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Free Trade, Time-Consistent Tariff, and Market Size:

The Role of GATT/WTO as Commitment Devices

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Free Trade, Time-Consistent Tariff, and Market Size:

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Abstract

We examine whether free trade is superior to tariff policy if the government of an importing country cannot precommit to an *ex ante* optimal tariff rate in the presence of a time lag between production and trade decisions. Based on a simple partial equilibrium model with an export monopoly, we show that the preferable choice between free trade and a time-consistent tariff policy depends on the market size of the importing country. More specifically, if the market size is larger than a certain level, the importing country prefers free trade to the time-consistent tariff policy. However, because a free trade policy is not credible in the presence of a time lag, the government of the importing country requires international organizations and rules such as GATT/WTO as commitment devices. Thus, using a game theoretic approach, we analyze under what conditions becoming a member of the international organizations is a subgame perfect Nash equilibrium and show that a free trade policy under the GATT/WTO regime is Pareto improving for the importing and exporting countries.

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1. Introduction

It is generally agreed upon that a large country should choose a tariff policy rather than a free trade policy, i.e., *laissez-faire*. However, this statement has to be examined in the presence of a time lag between production and trade (or consumption) decisions. We should reconsider this statement, however, if domestic and foreign firms decide prices and outputs in the short run as well as capacities and cost functions in the long run. This is because there is a time-inconsistency issue associated with an optimal policy. In other words, a government with some degree of discretion or without any credible commitments has an incentive to renege on an *ex ante* announced optimal policy. Furthermore, the same problem will occur with regard to a free trade policy. Thus, we have to investigate the credibility and superiority of free trade.

Since the publication of the seminal paper of Kydland and Prescott (1977), which addressed the time-inconsistency problem of optimal policy, there have been many theoretical and empirical papers in the field of trade policy. Based on the idea that an *ex ante* optimal trade policy is time inconsistent, Staiger and Tabellini (1987) find that a government with a sufficient degree of discretion may have an incentive to provide protection, because the redistribution effect of trade policy is larger if the policy is unanticipated. Furthermore, they show that a suboptimal but time-consistent trade policy involves excessive protection. Similarly, Lapan (1988) illustrates that the inability to commit to an *ex ante* optimal tariff reduces the welfare of both importing and exporting countries. In other words, in the presence of a time lag between production and consumption decisions, the welfare of these countries under an *ex post* tariff policy is lower than that under an *ex ante* optimal tariff policy.

Staiger and Tabellini (1989) analyze that the presence of a time lag between production and consumption causes an optimal trade policy to be time inconsistent. In their conclusion, however, they point out that international organizations such as GATT facilitate international cooperation among individual countries. In particular, Staiger (1995) states that "with a sufficient degree of discretion, an *ex ante* optimal policy is bound to lack credibility, because it is almost surely time inconsistent. When domestic institutions are too weak to provide the desired commitment, international trade agreements could serve as a possible device in interactions between a government and the private sector, and restore the credibility of the optimal trade policy." (p. 1516)

Furthermore, following these views, Staiger and Tabellini (1991, 1999) undertake an

empirical analysis in which GATT rules serve as a potential commitment device. Their empirical results provide some support for the view that GATT rules help member governments make trade policy commitments to their private sectors or domestic residents. As will be shown below, we examine under what conditions an importing country decides to become a member of GATT/WTO to precommit to a free trade policy.

The models mentioned above are based on perfect competition. Thus, the point of these studies is that the *ex post* foreign export elasticity of supply is less than the *ex ante* elasticity. Thus, the *ex post* optimal tariff rate is larger than the *ex ante* optimal tariff rate. In this paper, however, we clarify the strategic relations between the government of the importing country (home, hereafter) and a private sector, i.e., a monopolistic firm, in the exporting (foreign, hereafter) country, based on a game theoretic framework.

There are two papers, Horiba and Tsutsui (2000) and Ishizawa (1995), closely related to our model. Following the framework of Choi (1995) and assuming an international duopoly and the capacity decisions, Horiba and Tsutsui (2000) compare a discriminatory tariff regime and a uniform tariff regime. They show that the importing country's welfare is higher in the uniform tariff regime, and that free trade dominates tariff policy in terms of welfare ranking. Using a specific cost function, they examine the effect of adjustment costs on welfare and plant size. That is, if the adjustment costs are sufficiently large, the welfare in the case of free trade is larger than that for tariff policy. However, in this paper, we focus on the market size of an importing country. In addition, we illustrate explicitly the strategic relationships between the home government and the foreign firm.

Furthermore, based on a simple general equilibrium model, Ishizawa (1995) examines a time-consistent commercial policy in the presence of a foreign monopolist. He shows that an importing country attains a lower level of welfare with a time-consistent tariff policy than would be attained under an *ex ante* optimal tariff policy.

Exploiting the ideas of Lapan (1988), Horiba and Tsutsui (2000), and Ishizawa (1995), we present a very simple model composed of two (i.e., an importing and an exporting) countries, in other words, two players: the home government and the foreign firm. We also assume that the foreign firm is an export monopolist, and that there are no related domestic firms in the importing country. The foreign firm decides the production level and then the distribution of supply to the home and foreign markets. In other words, the foreign firm allocates the product to the home and foreign markets, respectively, given the production level. In this stage, the

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home government can enforce a tariff policy. We consider the precommitment and non-precommitment cases, respectively. In the case of precommitment, given the *ex ante* announced optimal tariff rate, the foreign firm decides the production level. Subsequently, the home government charges the tariff rate on the product supplied by the foreign firm. However, because the *ex ante* announced tariff policy is not credible without any commitments, the home government has an incentive to renege on the tariff rate after the production decision of the foreign firm. That is, a time-inconsistency problem occurs. Accordingly, if the home government does not have any commitment devices to make the foreign firm believe the tariff policy, it is forced to choose a time-consistent (*ex post* optimal) tariff policy, which is suboptimal and discretionary.

