Strategic Trade Policy and Managerial Delegation
in a Mixed Duopoly *

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Abstract

This paper incorporates the separation of ownership and management as well as import tariff policy into an international mixed duopoly model in which a home semipublic firm competes with a foreign private firm. We demonstrate three cases to examine how the presence of separation of ownership and management affects the home government’s tariff imposition incentive when a home firm is partially nationalized. We further examine how the move advantage of the home government and firm owners affects their payoffs. It is shown that the home government and home firm prefer to acting as the first mover, while the foreign firm does not always. The ranking of the optimal tariff rates in the three cases (no delegation, government moves first, owners move first) is dependent on the degree of nationalization of the home semipublic firm.

Keywords: strategic trade policy, managerial incentives, mixed duopoly

JEL Classification: C72, F13, L22, L32

1 Introduction

Modern enterprises are characterized by the separation of ownership and management. As indicated by Berle and Means (1932), firms are not behaving as simple profit-maximizers. Fershtman and Judd (1987) and Sklivas (1987) (the FJS model hereafter) designed a manager compensated contract to examine the presence of separation of ownership and management in the imperfect competition. They separated the owners and managers’ decisions into two stages, where, in the first stage, profit-maximizing owners offer compensation schemes to

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their managers and in the second stage, managers compete in quantities under precommitted compensation schemes. The FJS model clarified that firms behave as strategic leaders with a distorted (nonprofit-maximizing) objective function.

Since only a few papers analyzed managerial delegation involving international trade,¹ this paper incorporates the separation of ownership and management as well as import tariff policy to examine both firms and government’s strategic behaviors in a home market model. We add one more stage for government’s import tariff policy decision and extend the framework to an international mixed duopoly in which a home semipublic firm competes with a foreign private firm as in Chao and Yu (2006) and Chang (2007). Furthermore, we focus on the alternative move order of home government and firm owners, that is, the model wherein the home government moves first and that wherein the firm owners move first. In the research of mixed oligopoly, a number of papers² examined the alternative move orders of the public firm and private firm, but to our knowledge, no paper has discussed the move advantage between the governments and firms. This paper challenges to fill this blind spot.

This paper extends Wei (2010a) into an international mixed duopoly model. We clarify how the public ownership affects the government’s import tariff policy in the presence of separation of ownership and management. We also elucidate that acting as a Stackelberg leader mover may not lead to the higher payoff in view of the strategic behaviors of government and owners. We further find that the mutual relationship between the import tariff policy and managerial delegation is dependent on their alternative move orders and the degree of nationalization of the home semi-public firm. When home government moves first, the tariff policy works as a complement to managerial delegation only when the nationalization degree is small. However, when owners move first, managerial delegation always works as a substitute for the tariff policy independent of the nationalization degree.

The rest of the paper is organized as follows. Section 2 and 3 introduce the setup of the model and the benchmark case of Chao and Yu (2006). Sections 4 and 5 investigate two models considering the different timing of import tariff and managerial delegation decisions. Section 6 compares the equilibrium results in the three cases. The concluding remarks are summed in Section 7.

¹ Das (1997) applied an FJS-style delegation to a strategic trade policy model and clarified that managerial delegation reduces the scale of trade intervention in the quantity competition. Miller and Pazgal (2001) introduced the “relative performance” contract, which is a linear combination of own profit and the rival firm’s profit, to discuss the effects of traditional strategic trade policies. Wei (2010b) indicated that managerial delegation induces the firm to act as though it were subsidized with an optimal government subsidy in Brander and Spencer (1985).
2 Model Setup
Following Brander and Spencer (1984), we assume that a home firm (labeled as H) and a foreign firm (labeled as F) produce a homogeneous product and compete à la Cournot in the home market. The home firm is a semi-public firm and the foreign firm is a private one. The home government imposes a specific tariff \( t \) to the foreign imports. Each firm has a constant marginal cost \( c^0_i (i = H, F) \) and \( c^0_F < c^0_H \).\(^3\)

Let \( q_i (i = H, F) \) denote the output produced by firm \( i \) and \( Q = q_H + q_F \) the total output. The home market’s inverse demand function is \( P (Q) \) with \( P' (Q) < 0, \ P'' (Q) = 0 \).

