Sequential Tariffs in Cournot and Bertrand Competition[*]

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Abstract   We examine the welfare implication of the sequential tariff game between discriminatory and uniform tariff rates in which the importing country imposes tariffs on asymmetric foreign exporters. Under Cournot competition, the importing country has an incentive to manipulate the tariff structure through sequential tariffs. Imposing the sequential uniform tariff improves consumer surplus, as well as social and global welfare, when the cost difference is small. In contrast, under Bertrand competition, the importing country always prefers the simultaneous tariff over the sequential tariff. As a result, the importing country prefers the simultaneous discriminatory tariff to the uniform tariff under Bertrand competition. Moreover, consumer surplus, social and global welfare with the simultaneous discriminatory tariff under Bertrand competition are greater than with the sequential uniform or the discriminatory tariff under Cournot competition.

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1. INTRODUCTION

Tariffs are the most common protective trade policy implemented by importing countries to protect their domestic industries. Under the WTO (World Trade Organization) regime, countries should treat all trading countries equally according to the Most Favored Nation (MFN) principle. That is, importing countries must impose the same tariff rates on products exported by firms located from different countries under this principle, which means an agreement on nondiscrimination. With this principle, both of trade surplus of the importing country and production efficiency of the exporting country can be improved.

There are instances where tariff rates in some countries change over time. A common example is the reduction of tariff rates due to the renegotiation of free trade agreements between countries. Recent notable examples include the Korea-US FTA renegotiation and the USMCA negotiation[1]. Examples of tariff hikes exist in some countries, especially developing countries. Saudi Arabia raised tariffs twice in 2020 and 2022[2]. In addition, the Egyptian government announced that it would increase tariffs on 350 imported items in 2016. However, since Egypt decided not to apply tariff increases to countries with which it signed an FTA, discriminatory tariff rates were applied only to countries with which it had not signed an FTA with Egypt[3]. These cases mean that tariff can be imposed sequentially, either as uniform tariffs or as discriminatory tariffs. This phenomenon is also occurring in new markets. Recently, some countries have lowered tariff rates on imported electric vehicles to promote the growth of the electric vehicle industry and encourage consumer purchases. The Philippines, for instance, imposes tariffs ranging from 5% to 30% on imported vehicles, though these rates are reduced when trade agreements are in place. However, the Philippines recently announced that it would temporarily remove import tariffs on electric vehicles, regardless of whether the exporting countries have trade agreements[4]. Thailand imposes zero tariffs on electric vehicles imported from Japan, with which it has a free trade agreement, while levying a 50% import

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[1]The USMCA substituted the North America Free Trade Agreement (NAFTA), which was a free trade agreement between the United State, Canada and Mexico.

[2]Saudi Arabia raised its tariff from 0 to 20% in June 2020 to an average of 5.5% to 25%. And they increased tariffs on 99 imported items again in June, 2022. Although the Saudi government has specified the reason for protecting its own industries, it seems to be aiming to further improve the national fiscal balance by raising tariffs. (source from https://dream.kotra.or.kr/kotranews/cms/news/actionKotraBoardDetail.do?MENU-ID= 90&pNttSn=195039).

[3]Source from https://www.mofa.go.kr

[4]http://www.nvp.co.kr/news/articleView.html?idxno=305950.

tariff on electric vehicles manufactured in China. Tesla is a newcomer to the automotive industry, but it is a leading firm that has achieved economies of scale in the electric vehicle market. This sequential adjustment of tariffs on electric vehicles could influence the competition between cost-efficient firms like Tesla and firms that manufacture internal combustion engine vehicles[5].

In this aspect, it is important to analyze the effect of tariffs imposed sequentially in international trade. Given these observations, we will theoretically develop a simple model that addresses the implications of this sequential mechanism involving both uniform and discriminatory tariffs under Cournot and Bertrand competition. For analysis, a third-country model is introduced, where two foreign firms with different cost structures export to an importing country. The welfare of the importing country consists of the sum of consumer surplus and tariff revenue. Global welfare is assumed to comprise the profits of foreign firms and the welfare of the importing country.

This study presents the following findings. First, under Cournot competition, where exporters have asymmetric production costs, the importing country has an incentive to manipulate the tariff structure through sequential tariffs. With the advantage of a first-mover, the importing country prefers to impose tariffs first on the low-cost exporter. Roughly speaking, because sequential tariffs generate higher revenue than simultaneous tariffs, the importing country prefers sequential tariffs over simultaneous tariffs under uniform tariff policies. Consequently, imposing the uniform tariff improves social welfare, consumer surplus and global welfare when cost difference is small, as the reduction in cost asymmetry lowers the tariff level for the efficient exporter. However, when cost difference is large, the importing country opts for sequential discriminatory tariffs, even though consumer surplus and global welfare are higher under the sequential uniform tariffs.

Second, in contrast to Cournot competition, since there is a second-mover advantage under Bertrand competition, the low-cost exporter, acting as the follower, produces more under both uniform and discriminatory tariff regimes. However, the importing country prefers to impose tariffs simultaneously rather than sequentially, and as a result, neither discriminatory nor uniform tariffs are implemented in the sequential case. Therefore, the importing country prefers discriminatory tariff to uniform tariff under Bertrand competition, even though uniform tariffs improves consumer surplus and global welfare[6].

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[5]https://www.kiep.go.kr/aif/index.es?sid=a3&systemcode=03.

[6]Thus, the results of Hashimzade *et al.* (2011a) do not hold in our simultaneous tariff, however it may hold in sequential tariff with Cournot competition of the absence of subsidies of exporting

Finally, since there exists a necessary condition for welfare improvement with higher total output under Bertrand than under Cournot competition, simultaneous discriminatory tariff under Bertrand competition is always superior to sequential uniform or discriminatory tariff under Cournot competition.

Previous studies have primarily focused on comparing the uniform tariff policy and discriminatory tariff policy. Brander and Spencer (1985) analyzed that the importing country prefers a discriminated tariff policy in case of competing two exporting firms with different production costs. For the welfare comparison of the importing country, Gatsios (1990) and Hwang and Mai (1991) demonstrated that the importing country has preference for discriminatory tariffs than uniform tariffs, which impose high (low) tariffs on low (high) cost firms.

Choi (1995) and Horiba and Tsutsui (2000) examined the importing country's choice between two tariff regimes, focusing on the impact of short-run discriminatory tariffs on exporters' long-run choice of technology (or capacity). In particular, Choi (1995) analyzed that the importing country is better off with a uniform tariff policy while the foreign duopolists are better off when the importing country pursues a discriminatory tariff policy[7]. In addition, when the exporting governments are active, the implications of the strategic choice of tariffs have been investigated by Gatsios (1990), Hwang and Mai (1991), Liao and Wong (2006), Hashimzade *et al.* (2011a), and Hashimzade *et al.* (2011b) among others that are based on the simultaneous tariff games.

