender. Moreover, the credibility problem as to whether the sender lifts the sanction after the target's compliance can only be a non-trivial problem when the sender benefits from the sanction. The possibility that the sanction is actually imposed before the target complies also arises under complete information only in this context. Eaton and Engers (1999) analyze the effectiveness of sanctions when there exits asymmetric information between the sender and target. In one of the models that they examine, for example, a mere threat of a sanction may induce only a particular type of the target to comply. If the target happens to be a different type, the sender may resort to the sanction in vain. We show that in the context of a tariff-setting game, sanctions are actually carried out in some equilibria even under complete information.

Finally, our analysis basically applies to any problem of threats and concessions in which the payoff structure is of the prisoner's dilemma game.

2 The Model

We consider a tariff setting game between two large countries, the sender (S) and target (T). Each country consumes three goods: the sender's export good, the target's export good, and the numeraire good. Consumers within a country have a common quasi-linear utility function that is additively separable for three goods and linear with respect to the numeraire good. In such situations, we can proceed with the partial equilibrium analysis for the two non-numeraire goods, in which social welfare of each country is represented by the total surplus derived from the markets of the non-numeraire goods.

Each country imposes a tariff only on her imports of the corresponding non-numeraire good. Let s denote the sender's tariff rate and t denote the target's tariff rate. Also let M_S and X_S denote the functions that represent sender's surplus from the import and surplus from the export, respectively. The sender's surplus from the import is a function of s, while her surplus from the export is a function of t. Similarly, we define $M_T(t)$ and $X_T(s)$ as the target's surplus from the import and surplus from the export, respectively. The payoff for each country is the sum of the surplus from the import and surplus from the export. The payoffs for the sender and target are written as

$$\begin{aligned} u_S(s,t) &= M_S(s) + X_S(t), \\ u_T(s,t) &= M_T(t) + X_T(s). \end{aligned}$$

Figure 1 depicts the simultaneous move, one-shot Nash equilibrium point $B = (s_H, t_H)$, where s_H maximizes $M_S(s)$ and t_H maximizes $M_T(t)$, which is the intersection between the sender's reaction curve R_S and the target's reaction curve R_T.

For simplicity, we assume that each country can only choose either a low or high tariff rate. The sender's action space is $\{s_L, s_H\}$, where $s_L < s_H$, and the target's action space is $\{t_L, t_H\}$, where $t_L < t_H$. We assume that the high tariffs s_H and t_H are the sender's and target's individual Nash tariff rates. Given that each country can only choose either the high or low tariff rate, there are only four possible tariff pairs A, B, C, and D, as Figure 1 depicts. We mainly consider the situation in which the two countries are initially at $A = (s_L, t_H)$, the position in which only the sender has made a concession of lowering her tariff from the Nash equilibrium level. We examine whether or not the sender's threat of raising the tariff induces the target to lower the tariff from t_H, which leads to the target tariff profile $D = (s_L, t_L)$.

We consider the case in which both countries prefer the mutually cooperative tariff profile D to the mutually non-cooperative, Nash tariff profile B. Then, C is the best profile for the sender, followed by D, B, and A. On the other hand, A is the best profile for the target followed by D, B, and C. The two countries' individual preference orderings are shown in the square brackets in Figure 1 such that the first element represents the sender's ordering, 1 for the best and 4 for the worst, while the second element represents the target's. Notice that each country prefers the higher level for her own tariff rate for a given tariff rate of the other country. But each country values more the other country's policy to keep the tariff at the low level.

We examine the countries' tariff settings in the context of alternating-move, discrete-time model with infinitely many periods. Both countries' discount factors are the same and are denoted by δ. The countries alternate in setting their individual tariffs. Since we assume only one country moves in a period, once a country selects a particular tariff rate, it is fixed for two periods. We do not impose which country moves first in period 1 *a priori*. We derive a Markov perfect equilibrium for each of two games where the sender moves first and the target moves first, respectively.

We focus only on the Markov perfect equilibrium. The payoff-relevant histories can be summarized by the tariff profile that has prevailed in the last period and the information as to which country selects the tariff rate in the current period. Since there are four tariff profiles and two countries, there are eight states on which strategies are conditioned.

We also assume that at the target profile D, both countries select their respective low tariff rates when they are indifferent between high and low tariff rates. We make this assumption mainly for simplifying the analysis. It can be justified on the grounds that countries are likely to behave cooperatively when they are indifferent between specifying a cooperative, low tariff rate and selecting a high tariff rate, which may induce a tariff war.

