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Abstract

This paper considers an international bilateral trade model with corporate social responsibility (CSR) and examines the strategic interaction between tariffs and privatization policy. We demonstrate that strategic tariff in a private market is higher than that in a mixed market, while efficient tariff in a private market is lower than that in a mixed market. We then show that privatization policy raises strategic tariff and worsens (improves) domestic welfare when the degree of CSR is low (high). Further, we investigate endogenous choice of privatization policy and demonstrate that both the countries choose nationalization policy even though privatization policy is globally optimal when the degree of CSR is high. This indicates the existence of a prisoner's dilemma in choosing privatization policy in a bilateral trade model with higher CSR.

Keywords: Bilateral trade, Corporate social responsibility, Privatization, Tariff Policy
JEL Classifications: D43, F12, F31, L13, L33

1. Introduction

In the last few decades, many developed and developing countries have continued to reform and privatize their state-owned public firms under the global trend of trade liberalization, but the public firms are still significant players and control large portions of the world's resources.[1] In particular, they are strongly concentrated in a few strategic sectors such as finance, steel, manufacture, transportation, telecommunications, power generation, electricity, and other energy industries. Further, in these industries, the public firms compete with domestic and foreign private firms in mixed markets.

Many researchers in the field of industrial organization, international trade, and development economics have studied the privatization of public firms and explored how foreign competition affects the desire to privatize in mixed markets. Several studies have also analyzed import tariff and privatization policy in an international mixed market. For example, in a seminal research on the interaction between privatization and strategic trade policies, Pal and White (1998) found that privatization could increase welfare if import tariff is used. Pal and White (2003) also demonstrated

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[1] According to Barca and Becht (2001), OECD (2004), and Kowalski *et al.* (2013), among the largest state-owned public firms in the OECD countries, over 10% public firms have significant government ownership and their sales are equivalent to approximately 6% of the world GDP.

that the existence of public firms lowers optimal tariffs and the total volume of trade between two countries, which does not indicate lower levels of welfare for the trading countries. Chang (2005) argued that the decision to privatize depends crucially on the strategic substitutability-complementarity while Chang (2007), Yu and Lee (2011) and Han (2012) reported that privatization strategy is affected strongly by trade instruments and cost differences between firms. Chao and Yu (2006) also found that foreign competition lowers the optimal tariff rate, but privatization policy raises it. Wang *et al.* (2014) examined privatization policy and foreign entry, and demonstrated that domestic entry might be socially excessive whether it is free trade or the domestic government imposing a tariff policy.

Some studies have also explored the relationship between privatization and trade policies in an international trade framework in which public firms compete with domestic and foreign firms either in the third country or in both home and foreign countries. Barcena-Ruiz and Garzon (2005) considered an international integrated mixed market with two countries and demonstrated that only one government privatizes its public firms and that government indicates lower social welfare at equilibrium. Dadpay and Heywood (2006) found that two competing, domestic and foreign (public) firms play the role of trade barriers and the strategic interaction of the two governments usually reduces welfare. On the other hand, considering a bilateral trade framework in which both public and private firms compete in both home and foreign countries, Han and Ogawa (2008), Lee *et al.* (2013), Xu and Lee (2015) and Xu *et al.* (2016) examined the interaction of two countries in terms of strategic choices of privatization policy and import tariff. They demonstrated that the privatization policy depends not only on the relative efficiency of the public firm, but also on the choice of trade policy.

However, traditional economic theories commonly view profit maximization as the sole objective of a private firm. Porter and Kramer (2006) present a systematic analysis linking comparative advantage to CSR, which has now become a mainstream global business strategy.[2] Furthermore, while a large number of firms in the world issue various CSR statements/activities, many of them belong to industries characterized as mixed oligopolies in which CSR firms compete with public firms.

Recent works on oligopoly markets have analyzed different forms of market competition wherein profit-maximizing private firms compete with other private firms that adopt CSR activities.[3] For example, Wang *et al.* (2012) considered an international market under imperfect competition and explored the strategic tariff policy and welfare consequences of foreign firms adopting CSR. Chang *et al.* (2014) extended their work to examine the welfare implications of CSR and demonstrated the

[2] According to KPMG (2008, 2013), nearly 80% of the 250 largest companies worldwide issued CSR reports in 2008 and more than 30% (71% and 90%) of companies in the US (the UK and Japan, respectively) adopted CSR in 2013.

[3] As regards the recent research on CSR under oligopolistic competition, see Kopel and Brand (2012), Nakamura (2014), Matsumura and Ogawa (2014), Kopel (2015), Lambertini and Tampieri (2015), Manasakis *et al.* (2017), and Kim *et al.* (2017) among others.

feasibility of moving toward tariff reduction when both domestic and foreign firms adopt CSR initiatives.

In this paper, we consider an international bilateral trade model in which a domestic public firm competes with both domestic and foreign private firms with CSR initiatives. We focus on the intra-industry trade and examine the strategic interaction of two countries' optimal choices of tariffs and privatization policies. Our analysis has three different scenarios.

In the first scenario, we analyze a private market under a privatization policy in both the countries and demonstrate that tariff policy has an entry-reducing effect and thus, strategic tariff is positive and decreasing in the degree of CSR in a private market. We also demonstrate that strategic tariff is higher (lower) than efficient tariff when the degree of CSR is low (high).

In the second scenario, we analyze a mixed market under a nationalization policy in both the countries and demonstrate that the tariff policy is substitutable for the public firm, but strategic tariff is increasing first and then decreasing in the degree of CSR. We also demonstrate that strategic tariff is higher (lower) than the efficient tariff when the degree of CSR is low (high).

Furthermore, we compare these two different scenarios between a private market and a mixed market. We demonstrate that strategic tariff in a private market is higher than that in a mixed market, while efficient tariff in a private market is lower than that in a mixed market. Thus, privatization will raise strategic tariff and worsen (improve) domestic welfare when the degree of CSR is low (high).

In the third scenario, we investigate an asymmetric choice of privatization policy by the two countries and demonstrate that strategic tariff in a country with a mixed market is lower than that in a country with a private market. We also demonstrate that strategic tariff is higher (low) than efficient tariff when the degree of CSR is low (high) in both the markets.

Finally, we integrate these three cases in a super game and analyze it with an endogenous choice of privatization policy between the two countries. We demonstrate that both countries endogenously choose nationalization policy even though privatization policy is globally optimal when the degree of CSR is high. This finding suggests that there is a prisoner's dilemma problem in the endogenous privatization choice game in the presence of higher CSR. Therefore, an appropriate regulatory framework in both countries is necessary for a higher degree of CSR in international bilateral trade.

This paper is organized as follows. Section 2 presents the basic bilateral trade model with CSR. In Section 3, we analyze market equilibrium in private and mixed markets. In Section 4, we compare tariffs and welfares. In Section 5, we examine an endogenous choice game of privatization policy. The final section concludes the paper.

2. The Model

Suppose that there are two countries, 1 and 2, with a state-owned public firm and a consumer-friendly private firm coexisting in each of them. We define a consumer-friendly private firm as a profit-oriented private firm with a concern for consumer surplus as a CSR.[4] Both firms produce homogeneous products in each country and may export them to the other country. We denote the state-owned public firm's output in home country i as $q^s{}_{\mathrm{hi}}$ and its exports as $q^s{}_{\mathrm{ei}}$. Similarly, $q^c{}_{\mathrm{hi}}$ and $q^c{}_{\mathrm{ei}}$ are the CSR-oriented firm's output and exports, respectively, in home country $i=1,2$.

The government in each country can impose a tariff on the imports that are produced by both the public and the CSR-oriented firms in the other country, where the import tariff is denoted by t_i for country i. The import tariff revenue is denoted by $R_i = t_i(q^s{}_{\mathrm{ej}} + q^c{}_{\mathrm{ej}})$ in country i.

Total market outputs in country i is denoted by $Q_i = q^s{}_{\mathrm{hi}} + q^s{}_{\mathrm{ej}} + q^c{}_{\mathrm{hi}} + q^c{}_{\mathrm{ej}}$. The inverse demand function is assumed to be symmetric and identical, given by: $p_i = 1 - Q_i$ where the market price in country i is denoted by p_i. Then, consumer surplus is denoted by $\mathrm{CS}_i = \frac{1}{2}{Q_i}^2$.