When moving to different tariff regime between uniform and discriminatory tariffs, it gives another incentive to alter the strategic relationship between exporting countries. Liao and Wong (2006) showed that export subsidies/taxes are chosen by exporting countries in some cases, and that whereas the importing country prefers a uniform tariff regime, the exporting countries find a discriminatory tariff regime preferable. Going beyond Liao and Wong (2006), Hashimzade *et al.* (2011a) demonstrated, by using an export-rivalry model similar to Brander and Spencer (1985) framework, that export taxes or export subsidies which depend on the degree of product differentiation are chosen by the exporting country. Thus, they found that with asymmetric production costs between exporters controlling export taxes or export subsidies, the importing country always prefers

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country, while those do not hold under our setting of Bertrand competition.

[7]Saggi (2004) considered a model of *n* countries and *n* exporters with differential costs. He found that each country imposes higher tariffs of efficient exporters, while the adoption of the MFN clause by each country improves global welfare. Saggi and Yildiz (2005) considered that each exporting country has two exporters and showed that tariff discrimination can be welfare preferred to MFN globally when inefficient exporters are merged and the cost disadvantage of the merged unit relative to competing exporters is of intermediate magnitude.

a uniform tariff regime whereas exporters' preferences are divided between the two tariff regimes: the higher-cost exporter always prefers the discriminatory tariff regime but the lower-cost exporter prefers the uniform regime if there is a significant cost differential[8].

Theoretical approaches, as mentioned above, allow governments to actively choose the optimal values of their policies such as export subsidies/taxes for each exporting country and tariffs/subsidies for the importing country. However, we consider the banning of export subsidies/taxes of exporting countries. The reason for disregarding such strategic trade policies is that most subsidies are prohibited by Article 3 of the WTO Agreement on Subsidies and Countervailing Measures. This article disciplines the use of subsidies and defines prohibition of subsidies that require recipients to meet certain export targets, or to use domestic goods instead of imported goods (sources: www.wto.org).

On the other hand, tariff discrimination in international trade became a significant issue again with the rise of FTAs in the 2000s. However, little attention has been paid to the determination of discriminatory tariffs through the simultaneous and sequential offering rather than choosing exporting countries' an export subsidy/tax on theoretical grounds. Therefore, in the context of a ban on subsidy policies among asymmetric exporting countries, this differences in the market structures lead to notably different results. These allow all three governments to actively choose the optimal values of their policies, such as adopting a simultaneous or sequential tariff regime for the importing country and altering the mode of competition for exporting countries. Before analyzing the main result, it is worth relating our paper to the work of Kim and Sim (2015) who examined the case of sequential contracting with input buyers under only Cournot competition. As Choi (1995) argued, we make a key observation that an important analytical similarity can be drawn the problem of a government imposing tariffs on goods being imported from foreign exporters and the problem of a monopolistic supplier selling a required input to competing downstream firms. However, we will analyze how adding sequentiality to the tariff structure and incorporating consumer surplus into the importing country's objective function leads to qualitatively different behavior than a monopolistic supplier in the closed economy. In terms of international trade, compared to input pricing, sequential tariffs under

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[8]Most of the existing literature, such as Gatsios (1990), Saggi (2004), Saggi (2009), Ozerturk and Saggi (2005), Hashimzade *et al.* (2011a), and Hashimzade *et al.* (2011b), support the argument that uniform tariff is superior to discriminatory tariff in terms of global welfare, because tariff discrimination will result in cost asymmetry caused by imposing a higher (lower) tariff on the low-cost (high-cost) firm. Recently, Din *et al.* (2016) examined the superiority of MFN vs. tariff discrimination in global welfare by taking into account the cross ownership between exporters.

either Cournot or Bertrand competition will yield different results.

Although the assumption of simultaneous tariff and simultaneous-move game among exporters is frequently used when analyzing the efficiency between uniform and discriminatory tariffs, we should bear in mind that it restricts any analysis of tariff effects. Specifically, the assumption of simultaneous tariffs and simultaneous-move game leads previous studies to support the argument that uniform tariffs are superior to discriminatory tariffs in terms of global welfare. However, by taking into account sequential-move game, the opposite result including global and social welfare can occur. This study sheds light on the fact that the importing country strategically chooses the sequential tariffs to manipulate the tariff revenue and its social welfare. The existing literature on strategic trade policy has given relatively little attention to the timing of imposing discriminatory versus uniform tariffs in the context of Cournot and Bertrand competition.

2. THE MODEL

Consider an importing country which imports a heterogeneous product from two foreign producers. As in Choi (1995) and Brander and Spencer (1984), we assume that these foreign producers do not sell their products in other markets, and that there is no home producer. For tractability, we assume linear demand for the importing country. We consider the utility function of the representative consumer in the importing country is given by $U = a(q_i + q_j) - \frac{[(q_i)^2 + (q_j)^2 + 2bq_iq_j]}{2} + m; i, j = 1, 2, i \neq j$, where m is the consumption of the outside good, q_i represents the quantity of the good i, parameter a is a positive constant, and $b \in (0, 1)$ denotes the degree of product differentiation. Given the utility function of the representative consumer mentioned above, the direct and inverse demand functions for good i can be written as follows: $q_i = \frac{a(1-b) - p_i + bp_j}{1 - b^2}$, and $p_i = a - bq_j - q_i$, where p_i denotes the price of the final product i. Two foreign producers have different production cost structures. In other words, it is assumed that one foreign producer is cost-inefficient in production and the other foreign producer is cost-efficient. Throughout the paper, to incorporate inefficient firm into the model, it is assumed that firm i is less efficient than the firm j (i.e., $c_i = c > 0 = c_j$), and the costs c and 0 are public information without loss of generality. Furthermore, we assume $a = 1 > c$, and that output of each firm is positive in both discriminatory and uniform tariff regimes. Therefore, the profits of both foreign firms are given by $\pi_i = (p_i - c - t)q_i$, and $\pi_j = (p_j - t)q_j$, where t is an import tariff levied by the importing country.

The importing country's social welfare equals consumer surplus $CS = U - p_i q_i - p_j q_j$ plus tariff revenue of the importing country where the tariff revenue is $t(q_i + q_j)$ $(t_i q_i + t_j q_j)$ when imposing uniform tariff (discriminatory tariff): $SW_H = CS + t(q_i + q_j)$ or $SW_H = CS + t_i q_i + t_j q_j$[9]. Given the definition of social welfare, we can define that the sum of the aggregate exporters' profits plus social welfare of importing country as the global welfare, $GW = SW_H + \sum_{i=1}^{2} \pi_i$.

We posit a two-stage game. At stage one, the government of importing country determines the import tariff so as to maximize social welfare of importing country. At stage two, each exporting firm competes according to market variable selected at stage one. We solve a subgame perfect Nash equilibrium (SPNE) through backward induction.

We assume the following sufficient condition, which requires the cost be sufficiently small (see Figure 1 in subsection 3.3).

Assumption 1. $c < a^* \equiv \frac{(4-2b-b^2)\Delta_{A1}}{(2-b)(20-8b^2-b^3)}$, where $\Delta_{A1} = 8 - 4b - b^2$.