3 Trade Off

There are two possible paths from the initial point A to the target point D. The shortest path leads directly from A to D, in which case the sender's mere threat of raising the tariff rate induces the target to lower the tariff. The second path leads from A to D through B and C. The sender carries out the sanction in this case. She lifts the sanction after the target complies. Which path do the countries follow? Or are they able to reach D in the first place?

The answers to these questions depend obviously on which action the countries take at each point. Tariff profile A is the best point for the target and the worst for the sender. The sender's question is whether she raises the tariff to escape from the current worst situation or she keeps the low tariff rate hoping that the target cuts her own tariff in the next period. The target contemplates whether she should lower the tariff to avoid the sanction or to maintain the high tariff to enjoy the highest one-shot payoff.

The profile C has a similar characteristic to A. It is the best profile for the sender and the worst for the target. The target contemplates whether she should raise the tariff to escape from her worst situation or keep the low level hoping that the sender cuts her own tariff in the next period. The sender, on the other hand, is faced with the trade off between cutting her tariff rate to avoid moving to B and staying at C to enjoy the highest payoff for her.

The profiles A and C share an important feature. The better-off country is faced with the choice between cutting or maintaining her tariff rate. Whereas the worse-off country is faced with the choice between raising or maintaining her tariff rate. The better-off country wants to stay at her best position. But she may cut the tariff if the other country raises the tariff in the next period. The worse-off country wants to escape from her worst position by raising her tariff. But she may keep the low tariff if she expects that the other country lowers the tariff in the next period.

Their decisions depend on which of the following is more important for them. One is the benefit from their own high tariffs. For the sender, for example, it can be represented by $M_S(s_H) - M_S(s_L)$. The other is the discounted benefit from the other country's low tariffs. It is written as $\delta[X_S(t_L) - X_S(t_H)]$ for the sender. The following conditions, (C_S) for the sender and (C_T) for the target, are important to our analysis.

$$(C_S) \qquad M_S(s_H) - M_S(s_L) \geq \delta[X_S(t_L) - X_S(t_H)],$$
$$(C_T) \qquad M_T(t_H) - M_T(t_L) \geq \delta[X_T(s_L) - X_T(s_H)].$$

If the corresponding condition holds, the country is non-cooperative in the sense that she chooses to raise to or keep the high tariff rate rather than wait for one period for the other country to lower to or keep the low tariff. If the condition does not hold, the country is cooperative. For the clarity of notation, we define $m_S = M_S(s_H) - M_S(s_L)$, $x_S = X_S(t_L) - X_S(t_H)$, $m_T = M_T(t_H) - M_T(t_L)$, and $x_T = X_T(s_L) - X_T(s_H)$.

If (C_i), for $i = S, T$, is satisfied, the better-off maintains the high tariff rate even if the other country raises the tariff in the next period. If (C_i) is not satisfied, the better-off lowers the tariff if the other country raises the tariff in the next period. Similarly, the worse-off raises the tariff even if the other country cuts the tariff in the next period if (C_i) is satisfied. If (C_i) is not satisfied, the worse-off maintains the low tariff for the current period if the other country lowers the tariff in the next period.

There are four possible cases. The first case is the situation in which both (C_S) and (C_T) are satisfied. If the countries discount the future heavily, or if the countries' response lags are large, the discount factor δ is small so that both conditions are satisfied. The second case is the situation in which (C_S) is not satisfied while (C_T) is satisfied. If the sender's original concession is small, $M_S(s_H)-M_S(s_L)$ and $X_T(s_L)-X_T(s_H)$ are small. If the sender's demand for the target's concession is large, $X_S(t_L) - X_S(t_H)$ and $M_T(t_H) - M_T(t_L)$ are large. Both of these situations make the second case more likely. Moreover, if the sender is small relative to the target, $M_T(t_H) - M_T(t_L)$ tends to be small while $X_T(s_L) - X_T(s_H)$ tends to be large. Consequently, (C_S) is not likely to be satisfied.