The cost functions of both the firms in each country is assumed to be identical and quadratic, given by $\mathrm{C}(q^x{}_{\mathrm{hi}} + q^x{}_{\mathrm{ei}}) = \frac{1}{2}(q^x{}_{\mathrm{hi}} + q^x{}_{\mathrm{ei}})^2$, where $x = s, c$. Then, the profit of the firm is as follows:

$$\pi^x{}_{\mathrm{i}} = p_i q^x{}_{\mathrm{hi}} + (p_j - t_j)q^x{}_{\mathrm{ei}} - \frac{1}{2}(q^x{}_{\mathrm{hi}} + q^x{}_{\mathrm{ei}})^2. \quad (1)$$

The domestic welfare is defined as the sum of consumer surplus, industry profits, and import tariff revenues:

$$W_i = \mathrm{CS}_i + \pi^s{}_{\mathrm{i}} + \pi^c{}_{\mathrm{i}} + R_i. \quad (2)$$

The state-owned public firm is assumed to maximize the domestic welfare, while the CSR-oriented firm considers both its own profit and consumer surplus of the two countries. In specific, we assume that the objective function of the CSR-oriented firms is as follows:

$$T^c{}_{\mathrm{i}} = \alpha_i(\mathrm{CS}_i + \mathrm{CS}_j) + \pi^c{}_{\mathrm{i}}, \quad (3)$$

where α_i represents the degree of CSR of the firm in country i, which is exogenously given as $\alpha_i \in [0,1]$. That is, CSR-initiative implies that the private firm adopts consumer surplus as a proxy for its own CSR concerns. Then, a CSR-related incentive combines both profitability and consumer surplus as a convex combination formula. Thus, when a private firm engaged in CSR or altruistic concern places

[4] The recent emergence of consumer-friendly private firms in international competition is discussed and analyzed by Chang *et al.* (2014) and Wang *et al.* (2012).

a weight on consumer surplus in its objective function, it is analogous to assuming that the firm places a higher weight on output. Here, $\alpha_i = 0$ indicates a pure profit-maximizing private firm.[5]

3. Market Equilibrium

3.1 Private Market

We consider a private market in both the countries where the public firm is fully privatized. Thus, there is a private firm and a CSR-oriented firm in each country. Assuming positive outputs, the first-order conditions of the two private and the two CSR-oriented firms in the two markets, in which the privatized firm maximizes (1) and the CSR firm maximizes (3), yields the following equilibrium outputs:[6]

$$q^s{}_{\text{hi}} = \frac{1}{3}\left(1 + t_j - \frac{4-t_i-t_j}{7-\alpha_i-\alpha_j} + \frac{3(t_i-t_j)}{5-\alpha_i-\alpha_j}\right),\ q^c{}_{\text{hi}} = \frac{1}{3}\left(1 + t_j - \frac{(4-t_i-t_j)(1-\alpha_i)}{7-\alpha_i-\alpha_j} + \frac{3(t_i-t_j)(1-\alpha_i)}{5-\alpha_i-\alpha_j}\right),$$

$$q^s{}_{\text{ei}} = \frac{1}{3}\left(1 - 2t_j - \frac{4-t_i-t_j}{7-\alpha_i-\alpha_j} - \frac{3(t_i-t_j)}{5-\alpha_i-\alpha_j}\right),\ q^c{}_{\text{ei}} = \frac{1}{3}\left(1 - 2t_j - \frac{(4-t_i-t_j)(1-\alpha_i)}{7-\alpha_i-\alpha_j} - \frac{3(t_i-t_j)(1-\alpha_i)}{5-\alpha_i-\alpha_j}\right).$$

Then, we have that $\frac{\partial q^x{}_{\text{hi}}}{\partial t_i} > 0$, but $\frac{\partial q^x{}_{\text{ei}}}{\partial t_i} < 0$, $\frac{\partial q^x{}_{\text{hi}}}{\partial t_j} < 0$, and $\frac{\partial q^x{}_{\text{ei}}}{\partial t_j} < 0$, where x = s, c. This implies that in a private market, imposing a higher tariff in the home country will increase its domestic output, but reduce the domestic output and exports of the foreign country. Thus, tariff policy has an entry-reducing effect, which causes an output substitution effect between the domestic and foreign products in both the private markets.

Thus, total market output and price are given by:

$$Q_i = \frac{4-t_i-t_j}{7-\alpha_i-\alpha_j} - \frac{t_i-t_j}{5-\alpha_i-\alpha_j} \text{ and } p_i = 1 - \frac{4-t_i-t_j}{7-\alpha_i-\alpha_j} + \frac{t_i-t_j}{5-\alpha_i-\alpha_j}.$$

Note that $\frac{\partial Q_i}{\partial t_i} < 0$ and $\frac{\partial Q_i}{\partial t_j} > 0$. Thus, due to the output substitution effect, imposing tariff will reduce total market output in the home country, while raising it in the foreign country.

3.2 Mixed Market

We consider a mixed market in both the countries where the private firm is fully nationalized. Thus, there is a state-owned public firm and a CSR-oriented firm in each country. Assuming positive output

[5] Many theoretical papers have examined the altruistic perspective of CSR. For example, Wang *et al.* (2012) and Chang *et al.* (2014) compared the binary choice of CSR between $\alpha_i = 0$ or $\alpha_i = 1$, while Nakamura (2014), Kopel (2015), Matsumura and Ogawa (2014, 2016), and Kim *et al.* (2017) analyzed the optimal choice of CSR, that is, $0 < \alpha_i < 1$.

[6] Note that the sufficient conditions for positive outputs and prices are $2t_j - (5 - \alpha_i - \alpha_j)(3 - \alpha_i - \alpha_j) < 2t_i(6 - \alpha_i - \alpha_j) < 4(6 - \alpha_i - \alpha_j) - 2(2 - t_j)$, which are satisfied at equilibrium.

except the public firm's exports, the first-order conditions of the two public and the two CSR-oriented firms in the two markets, in which the public firm maximizes (2) and the CSR-firm maximizes (3) yields the following equilibrium outputs:[7]

$$q^s{}_{\text{hi}} = \frac{2(2\alpha_i+\alpha_j)^2+6(10-7\alpha_i-4\alpha_j)-t_i(1-\alpha_i)(15-4\alpha_i-2\alpha_j)-t_j(15-2\alpha_i(1-\alpha_j)-(10-\alpha_j)\alpha_j)}{3(2\alpha_i^2+(3-\alpha_j)(15-2\alpha_j)-\alpha_i(21-5\alpha_j))},$$

$$q^c{}_{\text{hi}} = \frac{15+21\alpha_i-10\alpha_i^2-(15+\alpha_i)\alpha_j+2\alpha_j^2+2t_i(1-\alpha_i)(15-4\alpha_i-2\alpha_j)+2t_j(15-2\alpha_i-2(5-\alpha_i)\alpha_j+\alpha_j^2)}{3(2\alpha_i^2+(3-\alpha_j)(15-2\alpha_j)-\alpha_i(21-5\alpha_j))},$$

$$q^c{}_{\text{ei}} = \frac{15(1+\alpha_i)-9\alpha_j-t_i(1-\alpha_i)(15-\alpha_i-2\alpha_j)-(4\alpha_i-\alpha_j)(\alpha_i+2\alpha_j)+2t_j(\alpha_i(4-\alpha_j)-(6-\alpha_j)(5-2\alpha_j))}{3(2\alpha_i^2+(3-\alpha_j)(15-2\alpha_j)-\alpha_i(21-5\alpha_j))}.$$

Then, we have that $\frac{\partial q^s{}_{\text{ei}}}{\partial t_k} < 0$ and $\frac{\partial q^s{}_{\text{hi}}}{\partial t_k} < 0$, but $\frac{\partial q^c{}_{\text{hi}}}{\partial t_k} > 0$ where k = s, c. This implies that in a mixed market imposing a higher tariff will not only reduce export from the foreign country, but also the output of the public firm. This, in turn, will increase the output of the CSR-oriented firm. Thus, tariff policy in a mixed market has an entry-reducing effect and output substitution effect between the public firm and the CSR-oriented firm. This implies that tariff policy is substitutable with the output of the public firm, but the substitutability depends on the degree of CSR.

Total market outputs and price are:

$$Q_i = \frac{5(2-t_i)(3-\alpha_i)-2(4-t_i-t_j)\alpha_j}{2\alpha_i^2+(3-\alpha_j)(15-2\alpha_j)-\alpha_i(21-5\alpha_j)} \text{ and } p_i = \frac{(3-\alpha_i)(5+5t_i-2\alpha_i)-(13+2t_i+2t_j-5\alpha_i)\alpha_j+2\alpha_j^2}{2\alpha_i^2+(-3+\alpha_j)(-15+2\alpha_j)+\alpha_i(-21+5\alpha_j)}.$$

Note that $\frac{\partial Q_i}{\partial t_i} < 0$ and $\frac{\partial Q_i}{\partial t_j} > 0$. This implies that imposing tariff will reduce domestic total market outputs while it will raise the foreign country's total market outputs.