This assumption ensures that both foreign firms produce in the simultaneous and sequential contracting setting.

3. COURNOT COMPETITION

Suppose that the government of importing country retains full discretionary power in setting the tariff rate in the sense that it is able to adopt an optimal ex post tariff rate that could be different (hence "discriminatory") between the two producers. Let t_i and t_j be the discriminatory tariff rates against the respective foreign duopolists. Following the backward induction method, we first solve four types of sub-games in a duopoly model—two asymmetric firms and then compare the simultaneous with sequential tariff systems.

3.1. SIMULTANEOUS TARIFF

[Discriminatory Tariff]: For given discriminatory tariff rates, the foreign firm i and j's profit maximization problem is $\max_{q_i} \pi_i = (p_i - c - t_i)q_i$, and $\max_{q_j} \pi_j = (p_j - t_j)q_j$. Solving the response function with asymmetry yields

$$q_i = \frac{2(1-c-t_i)-b(1-t_j)}{4-b^2}, \; q_j = \frac{2(1-t_j)-b(1-c-t_i)}{4-b^2}.$$

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[9]The assumption is also widely applied in the literature of international trade even though the importing country has an monopsony power.

The importing country chooses the tariff rates t_i and t_j to maximize the sum of the domestic consumer surplus and tariff revenue: $\max_{t_i, t_j} SW_H = CS + TR$ where TR is tariff revenue, $TR = \sum_{i=1}^{2} t_i q_i$ under discriminatory tariff. The first-order condition for the importing country's maximization problem and solving the response function with tariff yields

$$t_i^{DC} = \frac{3(1-c)-b}{9-b^2}, \quad t_j^{DC} = \frac{3-b(1-c)}{9-b^2}.$$

where superscript "D" stands for discriminatory tariff rules, and "C" signifies the Cournot structure[10]. Using t_i^{DC} and t_j^{DC}, we can calculate the equilibrium outcomes for the different combinations of tariffs, summarized in Table 1.

$$q_i^{DC} = t_i^{DC}, \quad q_j^{DC} = t_j^{DC},$$
$$\pi_i^{DC} = (q_i^{DC})^2, \quad \pi_j^{DC} = (q_j^{DC})^2,$$
$$CS^{DC} = \frac{2(3-b)^2(1+b)(1-c) + (9-5b^2)c^2}{2(9-b^2)^2},$$
$$SW_H^{DC} = \frac{2(3-b)(1-c) + 3c^2}{2(9-b^2)},$$
$$GW^{DC} = SW_H^{DC} + \pi_i^{DC} + \pi_j^{DC};$$

$$q_i^{UC} = \frac{2(2-b) - 5c}{2(6-b-b^2)}, \quad q_j^{UC} = \frac{2(2-b)+(1+2b)c}{2(6-b-b^2)},$$
$$\pi_i^{UC} = (q_i^{UC})^2, \quad \pi_j^{UC} = (q_j^{UC})^2,$$
$$CS^{UC} = \frac{4(2-b)^2(1+b)(1-c) + (13-3b-8b^2)c^2}{4(2-b)^2(3+b)^2},$$
$$SW^{UC} = \frac{4(2-b)^2(1-c) + (7-6b)c^2}{4(2-b)^2(3+b)},$$
$$GW^{UC} = SW^{UC} + \pi_i^{UC} + \pi_j^{UC}.$$

Table 1: EQUILIBRIUM OUTCOMES UNDER SIMULTANEOUS TARIFF POLICIES. When imposing tariffs simultaneously, it shows the equilibrium value for both a uniform tariff and a discriminatory tariff.

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[10]The discriminatory tariff on the efficient exporter should be higher than that on the inefficient firm.

[Uniform Tariff]: Suppose that the importing country imposes the uniform tariff (t). We can derive the equilibrium outputs in stage 2 by substituting $t_i = t_j = t$ into Eq. (1) as follows: $q_i = \frac{(2-b)(1-t)-2c}{4-b^2}$ and $q_j = \frac{(2-b)(1-t)+cb}{4-b^2}$.

In stage one, the importing country chooses t to maximize its profit, $\max_t SW_H = CS + TR$, where TR is tariff revenue, $TR = \sum_{i=1}^{2} tq_i$ under uniform tariff and which yields the equilibrium uniform tariff as follows:

$$t^{UC} = \frac{2-c}{2(3+b)},$$

where superscript "U" stands for uniform tariff rules, and "C" signifies the Cournot structure (i.e., simultaneous contracting). Hence, we can calculate the equilibrium outcomes for the different combinations of tariffs, summarized in Table 1.

It shows that the efficient exporter produces less and the inefficient exporter more under the discriminatory tariff than under the uniform tariff rule, and social surplus and consumer surplus are smaller under the former (note that Lemma 1 is similar to the previous studies under Bertrand competition. See section 5).

Lemma 1. *Suppose that the importing country simultaneously imposes the tariffs on goods exported by both exporters.*
  (i) $t_j^{DC} > t^{UC} > t_i^{DC}$ *and* $TR^{DC} > TR^{UC}$.
  (ii) $q_i^{UC} + q_j^{UC} > q_i^{DC} + q_j^{DC}$ *and* $q_j^{DC} > q_j^{UC} > q_i^{DC} > q_i^{UC}$.
  (iii) $CS^{UC} > CS^{DC}, GW^{UC} > GW^{DC}$ *and* $SW_H^{UC} < SW_H^{DC}$.

Proof: As usual, we can omit since equations in Lemma 1 are obvious.

Lemma 1(i) implies that the importing country imposes lower tariff rates on the inefficient exporter and higher tariff rates on the efficient exporter. It is well known that in an oligopolistic market, the importing country has an incentive to discriminate by setting higher tariff rates on the efficient exporters to benefit from higher tax revenues from a wider tax base. Our model suggests that this conventional wisdom holds true under Cournot and Bertrand competition.

Considering that the tariff level in the uniform tariff regime is determined between the two discriminatory rates, this result implies that the efficient exporter is handicapped while the inefficient exporter is subsidized in a discriminatory tariff regime. Consequently, import tariff discrimination diverts production from a cost-efficient country to a relatively cost-inefficient country. Roughly speaking, it has a negative trade-diverting effect. However, aggregate output is smaller

with discriminatory tariff rates because production diversion is not complete, and hence consumer surplus is lower with discriminatory tariffs compared to uniform tariffs; i.e., $CS^{UC} > CS^{DC}$. Thus, Lemma 1 supports the argument that uniform tariff is superior to discriminatory tariff in terms of global welfare, while importing country has more discretionary power with respect to policy options in the discriminatory regime compared to a uniform tariff, resulting in $SW_H^{UC} < SW_H^{DC}$.

3.2. SEQUENTIAL TARIFFS

In this subsection, if foreign exporters reject the simultaneous tariff for some coordination problem, to examine sequential tariff, we assume that the importing country can make the following sequential take-it-or-leave-it offers. By starting with a single foreign exporter, the importing country is forcing that foreign exporter to become a "Stackelberg" competitor (i.e., sequential-move game in production market) vis-a-vis its exporter rival.