The third case in which (C_S) is satisfied while (C_T) is not is the opposite case to the second. This case is likely to arise if the sender's original concession is large, the sender's demand for the target's concession is small, and the target is small relative to the sender. The final case is the situation in which neither (C_S) nor (C_T) holds. This case is likely to arise when δ is large. To see that a large δ is likely to induce this case, we show for example that (C_S) does not hold when δ is sufficiently large. Substituting $\delta = 1$ into (C_S), we obtain

$$\begin{aligned} M_S(s_H) + X_S(t_H) &\geq M_S(s_L) + X_S(t_L) \\ u_S(B) &\geq u_S(D). \end{aligned}$$

But the last inequality contradicts to our assumption that the sender prefers D to B. By continuity, we can conclude that if δ is large enough, (C_S) does not hold.

4 Markov Perfect Equilibria

In this section, we derive Markov perfect equilibria of the game. We find that there always exists a non-cooperative equilibrium in which each country selects the high tariff in every state where she selects a tariff. If both countries are cooperative, however, there are other equilibria in which the countries eventually attain the target tariff profile. Some of these equilibria involve stochastic delay. More importantly, the sender actually carries out the sanction that leads to the target compliance in some equilibria.

First, let us derive the non-cooperative equilibrium in which each country selects the high tariff in every state where she select a tariff. It is not difficult to understand why this strategy profile is Markov perfect, since a country selects the low tariff only when she expects that it would induce the other country to select the low tariff in return.

Indeed, given that the target never cuts the tariff rate, the sender should select s_H at A and B. Similarly, the target selects t_H at B and C. At C and D when the target's tariff rate is low, if the sender selects s_H, the countries experience the tariff profile C first and then move to B and continue to stay there. On the other hand, if the sender selects s_L, the countries stay at D for a period and then move to A and B. Since the sender prefers C to D and B to A, the sender selects s_H at C and D. Similarly, the target selects t_H at A and D.

Proposition 1 *There always exists a non-cooperative equilibrium in which each country selects the high tariff in every state where she selects a tariff. The threat of sanctions is not effective in inducing the target's compliance. The sender carries out the sanction immediately and sustain it thereafter.*

If the sender chooses to stay at D by selecting the low tariff rate, the target reduces the tariff at A when (C_T) is not satisfied, and the countries are expected to stay at D perpetually. However, if (C_S) holds, the sender does not choose to stay at D in the first place. Then, of course, the target does not cut the tariff at A.

This argument suggests that if neither (C_S) nor (C_T) is satisfied, there is an equilibrium in which the target tariff profile is reached and sustained. Indeed, there are such equilibria when both countries are cooperative. Those equilibria involve randomization of the actions.

To illustrate it, let us suppose B and D are absorbing states, i.e., once the countries reach either one of these states, they stay there perpetually. Then, at the initial point A, for example, if the sender chooses s_H, the target chooses t_L to avoid the sanction. But if the target chooses t_L, the sender chooses s_L rather than s_H to derive the benefit of mutual cooperation when (C_S) does not hold. Then the target has not incentive to choose t_L since A is her best tariff profile, which then induces the sender to choose s_H.

Let p^i, for $i = A, B, C, D$, denote the probability that the sender revises her prevailing tariff rate at position i. The sender leaves the prevailing position i with probability p^i and stay there with probability $1 - p^i$. Similarly, we let q^i denote the probability that the target revises her prevailing tariff rate. We derive three types of cooperative, Markov perfect equilibria, assuming that neither (C_S) nor (C_T) is satisfied.

In the first type of the equilibrium, the sender selects s_H and the target selects t_L at A. At B, the sender selects s_H while the target chooses t_L with probability q^B and t_H with probability $1 - q^B$. The probability q^B can take any value as long as it satisfies $q^* \leq q^B \leq \bar{q}$, where $q^* \equiv (\delta x_S - m_S)/\delta x_S$ and $\bar{q} \equiv (\delta x_S - m_S)/\delta^2 m_S$. At C, the sender chooses s_L with probability p^C and s_H with probability $1 - p^C$, while the target chooses t_L with probability $1 - q^C$ and t_H with probability q^C, where we derive p^C and q^C shortly. Finally at D, the sender and target select s_L and t_L, respectively.

To see that the above strategy profile is the Markov perfect equilibrium, we first notice that it is rational for the target to choose t_L at D when she chooses t_L at A since A and D are strategically equivalent for her. Similarly, since the sender is indifferent between s_L and s_H at C according to her strategy, it is rational for the sender to choose s_L at D.