Denote \( c_i \) as firm \( i \)’s effective (tax-inclusive) cost, i.e., \( c_H = c^0_H + t, \ c_F = c^0_F + t \). Firm \( i \)’s profit function is given by

\[
\pi_i (q, c_i) = (P (Q) - c_i) q_i, \quad (i = H, F)
\]

where \( q = (q_H, q_F) \) represents the output profile.

The home country’s welfare is a sum of consumer surplus, home firm’s profit and tax revenue as below:

\[
W_H (q, t) = CS(Q) + (P (Q) - c_H) q_H + t q_F,
\]

where \( CS (Q) = \int_0^Q P (z) dz - P (Q) Q \) denotes the consumer surplus in the home country.

3 Case N (benchmark case): No Managerial Delegation (Chao and Yu (2006))
We first consider a basic two-stage game without managerial delegation. In the first stage, the home government decides the import tariff rate. In the second stage, the two firms compete in the home market. Let \( k \) be the share of state ownership in the home firm. \( k \in [0, 1] \) is exogenously given and regarded as the degree of nationalization.

The home semi-public firm aims to maximize a weighed average of home welfare and firm profit as in Matsumura (1998).

\[
U_H (q, t; k) = kW_H (q, t) + (1 - k) \pi_H (q, c_H)
= k [CS(Q) + t q_F] + \pi_H (q, c_H)
\]

The above objective function shows that when \( k = 1 \), the home firm is a purely public firm and when \( k = 0 \), the home firm is a purely private firm.

The foreign firm’s objective function is the own profit function in (1). Denote \( R^H (q_F; k) \) as

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\(^3\) Many papers adopted that the public firm is not efficient as the private firm in the mixed oligopoly research.
home semi-public firm, and $R^H(q_H, t)$ as foreign private firm’s reaction function. The following first-order conditions (FOCs hereafter) should be satisfied as below:

\[ 0 = P(R^H(\cdot) + q_F) - c_H + R^H(\cdot) P'(R^H(\cdot) + q_F) - k(R^H(\cdot) + q_F) P'(R^H(\cdot) + q_F) \]  \quad (2)

\[ 0 = P(R^H(\cdot) + q_F) - c_F + R^F(\cdot) P'(R^H(\cdot) + q_F) \]  \quad (3)

The characteristics of the reaction functions yield $-1 < R^H_q = -\frac{1-k}{2-k} < 0$, $R^H_k = \frac{Q}{2-k} > 0$, $-1 < R^F_q = -\frac{k}{2} < 0$ and $R^F_k = \frac{Q}{2^m} < 0$ as shown in Figure 1. Note that when $k = 1$, the home firm’s reaction curve is vertical, as shown in Matsumura (2003).

Denote $q_i(t, k)$ as firm $i$’s equilibrium output where $\hat{q}_H = R^H(q_F(\cdot) (t, k), k)$ and $\hat{q}_F = R^F(\hat{q}_H (t, k), t)$. Comparative statics results yield:

\[ \frac{\partial q_H(t, k)}{\partial t} = -\frac{1-k}{P'(3-k)} > 0 \quad , \quad \frac{\partial q_F(t, k)}{\partial t} = -\frac{2-k}{P'(3-k)} < 0 \]

\[ \frac{\partial q_H(t, k)}{\partial k} = \frac{2Q}{3-k} > 0 \quad , \quad \frac{\partial q_F(t, k)}{\partial k} = -\frac{Q}{3-k} < 0 . \]

The import tariff $t$ always increases the home firm’s output and reduces the foreign firm’s output due to the strategic rent-shifting effect. The higher weight of welfare in the home semi-

Figure 1: Home and Foreign Firm’s Reaction Curve
public firm, the larger (smaller) the home (foreign) output. That is, increasing the degree of nationalization pushes the home firm to enlarge production so as to lower the market price.

Next, for the government decision, the home government chooses the optimal tariff to maximize its own welfare. The welfare function can be rewritten as $\hat{W}_H(t, k) = W_H(\hat{q}_H(t, k), \hat{q}_F(t, k), t)$. Differentiating $\hat{W}_H(t, k)$ with respect to $t$ yields

$$0 = \frac{\partial \hat{W}_H(t, k)}{\partial t} = -q_F \left( \frac{\partial P(\hat{q}_H + \hat{q}_F)}{\partial t} - 1 \right) + (p - c^0_H) \frac{\partial \hat{q}_H}{\partial t} + t \frac{\partial \hat{q}_F}{\partial t}.$$  \hspace{1cm} (4)