4. Tariffs and Welfares

In the following, for the sake of analytic convenience, we consider the symmetric case of the CSR-oriented firms in both the countries having the same degree of CSR, i.e., $\alpha_i = \alpha_j = \alpha$ and then, find the optimal tariff policies in each model.

4.1 Private Market

[7] Appendix (i) demonstrates that a state-owned public firm does not export at equilibrium, i.e., $q^s{}_{\text{ei}} = 0$. This is because $q^s{}_{\text{hi}} > q^c{}_{\text{hi}} + q^c{}_{\text{ei}}$ when $0 < \alpha_i < 1$. It indicates that the public firm produces more output than the CSR-oriented firm and thus, its marginal cost is higher than that of the CSR-oriented firm. Thus, as explained in Melitz (2003), Helpman *et al.* (2004), and Lee *et al.* (2013), the exposure to trade will induce only the more productive private firm to enter the export market, and the less productive public firm will continue to produce only for the domestic market. Note that the sufficient conditions for positive outputs and prices are $\alpha_i(11-5\alpha_j)-15-2\alpha_i^2+\alpha_j(13+2t_j-2\alpha_j) < t_i(15-5\alpha_i-2\alpha_j) < 30-10\alpha_i-2(4-t_j)\alpha_j$, which are satisfied at equilibrium.

Using the market equilibrium in a private market, the government of each country will independently and simultaneously set its optimal tariff to maximize domestic welfare in (2), which can be described as follows:

$$W_i^P = \frac{1}{18}\left\{2\left(8 - t_j(8 - 11t_j) - 6t_i(1 + t_j)\right) + \frac{9(9-4\alpha)(t_i-t_j)^2}{(5-2\alpha)^2} + \frac{(25-4\alpha(1+\alpha))(4-t_i-t_j)^2}{(7-2\alpha)^2} - \frac{9(t_i-t_j)(4+(5-2\alpha)t_i-(9-2\alpha)t_j)}{5-2\alpha} - \frac{(4-t_i-t_j)(4(8-\alpha)+(-39+6\alpha)t_i+(-7+2\alpha)t_j)}{7-2\alpha}\right\}.$$

The first-order condition for the maximization of W_i^P with respect to t_i in each country provides the following reaction function:

$$t_i = \frac{\partial(5-2\alpha)(219-267\alpha+116\alpha^2-20\alpha^3)+(358-411\alpha+180\alpha^2-28\alpha^3)t_j}{2(3314-4737\alpha+2521\alpha^2-592\alpha^3+52\alpha^4)}.$$

Note that strategic tariff policies between the two countries are strategic complements, i.e., $\frac{\partial t_i}{\partial t_j} > 0$.

We have the following equilibrium import tariff:

$$t_i^{P*} = \frac{219-\alpha(267-4\alpha(29-5\alpha))}{1254-\alpha(1311-448\alpha+52\alpha^2)}.$$

Note that $t_i^{P*} > 0$ and $\frac{\partial t_i^{P*}}{\partial \alpha} < 0$ when $\alpha \in [0,1]$. Then, we have Lemma 1 as follows.

LEMMA 1. *In a private market, strategic tariff is positive and decreasing in* α.

In a private market, strategic tariff is positive and thus it will reduce the export of the firms in the foreign country, but it is decreasing as the degree of CSR increases. This is because there is a business-stealing effect from the firm in the foreign country and thus, with regard to domestic welfare, each country's government will strategically set a positive tariff to lessen the business-stealing effect, which decreases as the degree of CSR of the firm increases. Thus, from the viewpoint of domestic welfare, CSR activities substitute strategic tariff.

Then, we have the following equilibrium outputs:

$$q^s{}_{\text{hi}} = \frac{273-4\alpha(91-40\alpha+6\alpha^2)}{1254-\alpha(1311-448\alpha+52\alpha^2)},\quad q^s{}_{\text{ei}} = \frac{54-\alpha(97-4(11-\alpha)\alpha)}{1254-\alpha(1311-448\alpha+52\alpha^2)},$$

$$q^c{}_{\text{hi}} = \frac{273-2\alpha(73+\alpha-2\alpha^2)}{1254-\alpha(1311-448\alpha+52\alpha^2)},\quad q^c{}_{\text{ei}} = \frac{54-\alpha(121-2(59-12\alpha)\alpha)}{1254-\alpha(1311-448\alpha+52\alpha^2)}.$$

Note that $q^s{}_{\text{hi}} + q^s{}_{\text{ei}} < q^c{}_{\text{hi}} + q^c{}_{\text{ei}}$. That is, the output of the private firm is lower than that of the CSR-oriented firm at equilibrium. The total market output and price are given by:

$Q_i^{P*} = \frac{654-6(81-14\alpha)\alpha}{1254-\alpha(1311-448\alpha+52\alpha^2)}$ and $p_i^{P*} = \frac{(5-2\alpha)(120-117\alpha+26\alpha^2)}{1254-\alpha(1311-448\alpha+52\alpha^2)}$.

Finally, the maximized social welfare of each country is:

$W_i^{P*} = \frac{(109-\alpha(81-14\alpha))(4581-\alpha(5679-2\alpha(937+6\alpha-28\alpha^2)))}{(1254-\alpha(1311-448\alpha+52\alpha^2))^2}$.

We can define global welfare as the sum of domestic welfare in a private market, that is, $W^P = W_i^P + W_j^P$. Then, we can compare strategic tariff with efficient tariff, which maximizes global welfare. The first-order condition for the maximization of W^P with respect to t_i yields the efficient import tariff:

$t_i^{PG} = \frac{18\alpha+8\alpha^2-9}{27+4\alpha^2}$.

Note that $t_i^{PG} \lessgtr 0$ when $a \lessgtr 0.42$, and $\frac{\partial t_i^{PG}}{\partial \alpha} > 0$. Then we have Lemma 2 as follows.

LEMMA 2. *In a private market, efficient tariff is negative (positive) when α is low (high), and it is increasing in α.*

In a private market, efficient tariff depends on the degree of CSR. This implies that free trade policy is not always the best policy in a private market. When the degree of CSR is low, it becomes a subsidy to remedy under-production under imperfect competition. However, when the degree of CSR is high, it should be positive to reduce the over-production effect of the CSR-oriented firm. Thus, from the viewpoint of global welfare, efficient tariff is complementary with CSR activities.

Finally, domestic welfare in each country and global welfare under efficient tariff are as follows:

$W_i^{PG} = \frac{9}{27+4\alpha^2}$ and $W^{PG} = \frac{18}{27+4\alpha^2}$.

PROPOSITION 1. *In a private market, strategic tariff is higher (lower) than efficient tariff when the degree of CSR is low (high).*

Proof: Comparing the results in a private market, we have: $t_i^P \geq t_i^{PG}$ when $0 \leq \alpha \leq 0.59$, and $t_i^P \leq t_i^{PG}$ when $0.59 \leq \alpha \leq 1$.

Proposition 1 implies that in a private market, the degree of CSR will affect the relative efficiency of the strategic tariff. When the degree of CSR is very low, the strategic tariff is positive and the efficiency tariff is negative. However, as the degree of CSR increases, strategic tariff becomes substitutable and thus, decreasing, while efficient tariff becomes complementary and thus, increasing. As such, when the degree of CSR is high, the strategic tariff is lower than the efficiency tariff.

