Tariffs and Privatization Policy in a Bilateral Trade with Corporate Social Responsibility

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Abstract

This paper considers corporate social responsibility (CSR) in an international bilateral trade model and examines the strategic interaction between tariffs and privatization policy. We show that strategic tariff in a private market is higher than that in a mixed market, while Pareto-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). When we endogeneize the strategic choice of privatization policy between the two countries, we show that both countries choose nationalization policy even though privatization policy is globally efficient when the degree of CSR is high.

1. Introduction

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

Many researchers have studied the privatization of public firms and explored how foreign competition affects the desire to privatize in mixed markets. In the early 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, while Pal and White (2003) demonstrated that the existence of public firms lowers optimal tariffs and the total volume of trade between two countries. In the

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[1] According to 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.

subsequent analysis, it is also shown that the decision to privatize depends crucially not only on the strategic substitutability-complementarity but also trade instruments such as quotas and subsidies and cost differences between firms. (Chang, 2005, 2007; Chao and Yu, 2006; Yu and Lee, 2011; Han, 2012; Wang *et al.*, 2014)

These analysis have extended into the model with strategic relationship between privatization and trade policies in an international trade framework. Barcena-Ruiz and Garzon (2005) considered an international integrated mixed market with two countries and demonstrated that only one government privatizes its public firms, which leads to lower social welfare. Dadpay and Heywood (2006) found that two competing, domestic (public) and foreign firms play the role of trade barriers and the strategic interaction of the two governments usually reduces welfare. On the other hand, some works considered a bilateral trade framework in which both public and private firms compete in both home and foreign countries, and demonstrated that the competitive privatization policy depends not only on the relative efficiency of the public firm, but also on the choice of trade policy. (Han and Ogawa, 2008; Lee *et al.*, 2013; Xu and Lee, 2015; Xu *et al.,* 2016).

However, all these works regarded profit maximization as the sole objective of a private firm. Since Porter and Kramer (2006) present a systematic analysis linking comparative advantage to corporate social responsibility (CSR), CSR activities have now become mainstream global business strategies and a large number of firms in the world issue various CSR statements/activities.[2] GE's Ecomagination program, Nestle's Creating Shared Values, and Unilevel's Simple Living Plan are excellent examples. Nowadays, more and more firms are gradually adopting corporate self-disciplines that take more into account than profits, i.e., that regard ethical issues and community welfare as important business routines.

Accordingly, recent researches on oligopoly markets have analyzed different forms of market competition wherein profit-maximizing private firms compete with other private firms that adopt CSR activities. There have been several contributions to various aspects of issues in CSR, either in horizontal models (Kopel and Brand, 2012; Matsumura and Ogawa, 2014; Lambertini and Tampieri, 2015; Liu et al., 2015; Leal et al., 2018), or in vertical models (Goering, 2012, 2014; Brand and Grothe, 2013, 2015).

As the world's economy is moving towards higher levels of globalization and economic liberalization, the interaction between imports tariffs and privatization policy has become an important policy agenda to ensure domestic welfare. Although several studies have demonstrated that consumer-oriented CSR initiatives significantly affect tariffs (Wang et al., 2012; Chang et al., 2014; Chao et al., 2016; Manasakis et al., 2017; Liu et al., 2018), the feedback of international CSR warrants greater attention.

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[2] According to KPMG (2013), nearly 92% of the 250 largest companies worldwide issued CSR reports and more than 30% (71% and 90%) of companies in the US (the UK and Japan, respectively) adopted CSR in 2013.

This paper extends their analysis into the a bilateral trade model where a domestic public firm competes with not only the domestic private firm with CSR initiative, but also foreign public and private firms in the two countries.[3] We focus on the intra-industry trade and examine the strategic interaction of two countries' optimal choices of tariffs and privatization policies in the context of CSR.

Our analysis has three different scenarios and the followings are main findings. .In the first scenario, we analyze a symmetric private market under a privatization policy in both countries. We 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 domestic-welfare increasing strategic tariff is higher (lower) than Pareto-efficient tariff when the degree of CSR is low (high).

In the second scenario, we analyze a symmetric mixed market under a nationalization policy in both countries. We 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).

We then compare these two different scenarios between these symmetric private and mixed markets. 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). It implies that the active role of governmental guideline for promoting CSR, rather than considering it on a voluntary basis, is necessary.[4]

In the third scenario, we investigate an asymmetric choice of privatization policy by the two countries. We 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 markets.

Finally, we integrate these three cases in a super game and analyze it with an endogenous choice of privatization policy between the countries. We demonstrate that both countries choose nationalization policy even though privatization policy is globally efficient 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 an international bilateral trade.