The first item in (4) captures the terms-of-trade effect that if the tariff raises the market price higher than the tariff, it worsens domestic welfare. The second item shows the resource allocation effect through an increase in the domestic firm’s output and thus improves domestic welfare. The third item reflects the tariff revenue effect. The optimal tariff in the equilibrium $t^*(k)$ is always positive shown as below.

$$t^*(k) = -q_F P + (p - c^0_H) \frac{1}{2-k} > 0.$$  

Differentiating $t^*(k)$ with respect to $k$ yields

$$\frac{dt^*(k)}{dk} = -\frac{\partial q_F}{\partial k} P^* + P^* \frac{\partial (q_H + q_F)}{\partial k} \frac{1}{2-k} - (p - c^0_H) \frac{1}{(2-k)^2}$$

$$= \frac{(3-2k)QP^*}{(3-k)(2-k)} - \frac{p - c^0_H}{(2-k)^2} < 0.$$  

When increasing the degree of nationalization of the home firm, the home government has weaker incentive to impose tariff to the foreign imports. That is, nationalization of the home firm leads to an increase of market supply and reduces the market price. The resource allocation effect fades and the government’s tariff imposition incentive becomes weaker.

4 Case G: Government Moves First (Chang (2007))

In the next two sections, we assume that each firm has one owner and one manager. Each owner designs an incentive contract to compensate its manager, which is expressed as a weighted-average combination of the firm’s profit and sales, as shown in Fershtman and Judd (1987).

$$M_i(q, \beta_i, c_i) = \beta_i \pi_i(q, c_i) + \beta_i (1 - \beta_i) P(Q) q_i$$

$$= [P(Q) - \beta_i c_i] q_i.$$  \hspace{1cm} (5)
where $\beta_i$ is the weight on the firm’s profit in the contract.

Note that the manager is paid $A_i + B_i M_i$ for some constants $A_i$ and $B_i$, with $B_i > 0$. The participation constraint is satisfied, i.e., $AA_i + B_i M_i = \overline{K}$ and the constant $\overline{K}$ is normalized to 0.\(^4\)

We adopt the owner’s subsidy equivalent approach in Wei (2010b). We term $\sigma_i$ as owner’s subsidy (or tax) equivalent of firm $i$ as below:\(^5\)

$$\sigma_i := c_i - \beta_i c_i = (1 - \beta_i) c_i,$$

where $\sigma_i$ captures the cost difference between the owner’s delegation and nondelegation behavior. In view of the definition of $\sigma_i$ in (6), we can rewrite (5) as follows:

$$M_i (q, c_i, \sigma_i) = \left[ P (Q) - c_i + \sigma_i \right] q_i.$$

Following Chang (2007), we consider a three-staged game wherein the home government moves first against firm owners. The timing of the game is as follows. In the first stage, the home government sets the import tariff rate. In the second stage, each firm’s owner employs a manager and designs its optimal contract. In the third stage, each manager determines its production quantity competing à la Cournot.

### 4.1 Output Stage Equilibrium

We solve the game by backward induction. Denote firm $i$’s reaction function in the third stage as $\Gamma^i(q, \bar{c}_i)$ where $\bar{c}_i := c_i - \sigma_i$. In view of (7), the managers decide their optimal outputs satisfying the following FOC:

$$0 = P (\Gamma^i() + q_j) + \Gamma^i() P^i (\Gamma^i() + q_j) - \overline{c}_i,$$

where $\Gamma^i() = \frac{\partial \Gamma^i()}{\partial q_j} = -\frac{1}{2} < 0$ and $\Gamma^i() = \frac{\partial \Gamma^i()}{\partial \bar{c}_i} = \frac{1}{2P} < 0$.

Denote firm $i$’s equilibrium output in the third stage as $q_i^* (\bar{c}_i, \bar{c}_j)$, which yields $\frac{\partial q_i^*(\bar{c}_i, \bar{c}_j)}{\partial \sigma_i} = \frac{2}{3P} > 0$ and $\frac{\partial q_i^*(\bar{c}_i, \bar{c}_j)}{\partial \bar{c}_i} = \frac{1}{3P} < 0$. Managerial delegation expands the own firm’s best response output and reduces the rival firm’s output.