Our main results are as follows.

(i)   The welfare of both the importing and exporting countries under the time-consistent (*ex post* optimal) tariff policy is always lower than that under the *ex ante* optimal tariff policy.

(ii)   The preferable choice between free trade and the time-consistent tariff policy depends on the market size of the importing country. More specifically, if the market size of the importing country is larger than a certain level, the importing country prefers free trade to the time-consistent tariff policy.

(iii)   In this case, because free trade is not credible in the presence of a time lag between production and trade decisions, international institutions and organizations' rules, such as GATT/WTO, are required for the government of the importing country to make a free trade policy commitment to the foreign firm. That is, whether or not joining GATT/WTO is a subgame perfect Nash equilibrium, SPNE hereafter, depends on the 'subjective probability' as believed by the foreign firm (defined as the degree to which the foreign firm expects that the importing government will make the first move or will renege on the announced tariff rate after the foreign firm decides the production level) and on the market size of the importing country.

(iv)   If the market size of the importing country is sufficiently large and/or the subjective probability as believed by the foreign firm is sufficiently small, a free trade policy for the importing country is credible, because it joins GATT/WTO as a commitment device. As a result, the benefits of free trade accrue to the importing and exporting countries.

The remainder of the paper is structured as follows. Section 2 presents the model, which is composed of a three-stage game. Section 3 considers the *ex ante* optimal tariff policy and free trade in the case of precommitment, and then the time-consistent tariff policy in the case of non-precommitment. Furthermore, we compare welfare in the cases of both the importing and exporting countries, and then show that free trade is superior to the tariff policy if the market size of the importing country is larger than a certain level. Section 4 discusses the credibility of a free trade policy. In particular, a free trade policy is Pareto superior for both the importing and exporting countries if the importing country's market size is larger than a certain size. In this case, we discuss the roles of international organizations such as GATT/WTO as commitment devices to accomplish a free trade regime. In particular, by extending the game presented in Section 3, we analyze under what conditions joining GATT/WTO is a subgame perfect Nash equilibrium. Finally, Section 5 summarizes our results.

2. The Model

2.1 Preliminary

To simplify, we assume that there are no import-competing firms in an importing, i.e., home, country. Only a firm in an exporting, i.e., foreign (*), country supplies a product such as crude oil, corn, wheat, and so on, to both the home and foreign markets. The foreign firm is assumed to be a monopoly. The inverse demand functions of both markets are given by:

$$P = a - \frac{q}{s} \quad \text{and} \quad P^* = a - q^*, \tag{1}$$

where P (P^*) is the price, and q (q^*) is the quantity supplied in the home (foreign) market. Furthermore, s represents the market size of the home country.

The profit function of the foreign firm is expressed as:

$$\Pi^* = (P - t)q + P^* q^* - c^* X^*,$$
$$X^* = q + q^*, \tag{2}$$

where $t(\geq 0)$ is a per unit import tariff, and thus $t = 0$ means a free trade policy. Furthermore, $c^*(< a)$ is the marginal cost of production and X^* is the production (or capacity) level. We assume that there are no international transfer costs.

The welfare of the home country is given by:

$$W = \int_0^q P(z)dz - Pq + tq = \frac{1}{2s}q^2 + tq. \tag{3}$$

Furthermore, the welfare of the foreign country is given by:

$$W^* = \int_0^{q^*} P^*(z)dz - P^*q^* + \Pi^* = \frac{1}{2}q^{*2} + \Pi^*. \tag{4}$$

2.2 The game structure

To analyze the cases of precommitment and non-precommitment, we consider a three-stage game as follows.

(i) In the case of precommitment, the foreign firm believes that the home government will charge the *ex ante* announced tariff rate after the firm decides the production level, and the home government then actually implements the tariff policy and does not renege on it.

In the first stage, the home government sets an *ex ante* optimal tariff rate; in the second stage, the foreign firm decides the production level, given the tariff rate; in the final stage, the foreign firm decides to allocate the product to the home and foreign markets, given the tariff rate and the production level.

The structure of the above game implies that the home government is a Stackelberg leader and the foreign firm is a Stackelberg follower. Accordingly, based on this structure, a free trade policy occurs when the home government precommits to zero tariffs in the first stage.

(ii) In the case of non-precommitment, the foreign firm does not believe that the home government will set the *ex ante* announced tariff rate after the firm decides the production level, and thus the home government has to decide the *ex post* tariff rate only after the foreign firm decides the production level.

In the first stage, the foreign firm decides the production level; in the second stage, given the production level, the home government sets an *ex post* optimal tariff rate; in the final stage, the foreign firm decides to allocate the product to the home and foreign markets, given the tariff rate and the production level. In this case, the foreign firm is a Stackelberg leader and the home government is a Stackelberg follower.

Here we introduce the zero stage into the game, in which the home government announces the tariff rates schedule that presents the relationship between the tariff rate and the production level before the production decision. As will be shown below, the announced tariff rate schedule represents a reaction function of the tariff rate with respect to the production

level. Thus, in the first stage, the foreign firm decides the production level, given the announced tariff rate schedule, i.e., the reaction function of the home government; in the second stage, the home government actually charges the tariff rate, which is determined by the production level; in the final stage, the foreign firm decides to allocate the product to the home and foreign markets, given the tariff rate and the production level.

For these cases, we derive a subgame perfect Nash equilibrium (SPNE) by backward induction.