4.2 Mixed Market

Using the market equilibrium in a mixed market, the government of each country will independently and simultaneously set its optimal tariff to maximize domestic welfare in (2), which can be described as follows:

$$W_i^M = \frac{1}{18(5-3\alpha)^2(-3+\alpha)^2}\{4(5-3\alpha)^2(13-7\alpha-2\alpha^2)-(1475-2620\alpha+1696\alpha^2-472\alpha^3+49\alpha^4)t_i^2-2(5-3\alpha)(35-64\alpha+5\alpha^2+8\alpha^3)t_j+(1075-\alpha(6-\alpha)(350-178\alpha+35\alpha^2)t_j^2+2t_i\big(2(5-3\alpha)(20-21\alpha+5\alpha^2-2\alpha^3)+(25-25\alpha+21\alpha^2-3\alpha^3-2\alpha^4)t_j\big)\}.$$

The first-order condition for the maximization of W_i^M with respect to t_i in each country generates the following reaction function:

$$t_i = \frac{2(5-3\alpha)\big(20-21\alpha+5\alpha^2-2\alpha^3\big)+\big(25-25\alpha+21\alpha^2-3\alpha^3-2\alpha^4\big)t_j}{(1475-2620\alpha+1696\alpha^2-472\alpha^3+49\alpha^4)}.$$

Thus, strategic tariff policies between the two countries are also strategic complements, that is., $\frac{\partial t_i}{\partial t_j} > 0$. The equilibrium import tariff is given by:

$$t_i^{M*} = \frac{40-2\alpha(21-5\alpha+2\alpha^2)}{290-\alpha(345-128\alpha+17\alpha^2)}.$$

Note that $t_i^{M*} > 0$ and $\frac{\partial t_i^{M*}}{\partial \alpha} \gtrless 0$ when $\alpha \lessgtr 0.40$. Then, we have Lemma 3 as follows.

LEMMA 3. *In a mixed market, strategic tariff is positive and first increasing, then decreasing in* α.

In a mixed market, strategic tariff is positive. Thus, it can be directly used to reduce the export of the foreign country's firm, but its effect depends on the degree of CSR. Further, the government can also use the public firm indirectly to reduce the business-stealing effect of the foreign country's firm. As regards the total market output, the public firm should produce more output, which will increase its production cost. Thus, the government will compare the relative effectiveness of the two policies on the public firm and the tariff to increase its domestic welfare. When CSR activities are low, tariff policy is more effective because the export from the foreign country's firm is low and thus, a lower tariff does not lead to higher cost-saving by the public firm even though it will encourage more export from the foreign country's firm. However, when CSR activities are high, tariff policy is less effective because the export from the foreign firm is high and increasing with a lower tariff, which will lead to higher cost-saving by the public firm. Thus, from the viewpoint of domestic welfare, strategic tariff has a nonlinear relationship with CSR activities.

Then, we have the equilibrium outputs as follows:

$$q^{s}{}_{\text{hi}} = \frac{2(2-\alpha)(30-\alpha(26-5\alpha))}{290-\alpha(345-128\alpha+17\alpha^2)},\ q^{c}{}_{\text{hi}} = \frac{50-\alpha(17+(16-3\alpha)\alpha)}{290-\alpha(345-128\alpha+17\alpha^2)},\ q^{c}{}_{\text{ei}} = \frac{10-\alpha(25-(26-7\alpha)\alpha)}{290-\alpha(345-128\alpha+17\alpha^2)}.$$

Note that $q^{s}{}_{\text{hi}} \gtreqless q^{c}{}_{\text{hi}} + q^{c}{}_{\text{ei}}$ when $\alpha \lesseqgtr 0.5$. That is, the output of the public firm is higher (lower) than that of the CSR firm at equilibrium when the degree of CSR is lower (higher). The total market output and price are given by:

$$Q_i{}^{M*} = \frac{6(30-\alpha(26-5\alpha))}{290-\alpha(345-128\alpha+17\alpha^2)} \text{ and } p_i{}^{M*} = \frac{110-\alpha(189-(98-17\alpha)\alpha)}{290-\alpha(345-128\alpha+17\alpha^2)}.$$

Finally, the maximized social welfare of each country is:

$$W_i{}^{M*} = \frac{2(30-26\alpha+5\alpha^2)(450-611\alpha+202\alpha^2+11\alpha^3-10\alpha^4)}{(290-\alpha(345-128\alpha+17\alpha^2))^2}.$$

Similarly, we can evaluate global welfare in a mixed market, $W^M = W_i{}^M + W_j{}^M$. The differentiation of W^M with respect to t_i yields the efficient import tariff:

$$t_i{}^{MG} = \frac{1+5\alpha+4\alpha^2}{2(7-\alpha+\alpha^2)}.$$

Note that $t_i{}^{MG} > 0$ and $\frac{\partial t_i{}^{MG}}{\partial \alpha} > 0$ when $\alpha \in [0,1]$. Then, we have Lemma 4 as follows.

LEMMA 4. *In a mixed market, strategic tariff is always positive and increasing in* α.

In a mixed market, efficient tariff depends on the degree of CSR. Again, free trade policy is not always the best policy in a mixed market. As the degree of CSR increases, efficient tariff increases to reduce the over-production effect of the CSR-oriented firm. Thus, efficient tariff in a mixed market is complementary with CSR activities.

Finally, domestic welfare of each country and global welfare under efficient tariff is as follows:

$$W_i{}^{MG} = \frac{9}{4(7-\alpha+\alpha^2)} \text{ and } W^{MG} = \frac{9}{2(7-\alpha+\alpha^2)}.$$

PROPOSITION 2. *In a mixed market, strategic tariff is higher (lower) than efficient tariff when the degree of CSR is low (high).*

Proof: Comparing the results in a mixed market, we have: $t_i{}^{M*} \geq t_i{}^{MG}$ when $0 \leq \alpha \leq 0.17$, and $t_i{}^{M*} \leq t_i{}^{MG}$ when $0.17 \leq \alpha \leq 1$.

Proposition 2 implies that in a mixed market, the degree of CSR will affect the relative efficiency of the strategic tariff, but its effect is more significant than that in a private market. In particular, in a mixed market, when the degree of CSR is low, strategic tariff is higher than efficiency tariff, which is always

positive and does not require free trade or subsidization. However, when the degree of CSR is high, strategic tariff is lower than efficiency tariff because a higher CSR encourages over-production.

4.3 Comparison

We examine the effects of the privatization policy on strategic tariffs and social welfare when both the countries implement the privatization policy simultaneously. Figure 1 compares strategic tariff and efficient tariff in a private market and a mixed market, respectively.

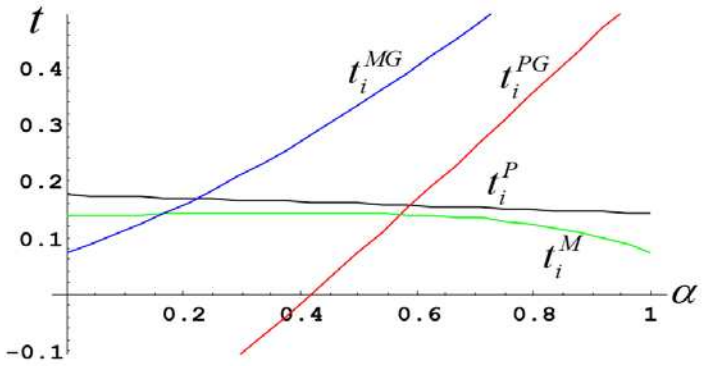

Figure 1. Comparisons of Tariffs in Private and Mixed Markets

LEMMA 5. $t_i{}^{P*} > t_i{}^{M*}$ and $t_i{}^{PG} < t_i{}^{MG}$.

It implies that strategic tariff in a private market is higher than that in a mixed market, while efficient tariff in a private market is lower than that in a mixed market.

LEMMA 6. *Comparing the strategic and efficient tariffs between private and mixed markets, we derive the following results:*

(i) When $0 \leq \alpha \leq 0.17$, *strategic tariffs are higher than efficient tariffs in both markets.*

(ii) When $0.17 \leq \alpha \leq 0.59$, *strategic tariff is lower than efficient tariff in a mixed market, while it is higher than efficient tariff in a private market.*

(iii) When $0.59 \leq \alpha \leq 1$, *strategic tariffs are lower than efficient tariffs in both markets.*

Proof: From Proposition 1 and 2, we have: $t_i{}^{M*} \gtreqless t_i{}^{MG}$ when $\alpha \lesseqgtr 0.17$ and $t_i{}^{P*} \gtreqless t_i{}^{PG}$ when $\alpha \lesseqgtr 0.59$.

Figure 2 compares domestic welfare with strategic tariff and efficient tariff in a private market and a mixed market, respectively.