### 4.2 Contract Stage Equilibrium

In the second stage, each owner decides $\sigma_i$ in the incentive contract to maximize its own objective function as follows:

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\(^5\) We regard as the owner’s subsidy equivalent if $\sigma_i > 0$ and owner’s tax equivalent if $\sigma_i < 0$. 
\[ U_H^\ast (\sigma, t; k) = kW_H (q_H^\ast (\mathbf{c} - \sigma), q_F^\ast (\mathbf{c} - \sigma), t) + (1 - k)\pi_H (q_H^\ast (\mathbf{c} - \sigma), q_F^\ast (\mathbf{c} - \sigma), \sigma_H^0), \]
\[ \pi_F^\ast (\sigma, t) = \pi_F (q_F^\ast (\mathbf{c} - \sigma), q_H^\ast (\mathbf{c} - \sigma), \sigma_H^0 + t) \]

where \( \sigma = (\sigma_H, \sigma_F) \) denotes the owner’s subsidy equivalent profile.

The FOCs for maximizing each firm’s objective function are given by

\[
0 = [p - c_H + q_H P^t - kQ P^t] \left( -\frac{\partial q_H^*}{\partial \mathbf{c}_H} \right) + [kQ P^t + kt + q_H P^t] \left( -\frac{\partial q_H^*}{\partial \mathbf{c}_H} \right) 
\]
\[
0 = [p - c_F + q_F P^t] \left( -\frac{\partial q_F^*}{\partial \mathbf{c}_F} \right) + q_F P^t \left( -\frac{\partial q_F^*}{\partial \mathbf{c}_F} \right).
\]

Using \( \frac{\partial q_H^*}{\partial \mathbf{c}_H} = \Gamma_H \frac{\partial q_H^*}{\partial \mathbf{c}_H} = -\frac{3}{2} \frac{\partial q_H^*}{\partial \mathbf{c}_H} \) and \( \frac{\partial q_F^*}{\partial \mathbf{c}_F} \neq 0 \), the above equations can be rewritten as

\[
0 = p - c_H + \frac{1}{2} [q_H P^t - kQ P^t - kt], \quad (9)
\]
\[
0 = p - c_F + \frac{1}{2} q_F P^t. \quad (10)
\]

Putting (8) into the above FOCs, we get:

\[ \sigma_H = -\frac{1}{2} \left[ q_H P^t + kQ P^t + kt \right], \quad \sigma_F = -\frac{1}{2} q_F P^t. \]

Without government intervention when \( t = 0 \), both owners have incentives to design a positive subsidy equivalent contract, i.e., \( \sigma_H, \sigma_F > 0 \).

Denote \( \gamma_H^t (\sigma_F, t; k) \) as home owner and \( \gamma_F^t (\sigma_H, t) \) foreign owner’s reaction function in the second-stage. Evaluating \( q^*_i (c_i - \sigma_i, c_j - \sigma_j) \) into (9) (10) yields:

\[
\gamma_H^t (\sigma_F, t; k) = -\frac{1}{2} q_H P^t + kQ P^t + kt \]
\[
\gamma_F^t (\sigma_H, t; k) = -\frac{1}{2} q_F P^t \]
\[
\gamma_H^t (\sigma_F, t; k) = -\frac{3}{4} (Q P^t + t) \]
\[
\gamma_F^t (\sigma_H, t; k) = -\frac{1}{4} \]
Depict the two owners’ reaction curves in Figure 2. The two reaction curves are downward sloping since \( \gamma_H^F \), \( \gamma_H^F < 0 \). Note when \( k = 1 \), the home firm owner’s reaction curve is vertical. An increase in the degree of nationalization \( k \) always shifts the home reaction curve outward, i.e., \( \gamma_H^F \rvert_{k>0} > 0 \) without government intervention. That is, shifting the home owner’s reaction curve outward expands the home output. An increase in the import tariff always shifts the foreign reaction curve downward, i.e., \( \gamma_F^F < 0 \), but the effect to the home reaction curve is dependent on the value of \( k \), since \( \gamma_H^F \) is positive if \( k < 1/4 \) and negative if \( k > 1/4 \). When \( k \) is not small enough, an increase in the import tariff shifts the home reaction curve inward. Since the home firm puts more weight on the welfare, shifting the home owner’s reaction curve inward strengthens foreign owner’s subsidization incentive and expands foreign firm’s output as well as total output.