2.3 Trade decision in the final stage

Let us derive the equilibrium of the trade decision in the final stage, in which, given the production level, $X^* > 0$, and the tariff rate, $t \geq 0$, the foreign firm decides to distribute the product between both the home and foreign markets according to:

$$\frac{\partial \Pi^*}{\partial q} = (P - t) + \frac{\partial P}{\partial q} q - P^* + \frac{\partial P^*}{\partial q}(X^* - q) = -\frac{2(s+1)}{s} q + 2X^* - t = 0. \tag{5}$$

Thus, we derive the quantities in both markets in the final stage as follows:

$$q(X^*, t) = \frac{s}{s+1} X^* - \frac{s}{2(s+1)} t \quad \text{and} \quad q^*(X^*, t) = \frac{1}{s+1} X^* + \frac{s}{2(s+1)} t, \tag{6}$$

where $\bar{t} \equiv 2X^* > t \geq 0$, so that $\bar{t}$ is the prohibitive tariff level.

3. Tariff Policies and Production Decision

In this section, we address the equilibrium in the first and the second stages, i.e., in the stages involving the tariff rate and the production level decisions. First, in Section 3.1, we consider the precommitment case, in which the home government decides the *ex ante* optimal tariff in advance. We also consider a free trade policy, i.e., zero tariff rates. Second, in Section 3.2, we analyze the non-precommitment case, in which the home government cannot precommit to the tariff policy before the foreign firm's production decision. Thus, given the production level, the home government has to choose the *ex post* optimal tariff rate. In Section 3.3, we compare the cases of the *ex ante* tariff policy, the *ex post* tariff policy, and the free trade policy, respectively.

3.1 The precommitment case: an *ex ante* optimal tariff and a free trade policy

We begin by discussing the case of an *ex ante* optimal tariff policy. In particular, in the presence of a time lag between production and trade decisions, the foreign firm believes that the home government will execute the *ex ante* optimal tariff rate after the firm's production decision. In other words, the home government will not revise the tariff rate.

Taking (1), (2), and (6) into account, in the second stage, given the tariff rate, the first-order condition (FOC) to maximize the foreign firm's profit with respect to the production level is given by:

$$\frac{\partial \Pi^*}{\partial X} = A - \frac{2}{s+1} X^* - \frac{s}{s+1} t = 0, \tag{7}$$

where $A = a - c^* > 0$. Thus, the production level in the second stage is expressed as:

$$X^* = \frac{s+1}{2} A - \frac{s}{2} t. \tag{8}$$

Eq. (8) is the reaction function of the foreign firm with respect to the tariff rate. Based on (6) and (8), the supplies to the home and foreign markets are respectively given by:

$$q^{pc}(t) = \frac{s}{2}(A-t) \quad \text{and} \quad q^{*pc} = \frac{1}{2} A, \tag{9}$$

where superscript *pc* stands for the *ex ante* optimal tariff policy in the precommitment case.

In view of (1), (3), (8), and (9), the home country's welfare function is expressed as:

$$W^{pc}(t) = \frac{1}{2s} \{q^{pc}(t)\}^2 + tq^{pc}(t). \tag{10}$$

Given (10), the FOC to maximize the home country's welfare is given by:

$$\frac{\partial W^{pc}(t)}{\partial t} = \frac{1}{s} q^{pc}(t) \frac{\partial q^{pc}(t)}{\partial t} + q^{pc}(t) + t \frac{\partial q^{pc}(t)}{\partial t}$$
$$= \frac{q^{pc}(t) - st}{2} = 0. \tag{11}$$

Therefore, we have the *ex ante* optimal tariff rate as follows:

$$t^{pc} = \frac{A}{3}. \tag{12}$$

For the following analysis, substituting (12) into (8), we have the production level in the precommitment case as follows:

$$X^{*pc} = \frac{2s+3}{6} A. \tag{13}$$

We understand that point pc in Fig. 1 and 2, $\{t^{pc}, X^{*pc}\}$ is a Stackelberg equilibrium in which the home government is a leader and the foreign firm is a follower. Based on (3), (4), (9), and (12), the welfare of the home and foreign countries are:

$$W^{pc} = \frac{s}{6} A^2 \quad \text{and} \quad W^{*pc} = \frac{8s+27}{72} A^2. \tag{14}$$

Now we proceed to the case of a free trade policy. Suppose that the home government precommits to zero tariffs, i.e., $t = 0$. Hence, from (8), the production level is given by:

$$X^{*f} = \frac{s+1}{2} A > X^{*pc}, \tag{15}$$

where superscript f indicates a free trade policy (see point f in Fig. 1 and 2). Accordingly, in view of (9), the supplies to the home and foreign markets are given by:

$$q^f = \frac{s}{2} A \quad \text{and} \quad q^{*f} = \frac{1}{2} A = q^{*pc}. \tag{16}$$

We thus obtain the welfare of both countries under a free trade policy as follows:

$$W^f = \frac{s}{8} A^2 \quad \text{and} \quad W^{*f} = \frac{2s+3}{8} A^2. \tag{17}$$

Taking (14) and (17) into account, let us compare the welfare of both countries in the case of the *ex ante* optimal tariff and the free trade policies. We obtain easily $W^{pc} > W^f$ and $W^{*pc} < W^{*f}$. As already shown in Brander and Spencer (1984, Proposition 1), the *ex ante* optimal tariff policy is superior to the free trade policy for the home country. That is, the tariff policy reduces imports, and thus reduces consumer surplus, whereas it increases tariff revenues by snatching the rent of the foreign firm's (i.e., the monopolist's) profits. The latter positive effect outweighs the former negative effect, so that the *ex ante* optimal tariff policy improves the home country's welfare, compared with the free trade policy case. However, from the viewpoint of world welfare composed of both the importing and exporting countries, the *ex ante* optimal tariff policy is inferior to the free trade policy, because it holds that

$$W^{pc} + W^{*pc} = \frac{20s+27}{72} A^2 < \frac{3(s+1)}{8} A^2 = W^f + W^{*f}.$$

3.2   The non-precommitment case: a time-consistent tariff policy

We assume that the home government cannot precommit to the tariff policy before the production decision by the foreign firm. In other words, as addressed below, the foreign firm expects that the home government has an incentive to renege on the *ex ante* announced tariff rate after the production decision. In a sense, there exists a time-inconsistency problem with respect to the tariff policy.