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[3] As related works, Ouattara (2017), Itano (2017) and Kim et al. (2017) also examined the optimal privatization policies in the context of CSR activities, but they focus only on a domestic mixed market without international trade.

[4] The promotion of CSR has become a top priority in the policy agenda for sustainable development in many countries and international organization. Further encouragement of CSR became a central policy objective in the United States and European Union. For example, the UK government website (http://www.csr.gov.uk/policy.shtml) stated that: "The Government can provide a policy and institutional framework that stimulates [socially responsible] companies to raise their performance [voluntarily] beyond minimum legal standards. Our approach is to encourage and incentivize the adoption of CSR, through best practice guidance, and, where appropriate, intelligent [soft-law] regulation and fiscal incentives." See also Steurer (2010).

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, i and j, 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. Both firms produce homogeneous products in each country and may export them to the other country. In other words, four firms compete among each other in the two symmetric markets. We denote the state-owned public firm's output in home country i as q^s_{hi} and its exports as q^s_{ei}. Similarly, q^c_{hi} and q^c_{ei} are the CSR-oriented firm's output and exports, respectively, in home country i, where $i \neq j$.

The government in each country can impose a tariff on the imports that are produced by both public and 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 $R_i = t_i(q^s_{ej} + q^c_{ej})$ in country i.

Total market outputs in country i is denoted by $Q_i = q^s_{hi} + q^s_{ej} + q^c_{hi} + q^c_{ej}$. 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 $CS_i = \frac{1}{2}Q_i^2$.

The cost functions of both the firms in each country is assumed to be identical and quadratic[5], given by $C(q^x_{hi} + q^x_{ei}) = \frac{1}{2}(q^x_{hi} + q^x_{ei})^2$, where $x = s, c$. Then, the profit of the firm is as follows:

$$\pi^x_i = p_i q^x_{hi} + (p_j - t_j)q^x_{ei} - \frac{1}{2}(q^x_{hi} + q^x_{ei})^2. \tag{1}$$

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

$$W_i = CS_i + \pi^s_i + \pi^c_i + R_i. \tag{2}$$

The objective function of the state-owned public firm depends on whether it is privatized or not: the state-owned public firm is assumed to maximize the domestic welfare, while the fully privatized firm

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[5] The assumption of increasing marginal cost is for the purpose of guaranteeing the interior solution of the equilibrium. In the literature on mixed markets, firms with different productivity levels also coexist in an industry. Matsumura and Shimizu (2010) pointed out that there is an endogenous cost differential between the privatized firms.

is assumed to maximize its own profits.[6] On the other hand, the CSR-firm considers both its own profit and consumer surplus of the two countries. In specific, we assume that the objective function of the CSR-firm is as follows:

$$T^c_i = \alpha_i(\text{CS}_i + \text{CS}_j) + \pi^c_i, \tag{3}$$

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 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.[7]

The three-stage game is constructed. In the first stage, both governments decide whether or not to implement the privatization policy independently and simultaneously. In the second stage, they choose the levels of tariffs to maximize their domestic welfares respectively and simultaneously. In the third stage, observing the decision on privatization and the levels of tariff, the firms compete in quantities in a Cournot fashion. The subgame perfect Nash equilibrium is solved by backward induction.

3. Market Equilibrium

3.1 Private Market

We consider a private market in both countries where both public firms are fully privatized, i.e., there is a private firm and a CSR-firm in each country. Assuming positive outputs, the first-order conditions of the two private and the two CSR-firms in the two markets, in which the privatized firm maximizes (1) and the CSR-firm maximizes (3), yield the following equilibrium outputs in county i:[8]

$$q^s_{hi} = \frac{1}{3}(1 + t_j - \frac{4 - t_i - t_j}{7 - \alpha_i - \alpha_j} + \frac{3(t_i - t_j)}{5 - \alpha_i - \alpha_j}), \quad q^c_{hi} = \frac{1}{3}(1 + t_j - \frac{(4 - t_i - t_j)(1 - \alpha_i)}{7 - \alpha_i - \alpha_j} + \frac{3(t_i - t_j)(1 - \alpha_i)}{5 - \alpha_i - \alpha_j}),$$

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[6] Note that the fully privatized firm is assumed as a pure profit maximizing firm, compared to the CSR-firm. This asymmetry implies that firms behave differently to the government policies due to different corporate cultures, values, structures and strategies. See Post et al. (2002), Kim et al. (2017) and Liu et al. (2018). Note also that we can easily incorporate the symmetric case where the fully privatized firm becomes CSR-firm without loss of further economic insights.