The equilibrium action profile at C involves mixed strategies. To see it, let us imagine the case where $q^B = 0$. Since neither (C_S) nor (C_T) is satisfied, the sender lowers the tariff if and only if the target raises t, while the target raises t if and only if the sender keeps the high tariff. As we have argued, there is no pure-strategy equilibrium in the continuation game. The probability q^B cannot be too large, however. If q^B is very large, the sender's expected loss of departing from C is reduced so that the sender may be willing to stay at C. But the sender selects s_H at C, the target strictly prefer choosing t_H whenever the sender has selected s_H, which is a contradiction to $q^B > 0$.

Supposing for now that q^B is small enough that both countries mix their actions at C, we derive p^C and q^C. Given that the prescribed strategy profile specifies that the sender chooses s_H at B, the target can make the countries stay at B perpetually after she chooses t_H at C. Therefore, the expected average payoff when the target chooses t_H is $u_T(B)$. If the target chooses t_L, on the other hand, the countries stay at C for one period and then move perpetually to D with probability p^C, and stay at C for two periods and come back to the original state where the target selects the tariff with probability $1 - p^C$. Since the target is indifferent between t_H and t_L, we have

$$u_T(B) = p^C[(1-\delta)u_T(C) + \delta u_T(D)] + (1-p^C)[(1-\delta^2)u_T(C) + \delta^2 u_T(B)],$$

where the last term on the right-hand side reflects the fact that the target is indifferent between t_L and t_H. Subtracting $u_T(C)$ from both sides of the equation and rearranging terms give us

$$p^C = \frac{(1-\delta^2)m_T}{\delta(x_T - \delta m_T)}. \tag{1}$$

The probability p^C increases if δ decreases, m_T increases, or x_T decreases.

Since the sender is willing to choose s_H at C in every turn of hers, the expected average payoff when she chooses s_H at C equals

$$\begin{aligned} u_S(D) \;=\;& (1-q^C)[(1-\delta^2)u_S(C) + \delta^2 u_S(D)] \\ & + q^C\{q^B[(1-\delta)u_S(C) + \delta(1-\delta^2)u_S(B) + \delta^3(1-\delta)u_S(C) + \delta^4 u_S(D)] \\ & + (1-q^B)q^B[(1-\delta)u_S(C) + \delta(1-\delta^4)u_S(B) + \delta^5(1-\delta)u_S(C) + \delta^6 u_S(D)] \\ & + \cdots\}. \end{aligned}$$

On the other hand, the sender's average payoff equals $u_S(D)$ if she chooses s_L. Equating these expected payoffs and subtracting $u_S(C)$ from both sides of resulting equation, we obtain

$$q^C = \frac{[1-(1-q^B)\delta^2]m_S}{\delta(x_S - \delta m_S)}. \tag{2}$$

The probability q^C is increasing in q^B. The simple computation tells us that $q^C \leq 1$ if and only if $q^B \leq \bar{q}$, where $\bar{q}$ is defined earlier. We have thus derived the exact limit of q^B such that the two countries mix their actions at C if q^B is below this limit.

The sender's decision as to whether she selects s_L or s_H when $t = t_H$, i.e., at A and B, also depends on the value of q^B. If $q^B = 1$, for example, if the sender chooses s_H, the countries stay at B for one period and then move to C at which the sender and target mix their actions. Since the sender is indifferent at C between moving to D and staying at C, the expected payoff when she chooses s_H when $t = t_H$ equals the payoff that she receives when the countries follows the path: B, C, and then D. On the other hand, if she chooses s_L, she can expect at most the payoff when she stays at A for a period and then moves to D. It follows from the fact that the sender prefers B to A and C to D that the sender chooses s_H at A and B. When $q^B = 0$, at the other extreme, the sender chooses s_H and the countries stay at B perpetually if $u_S(B) \geq (1-\delta)u_S(A) + \delta u_S(D)$. However, this inequality is not satisfied when (C_S) does not hold. Therefore, the sender chooses s_L at A and B if the target lowers the tariff rate in the next period.

The critical value of q^B is the probability which equates the sender's payoff when she chooses s_L at A and B before the target cuts the tariff in the next period with the payoff that the sender expects when she chooses s_H. Therefore, we have

$$\begin{aligned}
&(1-\delta)u_S(A) + \delta u_S(D) \\
&\quad = q^B[(1-\delta)u_S(B) + \delta(1-\delta)u_S(C) + \delta^2 u_S(D)] \\
&\quad +(1-q^B)q^B[(1-\delta^3)u_S(B) + \delta^3(1-\delta)u_S(C) + \delta^4 u_S(D)] \\
&\quad +(1-q^B)^2 q^B[(1-\delta^5)u_S(B) + \delta^5(1-\delta)u_S(C) + \delta^6 u_S(D)] \\
&\quad + \cdots .
\end{aligned}$$

Subtracting $u_S(A)$ from both sides, we obtain

$$\delta x_S = m_S + \frac{q^B \delta(x_S - \delta m_S)}{1-(1-q^B)\delta^2},$$

Which gives us the critical value q^* as we have defined in the above.