The foreign firm does not believe the *ex ante* tariff rate announced by the home government, because the tariff policy is not credible. Accordingly, in the second stage, given $X^* > 0,$ and in view of (3) and (6), the home government has to choose the tariff rate to maximize the welfare function as follows:

$$W(X^*, t) = \frac{1}{2s}\{q(X^*, t)\}^2 + tq(X^*, t).\tag{18}$$

Given (18), the FOC is given by:

$$\frac{\partial W(t)}{\partial t} = \frac{1}{s} q(X^*, t) \frac{\partial q(X^*, t)}{\partial t} + q(X^*, t) + t \frac{\partial q(X^*, t)}{\partial t}$$

$$= \frac{(2s+1)q(X^*, t) - st}{2(s+1)} = 0.\tag{19}$$

Thus, the tariff rate depends on the production level as follows:

$$t = \frac{2(2s+1)}{4s+3} X^*.\tag{20}$$

Eq. (20) denotes the reaction function (or the optimal tariff rate schedule) of the home government with respect to the production level. Thus, the foreign firm has an incentive to decrease the production level to reduce the tariff rate. Furthermore, eq. (20) implies that the home government does not have any incentive to revise the tariff rate decided by the production level, so that the tariff policy is time consistent.

Taking (6) and (20), we derive the following:

$$q^{tc}(X^*) = \frac{2s}{4s+3} X^* \quad \text{and} \quad q^{*tc}(X^*) = \frac{2s+3}{4s+3} X^*,\tag{21}$$

where superscript *tc* indicates a time-consistent tariff policy in the non-precommitment case.

In the first stage, based on (1), (2), (20), and (21), the foreign firm decides the production level to maximize the profit: $\Pi^{*tc}(X^*) = X^*\left\{A - \frac{12s^2 + 20s + 9}{(4s+3)^2} X^*\right\}.$ That is, from the FOC, we obtain the production level as follows:

$$X^{*tc} = \frac{(4s+3)^2}{2(12s^2+20s+9)}A < X^{*pc}. \tag{22}$$

In view of (22), to avoid a heavy tariff, the foreign firm will reduce its production level. Thus, substituting (22) into (20), the time-consistent tariff, which is *ex post* optimal, is:

$$t^{tc} = \frac{(2s+1)(4s+3)}{12s^2+20s+9}A. \tag{23}$$

In view of (12) and (23), it holds that $t^{tc} > t^{pc}$. As pointed out by Lapan (1988), in which he analyzes the perfect competition case, we confirm that the *ex post* optimal tariff rate is higher than the *ex ante* optimal tariff rate in the case of an export monopoly. Furthermore, we understand that point *tc* in Fig. 1 and 2, $\{t^{tc}, X^{*tc}\}$, is a Stackelberg equilibrium, in which the home government is a follower and the foreign firm is a leader.

Using (4), (18), (21), (22), and (23), the welfare of the home and foreign countries are:

$$W^{tc} = \frac{s(4s+3)^3}{2(12s^2+20s+9)^2}A^2 \quad \text{and} \quad W^{*tc} = \frac{(4s+3)^2(28s^2+52s+27)}{8(12s^2+20s+9)^2}A^2. \tag{24}$$

Fig. 1 & Fig. 2

3.3 Comparison: a free trade and a time-consistent tariff policy

Based on (14) and (24), although omitting some calculations, we obtain directly $W^{pc} > W^{tc}$ and $W^{*pc} > W^{*tc}$. Thus, we show that the welfare of the home and foreign countries under the *ex ante* optimal tariff policy is always larger than that under the *ex post* time-consistent optimal tariff policy. Taking (21), (22), and (23) into account, because the *ex post* tariff rate is larger than the *ex post* tariff rate, the amount of imports in the home country and the production level of the foreign firm are sufficiently smaller than those in the case of the *ex ante* optimal tariff policy. Furthermore, it holds that $W^{pc} + W^{*pc} > W^{tc} + W^{*tc}$. The results are basically similar to those shown by Lapan (1988, Proposition 1).

Let us now compare the welfare in the case of the *ex post* time-consistent tariff policy and in the case of the free trade policy. In view of (17) and (24), with regard to the welfare of the home country, we derive the following relationship:

$$W^{tc} \geq (<)W^f \Leftrightarrow \hat{s} \geq (<)s, \tag{25}$$

where $\hat{s} \approx 0.564$. In view of (25), we derive the following proposition.

Proposition 1

If the market size of an importing country is larger (smaller) than a certain level, i.e., $s > (<)\hat{s}$, the importing country prefers a free trade (an ex post time-consistent tariff) policy.

Horiba and Tsutsui (2000, Proposition 5, Corollary 2) shows that free trade dominates the tariff policy in terms of welfare ranking, if the adjustment costs of the duopolistic firms are sufficiently large. Although their result is closely related to ours, the point of our result is the degree of market size of an importing country, not the adjustment costs of the firms.

To consider the effect of market size on the production level, taking (15) and (22) into account, the difference in production levels between the cases of free trade and the tariff policy is:

$$\Delta X^* \equiv X^{*f} - X^{*tc} = \frac{s(12s^2 + 16s + 5)}{2(12s^2 + 20s + 9)} A. \tag{26}$$

Given (26), we derive $\frac{d(\Delta X^*)}{ds} > 0$. The difference increases with an increase in the market size of the importing country. In other words, if the market size is small, the difference is not large. For example, consider a non-oil-producing developing country. Even if the developing country charges a tariff on the export monopoly, such as OPEC, the effect on the production level is not significant. Although the amount of imports certainly decreases, and thus consumer surplus falls, compared with the free trade case, the developing country can take rents from the profits of the export monopoly as tariff revenues. Hence, because the latter positive effect outweighs the former negative effect, the developing country prefers the tariff policy.