We simply assume that the importing country imposes tariffs first on the efficient exporter j under either uniform or discriminatory tariff. Given this, the efficient exporter decides to produce first as like Stackelberg leader. This will show later that the import country does so. After the importing country imposes on the efficient exporter j at stage one, which is then announced by either party, it then imposes tariffs on the inefficient exporter i at stage two. Similar to the efficient exporter, the inefficient exporter i begins to produce output given each tariff system[11].

To be specific, the timing of game is as follows. At stage 1, the importing country imposes tariffs on the efficient exporter j under Cournot competition. At stage 2, the efficient exporter sets the quantity of its product. At stage 3, the importing country imposes on the inefficient exporter under discriminatory tariff, $t_i \neq t_j$ at stage 3. Under sequential-move game with uniform tariff, we omit this stage 3 since $t_i = t_j = t$. At stage 4, the inefficient exporter sets the quantity of its product i under Cournot competition[12].

[Sequential Uniform Tariff]: When discriminatory tariff is not implemented, the importing county imposes $t_i = t_j = t$ on both exporters. Consider stage 4 first.

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[11]It is worth relating our paper to the work of Kim and Sim (2015) who employed the same structure of timing in IO of vertically related market.

[12]In fact, the tariff rate changes very often in the economy due to a variety of factors, supporting the above-mentioned game order as a reasonable assumption. For example, these tariffs are subject to change due to its characteristics during the US-China trade war in the Trump administration.

Given (q_j, t), the follower chooses q_i : $q_i(q_j, t) = \arg\max_{q_i} \pi_i = (p_i - c - t)q_i$. Solving the first order condition, we obtain the equilibrium quantity as follows: $q_i = \frac{1-c-bq_j-t}{2}$. In stage 2, the leader, taking t as given, chooses q_j since we assume Stackelberg move game in the product market. That is, the efficient firm maximizes the output given the inefficient output and uniform tariff level, $q_j = \frac{(2-b)(1-t)+bc}{2(2-b^2)}$. At first stage, the importing country wants to set $\arg\max_t SW_H = CS + tq_i$. In stage 1, the importing country chooses t to maximize its social welfare, $\arg\max_t SW_H = CS + \sum_{i=1}^{2} tq_i$. Solving the first order conditions, we obtain the uniform tariff as follows:

$$t^{US} = \frac{2(8 - 8b - 2b^2 + 3b^3)(2-c) - b^4(1-c)}{\Psi_{US}},$$

where $\Psi_{US} \equiv 96 - 64b - 48b^2 + 28b^3 + 3b^4$. Then, using t^{US} and $\Delta_{A1} = 8 - 4b - b^2$, we can calculate the equilibrium outcomes for the different combinations of tariffs, summarized in Table 2.

For the comparison of the case of inefficient leader, repeating same process yields the equilibrium outcomes under uniform pricing as follows (note that "$\sim$" represents the inefficient exporter acts as a leader):

$$\tilde{t}^{US} = \frac{32 - 32b - 8b^2 + 12b^3 - b^4 - 2c(8 - 8b - 2b^2 + 3b^3)}{\Psi_{US}},$$

$$\tilde{q}_i^{US} = \frac{2[(2-b)\Delta_{A1} - c(20 - 10b - 3b^2)]}{\Psi_{US}},$$

$$\tilde{q}_j^{US} = \frac{(4 - 2b - b^2)\Delta_{A1} + 4c(2 + 3b - 3b^2)}{\Psi_{US}},$$

$$\tilde{SW}_H^{US} = \frac{\Delta_{A1}^2 - 4c(4-b)(4-3b) + 4c^2(7-6b)}{2\Psi_{US}}.$$

[Sequential Discriminatory Tariff]: Consider stage 4 first. Given (q_j, t_j), the follower chooses q_i taking q_j, t_j but also t_i as given: $q_i(q_j, t_j) = \arg\max_{q_i} \pi_i = (p_i - c - t_i)q_i$. Solving the first order condition, we obtain the equilibrium quantity as follows: $q_i = \frac{1-c-bq_j-t_i}{2}$. Then, in stage 3, the importing country wants to set $\arg\max_{t_i} SW_H = CS + t_iq_i$. In stage 2, the leader, taking t_j as given, chooses q_j. In stage 1, the home government chooses t_j to maximize its profit, $\arg\max_{t_j} SW_H = CS + t_iq_i + t_jq_j$. Solving the first order conditions, we obtain the equilibrium discriminatory tariff as follows:

$$t_i^{DS} = \frac{9 - 3b - 2b^2 - (9 - 2b^2)c}{9(3 - b^2)}, \quad t_j^{DS} = \frac{3 - b(1-c)}{9}.$$

$$q_i^{US} = \frac{(4 - 2b - b^2)\Delta_{A1} - c(2 - b)(20 - 8b^2 - b^3)}{\Psi_{US}},$$

$$q_j^{US} = \frac{2(2 - b)\Delta_{A1} + 2c(4 + 6b - 5b^2 - b^3)}{\Psi_{US}},$$

$$\pi_i^{US} = (q_i^{US})^2, \pi_j^{US} = \frac{2 - b^2}{2}(q_j^{US})^2,$$

$$CS^{US} = \frac{\Delta_{A1}^2(32 - 32b^2 + 4b^3 + 5b^4) - 2c\Delta_C\Xi_0 + \Xi_1 c^2}{2\Psi_{US}^2},$$

$$SW_H^{US} = \frac{\Delta_{A1}^2 - 2c(32 - 32b - 6b^2 + 8b^3 + b^4) + (28 - 24b - 12b^2 + 8b^3 + b^4)c^2}{2\Psi_{US}},$$

$$GW^{US} = SW_H^{US} + \pi_i^{US} + \pi_j^{US};$$

$$q_i^{DS} = t_i^{DS}, \quad q_j^{DS} = \frac{3 - b(1 - c)}{3(3 - b^2)},$$

$$\pi_i^{DS} = (q_i^{DS})^2, \ \pi_j^{DS} = (q_j^{DS})^2,$$

$$CS^{DS} = \frac{2[(81 + 27b - 63b^2 - 3b^3 + 8b^4) - c\Xi_2] + (81 - 81b^2 + 16b^4)c^2}{162(3 - b^2)^2},$$

$$SW_H^{DS} = \frac{2(9 - 3b - b^2) - 2(9 - 3b - 2b^2)c + (9 - 2b^2)c^2}{18(3 - b^2)},$$

$$GW^{DS} = SW_H^{DS} + \pi_i^{DS} + \pi_j^{DS}.$$

Table 2: EQUILIBRIUM OUTCOMES UNDER SEQUENTIAL TARIFF POLICIES.
When tariffs are imposed sequentially, it presents the equilibrium value for a uniform
tariff and a discriminatory tariff. $\Xi_0 = (128 - 64b - 192b^2 + 112b^3 + 60b^4 - 30b^5 - 5b^6)$,
$\Xi_1 = (1664 - 2048b - 1536b^2 + 2384b^3 + 196b^4 - 752b^5 + 40b^6 + 56b^7 + 5b^8)$, $\Xi_2 = (81 + 27b - 81b^2 - 3b^3 + 16b^4)$

Then, using t_i^{DS} and t_j^{DS}, we can calculate the equilibrium outcomes for the different combinations of tariffs, summarized in Table 2.