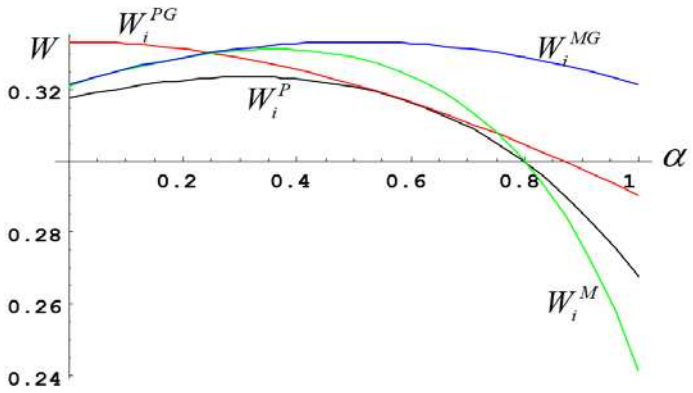

Figure 2. Comparisons of Welfare in Private and Mixed Markets

PROPOSITION 3. *Privatization policy in both the countries will raise strategic tariff and worsen (improves) domestic welfare when the degree of CSR is low (high).*

Proof: Using Figure 1 and Figure 2, we have that $W_i^{M*} \gtreqless W_i^{P*}$ when $\alpha \lesseqgtr 0.81$.

This indicates that privatization may be harmful to the society when a CSR firm engages in international trade. This is because privatization will eliminate the role of the public firm as an indirect instrument for reducing the business-stealing effect of the foreign country's firm. Thus, privatization will induce an increase in strategic tariff, which might be higher or lower than efficient tariff depending on the degree of CSR. In particular, privatization may not be a welfare-improving policy if the degree of CSR is low. However, privatization improves welfare when the degree of CSR is high.

5. Endogenous Choice of Privatization Policy

In the previous subsection, we examined a symmetric choice of privatization policy, which can be implemented in both the countries simultaneously. In this section, we investigate the sequence of the privatization policy and determine whether coordination in privatization policy can improve social welfare. First, we examine an asymmetric choice of privatization policy in which one country has a private market and the other country has a mixed market. Then, we discuss the effects of asymmetric choice of strategic tariffs and social welfare. Finally, we find the equilibrium of the endogenous choice of privatization policy between the two countries.

5.1 Asymmetric Choice of Privatization Policy

First, we examine an asymmetric case where country *i* has a mixed market and country *j* has a private market. Then, from the first-order conditions of the public and CSR firms in country *i* and the private and CSR firms in country *j*, we have the following equilibrium outputs:[8]

$$q^s{}_{\mathrm{hi}} = \frac{2(2-\alpha)(15-7\alpha)-2(1-\alpha)(11-4\alpha)t_i-(17-(11-2\alpha)\alpha)t_j}{3(43-33\alpha+6\alpha^2)},$$

$$q^c{}_{\mathrm{hi}} = \frac{9+(17-10\alpha)\alpha+4(1-\alpha)(11-4\alpha)t_i+(34-22\alpha+4\alpha^2)t_j}{3(43-33\alpha+6\alpha^2)},\ q^c{}_{\mathrm{ei}} = \frac{24-\alpha(5+3\alpha)-2(1-\alpha)(13-3\alpha)t_i-(67-(41-6\alpha)\alpha)t_j}{3(43-33\alpha+6\alpha^2)},$$

$$q^s{}_{\mathrm{hj}} = \frac{6(2-\alpha)^2+(17-3\alpha(9-2\alpha))t_i+(19-6\alpha)t_j}{3(43-33\alpha+6\alpha^2)},\ q^s{}_{\mathrm{ej}} = \frac{9-\alpha(17-6\alpha)-2(3-\alpha)(7-6\alpha)t_i-(9-2\alpha)t_j}{3(43-33\alpha+6\alpha^2)},$$

$$q^c{}_{\mathrm{hj}} = \frac{24-\alpha(5+3\alpha)+(17-\alpha)t_i+(1-\alpha)(19-6\alpha)t_j}{3(43-33\alpha+6\alpha^2)},\ q^c{}_{\mathrm{ej}} = \frac{9+(17-10\alpha)\alpha-(42-6\alpha-4\alpha^2)t_i-(1-\alpha)(9-2\alpha)t_j}{3(43-33\alpha+6\alpha^2)}.$$

It provides different interpretations of tariff policy to each country. From the viewpoint of country *j*, which has a private market, imposing a higher tariff will decrease exports of all firms in both the countries ($\frac{\partial q^c{}_{\mathrm{ei}}}{\partial t_j} < 0$, $\frac{\partial q^s{}_{\mathrm{ej}}}{\partial t_j} < 0$ and $\frac{\partial q^c{}_{\mathrm{ej}}}{\partial t_j} < 0$) and domestic output of the public firm in the foreign country ($\frac{\partial q^s{}_{\mathrm{hi}}}{\partial t_j} < 0$). However, it will increase not only the output of the public firm ($\frac{\partial q^s{}_{\mathrm{hj}}}{\partial t_j} > 0$) and the CSR-oriented firm ($\frac{\partial q^c{}_{\mathrm{hj}}}{\partial t_j} > 0$) of the home country, but also the domestic output of the CSR-oriented firm in the foreign country ($\frac{\partial q^c{}_{\mathrm{hi}}}{\partial t_j} > 0$). On the other hand, from the viewpoint of country *i* which has a mixed market, imposing a higher tariff will decrease export outputs of all firms in both the countries ($\frac{\partial q^s{}_{\mathrm{ei}}}{\partial t_i} < 0$, $\frac{\partial q^s{}_{\mathrm{ej}}}{\partial t_i} < 0$ and $\frac{\partial q^s{}_{\mathrm{ej}}}{\partial t_i} < 0$) and domestic output of the public firm in the home country ($\frac{\partial q^s{}_{\mathrm{hi}}}{\partial t_i} < 0$). However, it will increase the outputs of the CSR-oriented firms in both the countries ($\frac{\partial q^c{}_{\mathrm{hi}}}{\partial t_i} > 0$ and $\frac{\partial q^c{}_{\mathrm{hj}}}{\partial t_i} > 0$) and the output of the public firm in the foreign country only when the degree of CSR is high, that is, $\frac{\partial q^s{}_{\mathrm{hj}}}{\partial t_i} \lessgtr 0$ when $17 - 3\alpha(9 - 2\alpha) \gtrless 0$.

The total market outputs and prices in each country are given by:

$$Q_i = \frac{87-41\alpha-(62-26\alpha)t_i-(1-2\alpha)t_j}{3(43-33\alpha+6\alpha^2)} \text{ and } p_i = \frac{42-2\alpha(29-9\alpha)+(62-26\alpha)t_i+(1-2\alpha)t_j}{3(43-33\alpha+6\alpha^2)},$$

$$Q_j = \frac{72-34\alpha+4(2+\alpha)t_i-(29-10\alpha)t_j}{3(43-33\alpha+6\alpha^2)} \text{ and } p_j = \frac{57-65\alpha+18\alpha^2-4(2+\alpha)t_i+(29-10\alpha)t_j}{3(43-33\alpha+6\alpha^2)}.$$

[8] Appendix (ii) demonstrates that a state-owned public firm in country *i* does not export at equilibrium, that is, $q^s{}_{\mathrm{ei}} = 0$. Note that the sufficient conditions for positive outputs and prices in both the countries are $42 - 58\alpha + 18\alpha^2 + t_j - 2\alpha t_j < t_i(2(-31 + 13\alpha)) < 87 - 41\alpha - t_j + 2\alpha t_j$ for country i and $-57 + 65\alpha - 18\alpha^2 + 4(2 + \alpha)t_i < t_i(29 - 10\alpha) < 2(36 - 17\alpha + 4t_i + 2\alpha t_i)$ for country *j*, which are satisfied at equilibrium.

Note that $\frac{\partial Q_i}{\partial t_i} < 0$ and $\frac{\partial Q_j}{\partial t_i} > 0$, but $\frac{\partial Q_i}{\partial t_j} \lessgtr 0$ when $\alpha \lessgtr 0.5$. This implies that imposing a higher tariff will reduce its domestic total market outputs in both the countries. As regards the total market output of the foreign country, a higher tariff in a mixed market will increase the total market output in a private market, but the effect of the tariff depends on the degree of CSR. In particular, as the degree of CSR increases, it first reduces and then raises the foreign country's total market output in a mixed market.