Let us assume that the market size of the home country is smaller. See points f and tc in Fig. 1. In this case, the negative slope of the reaction function of the production level with respect to the tariff rate is not steep, and therefore the degree of the decrease in the production level in response to an increase in the tariff rate is small. On the other hand, the positive slope of the reaction function of the tariff rate with respect to the production level is also not steep, and therefore the decrease in the tariff rate in response to a decrease in the production level is small. Thus, even if the small home country charges a tariff, the decrease in the amount of

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imports is not large, compared with the free trade case. Instead, to extract rents from the foreign export monopoly, the small home country will use the tariff policy. Thus, it holds that $W^{tc} > W^f$.

In contrast, in the case of a non-oil-producing developed country with a larger market, the effect of a decrease in consumer surplus outweighs that of rent snatching, so that the developed country prefers a free trade policy. See points f and tc in Fig. 2. In this case, in contrast to the case of a small market size, the decrease in the production level in response to an increase in the tariff rate, and the decrease in the tariff rate in response to a decrease in the production level are large. If a large home country charges a tariff rate, the magnitude of the associated decrease in imports is large. This leads to a huge reduction of consumer surplus in the home country. Hence, because it holds that $W^f > W^{tc}$, the large home country prefers a free trade policy.

Furthermore, avoiding the tedious calculations, we obtain $W^{*tc} < W^{*pc} < W^{*f}$. Thus, the foreign country always prefers free trade to the tariff policy.

Finally, with respect to the total welfare of the world economy, composed of both the importing and exporting countries, we have:

$$\breve{W}^{tc} = \frac{(4s+3)^2(44s^2 + 64s + 27)}{8(12s^2 + 20s + 9)^2} A^2 < \frac{3(s+1)}{8} A^2 = \breve{W}^f. \tag{27}$$

where $\breve{W}^j \equiv W^j + W^{*j}, j = f, tc$. It is shown clearly in (27) that free trade is superior to the *ex post* time-consistent tariff policy for the world economy.

In the case of a small home country, the home government chooses an *ex post* time-consistent tariff policy. Thus, the tariff policy reduces the welfare of the exporting country and the world economy. However, based on (27), we obtain the effect of an increase in market size on the magnitude of the difference in the welfare between free trade and the tariff policy as follows:

$$\Delta \breve{W} \equiv \breve{W}^f - \breve{W}^{tc} = \frac{3(s+1)(12s^2 + 20s + 9)^2 - (4s+3)^2(44s^2 + 64s + 27)}{8(12s^2 + 20s + 9)^2} A^2 (>0).$$

Because we have $\dfrac{d(\Delta \breve{W})}{ds} > 0,$ if the market size is small, then the welfare gap between free trade and the tariff policy is not large. This is also true for the effect of an increase in the

market size on the welfare gap with respect to the foreign country, i.e., $\dfrac{d(\Delta W^*)}{ds} > 0,$ where

$\Delta W^* \equiv W^{*f} - W^{*tc} (> 0).$ This result implies that the welfare loss under the tariff policy is not very significant unless the market size is large.

If the market size is larger than a certain level, i.e., $s > \hat{s},$ then the home government prefers a free trade policy that is also preferable for the foreign country. However, can a free trade policy be credible? In the next section, we discuss this issue.

4. The Role of GATT/WTO as Commitment Devices

4.1 Is a free trade policy credible?

As mentioned above, a free trade policy is the specific case, in which the home government can precommit in advance to zero tariffs. Based on (8) and (9), we have $X^{*f} = X^{*pc}(t = 0)$ and $q^f = q^{pc}(t = 0).$ In addition, taking (11) into account, we derive

$$\left. \frac{\partial W^{pc}(t)}{\partial t} \right|_{t=0} = \frac{q^{pc}(t=0)}{2} > 0.$$ Thus, it holds that $W^f = W^{pc}(t = 0) < W^{pc}(t = t^{pc}).$

However, a free trade policy in itself is not credible because the home government has an incentive to renege on zero tariffs after the production level decision by the foreign firm. Suppose that the foreign firm decides the production level under free trade, i.e., zero tariffs, in the first stage because it expects a free trade policy will be implemented by the home government. In the second stage, the home government changes the tariff rate from zero to some positive value that maximizes welfare, given the production level in the case of free trade. Hence, we have $W^R = W(X^{*f}, t > 0) > W^f = W(X^{*f}, t = 0),$ where W^R stands for the welfare of the home country when it reneges on the tariff rate. Therefore, a free trade policy is not credible for the foreign firm. See point f and R in Fig. 1 and 2.

Similarly, for the case of an *ex ante* optimal tariff policy without any commitment devices, it holds that $W^{R'} = W(X^{*pc}, t > t^{pc}) > W^{pc} = W(X^{*pc}, t = t^{pc}).$ See points f and R' in Fig. 1 and 2. In other words, only a time-consistent tariff policy is credible for the foreign firm.

4.2 Free trade and GATT/WTO as commitment devices

As shown in previous sections, the time-consistent tariff policy is rational for an importing country with a small market, such as developing countries. However, cannot a home country with a large market, for example developed countries such as Japan and the US, enforce a free trade policy? In this case, it holds that $\Pi^{*f} > \Pi^{*pc} > \Pi^{*tc}$ and $W^{*f} > W^{*pc} > W^{*tc}$, so that both the foreign firm and foreign government prefer free trade. Thus, the home government expects that a free trade policy can be made credible by becoming a member of GATT/WTO as a commitment device. That is, the home government has to be punished if it deviates from the rules of GATT/WTO. In turn, by observing that the home country is a member of GATT/WTO, the foreign firm and the foreign government anticipate that the free trade policy is credible. Therefore, if the home government joins GATT/WTO, the home and foreign countries Pareto improve from the suboptimal time-consistent tariff policy equilibrium.