As we have seen, the target is indifferent between t_L and t_H when $s = s_H$. Therefore, it is rational for her to randomize her action at B. If q^B is chosen such that $q^* \leq q^B \leq \bar{q}$, the sender selects s_H at A and B. Now, the target's expected payoff when she chooses t_H at A equals $(1-\delta)u_T(A) + \delta u_T(B)$, since the target can make the countries stay at B perpetually when she selects t_H. Since this expected payoff is lower than $u_T(D)$ when (C_T) does not hold, the target chooses t_L at A.

We have shown the equilibrium in which the sender raises the tariff and the target cuts the tariff in their respective turns at A. The sender keeps the high tariff while the target cuts the tariff rate with probability q^B at B. At C, the sender cuts the tariff with probability p^C and the target raises the tariff with probability q^C. Once the countries reach the target profile D, they will keep this profile perpetually.

Proposition 2 *Consider the case where the target is likely to comply when sanctions are in effect. If the sender moves first, she carries out the sanction immediately. Sooner or later, the target complies, which induces the sender to lift the sanction stochastically. The countries reach the target tariff profile eventually. If the target moves first, on the other hand, the target immediately complies, leading to the target tariff rate.*

Due to the symmetry between the two countries, we immediately find that there is a Markov perfect equilibrium in which the countries mix their actions at A while they choose pure actions at C. Specifically, the sender chooses s_L with probability $1-p^A$ and s_H with probability p^A at A, whereas the target chooses t_L with probability q^A and t_H with probability $1-q^A$. As we can infer from (2) and (1), these probabilities are given by

$$p^A = \frac{[1-(1-p^B)\delta^2]m_T}{\delta(x_T-\delta m_T)}, \tag{3}$$

$$q^A = \frac{(1-\delta^2)m_S}{\delta(x_S-\delta m_S)}. \tag{4}$$

At B, the sender chooses s_L with probability p^B and s_H with probability $1-p^B$, while the target chooses t_H. The probability p^B can take any value that satisfies $p^* \leq p^B \leq \bar{p}$, where $p^* \equiv (\delta x_T - m_T)/\delta x_T$ and $\bar{p} \equiv (\delta x_T - m_T)/\delta^2 m_T$. At C, the sender selects s_L and the target selects t_H. Finally at D, the sender and target select s_L and t_L, respectively.

In this equilibrium, both countries randomize their actions at the initial point A. Although the target never complies when the sanction is in effect, she will eventually complies when the sender has selected the low tariff rate.

Proposition 3 *If the probability that the sender lifts sanctions before the target complies is high, the target never complies when sanctions are in effect. Nevertheless, the sender carries* *out sanctions stochastically, which induces the target to comply stochastically when sanctions are not activated.*

In the final type of the equilibrium, both countries mix their actions at any state corresponding their own turns, except at D where the sender and target choose s_L and t_L, respectively. Similarly to the above two types of the equilibrium, the probabilities that the countries revise their prevailing tariffs at B can take any values as long as they are small such that $0 \leq p^B < p^*$ and $0 \leq q^B < q^*$. As we can infer from the earlier arguments, the countries randomize their individual actions at A if $q^B < q^*$, while they randomize their individual actions at C if $p^B < p^*$.

To show that this strategy profile is a Markov perfect equilibrium, we first notice that it is rational that the sender selects s_L and the target selects t_L at D when the sender is indifferent between s_L and s_H at C and the target is indifferent between t_L and t_H. Similarly, when the sender is indifferent between s_L and s_H at A and the target is indifferent between t_L and t_H at C, it is rational that the two countries revise the prevailing tariffs at B with probabilities p^B and q^B, respectively.