This asymmetry leads to domestic welfare in each country, as given by:

$$W_i{}^A = \frac{1}{18(43-33\alpha+6\alpha^2)^2}\{11412 - 16104\alpha + 6099\alpha^2 + 206\alpha^3 - 329\alpha^4 + 4t_i(591 - 1380\alpha + 1225\alpha^2 - 551\alpha^3 + 103\alpha^4 - (3873 - 6254\alpha + 3876\alpha^2 - 1068\alpha^3 + 113\alpha^4)t_i) - 6828t_j + 2(\alpha(6039 - 3353\alpha + 630\alpha^2 - 16\alpha^3) + (2172 - 3977\alpha + 2849\alpha^2 - 820\alpha^3 + 76\alpha^4)t_i)t_j + (12057 - 18592\alpha + 10280\alpha^2 - 2432\alpha^3 + 208\alpha^4)t_j^2\},$$

$$W_j{}^A = \frac{1}{18(43-33\alpha+6\alpha^2)^2}\{9990 - 14616\alpha + 5549\alpha^2 + 326\alpha^3 - 349\alpha^4 + 2(4763 - 9064\alpha + 5881\alpha^2 - 1498\alpha^3 + 118\alpha^4)t_i^2 + 2(3168 - 4435\alpha + 2334\alpha^2 - 595\alpha^3 + 70\alpha^4)t_j - (14477 - 21164\alpha + 11358\alpha^2 - 2664\alpha^3 + 232\alpha^4)t_j^2 - 2t_i(954 - 3139\alpha + 1498\alpha^2 + 231\alpha^3 - 160\alpha^4) + (1282 - 2919\alpha + 2271\alpha^2 - 734\alpha^3 + 88\alpha^4)t_j)\}.$$

Finally, from the first-order conditions for the maximization of $W_i{}^A$ and $W_j{}^A$ with respect to t_i and t_j of each country, we have the following reaction functions:

$$t_i = \frac{2(591-1380\alpha+1225\alpha^2-551\alpha^3+103\alpha^4)+(2172-3977\alpha+2849\alpha^2-820\alpha^3+76\alpha^4)t_j}{4(3873-6254\alpha+3876\alpha^2-1068\alpha^3+113\alpha^4)},$$

$$t_i = \frac{3168-4435\alpha+2334\alpha^2-595\alpha^3+70\alpha^4-(14477-21164\alpha+11358\alpha^2-2664\alpha^3+232\alpha^4)t_j}{(1282-2919\alpha+2271\alpha^2-734\alpha^3+88\alpha^4)}.$$

Thus, the strategic tariff policies of the two countries are strategic complements, that is, $\frac{\partial t_i}{\partial t_j} > 0$. We have the following import tariffs at an asymmetric equilibrium:

$$t_i{}^{A*} = \frac{557970-1599798\alpha+1927869\alpha^2-1276550\alpha^3+490953\alpha^4-102492\alpha^5+8852\alpha^6}{5280516-12260718\alpha+11947797\alpha^2-6221551\alpha^3+1822344\alpha^4-284940\alpha^5+18592\alpha^6},$$

$$t_j{}^{A*} = \frac{2(553062-1214733\alpha+1110816\alpha^2-538471\alpha^3+145233\alpha^4-20457\alpha^5+1126\alpha^6)}{5280516-12260718\alpha+11947797\alpha^2-6221551\alpha^3+1822344\alpha^4-284940\alpha^5+18592\alpha^6}.$$

Note that $t_i{}^{A*} > 0$ and $\frac{\partial t_i{}^{A*}}{\partial \alpha} < 0$; $t_j{}^{A*} > 0$ and $\frac{\partial t_j{}^{A*}}{\partial \alpha} > 0$ when $a \in [0,1]$. Further, $t_j{}^{A*} > t_i{}^{A*}$. Then, we have Lemma 7 as follows.

LEMMA 7. *In an asymmetric choice of privatization policy, the strategic tariff in a mixed market is lower than that in a private market, and it is decreasing (increasing) in* α *in a mixed (private) market.*

It implies that in an asymmetric case with private and mixed markets, the strategic tariff is positive and thus, it can be directly used to reduce export from the foreign country's firm. Further, strategic tariff in a mixed market is lower than that in a private market, but its difference depends on the degree of CSR.

The economic reasoning is as follows: For country i having a mixed market, the government can use the public firm and tariff policy as a substitute for CSR activities. Thus, it will reduce the tariff as the degree of CSR increases. This also implies that the tariff in a mixed market is substitutable with the degree of CSR. However, the government in country *j*, which has a private market, has no option besides the tariff policy. Thus, knowing that the other government in country *i* can reduce tariffs, but increase the production of the public firm as the degree of CSR increases, it will increase tariff to not only reduce the export from the foreign firm, but also increase the outputs of the public firm and the CSR-oriented firm of the home country. This implies that the tariff in a private market is complementary to the degree of CSR. Thus, it explains why the effect of CSR in an asymmetric case goes through differently between the countries. This contrasting effect indicates that the difference between strategic tariffs increases the degree of CSR increases in an asymmetric case.

Finally, we have the domestic welfare in each country as follows:

$$W_i{}^{A*} = (17901795619872 - 80628483326544\alpha + 163844616810852\alpha^2 - 197345348913120\alpha^3 + 155356209692196\alpha^4 - 82806460427756\alpha^5 + 29652301108887\alpha^6 - 6625004287830\alpha^7 + 649002319951\alpha^8 + 86319463860\alpha^9 - 37365969600\alpha^{10} + 4890737104\alpha^{11} - 242562096\alpha^{12})/(2(5280516 - 12260718\alpha + 11947797\alpha^2 - 6221551\alpha^3 + 1822344\alpha^4 - 284940\alpha^5 + 18592\alpha^6)^2),$$

$$W_j{}^{A*} = (17644160443752 - 79870846773168\alpha + 162575769868924\alpha^2 - 195554213079156\alpha^3 + 153304314892444\alpha^4 - 81174490282226\alpha^5 + 28858701475687\alpha^6 - 6453184755052\alpha^7 + 685431248451\alpha^8 + 49457588632\alpha^9 - 26301258816\alpha^{10} + 3292895488\alpha^{11} - 149082416\alpha^{12})/(2(5280516 - 12260718\alpha + 11947797\alpha^2 - 6221551\alpha^3 + 1822344\alpha^4 - 284940\alpha^5 + 18592\alpha^6)^2).$$

Using a similar process, we can examine the efficient tariff to maximize global welfare, which is given by:

$$\mathrm{W}^A = W_i{}^A + W_j{}^A = \frac{1}{9(43-33\alpha+6\alpha^2)^2}\{10701 - 15360\alpha + 5824\alpha^2 + 266\alpha^3 - 339\alpha^4 - (2983 - 3444\alpha + 1871\alpha^2 - 638\alpha^3 + 108\alpha^4)t_i^2 + t_j(-246 + 1604\alpha - 1019\alpha^2 + 35\alpha^3 + 54\alpha^4 - (1210 - 1286\alpha + 539\alpha^2 - 116\alpha^3 + 12\alpha^4)t_j) + t_i(228 + \alpha(379 + \alpha(8 - 3\alpha)(119 - 122\alpha)) + 2(445 - 529\alpha + 289\alpha^2 - 43\alpha^3 - 6\alpha^4)t_j)\}.$$

The differentiation of W^A with respect to t_i and t_j yields the efficient import tariff as:

$$t_i{}^{AG} = \frac{90+684\alpha+655\alpha^2-451\alpha^3+113\alpha^4}{2(1845-1242\alpha+691\alpha^2-190\alpha^3+35\alpha^4)} \text{ and } t_j{}^{AG} = \frac{2547\alpha-518\alpha^2+44\alpha^3+101\alpha^4-342}{2(1845-1242\alpha+691\alpha^2-190\alpha^3+35\alpha^4)}.$$

Note that $t_i{}^{AG} > 0$ and $\frac{\partial t_i{}^{AG}}{\partial \alpha} > 0$; $t_j{}^{AG} \lessgtr 0$ when $\alpha \lessgtr 0.14$ and $\frac{\partial t_j{}^{AG}}{\partial \alpha} > 0$. Then, we have Lemma 8 as follows.

LEMMA 8. *In an asymmetric case, efficient tariff is increasing in α. However, it is always positive in a mixed market, but can be negative (positive) when α is low (high) in a private market.*

It implies that in the asymmetric case an efficient tariff depends on the degree of CSR. As the degree of CSR increases, efficient tariff increases to reduce the over-production effect of the CSR-oriented firm. Thus, efficient tariff in an asymmetric case is complementary to the degree of CSR.

Finally, the maximized global welfare is given by:

$$W^{AG} = \frac{2376-1386\alpha+435\alpha^2-34\alpha^3-\alpha^4}{2(1845-1242\alpha+691\alpha^2-190\alpha^3+35\alpha^4)}.$$

PROPOSITION 4. *In an asymmetric choice of privatization policy, strategic tariff is higher (low) than efficient tariff when the degree of CSR is low (high).*

Proof: Comparing the tariffs and global welfares in the case of both the markets, we can find: (i) ${t_i}^{A*} \geq {t_i}^{AG}$ when $0 \leq \alpha \leq 0.24$, and ${t_i}^{A*} \leq {t_i}^{AG}$ when $0.24 \leq \alpha \leq 1$; (ii) ${t_j}^{A*} \geq {t_j}^{AG}$ when $0 \leq \alpha \leq 0.42$ and ${t_j}^{A*} \leq {t_j}^{AG}$ when $0.42 \leq \alpha \leq 1$; and (iii) $W^{A*} = W^{AG}$ when $\alpha = 0.35$ and $W^{A*} < W^{AG}$ otherwise.