For the comparison of the case of inefficient leader, repeating same process yields the equilibrium outcomes under discriminatory tariff as follows.

$$\tilde{t}_i^{DS} = \tilde{q}_i^{DS} = \frac{3(1 - c) - b}{9},$$

$$\tilde{t}_j^{DS} = \tilde{q}_j^{DS} = \frac{9 - 3b - 2b^2 + 3bc}{9(3 - b^2)},$$

$$\tilde{SW}_H^{DS} = \frac{2(9-3b-b^2)-6(3-b)c+9c^2}{18(3-b^2)}.$$

Next, before comparing social and global welfare, we compare each equilibrium tariff level as follows.

Lemma 2. *Under Assumption 1 and* $a^* > \overline{c} \equiv \frac{b^2(72-88b-6b^2+43b^3-15b^4)}{432-144b-372b^2+74b^3+114b^4-2b^5-15b^6}$ $> \underline{c} \equiv \frac{(1-b)b^2}{9+3b-2b^2-b^3}$, *suppose that the importing country sequentially imposes tariffs on goods exported by the exporters.*
  (i) If and only if $c \in (\overline{c}, a^*)$, *then* $t_j^{DS} > t^{US} > t_i^{DS}$.
  (ii) If and only if $c \in (\overline{c}, \underline{c})$, *then* $t_j^{DS} > t_i^{DS} > t^{US}$.
  (iii) If and only if $c \in (0, \underline{c})$, *then* $t_i^{DS} > t_j^{DS} > t^{US}$.

Proof: See Appendix 1.

3.3. COMPARISONS IN SEQUENTIAL TARIFFS

In the previous subsections, we analyzed each subgame between price discriminatory and uniform tariffs.

Comparing equilibrium outcomes yields Proposition 1 (recall that the superscript 'XY' where $X = U, D$ and $Y = C, S$ implies that the first superscript classifies the tariff (i.e., $U(D)$ is uniform (discriminatory) tariff) and second superscript classifies the order of game between simultaneous- and sequential-mover game (i.e., $C(S)$ is Cournot (Stackelberg) competition)) with tariffs.

Proposition 1. *Suppose that the importing country sequentially imposes tariffs on the exporters. Using* $a^* > c^a$, $a^* > c^\dagger$, *and* $a^* > c^*$, *where*

$$c^a \equiv \frac{b^2(2-3b)(18-10b-3b^2+b^3)}{216+36b-168b^2-38b^3+48b^4+2b^5-3b^6},$$

$$c^\dagger \equiv \frac{(3-b)b^2\tau_0+9b(3-b^2)\Delta_{A1}\sqrt{(9-b^2)\tau_1}}{\tau_2}, \text{ and}$$

$$c^* \equiv \frac{b^2(18+20b-42b^2+7b^3+3b^4)+6b\sqrt{(3-b^2)}\Psi_{US}}{\Theta_0}.$$

  (i) The importing country chooses the efficient exporter as the leader under Cournot competition regardless of tariff regime.
  (ii) Regardless of c, *we have* $q_i^{US}+q_j^{US} > q_i^{DS}+q_j^{DS}$. *On the other hand, if* $c > c^a$, *then* $q_j^{US} > q_j^{DS} > q_i^{DS} > q_i^{US}$; *if* $c < c^a$, *then* $q_j^{US} > q_j^{DS} > q_i^{US} > q_i^{DS}$.
  (iii) If $c < c^\dagger$, *then* $TR^{DS} < TR^{US}$ *and vice versa if* $c > c^\dagger$.

(iv) Regardless of c, we have $CS^{DS} < CS^{US}$. On the other hand, if $c < c^*$, then $SW_H^{DS} < SW_H^{US}$, and vice versa if $c > c^*$.

Proof: See Appendix 1 and see also Figure 1.

Proposition 1(i) suggests that under Cournot setting, the importing country prefers to impose tariff first with the efficient exporter since there is a first-mover advantage, which implies that the efficient exporter who acts as a leader produces more under both uniform and discriminatory tariff regimes ($q_i^{US} < q_j^{US}$ and $q_i^{DS} < q_j^{DS}$)[13].

Consider the uniform tariff case. Noting that "~" represents the inefficient exporter acts as a leader, we can check $q_i^{US} + q_j^{US} > \tilde{q}_i^{US} + \tilde{q}_j^{US}$. This implies that the increased production by the efficient leader strictly dominates the reduced production of the inefficient follower when the efficient exporter acts as the leader. As a result, the tariff rate is higher when the efficient acts as a leader than when the inefficient acts as a leader, $t^{US} > \tilde{t}^{US}$.

Furthermore, consider the discriminatory tariff in Proposition 1(i). We also check $q_i^{DS} + q_j^{DS} > \tilde{q}_i^{DS} + \tilde{q}_j^{DS} \Leftrightarrow \frac{2b^2c}{9(3-b^2)} > 0$. Note that we obtain $t_i^{DS} < \tilde{t}_i^{DS}$ and $t_j^{DS} < \tilde{t}_j^{DS}$ with $q_i^{DS} < \tilde{q}_i^{DS}$ and $q_j^{DS} > \tilde{q}_j^{DS}$. Since demand q_j^{DS} is more elastic to discriminatory tariff t_j^{DS} (i.e., $t_j^{DS} < \tilde{t}_j^{DS}$ and $q_j^{DS} > \tilde{q}_j^{DS}$), this results in the efficient leader's increased production dominating the inefficient follower's reduced production. Under Cournot competition, this explains why the import country prefers to impose tariffs on the efficient exporter first, rather than the inefficient exporter.