Applying the three-stage game presented in the previous section, we develop the game as follows (see Fig. 3). In the zero stage, the home government decides whether to join GATT/WTO or not. If it chooses to become the member, the home government can precommit to a free trade policy, i.e., zero tariffs, consistent with the rules of GATT/WTO. This means that the foreign firm believes that the free trade policy of the home government is credible. Otherwise, the game proceeds to the first stage. In this stage, whether the home government decides to make the first move or not depends on the foreign firm's expectation of the tariff policy. That is, we assume that p is the subjective probability as believed by the foreign firm that the home government will move first (or become a Stackelberg leader). That is, the foreign firm expects that the home government will actually implement the *ex ante* announced tariff rate after the firm's production decision; however, the tariff policy is not necessarily credible. In this case, however, because it holds that $W^{pc} > W^{tc}$ and $\Pi^{*pc} > \Pi^{*tc}$, if the foreign firm believes it, then the home government itself prefers the *ex ante* tariff rate to the *ex post* tariff rate. However, the *ex ante* tariff policy is not a credible commitment. Thus, in this stage, the home government decides to make the first move or not with a certain probability. We also assume that this proportion is common knowledge. Finally, in the second stage, as examined in the previous section, if the home government is a leader, the Stackelberg equilibrium in the case of precommitment tariff policy holds, i.e., point *pc* in

Fig. 1 and 2. Otherwise, the Stackelberg equilibrium in the case of non-precommitment tariff policy holds, i.e., point *tc* in Fig. 1 and 2. By backward induction, we derive an SPNE.

Fig. 3

We obtain directly that becoming a member of GATT/WTO is chosen as an SPNE of the extended game if and only if it holds that

$$W^f \geq pW^{pc} + (1-p)W^{tc}.$$ (28)

Eq. (28) implies the incentive compatibility constraint in which the home government joins GATT/WTO. Eq. (28) can be rewritten as:

$$1 > \frac{W^f - W^{tc}}{W^{pc} - W^{tc}} \geq p.$$ (29)

That is, to ensure that becoming a member of GATT/WTO is an SPNE, the subjective probability as believed by the foreign firm should be less than a certain value.

Based on (14), (17), and (24), eq. (29) can be rewritten as follows.

$$\omega(s) \equiv \frac{\frac{1}{4} - \Omega(s)}{\frac{1}{3} - \Omega(s)} \geq p,$$ (30)

where $\Omega(s) = \left(\dfrac{4s+3}{12s^2 + 20s + 9}\right)^2$ and $\Omega'(s) < 0$. Note that $\omega'(s) > 0$ and $\dfrac{5}{8} \leq \omega(s) < \dfrac{3}{4}$, for $\infty > s \geq 0$.

Before discussing the conditions for which becoming a member of GATT/WTO is an SPNE, we consider the case of an importing country with a smaller market size, i.e., $s < \hat{s}$. Suppose $\omega(\hat{s}) > p$. Hence, there exists $s' \equiv \{s|\omega(s) = p\}$. Therefore, based on eq. (30), for $\hat{s} > s > s'$, the importing country chooses to become the member to maintain free trade. However, in view of Proposition 1, the importing country prefers the time-consistent tariff policy to free trade. In other words, we omit the case of the importing country with a smaller market size, i.e., $s < \hat{s}$, to analyze the conditions of an SPNE. Furthermore, an SPNE does not exist if it holds that $p \geq \dfrac{3}{4} > \omega(s)$.

Now we consider the case of the importing country with a relatively large market size,

$s > \hat{s}.$ Using Proposition 1 and eq. (30), the conditions to ensure that becoming a member of GATT/WTO is an SPNE are:

(i) for $s > \hat{s},$ if $\omega(\hat{s}) > p,$ or (31)

(ii) for $s > \tilde{s}\,(> \hat{s}),$ where $\tilde{s} \equiv \{s | \omega(s) = p\},$ if $\dfrac{3}{4} > p > \omega(s).$ (32)

Condition (i) states that if the subjective probability as believed by the foreign firm is small, in other words, if the foreign firm expects that the home government might not make the first move, then the importing home country with the relatively larger market size, $s > \hat{s},$ decides to become a member of GATT/WTO. Similarly, condition (ii) states that if the subjective probability as believed by the foreign firm falls within a certain range, the importing home country with a large market size, $s > \tilde{s}\,(> \hat{s}),$ decides to become a member of GATT/WTO. In this case, the foreign firm expects that the home government might make the leader, and thus *ex post* renege on the tariff policy. Thus, for joining GATT /WTO to be an SPNE, the market size of the importing county must be sufficiently large.

We summarize the above discussions as the following proposition.

Proposition 2

With respect to the market size of an importing country, if either (31) or (32) hold, the importing country decides to join a member of GATT/WTO as a commitment device. In this case, the importing country can commit credibly to a free trade policy under which both the importing and exporting countries achieve a Pareto improvement.

4.3 Discussion

In view of the discussion in Section 4.1, we can interpret the subjective probability or the belief as the degree to which the foreign firm expects that the home government would *ex post* renege on the *ex ante* announced tariff rate charged in the precommitment case. Hence, eq. (29) or eq. (30) is rewritten as follows:

$$1 > \omega(s) > \psi(s) \equiv \frac{W^f - W^{tc}}{W^{R'} - W^{tc}} \geq p. \qquad (33)$$

That is, with respect to the conditions that ensure an SPNE, eq. (33) states that the subjective probability must be sufficiently small and/or the market size of an importing country must be sufficiently large, compared with the case shown in Proposition 2. However,

even in that case, our main results cannot be revised qualitatively.

5. Concluding Remarks

Lapan (1988) analyzes a time-consistent tariff policy in the presence of a time lag between production and consumption decisions in the case of perfect competition, based on a general equilibrium model. He illustrates that the welfare of both importing and exporting countries in the case of a time-consistent tariff policy is lower than in the case of an *ex ante* optimal tariff policy.