Denote firm \( i \)'s optimal owner’s equivalent as \( \sigma_i(t; k) \). The comparative statics results yield the following results:

\[
\frac{\partial \sigma_i(t; k)}{\partial t} = \gamma_H^H + \gamma_H^F \gamma_F^H \frac{2(1 - 3k)}{5 - k}, \quad \frac{\partial \sigma_i(t; k)}{\partial t} = \gamma_F^F + \gamma_F^H \gamma_H^F \frac{3 - 2k}{5 - k} < 0.
\]

(11)

Figure 2: Home and Foreign Owner’s Reaction Curves
\[
\frac{\partial\sigma^*(t; k)}{\partial k} \bigg|_{t=0} = \frac{\gamma^u_t}{1 - \gamma^u_t \gamma^F_t} = -\frac{4OP^*}{5 - k} > 0 , \quad \frac{\partial\sigma^*(t; k)}{\partial k} \bigg|_{t=0} = \frac{\gamma^F_t \gamma^H_t}{1 - \gamma^u_t \gamma^F_t} = \frac{OP^*}{5 - k} < 0 .
\]

(12)

An increase in the import tariff rate makes the foreign firm less efficient due to the increase in marginal cost. Thus, the foreign owner has a weaker subsidization incentive as indicated by de Meza (1986). However, the effect to the home semi-public firm is dependent on the degree of nationalization. When \(k\) is large, the home firm concerns more on the home welfare which includes the consumer surplus and tax revenue. The home owner’s subsidization incentive becomes weaker because the combination of home owner’s subsidization and import tariff reduces the foreign product too much and thus loses the tax revenue.

The resulting equilibrium output can be rewritten as \(q^*_H(t; k) = q^*_F(c - \sigma^*(t; k))\). Differentiating with respect to \(t\) yields:

\[
\frac{\partial q^*_H(t; k)}{\partial t} = \frac{\partial q^*_H(.)}{\partial \sigma_H} \frac{\partial \sigma_H}{\partial t} + \frac{\partial q^*_H(.)}{\partial c_F} \frac{\partial c_F}{\partial t} = \frac{5k - 4}{P(5 - k)} \tag{13}
\]

\[
\frac{\partial q^*_F(t; k)}{\partial t} = \frac{\partial q^*_F(.)}{\partial \sigma_F} \frac{\partial \sigma_F}{\partial t} + \frac{\partial q^*_F(\cdot)}{\partial \sigma_H} \frac{\partial \sigma_H}{\partial t} = \frac{5(3 - 2k)}{P(5 - k)} < 0 \tag{14}
\]

\[
\frac{\partial q^*_F(t; k)}{\partial k} = \frac{\partial q^*_F(\cdot)}{\partial \sigma_H} \frac{\partial \sigma_F}{\partial k} + \frac{\partial q^*_F(\cdot)}{\partial \sigma_F} \frac{\partial \sigma_H}{\partial k} = \frac{3Q}{5 - k} > 0 \tag{15}
\]

\[
\frac{\partial q^*_H(t; k)}{\partial k} = \frac{\partial q^*_H(\cdot)}{\partial \sigma_F} \frac{\partial \sigma_F}{\partial k} + \frac{\partial q^*_H(\cdot)}{\partial \sigma_H} \frac{\partial \sigma_H}{\partial k} = \frac{-2Q}{5 - k} < 0 \tag{16}
\]

An increase in the import tariff rate always reduces foreign product, but it increases domestic product only if the degree of nationalization \(k\) is not large enough. In the case of pure public firm when \(k = 1\), an increase in the import tariff reduces the public firm’s output. The resulting total output can be rewritten as \(Q^* (t; k) = q^*_H (t; k) + q^*_F (t; k)\).

### 4.3 Tariff Stage Equilibrium

In the first stage, the home country’s welfare function can be rewritten as \(W^*_H (t; k) = W^*_H (q^*_H (t; k), q^*_F (t; k), t)\). Differentiating with respect to \(t\) yields

\[
\frac{\partial W^*_H(t; k)}{\partial t} = -q^*_F \left( \frac{\partial (q^*_H + q^*_F)}{\partial t} - 1 \right) + (p - c_H) \frac{\partial q^*_H}{\partial t} + t \frac{\partial q^*_F}{\partial t} .
\]

Substituting (9) (13) and (14) into the above equation, we get
\[(3 - 2k) q_f P^r + \frac{1}{2} (q_H P^r - k Q P^r - k t)(4 - 5k) + 2t(3 - 2k) = 0.\]

Solving for \(t\) yields the equilibrium tariff as below.\(^5\)

\[t^G = \frac{-P^r}{12 - 12k + 5k^2} [(6 - 8k + 5k^2) Q - (2 + k) q_H] > 0\]

(17)

where the superscript \(G\) denotes the equilibrium results under Case \(G\). In the presence of separation of ownership and management, the home government still has incentive to impose tariff to the foreign imports.