[7] 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 Matsumura and Ogawa (2014, 2016), and Kim *et al.* (2017) allowed the interior choice of CSR, that is, $0 < \alpha_i < 1$.

[8] The equilibrium outputs in country *j* are the same as those in county *i* because the two countries are symmetric. The sufficient conditions for positive outcomes 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.

$$q^s_{ei} = \frac{1}{3}\left(1 - 2t_j - \frac{4 - t_i - t_j}{7 - \alpha_i - \alpha_j} - \frac{3(t_i - t_j)}{5 - \alpha_i - \alpha_j}\right), \quad q^c_{ei} = \frac{1}{3}\left(1 - 2t_j - \frac{(4 - t_i - t_j)(1 - \alpha_i)}{7 - \alpha_i - \alpha_j} - \frac{3(t_i - t_j)(1 - \alpha_i)}{5 - \alpha_i - \alpha_j}\right).$$

We have that $\frac{\partial q^x_{hi}}{\partial t_i} > 0$, but $\frac{\partial q^x_{ei}}{\partial t_i} < 0$, $\frac{\partial q^x_{hi}}{\partial t_j} < 0$, and $\frac{\partial q^x_{ei}}{\partial t_j} < 0$, 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 private markets.

Thus, total market output and price are given by:

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

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, i.e., there is a state-owned public firm and a CSR-firm in each country. 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) yield the following equilibrium outputs:[9]

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

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

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

We have that $\frac{\partial q^s_{ei}}{\partial t_k} < 0$ and $\frac{\partial q^s_{hi}}{\partial t_k} < 0$, but $\frac{\partial q^c_{hi}}{\partial t_k} > 0$ 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

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[9] As shown in Appendix I, a state-owned firm does not export at equilibrium, i.e., $q^s_{ei} = 0$, because $q^s_{hi} > q^c_{hi} + q^c_{ei}$ when $0 < \alpha_i < 1$. It shows that the public firm produces more output than the CSR-firm and thus, its marginal cost is higher than that of the CSR-firm. It also supports that, 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. 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.

public firm. This, in turn, will increase the output of the CSR-firm. Thus, tariff policy in a mixed market has also an entry-reducing effect, but there is other output substitution effect between the public firm and the CSR-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-firms in both countries having the same degree of CSR, i.e., $\alpha_i = \alpha_j = \alpha$ and then find the optimal tariff policies in each market.

4.1 Private Market

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

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

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 $a \in [0,1]$. 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 sets 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:

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

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 define global welfare as the sum of domestic welfare in a private market, i.e., $W^P = W_i^P + W_j^P$. Then, we can compare strategic tariff with (Pareto-improving) 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 $t_i^{PG} \underset{>}{\overset{<}{=}} 0$ when $a \underset{>}{\overset{<}{=}} 0.42$, 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.*

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In a private market, efficient tariff depends on the degree of CSR. 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:

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

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 sets its optimal tariff to maximize domestic welfare in (2), which can be described as follows:

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

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

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

Thus, strategic tariff policies between the two countries are also strategic complements, i.e., $\frac{\partial t_i}{\partial t_j} > 0$. 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 $a \lessgtr 0.40$. Then, we have Lemma 3 as follows.

LEMMA 3. *In a mixed market, strategic tariff is positive and has an inversed-U shape 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:

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

Note that $q^s_{hi} \gtrless q^c_{hi} + q^c_{ei}$ when $\alpha \lessgtr 0.5$. 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:

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

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:

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

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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. As the degree of CSR increases, efficient tariff increases to reduce the over-production effect of the CSR-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:

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

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 countries implement their privatization policies simultaneously. Figure 1 compares strategic tariff and efficient tariff in a private market and a mixed market, respectively.
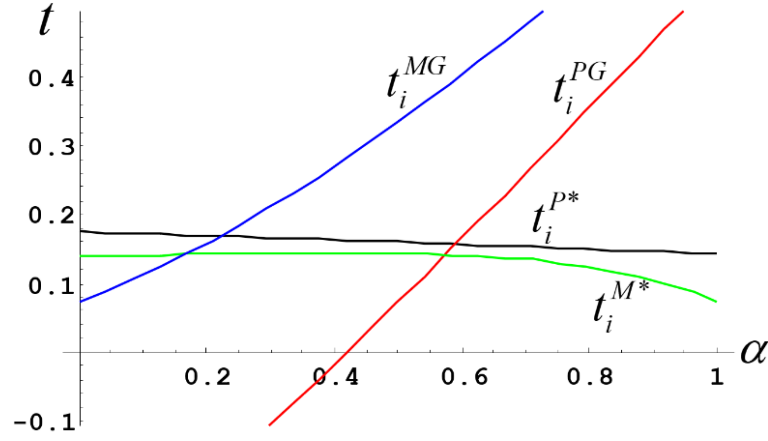
Figure 1. Comparisons of Tariffs in Private and Mixed Markets