5.2 Comparisons

In the following, we compare the equilibrium outcomes under sequential choice of privatization with those under simultaneous choice. Figure 3 compares the strategic tariffs in the symmetric case, that is, private and mixed markets, to the asymmetric case. It indicates that asymmetric choice leads to the strategic tariff being higher in a private market, but lower in a mixed market.

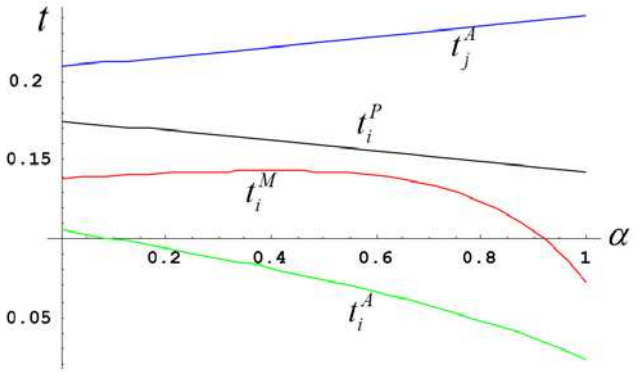

Figure 3. Comparison of Strategic Tariffs in the Symmetric and Asymmetric cases

LEMMA 9. ${t_j}^{A*} > {t_i}^{P*} > {t_i}^{M*} > {t_i}^{A*}$.

Figure 4 compares the domestic welfare of both the countries in the symmetric and the asymmetric cases.

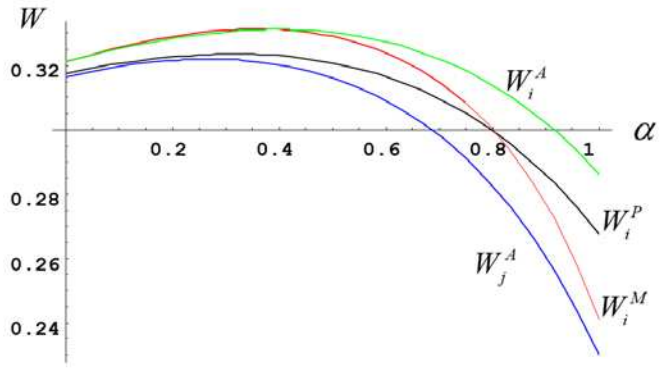

Figure 4. Comparison of Domestic Welfare in the Symmetric and the Asymmetric cases

LEMMA 10. *We have the following welfare ranks:*

$(i)\ W_i{}^M \geq W_i{}^A > W_i{}^P > W_j{}^A$ *when* $0 \leq \alpha \leq 0.40$

$(ii)\ W_i{}^A > W_i{}^M \geq W_i{}^P > W_j{}^A$ *when* $0.40 < \alpha \leq 0.85$

$(iii)\ W_i{}^A > W_i{}^P > W_i{}^M > W_j{}^A$ *when* $0.85 < \alpha \leq 1$

5.3 Endogenous Choice Game

Finally, we consider a privatization choice game in a super game between the two countries. Table 1 describes the payoffs in a game with symmetric and asymmetric choices of privatization policy.

Table 1. Privatization Choice Game

Country i, j	*Nationalization*	*Privatization*
Nationalization	$W_i{}^{M*},\ W_j{}^{M*}$	$W_i{}^{A*},\ W_j{}^{A*}$
Privatization	$W_j{}^{A*},\ W_i{}^{A*}$	$W_i{}^{P*},\ W_j{}^{P*}$

PROPOSITION 5. *In a privatization choice game, nationalization policy in both the countries is the unique Nash equilibrium.*

Proof: Using the welfare ranks, we have $W_i{}^{M*} = W_j{}^{M*} > W_j{}^{A*}$ and $W_i{}^{A*} > W_i{}^{P*} = W_j{}^{P*}$. Hence, there exists a unique Nash equilibrium where the governments of both the countries choose nationalization.

PROPOSITION 6. *Nationalization (Privatization) policy in both the countries is a Pareto-efficient outcome when the degree of CSR is low (high).*

Proof: Comparing the results, we get $W_i^M \gtreqless W_i^P$ when $\alpha \lesseqgtr 0.81$.

This implies that when the degree of CSR is high, simultaneous choice of privatization policy in both the countries is globally optimal, while the equilibrium is the simultaneous choice of nationalization policy in both countries. Therefore, there is a prisoner's dilemma in choosing privatization policy in the presence of higher CSR.

6. Concluding Remarks

We considered an international bilateral trade model with CSR and examined strategic tariffs and privatization policies. Our analysis and main findings are as follows: First, we analyzed symmetric choice of privatization policy and demonstrated that tariff policy has an entry-reducing effect and thus, the strategic tariff is positive and decreasing in the degree of CSR in a private market. We also demonstrated that the strategic tariff is higher (lower) than the efficient tariff when the degree of CSR is low (high).

Second, we analyzed symmetric choice of nationalization policy and demonstrated that tariff policy is substitutable for the public firm, but the strategic tariff is increasing and then decreasing in the degree of CSR. We also demonstrated that the strategic tariff is higher (lower) than the efficient tariff when the degree of CSR is low (high).

Third, we compared private and mixed markets under symmetric choice of privatization policy and demonstrated that strategic tariff is higher in a private market than that in a mixed market, while efficient tariff is lower in a private market than that in a mixed market. Thus, privatization will raise strategic tariff and worsen (improve) domestic welfare when the degree of CSR is low (high).

Fourth, we investigated asymmetric choice of privatization policy and demonstrated that strategic tariff in a mixed market is lower in a mixed market than that in a private market. We also demonstrated that the strategic tariff is higher (low) than the efficient tariff when the degree of CSR is low (high) in both the markets.

Finally, we examined the endogenous choice of privatization policy by the two countries and demonstrated that both the countries endogenously choose symmetric nationalization policy even though symmetric privatization policy in both the countries is globally optimal when the degree of CSR is high. Therefore, there is a prisoner's dilemma problem in a privatization choice game within a bilateral trade framework with higher CSR.

There are challenging issues for future study on the robustness of the outcomes under alternative scenarios such as various modes of competition like Bertrand competition and/or product differentiation, the number of private firms, and more general specifications of demand and cost functions between the firms.

Appendix. Proof of No Export of the Public Firm

(i) Symmetric Mixed Market

We first examine the symmetric mixed market case. For expositional convenience, we consider the symmetric case in which the CSR-oriented firms of both the countries have the same degree of CSR, that is, $\alpha_i = \alpha_j = \alpha$. Allowing boundary solutions for the public firm's export output requires Kuhn-Tucker conditions for the maximization problem. However, for the time being, we suppose that the optimal output for the public firm's export output is zero. Then, the first-order conditions of the CSR-oriented firm and the public firm of each country yield the following equilibrium outputs:

$$q^c{}_{\text{hi}} = \frac{12(1+\alpha)+(1-\alpha)(29-6\alpha)t_i+(13+17\alpha-6\alpha^2)t_j}{24(4-\alpha)},$$

$$q^c{}_{\text{ei}} = \frac{12(1+\alpha)-35t_j-(19-6\alpha)((1-\alpha)t_i+\alpha t_j)}{24(4-\alpha)},\ q^s{}_{\text{hi}} = \frac{36-17t_i+18\alpha t_i-t_j-18\alpha t_j}{72}.$$

The domestic welfare is:

$$W_i^M = \frac{1}{5184(4-\alpha)^2}\{1296(3-2\alpha)(7+2\alpha) - 5(6103-3254\alpha+508\alpha^2)t_i^2 - 216(11+\alpha)(1-4\alpha)t_j + 5(3977-2434\alpha+284\alpha^2)t_j^2 + 2t_i\big(540(1-\alpha)(1-4\alpha) + \big(2237-2\alpha(863+44\alpha)\big)t_j\big)\}.$$