Next, when comparing social welfare in the sequential tariff game, the intuition behind Proposition (iv) is as follows. Suppose that c is sufficient small and discriminatory tariff is implemented. Compared to the discriminatory tariff, the efficient leader faces strong residual demand before the inefficient follower chooses its quantity under uniform tariff. This increased production by the leader dominates the follower's reduced production, resulting in a higher total importing volume under the uniform tariff than under the discriminatory tariff. Moreover, when c is sufficient small, the tariff revenue under the uniform tariff is higher than under the discriminatory tariff(i.e., $TR^{US} > TR^{DS}$ and

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[13]Here, we provide some comparisons for the intuition: $q_i^{US} + q_j^{US} - (\tilde{q}_i^{US} + \tilde{q}_j^{US}) = \frac{b^2(12-8b-b^2)c}{\Psi_{US}} > 0$, $q_i^{DS} - \tilde{q}_i^{DS} = \frac{-2b^2(1-c)}{9(3-b^2)} < 0$, $q_j^{DS} - \tilde{q}_j^{DS} = \frac{2b^2}{9(3-b^2)} > 0$, $q_i^{US} - \tilde{q}_i^{US} = \frac{-2b^2(1-c)}{9(3-b^2)} < 0$, $q_j^{US} - \tilde{q}_j^{US} = \frac{2b^2}{9(3-b^2)} > 0$, $t^{US} - \tilde{t}^{US} = \frac{b^4c}{\Psi_{US}} > 0$, $t_i^{DS} - \tilde{t}_i^{DS} = \frac{b^2(1-b-c)}{9(3-b^2)} > 0$, $t_j^{DS} - \tilde{t}_j^{DS} = \frac{-b^2(1-b+bc)}{9(3-b^2)} < 0$.

see Figure 1 (b)). This is because the leader, under discriminatory tariff and expecting discounts, produces less due to $t_j^{DS} > t^{US}$ from Lemma 1, while the follower produces more due to $t_i^{DS} > t^{US}$ from Lemma 1 if c is small. As a result, both the effects of import volume and tariff revenue are greater under the uniform tariff. The importing country offers the efficient leader large discounts to encourage production. Meanwhile, the follower, anticipating these discounts, produces less under the uniform tariff than under the discriminatory tariff. Thus, $SW_H^{DS} < SW_H^{US}$ if c is sufficient small (see Figure 1), while this effect leads to $CS^{DS} < CS^{US}$ with lower sequential uniform tariff due to $q_i^{US} + q_j^{US} > q_i^{DS} + q_j^{DS}$ regardless of the degree of c.

All intuitions are reversed in the sequential tariff if c is sufficiently large when comparing SW_H^{DS} and SW_H^{US}. If discriminatory tariff is implemented, the importing country offers the follower large discounts to encourage production, i,e., $q_i^{DS} > q_i^{US}$ from Proposition 1(ii). The leader, expecting the discounts, produces less and the follower produces more than under the uniform pricing rule. From $TR^{US} < TR^{DS}$ when c is sufficiently large, this increased tariff revenue by the follower dominates the leader's reduced production so that social surplus of importing country increases under discriminatory tariff regime.

The fact that the preferences of the countries are not aligned raises an interesting question: which regime maximizes the aggregate level of welfare This question is answered by the next proposition which defines global welfare as the sum of the welfare levels of the importing country and two exporting countries.

Proposition 2. *Suppose that the importing country sequentially imposes tariffs on the exporters. Then, $GW^{DS} < GW^{US}$.*

Proof: See Appendix 1.

Proposition 2 suggests that regardless of the degree of cost difference, global welfare is higher under the uniform tariff than discriminatory tariff. From Lemma 2 (iii), we know that $t_i^{DS} > t_j^{DS} > t^{US}$ for very small values of the cost differential, which leads to the efficient (inefficient) exporter are only better off under the discriminatory (uniform) tariff regime for very small values of the cost differential. Otherwise, regardless of what tariffs are imposed, the efficient exporter is handicapped while the inefficient exporter is subsidized (i.e., from Lemma 2 (i) and (ii), we know $t_j^{DS} > t^{US} > t_i^{DS}$ and $t_j^{DS} > t_i^{DS} > t^{US}$) unless the cost differential is small. Since the total importing output is larger under uniform tariff than under discriminatory tariff, uniform tariff could increase the inefficient exporter's output and enhance global welfare. Thus, the effect of profits of all exporters
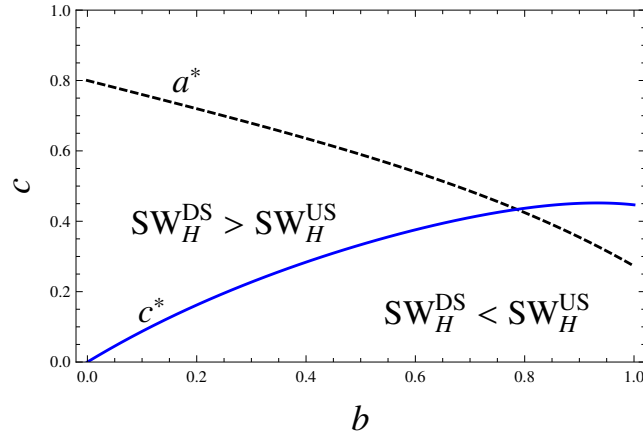
(a) Comparison of Social Welfare
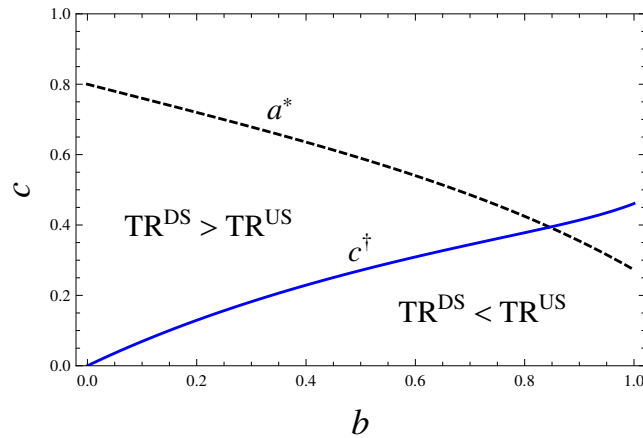
(b) Comparison of Tariff Revenue

Figure 1: COMPARISONS IN SEQUENTIAL CONTRACTING UNDER COURNOT COMPETITION. a^* represents Assumption 1, and c^* in (a) represents the result of comparing the magnitudes of the uniform tariff and the discriminatory tariff. $c^\dagger$ shows the result of comparing the tariff revenue from the uniform tariff and the discriminatory tariff.

under uniform tariff dominates that of under discriminatory tariff. Even though the degree of inefficient exporter's cost affects global welfare, there exists the fact where an increase in total output is a necessary condition for global welfare improvement when uniform tariff is implemented.

4. SIMULTANEOUS VS. SEQUENTIAL TARIFF

We now compare the market outcomes under both tariff regimes whether the importing country has an incentive to choose sequential tariffs. Before describing Proposition 3 to compare simultaneous with sequential tariff regime, we compare equilibrium outcomes as follows.

Lemma 3. *Given that the home government chooses the efficient exporter as the leader, we obtain*
  (i) $t^{UC} > t^{US}$, $t_i^{DC} > t_i^{DS}$ *and* $t_j^{DC} > t_j^{DS}$.
  (ii) $q_i^{DC} > q_i^{DS}$, $q_j^{DC} < q_j^{DS}$ *and* $p_i^{DC} > p_i^{DS}$, $p_j^{DC} > p_j^{DS}$.

Proof: We can omit since equations in Lemma 3 are obvious.

Based on Lemma 3, we summarize these findings in Proposition 3.