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 can 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: $t_i^{M*} \gtrless t_i^{MG}$ when $\alpha \lessgtr 0.17$ and $t_i^{P*} \gtrless t_i^{PG}$ when $\alpha \lessgtr 0.59$.

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

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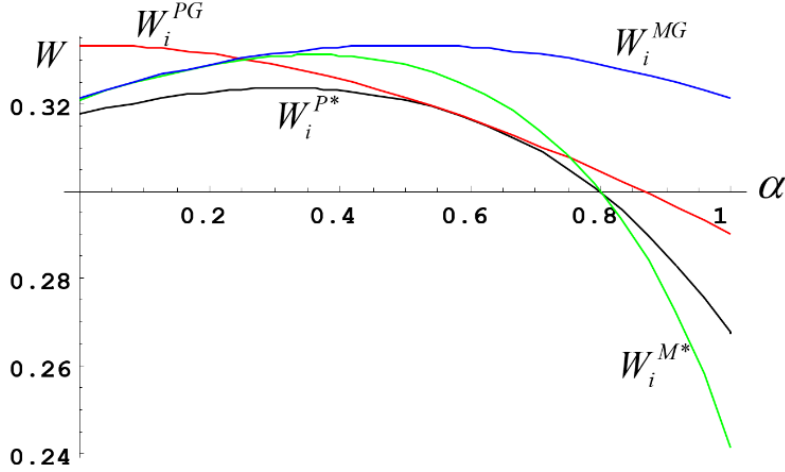*Figure 2. Comparisons of Welfare in Private and Mixed Markets*

PROPOSITION 3. *Privatization policy in both 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 $W_i^{M*} \gtrless W_i^{P*}$ when $\alpha \lessgtr 0.81$.

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. It implies that the active role of governmental guideline for CSR, rather than considering it on a voluntary basis, is necessary.

5. Endogenous Choice of Privatization Policy

In the previous subsection, we examined a symmetric choice of privatization policy, which can be implemented in both countries simultaneously. In this section, we investigate the asymmetric choice 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.

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5.1 Asymmetric Choice of Privatization Policy

In an asymmetric case, we assume that 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:[10]

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

$$q^c_{hi} = \frac{9 + (17-10\alpha)\alpha + 4(1-\alpha)(11-4\alpha)t_i + (34-22\alpha+4\alpha^2)t_j}{3(43-33\alpha+6\alpha^2)}, \quad q^c_{ei} =$$

$$\frac{24 - \alpha(5+3\alpha) - 2(1-\alpha)(13-3\alpha)t_i - (67-(41-6\alpha)\alpha)t_j}{3(43-33\alpha+6\alpha^2)},$$

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

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

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

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

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[10] Appendix II shows that a state-owned firm in country i does not export at equilibrium, that is, $q^s_{ei} = 0$. The sufficient conditions for positive outcomes in both 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.

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

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

We have that $\frac{\partial Q_i}{\partial t_i} < 0$ and $\frac{\partial Q_j}{\partial t_i} > 0$, but $\frac{\partial Q_i}{\partial t_j} \gtrless 0$ when $\alpha \lessgtr 0.5$. This implies that imposing a higher tariff will reduce its domestic total market outputs in both countries. As regards the total market output of the foreign country, a 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, i.e., there is a U-shaped relationship.

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-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:

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

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 $\frac{\partial t_i^{AG}}{\partial \alpha} > 0$; $t_j^{AG} \overset{<}{\underset{>}{}} 0$ when $\alpha \overset{<}{\underset{>}{}} 0.14$ 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