Assuming an export monopoly, we considered explicitly the strategic relationship between an importing (home) government and an exporting (foreign) firm in a game theoretic framework, based on a very simple partial equilibrium model. In this case, *ex ante* (*post*) optimal tariff policy is interpreted as a Stackelberg equilibrium, in which the home government is a leader (follower) and the foreign firm is a follower (leader, respectively).

Furthermore, we showed that the reaction functions of the home government and the foreign firm depend on the market size of the home country. In addition, we showed that, compared with the free trade case, whether the welfare of the home country decreases or not depends on the market size. In particular, if the market size is larger (smaller) than a certain level, the welfare in the case of a free trade policy is higher (lower) than that in the case of a time-consistent tariff policy. Thus, the home country with a larger market prefers free trade, and needless to say, so does the foreign firm.

However, a free trade policy is not credible and is time-inconsistent. In this case, we interpreted the GATT/WTO rules as commitment devices. Staiger and Tabellini (1989, 1991, and 1999) examine empirically whether GATT/WTO rules can help governments make commitments to superior trade policies that would not be credible to domestic agents in the absence of such rules. Following their approach, using a game theoretic framework, we showed that the condition under which becoming a member of GATT/WTO is a subgame perfect Nash equilibrium depends on the subjective probability as believed by the foreign firm and on the market size of the importing country. Based on this result, we suggest that a country with a large market such as the US, Japan, or any other developed countries, maybe including China, should join the GATT/WTO regime to make trade partners believe that they

have committed to free trade, and, as a result, the significant benefits of free trade accrue to the world economy.