The differentiation of W_i^M with respect to t_i yields the equilibrium import tariff:

$$t_i^M = \frac{30(1-5\alpha+4\alpha^2)}{1571-808\alpha+146\alpha^2}.$$

Then, we can have the supposed equilibrium outputs as follows:

$$q^s{}_{\text{hi}} = \frac{(4-\alpha)(389-86\alpha)}{2(1571-808\alpha+146\alpha^2)},\ q^c{}_{\text{hi}} = \frac{419+17\alpha(9+2\alpha)}{2(1571-808\alpha+146\alpha^2)},\ q^c{}_{\text{ei}} = \frac{359+(453-206\alpha)\alpha}{2(1571-808\alpha+146\alpha^2)}.$$

Finally, we demonstrate that these equilibrium outputs satisfy the supposition that the optimal output of the public firm's export output is zero. From the Kuhn-Tucker conditions for maximizing the objective of the public firm, that is, $q^s{}_{\text{ei}} \geq 0$, $\frac{\partial W_i}{\partial q^s{}_{\text{ei}}} \leq 0$ and $q^s{}_{\text{ei}}.\frac{\partial W_i}{\partial q^s{}_{\text{ei}}} = 0$, the necessary condition for having a boundary solution for the public firm's zero export output is as follows:

$$\frac{\partial W_i}{\partial q^s{}_{\text{ei}}} = 1 - 2q^c{}_{\text{ei}} - q^c{}_{\text{hj}} - 3q^s{}_{\text{ei}} - q^s{}_{\text{hi}} - q^s{}_{\text{hj}} - t_j = -\frac{3(1+\alpha)(389-86\alpha)}{3142-4\alpha(404-73\alpha)} < 0.$$

Therefore, the supposed equilibrium outputs indicate that the export output of the public firm is zero, that is, the public firm would not export at the equilibrium.

(ii) Asymmetric Mixed Market

We examine the asymmetric case where country *i* has a mixed market while country *j* has a private market with the same degree of CSR, that is, $\alpha_i = \alpha_j = \alpha$. Using a similar procedure as in the previous proof, the first-order conditions of the CSR-oriented firm and the public firm in country *i* and the CSR-oriented firm and the private firm in country *j* yield the following equilibrium outputs:

$$q^s{}_{\text{hi}} = \frac{105-\alpha(68-7\alpha)-2(4-\alpha)(7-8\alpha)t_i-(1+\alpha)(165\alpha)t_j}{3(4-\alpha)(16-5\alpha)},$$

$$q^c{}_{\text{hi}} = \frac{3+2(5-\alpha)\alpha+6(4-\alpha)(1-\alpha)t_i+(16-5\alpha)t_j}{(4-\alpha)(16-5\alpha)},\ q^c{}_{\text{ei}} = \frac{14-\alpha-2\alpha^2-4(4-\alpha)(1-\alpha)t_i-(32-10\alpha)t_j}{(4-\alpha)(16-5\alpha)},$$

$$q^s{}_{\text{hj}} = \frac{42-5(5-\alpha)\alpha+(4-\alpha)(4-5\alpha)t_i+(32-10\alpha)t_j}{3(4-\alpha)(16-5\alpha)},\ q^s{}_{\text{ej}} = \frac{9-5(5-\alpha)\alpha-2(4-\alpha)(7-5\alpha)t_i-(16-5\alpha)t_j}{3(4-\alpha)(16-5\alpha)},$$

$$q^c{}_{\text{hj}} = \frac{3\left(14-\alpha-2\alpha^2\right)+(4-\alpha)(4+7\alpha)t_i+2(1-\alpha)(16-5\alpha)t_j}{3(4-\alpha)(16-5\alpha)},\ q^c{}_{\text{ej}} = \frac{9+6(5-\alpha)\alpha-2(4-\alpha)(7+4\alpha)t_i-(1-\alpha)(16-5\alpha)t_j}{3(4-\alpha)(16-5\alpha)}.$$

The domestic welfare in each country is as follows:

$$W_i{}^A = \frac{1}{18(16-5\alpha)^2(-4+\alpha)^2}\{25209 - 2\alpha(12693 - 2563\alpha - 509\alpha^2 + 140\alpha^3) - 4(4-\alpha)^2(487 - 262\alpha + 25\alpha^2)t_i^2 - (16-5\alpha)t_j\big(2(357 - 454\alpha + 112\alpha^2 - 4\alpha^3) - (16-5\alpha)(113 - 74\alpha + 11\alpha^2)t_j\big) + 2(4-\alpha)t_i\big(402 - 868\alpha + 655\alpha^2 - 145\alpha^3 + (16-5\alpha)(22 + 44\alpha - 23\alpha^2)t_j\big)\},$$

$$W_j{}^A = \frac{1}{18(16-5\alpha)^2(-4+\alpha)^2}\{(22383 - 2\alpha(12048 - 2134\alpha - 629\alpha^2 + 152\alpha^3) + 2(4-\alpha)^2(542 - 440\alpha + 17\alpha^2)t_i^2 - 2(4-\alpha)t_i(258 - 1492\alpha + 238\alpha^2 + 17\alpha^3 - 2(16-5\alpha)(13 - 34\alpha + 10\alpha^2)t_j) + (16-5\alpha)t_j(2(285 - 292\alpha + 158\alpha^2 - 30\alpha^3) + (16-5\alpha)(137 - 80\alpha + 13\alpha^2)t_j))\}.$$

The differentiation of $W_i{}^A$ with respect to t_i yields the equilibrium import tariff:

$$t_i{}^A = \frac{15336-32406\alpha+29017\alpha^2-10381\alpha^3+1195\alpha^4}{2(133152-149532\alpha+63007\alpha^2-12034\alpha^3+880\alpha^4)},\ t_j{}^A = \frac{17676-23145\alpha+15467\alpha^2-5132\alpha^3+590\alpha^4}{133152-149532\alpha+63007\alpha^2-12034\alpha^3+880\alpha^4}.$$

Then, we can have the supposed equilibrium outputs as follows:

$$q^s{}_{\text{hi}} = \frac{69108-3\alpha(27101-10061\alpha+1107\alpha^2+10\alpha^3)}{133152-149532\alpha+63007\alpha^2-12034\alpha^3+880\alpha^4},$$

$$q^c{}_{\text{hi}} = \frac{13536+\alpha(4572-3628\alpha-1202\alpha^2+365\alpha^3)}{133152-149532\alpha+63007\alpha^2-12034\alpha^3+880\alpha^4},\ q^c{}_{\text{ei}} = \frac{18372-\alpha(3675+12064\alpha-6384\alpha^2+830\alpha^3)}{3675+12064\alpha-6384\alpha^2+830\alpha^3},$$

$$q^s{}_{\text{hj}} = \frac{65424-\alpha(77468-39189\alpha+10023\alpha^2-985\alpha^3)}{133152-149532\alpha+63007\alpha^2-12034\alpha^3+880\alpha^4},\ q^s{}_{\text{ej}} = \frac{2532-\alpha(13651-6935\alpha+426\alpha^2+105\alpha^3)}{3675+12064\alpha-6384\alpha^2+830\alpha^3},$$

$$q^c{}_{\text{hj}} = \frac{65424-\alpha(49012-6167\alpha-2465\alpha^2+475\alpha^3)}{133152-149532\alpha+63007\alpha^2-12034\alpha^3+880\alpha^4},\ q^c{}_{\text{ej}} = \frac{2532+\alpha(23089-18456\alpha+3969\alpha^2-230\alpha^3)}{3675+12064\alpha-6384\alpha^2+830\alpha^3}.$$

Finally, from the Kuhn-Tucker conditions for maximizing the objective of the public firm, that is, $q^s{}_{\text{ei}} \geq 0$, $\frac{\partial W_i{}^A}{\partial q^s{}_{\text{ei}}} \leq 0$ and $q^s{}_{\text{ei}} \cdot \frac{\partial W_i{}^A}{\partial q^s{}_{\text{ei}}} = 0$, the necessary condition for having a boundary solution for the public firm's zero export output is as follows:

$$\frac{\partial {W_i}^A}{\partial {q^s}_{\mathrm{ei}}} = 1 - 2{q^c}_{\mathrm{ei}} - {q^c}_{\mathrm{hj}} - 3{q^s}_{\mathrm{ei}} - {q^s}_{\mathrm{hi}} - {q^s}_{\mathrm{hj}} - t_j = -\frac{3(18600-8502\alpha-6269\alpha^2+4190\alpha^3-575\alpha^4)}{133152-149532\alpha+63007\alpha^2-12034\alpha^3+880\alpha^4} < 0.$$

Therefore, the supposed equilibrium outputs indicate that the export output of the public firm is zero, that is, the public firm would not export at equilibrium.

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