We compare the equilibrium outcomes under asymmetric 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.
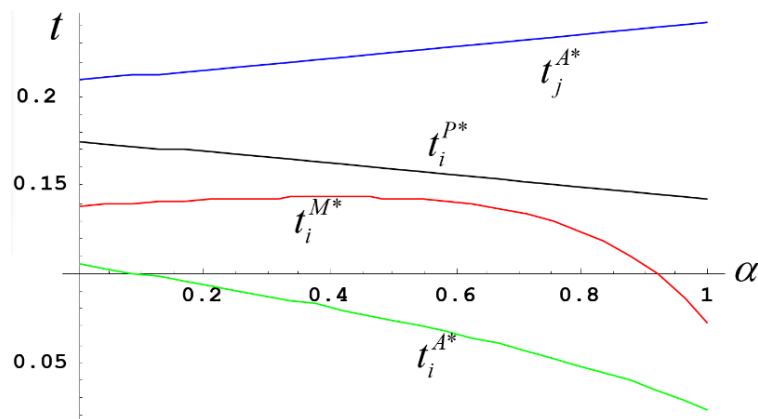
Figure 3. Comparison of Strategic Tariffs in the Symmetric and Asymmetric cases

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

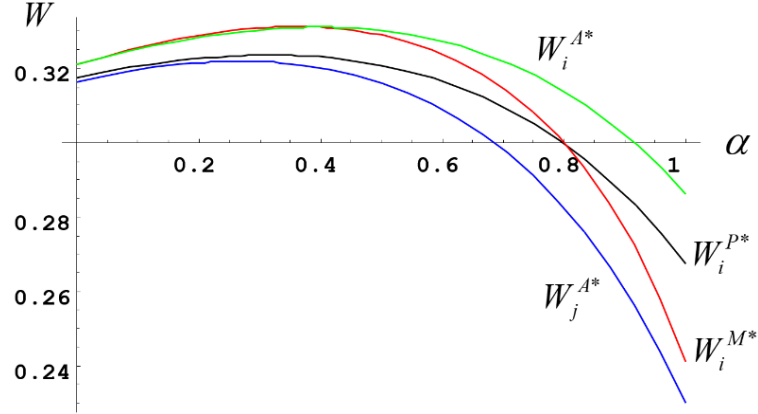Figure 4 compares the domestic welfare of both the countries in the symmetric and the asymmetric cases.

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 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 $W_i^M \overset{>}{\underset{<}{=}} W_i^P$ when $\alpha \overset{<}{\underset{>}{=}} 0.81$.

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. Thus, there is a prisoner's dilemma in choosing privatization policy in the presence of higher CSR. It represents that an ambitious regulatory framework in both countries is required for a higher degree of CSR in an international bilateral trade.[11] The appropriate policies can provide clear benchmark of CSR-orientation, which induces CSR-firms to be more sustainable with international CSR

6. Concluding Remarks

We have considered CSR in an international bilateral trade model and examined strategic tariffs and privatization policies. Our analysis provides the strategic interplay between privatization and tariffs policies, of which strategic substitutability crucially depends on the degree of CSR. In particular, we demonstrated that privatization policy will raise strategic tariff and worsen (improve) domestic welfare when the degree of CSR is low (high). It implies that the active role of governmental guideline for promoting CSR, rather than considering it on a voluntary basis, is necessary. Further, we examined the endogenous choice of privatization policy by the two countries and demonstrated that both the countries choose nationalization policy even though privatization policy in both countries is globally efficient when the degree of CSR is high. Therefore, our analysis indicates that an ambitious regulatory framework in both countries is required for a higher degree of CSR in an international bilateral trade.

This paper used a simple oligopolistic model capable of producing optimal privatization and tariff policies. Further studies under alternative scenarios such as various competition mode with product differentiation, different number of private firms and more general specifications of demand and cost functions between the firms remain as future research.

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[11] As emphasized by Steurer (2010) and Liu et al. (2018), the governments can choose other moderate measures to stimulate and induce firms to better integrate social concerns into business routines.

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:

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

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

The domestic welfare is:

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

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:

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

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, $q^s_{ei} \geq 0$, $\frac{\partial W_i}{\partial q^s_{ei}} \leq 0$ and $q^s_{ei} \cdot \frac{\partial W_i}{\partial q^s_{ei}} = 0$, the necessary condition for having a boundary solution for the public firm's zero export output is as follows:

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

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:

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

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

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

$$q^c_{hj} = \frac{3(14 - \alpha - 2\alpha^2) + (4 - \alpha)(4 + 7\alpha)t_i + 2(1 - \alpha)(16 - 5\alpha)t_j}{3(4 - \alpha)(16 - 5\alpha)}, \quad q^c_{ej} =$$

$$\frac{9 + 6(5 - \alpha)\alpha - 2(4 - \alpha)(7 + 4\alpha)t_i - (1 - \alpha)(16 - 5\alpha)t_j}{3(4 - \alpha)(16 - 5\alpha)}.$$

The domestic welfare in each country is as follows:

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

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

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

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

.

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

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

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

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

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

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

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

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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