Next, let us derive the probabilities that the countries revise their prevailing tariffs at C. Since the target is willing to continue to select t_H at B and the target is indifferent between t_L and t_H at A, the target expected average payoff when she chooses t_H at C equals

$$\begin{aligned}
&p^B[(1-\delta)u_T(B) + \delta(1-\delta)u_T(A) + \delta^2 u_T(D)] \\
&\quad +(1-p^B)p^B[(1-\delta^3)u_T(B) + \delta^3(1-\delta)u_T(A) + \delta^4 u_T(D)] \\
&\quad +(1-p^B)^2 p^B[(1-\delta^5)u_T(B) + \delta^5(1-\delta)u_T(A) + \delta^6 u_T(D)] \\
&\quad +\cdots.
\end{aligned}$$

On the other hand, the target's expected average payoff when she chooses t_L at C equals her expected average payoff when she never raises t at C, which is given by

$$\begin{aligned}
&p^C[(1-\delta)u_T(C) + \delta u_T(D)] \\
&\quad +(1-p^C)p^C[(1-\delta^3)u_T(C) + \delta^3 u_T(D)] \\
&\quad +(1-p^C)^2 p^C[(1-\delta^5)u_T(C) + \delta^5 u_T(D)]
\end{aligned}$$

$$+\cdots.$$

Equating these two expressions and subtracting $u_T(C)$ from both sides of the resulting equation, we obtain

$$p^C = \frac{(1-\delta^2)m_T + p^B\delta x_T}{\delta(x_T - \delta m_T)}. \tag{5}$$

It can be readily verified as p^B increases from 0 to p^*, p^C increases from $(1-\delta^2)m_T/\delta(x_T - \delta m_T)$ to 1.

Next, consider the sender's decision at C. Since the sender is willing to continue to choose s_H at B, the sender's expected average payoff when she chooses s_H at C is the same as the expected average payoff when she choose s_H whenever she select the tariff at B. The situation is exactly the same as the one in which the sender faces at C in the first type of the equilibrium, yielding the same q^C, i.e.,

$$q^C = \frac{[1-(1-q^B)\delta^2]m_S}{\delta(x_S - \delta m_S)}. \tag{6}$$

Since A is symmetric to C, we immediately obtain from (6) and (5) that

$$p^A = \frac{[1-(1-p^B)\delta^2]m_T}{\delta(x_T - \delta m_T)}, \tag{7}$$

$$q^A = \frac{(1-\delta^2)m_S + q^B\delta x_S}{\delta(x_S - \delta m_S)}. \tag{8}$$

Notice from (5) and (7) that both p^A and p^C increase in p^B from $(1-\delta^2)m_T/\delta(x_T - \delta m_T)$. However, p^C increases more quickly so that it reaches 1 when p^B reaches p^* whereas p^A only reaches $m_T/\delta x_T$ which is less than 1 since (C_T) is not satisfied. Similarly, q^A increases more quickly than q^C as q^B increases from 0 to q^*.

In this equilibrium, the two countries randomize their individual actions at any state that corresponds to their own turns. They eventually reach the target tariff profile with probability 1, although the actual path to the target profile can be very complex.

Proposition 4 *If the probability that the sender withdraw sanctions is low, the target stochastically complies when sanctions are in effect. Both countries randomize their individual actions at the initial point, so that the target may also comply when sanctions are not activated.*

5 Concluding Remarks

We have analyzed a tariff-setting game between two large countries, in which the sender urges the target to lower the tariff by threatening to raise her own tariff rate to the Nash equilibrium level. Although there always exists a non-cooperative equilibrium in which the sanction is carried out and the countries remain in selecting their individual Nash tariff rates thereafter, there also exist equilibria in which the countries attain the target cooperative tariff profile if both countries are cooperative. The sanctions may actually be carried out to induce the target to comply in some of those equilibria.

In order to examine whether threats of sanctions are effective in inducing the target to comply, we have considered the game in which the sender's initial tariff rate is low while the target's is high. However, since we have derived Markov perfect equilibrium where the strategies only depend on prevailing tariff rates, we need not confine our attention to this initial situation. Suppose now that the countries are initially at the position where both have set their individual Nash tariff rates. Our analysis indicates that if both countries are cooperative, there are Markov perfect equilibria in which a country's unilateral trade liberalization induces the other country to reciprocate. The initiating country lowers the tariff specifically hoping for this consequence. In most cases, the other country eventually reciprocates. The initiating country lowers the tariff rate to establish her position as a sender that threatens to raise her tariff in order to induce the other country to comply.