Proposition 3. *Given that the home government chooses the efficient exporter as the leader, we obtain*
  (i) $SW_H^{US} > SW_H^{UC}$, $CS^{US} > CS^{UC}$, $GW^{US} > GW^{UC}$.
  (ii) $SW_H^{DS} > SW_H^{DC}$, $CS^{DS} > CS^{DC}$, $GW^{DS} > GW^{DC}$.
  (iii) $q_i^{UC} + q_j^{UC} < q_i^{US} + q_j^{US}$.
  (iv) $q_i^{DC} + q_j^{DC} < q_i^{DS} + q_j^{DS}$ *if* $c > c^{\ddagger} \equiv \frac{2(3-b)b^3}{(3+2b)(27-9b-3b^2-b^3)}$ *and vice versa if*
    $c < c^{\ddagger}$.

Proof: See Appendix 1.

Proposition 3 (i) and 3 (ii) show that the importing country prefers sequential to simultaneous tariff, which implies that sequential tariff is more likely implemented under Cournot competition whether discriminatory tariff implemented or not.

The intuition behind Proposition 3 (i) is as follows. Consider the uniform tariff. Then, the efficient exporter always faces strong residual demand under uniform tariff with sequential contracting (i.e., $q_j^{US} > q_j^{UC}$), while the inefficient exporter faces strong residual demand if c is large (i.e., $q_i^{US} > q_i^{UC}$) and vice versa. However, imposing uniform tariff is more inelastic to final output under the simultaneous contracting than under sequential contracting (i.e., $t^{UC} > t^{US}$). The both effects of $t^{UC} > t^{US}$ and $q_i^{US} > q_i^{UC}$ dominate $q_j^{US} > q_j^{UC}$ when c is large. This results in $q_i^{US} + q_j^{US} > q_i^{UC} + q_j^{UC}$. Hence, with higher sequential tariff revenue than under simultaneous tariff revenue, the importing country prefers to contract sequentially instead of simultaneously under uniform tariff.

The intuition behind Proposition 3 (ii) is as follows. Suppose discriminatory tariff regime. In this case, even though the tariff policies are publicly announced, when the importing country imposes tariff sequentially, a commitment problem exists (McAfee and Schwartz (1994)). That is, the efficient exporter faces more stronger residual demand under sequential tariff than under simultaneous tariff (i.e., $q_j^{DC} < q_j^{DS}$), while the inefficient exporter faces strong residual demand under simultaneous tariff than under sequential tariff (i.e., $q_i^{DC} > q_i^{DS}$). However, an additional effect is in place. Compared to sequential tariff, simultaneous tariff hurts the importing country because it introduces a commitment problem, which leads to $t_i^{DC} > t_i^{DS}$ with $q_i^{DC} > q_i^{DS}$ and $t_j^{DC} > t_j^{DS}$ with $q_j^{DC} < q_j^{DS}$. Compared to sequential discriminatory tariff, the inefficient exporter produces more and the efficient exporter produces less with a higher price (i.e., $p_i^{DC} > p_i^{DS}$ and $p_j^{DC} > p_j^{DS}$ from Lemma 3) paying the higher simultaneous discriminatory tariff. This leads to higher consumers surplus and social welfare under sequential discriminatory tariff than under simultaneous discriminatory tariff. From the importing country's perspective, it prefers to impose sequentially instead of simultaneously, even though it holds $q_i^{DS} + q_j^{DS} < q_i^{DC} + q_j^{DC}$ when c is sufficiently small. Furthermore, even if c is sufficiently small, the effect of $q_i^{DC} > q_i^{DS}$ forces to increase $p_i^{DC} > p_i^{DS}$ under simultaneous tariff and the effect of $CS^{DS} > CS^{DC}$ dominates $q_i^{DS} + q_j^{DS} < q_i^{DC} + q_j^{DC}$ if c is sufficiently small so that we have $SW^{DS} > SW^{DC}$.

Here, we need to note the comparison of equilibrium outcomes between simultaneous tariff under discriminatory tariff (i.e., Lemma 1) and sequential tariff under uniform tariff (i.e., Proposition 3 (i) and (ii)). The situation of discriminatory tariff under simultaneous tariff does not implement under Cournot competition as long as the import country moves first. If so, Proposition 3 makes us return to the case of sequential contracting (i.e., Propositions 1 and 2). That is, we can understand that $SW^{US} > SW^{DS}(SW^{NS} < SW^{DS})$ if c is sufficient small (large); regardless of c, $GW^{US} > GW^{DS}$ and $CS^{US} > CS^{DS}$. Hence, if c is small, then the efficiency loss when discriminatory tariff is dominated the increased production by the efficient exporter so that consumer surplus, global welfare and social welfare of importing country increase under uniform tariff with Cournot competition.

Consequently, from Propositions 1, 2 and 3, whether discriminatory and uniform tariffs under either simultaneous or sequential tariff increase consumers' surplus and social welfare depend on the relative size of the efficiency loss, increased total output and the degree of cost efficiency.

In sum, from Lemma 1, Propositions 1, 2 and 3, we obtain the following

results:

Proposition 4. *Suppose Cournot competition. The sequential tariff policy under uniform tariffs raises consumers' surplus, social welfare and global welfare only when c is small.*

Hashimzade *et al.* (2011a) and Liao and Wong (2006) demonstrated that, for any degree of product differentiation with subsidy of export taxes, the importing country always prefers a simultaneous uniform tariff regime, while our results are changed by offering sequential timing between uniform and discriminatory tariffs in the banning of subsidy depending on the cost differences.

Table 3 summarizes the relationship among the degree of cost asymmetry between exporters, consumer surplus and welfare ranking in the uniform and discriminatory tariffs.

	Consumer Surplus	Social Welfare
Simultaneous tariffs	$CS^{UC} > CS^{DC}$	$SW^{UC} < SW^{DC}$
Sequential tariffs	$CS^{US} > CS^{DS}$	$SW^{US} > SW^{DS}$ if $c < c^*$
Simultaneous vs.	$CS^{US} > CS^{UC}$	$SW^{US} > SW^{UC}$
Sequential tariffs	$CS^{DS} > CS^{DC}$	$SW^{DS} > SW^{DC}$

Table 3: RANKING OF CONSUMER SURPLUS AND WELFARE UNDER COURNOT COMPETITION. The first and second rows compare the magnitudes of consumer surplus and social welfare under simultaneous and sequential tariffs. The third row presents the results of comparing consumer surplus and social welfare when tariffs are imposed simultaneously and sequentially.

5. BERTRAND COMPETITION

The analysis has revealed a fundamental sense in which sequential tariff will arise over trade agreements under Cournot competition. We now test this result for robustness by considering Bertrand competition. The outcome is that the form of competition does affect the qualitative properties of the conclusions, so what we have analyzed above for Cournot competition may not hold for Bertrand competition.