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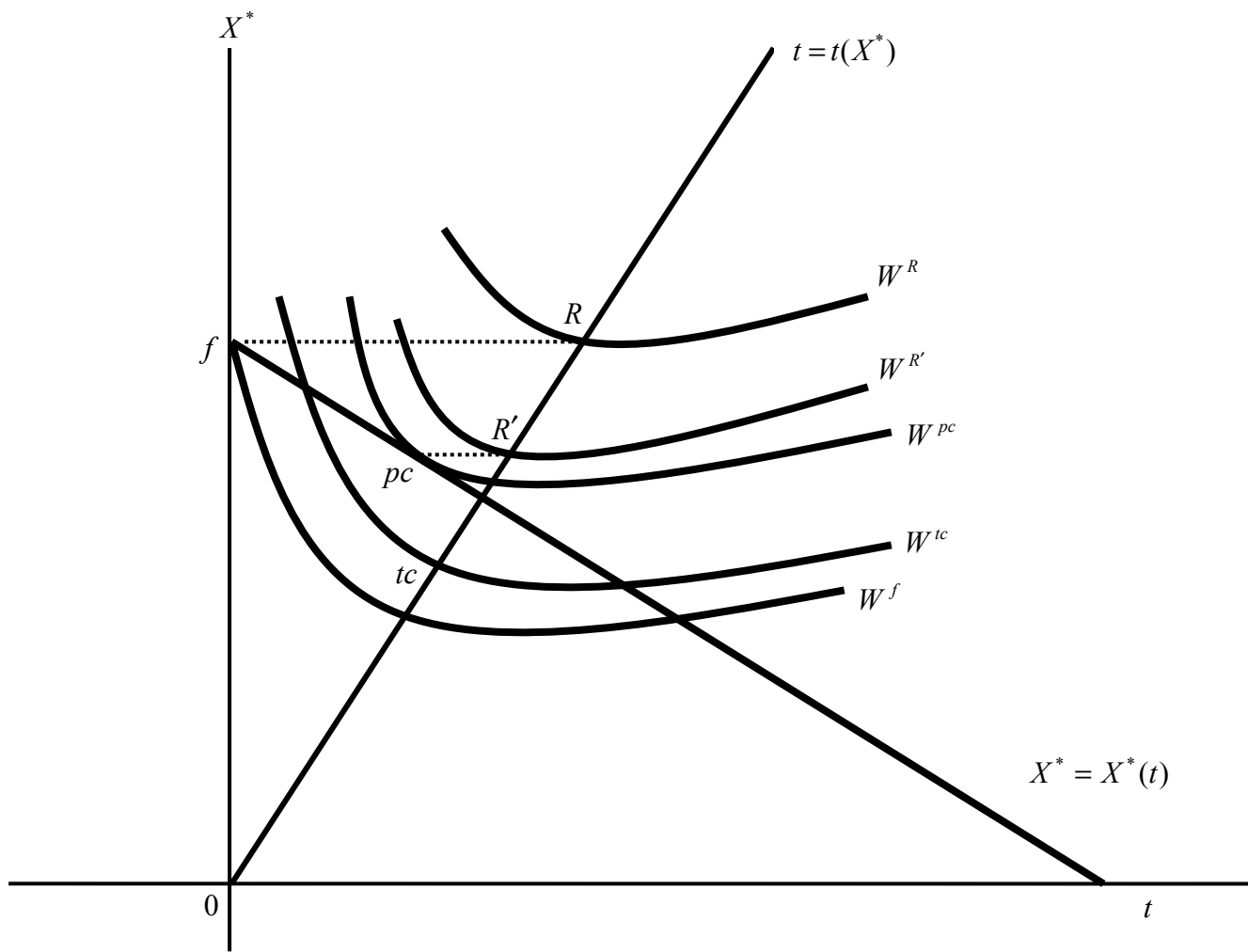
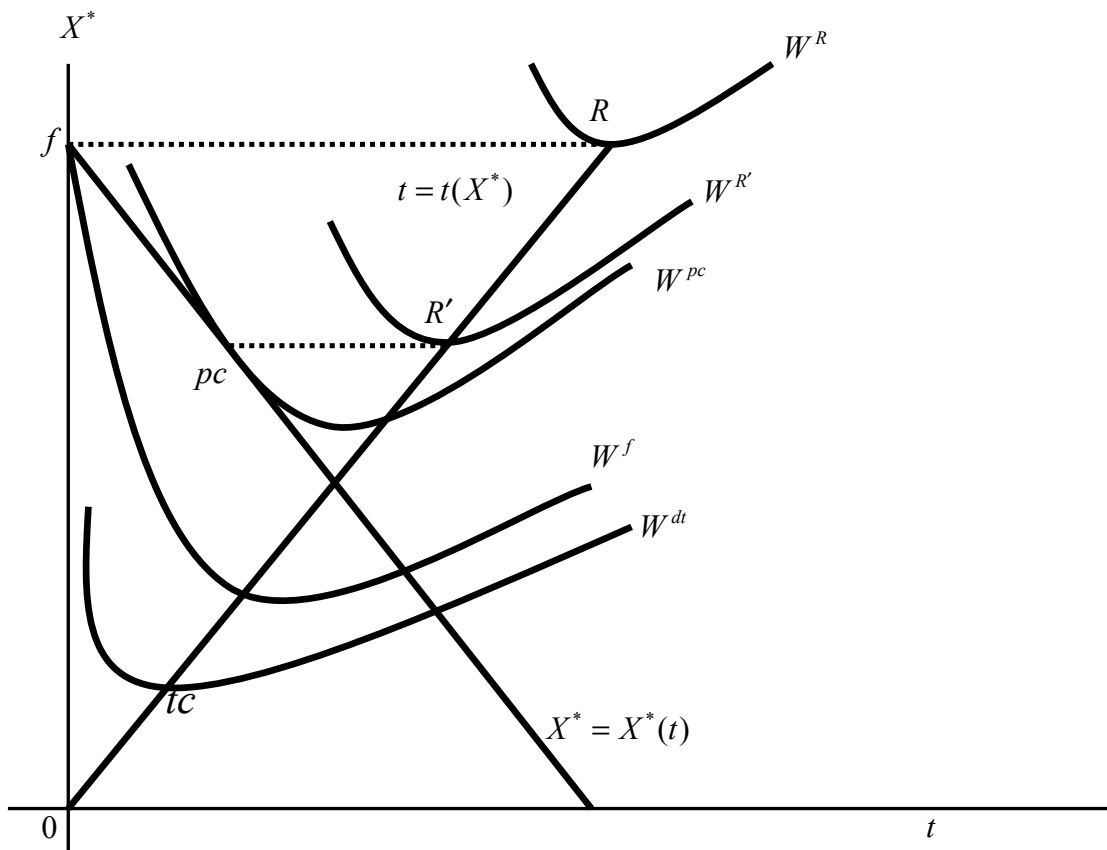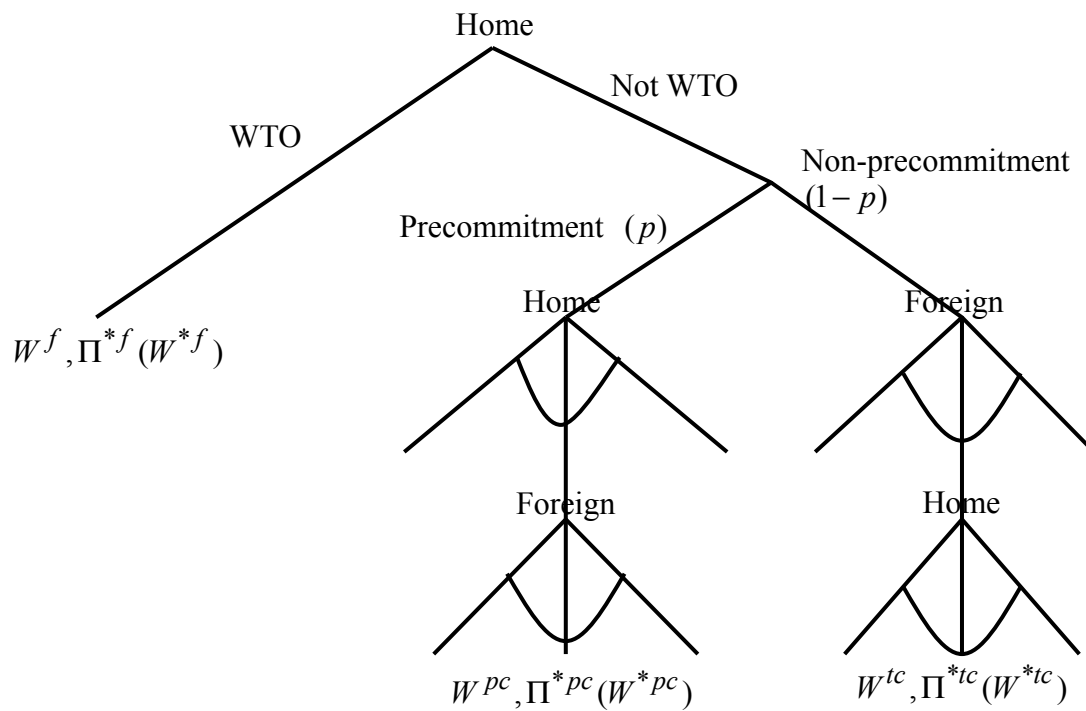Fig.1 Equilibrium in the case of $\hat{s} > s$

Fig.2 Equilibrium in the case of $\hat{s} < s$

Home

WTO

Not WTO

Non-precommitment
$(1-p)$

Precommitment (p)

$W^{f}, \Pi^{*f}(W^{*f})$

Home

Foreign

Foreign

Home

$W^{pc}, \Pi^{*pc}(W^{*pc})$

$W^{tc}, \Pi^{*tc}(W^{*tc})$

Home: The home government

Foreign: The foreign firm

Fig. 3 The structure of the game