Krishna and Mitra (1999) show in a political economy model that unilateral trade liberalization induces reciprocal tariff reduction through the endogenous lobby formation in the target country's export good industry. Our model provides another mechanism though which unilateral trade liberalization induces reciprocal tariff reduction.

References

Bhagwati, Jagdish (1990), "Aggressive Unilateralism: An Overview," in Jagdish Bhagwati and Hugh T. Patrick (eds.), *Aggressive Unilateralism: America's 301 Trade Policy and the World Trading System*, University of Michigan Press, Ann Arbor.

Dixit, Avinash (1987), "How Should the United States Respond to Other Countries' Trade Policies?" in Robert M. Stern (ed.) *U.S. Trade Policies in a Changing World Economy*, MIT Press, Cambridge.

Eaton, Jonathan and Maxim Engers (1992), "Sanctions," *Journal of Political Economy*, 100, 899-928.

Eaton, Jonathan and Maxim Engers (1994), "Threats and Promises," NBER Working Paper No.4849.

Eaton, Jonathan and Maxim Engers (1999), "Sanctions: Some Simple Analytics," *American Economic Review*, 89, 409-414.

Krishna, Pravin and Devashish Mitra (1999), "Reciprocated Unilateralism: A Political Economy Approach," Working paper, Stanford University.

Schelling, Thomas C. (1960), *The Strategy of Conflict*, Harvard University Press, Cambridge.

Schelling, Thomas C. (1966), *Arms and Influence*, Yale University Press, New Haven.

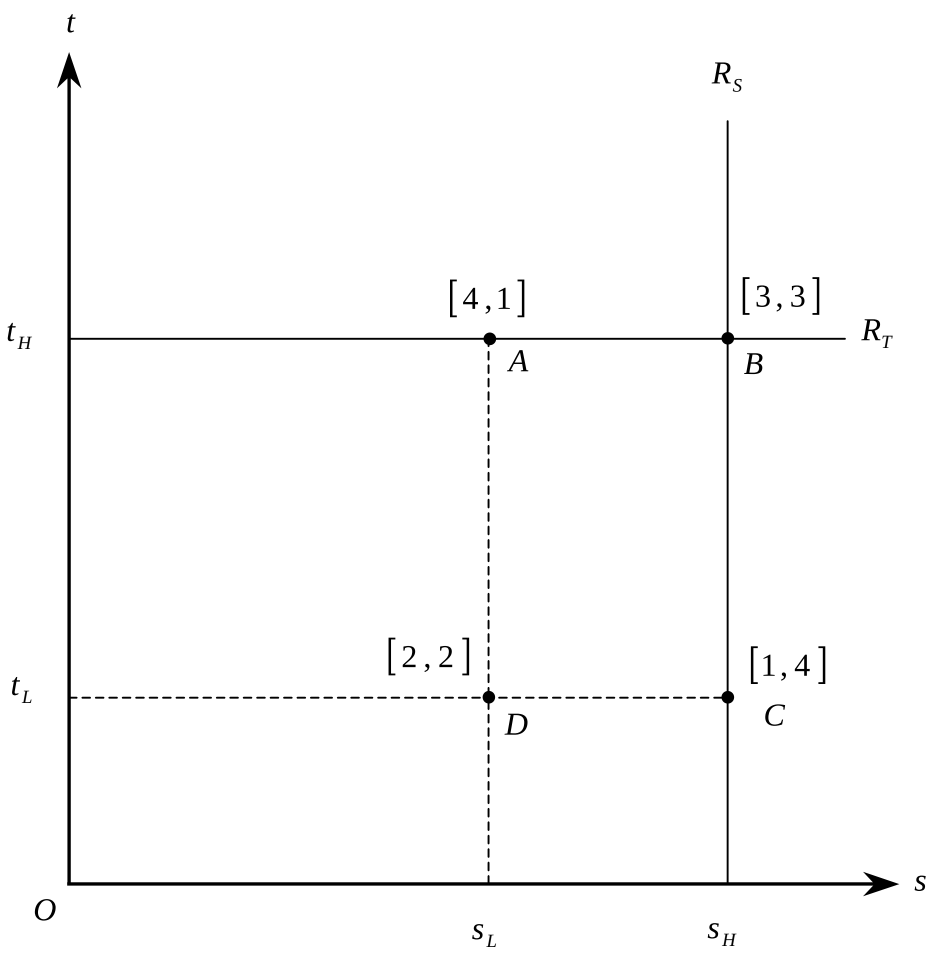

Figure 1. Tariff profiles