Equilibrium outcomes under Bertrand competition between the exporters are not qualitatively identical to the those under Cournot competition. All intuitions are reversed under Bertrand competition so that we provide only a brief summary

of the conclusions (note that under Bertrand competition, the superscript 'XZ' where $X = U, D$ and $Z = B, S$ implies that the first superscript classifies the tariff (i.e., $U(D)$ is uniform (discriminatory) tariff) and second superscript classifies the order game between simultaneous- and sequential-mover game (i.e., $B(S)$ is Bertrand (Stackelberg) competition)). Under Bertrand competition, we assume the following sufficient condition, which requires that the costs be sufficiently low. If the cost exceeds $\hat{a}^*$, the equilibrium output values become negative.

Assumption 1. $c < \hat{a}^* \equiv \frac{(1-b)(2+b)\Delta_{A2}}{20+10b-19b^2-8b^3+4b^4+b^5}$, where $\Delta_{A2} = 8 + 4b - 3b^2 - b^3$.

As the same process is repeated under Bertrand competition (we use '$\wedge$' to denote the Bertrand competition), we have following Lemma 4, Propositions 5 and 6.

Lemma 4. $\hat{CS}^{UB} > \hat{CS}^{DB}$, $\hat{GW}^{UB} > \hat{GW}^{DB}$ and $\hat{SW}_H^{UB} < \hat{SW}_H^{DB}$.

Proof: See Appendix 1.

Proposition 5. *Suppose that the importing country sequentially imposes tariff on the exporters.*
  (i) *The importing country chooses the inefficient exporter as the leader under Bertrand competition.*
  (ii) $\hat{SW}_H^{DS} < \hat{SW}_H^{US}$ *if* $c < \hat{c}^*$, *and vice versa if* $c > \hat{c}^*$; $\hat{CS}^{DS} < \hat{CS}^{US}$, $\hat{GW}^{DS} < \hat{GW}^{US}$.

Proof: See Appendix 1.

Proposition 6. *Given that the importing country chooses the inefficient exporter as the leader, we obtain that* $\hat{SW}_H^{US} < \hat{SW}_H^{UB}$, $\hat{CS}^{US} < \hat{CS}^{UB}$; $\hat{SW}_H^{DS} < \hat{SW}_H^{DB}$, $\hat{CS}^{DS} < \hat{CS}^{DB}$.

Proof: See Appendix 1.

Under Bertrand competition, the situation of sequential discriminatory tariff does not implement as long as the supplier moves first due to Proposition 6. If so, Proposition 6 makes us return to the case of the simultaneous tariff (i.e., Lemma 4), which shows that $\hat{CS}^{UB} > \hat{CS}^{DB}$ and $\hat{SW}_H^{UB} < \hat{SW}_H^{DB}$. Consequently, in contrast to Cournot competition, we find that (i) under the sequential tariff regime, the importing country prefers to impose on an inefficient exporter first and on an efficient exporter later. Under Bertand competition between the exporters,

there is a second-mover advantage, which implies that the efficient exporter who acts as a follower produces more under both the uniform and discriminatory tariff regimes; (ii) when comparing social welfare under the simultaneous and sequential tariffs with uniform and discriminatory tariffs, welfare is smaller in the sequential than in the simultaneous tariff. Thus, the importing country always prefers the simultaneous tariff over the sequential tariff under Bertrand competition as long as the importing country moves first. Consequently, the importing country prefers simultaneous discriminatory tariff to simultaneous uniform tariff under Bertrand competition.

In sum, from Lemma 4, Propositions 5 and 6, we obtain the following results:

Proposition 7. *Suppose Bertrand competition. The simultaneous discriminatory tariff is implemented. However, banning discriminatory tariff raises both consumers' surplus and global welfare.*

6. COMPARISON UNDER BERTRAND AND COURNOT COMPETITION

Until now, we analyzed welfare implication of the sequential tariff game between discriminatory and uniform tariff rates under Bertrand and Cournot competition, separately. Given the equilibrium tariffs with each competition, we will compare consumer surplus, social welfare and global welfare in equilibrium between both competitions.

Comparing equilibrium of Cournot case to Bertrand case yields the following results.

Proposition 8. *Consumer surplus, social and global welfare are always greater under Bertrand competition with the simultaneous discriminatory tariff than under Cournot competition with either the sequential discriminatory or sequential uniform tariff.*

Proof: See Appendix 1.

Proposition 8 suggests that even though most of the existing literature support the argument that uniform tariff is superior to discriminatory tariff in terms of global welfare, Bertrand competition is superior to Cournot competition in out setting. The main intuition is as follows. From the fact that

$$q_i^{US} + q_j^{US} - (\hat{q}_i^{DB} + \hat{q}_j^{DB})$$
$$= \frac{-b^2[96 - 96b - 5b^2 + 15b^3 + 2b^4 - c(66 - 54b - 20b^2 + 15b^3 + 2b^4)]}{(1+b)(3-2b)\Psi_{US}} < 0,$$

$$q_i^{DS} + q_j^{DS} - (\hat{q}_i^{DB} + \hat{q}_j^{DB})$$
$$= \frac{-2b^2[(3-b)(54+3b-17b^2-2b^3) - c(81-27b-30b^2+8b^3+2b^4)]}{9(9-b^2)(1+b)(3-2b)(3-b^2)} < 0,$$

there exists a necessary condition for welfare improvement through three effects of increased total output, the relative size of the efficiency loss and the degree of cost efficiency as mentioned earlier.

7. CONCLUSION

This paper examines the welfare implication of the sequential tariff game between discriminatory and uniform tariff rates in which the importing country imposes tariff on asymmetric foreign exporters. We compared the uniform and discriminatory tariff regimes in terms of the welfare of the countries given the simultaneous and sequential tariff for importing country.

Under Cournot competition, we demonstrate that the importing country has an incentive to manipulate the tariff structure through sequential tariff, and imposing the uniform tariff improves social welfare, consumer surplus and global welfare when cost difference is small. In contrast to Cournot competition, the importing country always prefers simultaneous over sequential tariff under Bertrand competition. Hence, the importing country prefers simultaneous discriminatory tariff to uniform tariff under Bertrand competition even though simultaneous uniform tariff improves consumer surplus and global welfare. Finally, simultaneous discriminatory tariff under Bertrand competition is always superior to either sequential uniform or discriminatory tariff under Cournot competition.

As in model, we have assumed export-rivalry model where two exporting firms with one importing country. Thus, there is no firm in importing country, which needs to analyze with import-competing model. With each tariff regime, we also need to analyze that the exporters should forwardly see the movement trend of tariff regime switching to an ad valorem tariff form specific tariff policy. In a dynamic setting, unlike the static model used in this paper, imposing higher tariffs on the efficient firm under the uniform tariff policy and on the inefficient firm under the discriminatory tariff policy could indeed alter competitive dynamics. Since we only analyzed the static model, our results can be generalized to other settings. Further research that considers a dynamic framework would be needed to asses how robust these findings are across different market structures and competitive environments. Finally, our results provide a caution in the policy debate on the merits of the uniform tariff, however, as Choi (1995) pointed

out, the adverse long-run effect needs to analyze for more extensive model. The extension of our model in this regard remains a direction for future research.

The supplementary file is downloadable from the following link:

Link

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