In view of the owner’s subsidy equivalent in the managerial delegation, we define the effective tariff rate as the government import tariff exclusive of owner’s subsidy equivalent as below.

\[T^G := t^G - \sigma^G = \frac{-P^r}{12 - 12k + 5k^2} [(6 - 8k + 5k^2) Q - (2 + k) q_H] + \frac{1}{2} q_f P^r\]

\[= \frac{-P^r(5k - 4)}{12 - 12k + 5k^2} [k Q + (k - 2) q_H]\]

Note that \([k Q + (k - 2) q_H]\) is increasing with \(k\). The sign of \([k Q + (k - 2) q_H]\) as well as \(T^G\) is ambiguous. When \(k\) is large enough, \(T^G > 0\) holds. When \(k\) is small enough, the import tariff may be canceled out by the managerial delegation, that is, the foreign firm maybe subsidized by the home government actually. Therefore, the effective tariff rate to the foreign firm is dependent on the degree of home firm’s nationalization.

### 5 Case O: Owners Move First

Next, consider the case when the owners move first against home government. The timing of the game is as follows. In the first stage, the owners determine their optimal incentive contracts. In the second stage, the home government sets the import tariff rate, and the third stage is the same

\(^5\) From (9) and (10), We get the equation

\[c^e - c^h + \frac{P^r}{2} (q_a - k Q - q_f) = 0\]

without government intervention. Since \(c^e < c^h\), then we get \(q_H < \frac{1}{2} - Q\). Substituting the result into (17), we find the equilibrium tariff is always positive.
as Case G in the previous section.

5.1 Tariff Stage Equilibrium

The equilibrium outputs in the third stage is the same as those in Case G, i.e., \( q_i^* (\bar{e}) \) in Section 4.1. Then, we solve the game from the second stage. Using the results in Section 4.1, the FOC for maximizing home country’s welfare yields

\[
0 = -q_F \left( \frac{\partial P(Q^*)}{\partial c_F} - 1 \right) + (p - c_H) \frac{\partial q_H^*}{\partial c_F} + t \frac{\partial q_F^*}{\partial c_F} + 2q_F P' + q_H P' + \sigma_H + 2t.
\]

Denote the equilibrium tariff rate in the second stage as \( t^*(\sigma) \). The effects of managerial delegation to the import tariff yield:

\[
\frac{\partial t^*(\sigma)}{\partial \sigma_H} = -\frac{2P \frac{\partial q_H}{\partial c_F} + P \frac{\partial q_H^*}{\partial c_F} + 1}{2P \frac{\partial q_H}{\partial c_F} + P \frac{\partial q_H^*}{\partial c_F} + 2} = -\frac{1}{3}
\]

(18)

\[
\frac{\partial t^*(\sigma)}{\partial \sigma_F} = \frac{2P \frac{\partial q_F}{\partial c_F} + P \frac{\partial q_F^*}{\partial c_F}}{2P \frac{\partial q_F}{\partial c_F} + P \frac{\partial q_F^*}{\partial c_F} + 2} = \frac{1}{3}
\]

(19)

The above results show that the home owner’s subsidy equivalent contract reduces the equilibrium import tariff rate since managerial delegation expands the home firm’s production and weakens its resource allocation effect. However, the foreign owner’s subsidy equivalent contract increases the equilibrium import tariff rate since the expansion of foreign production strengthens the tariff revenue effect.

In view of the comparative statics results in Case G in (11), the mutual relationship between the import tariff policy and managerial delegation is dependent on their move orders and the degree of nationalization. When home government moves first, the tariff policy strengthens (weakens) the home owner’s subsidization incentive if \( k < (>) \frac{1}{2} \). However, when owners move first, home managerial delegation always weakens the home government’s tariff imposition incentive.

**Proposition 1** When the home government moves first, the tariff policy is a complement (substitute) to managerial delegation if \( k \) is small (large). When owners move first, managerial delegation is always a substitute to the tariff policy.
Since $\tilde{c}_H (\sigma_H) = c^0_H - \sigma_H$ and $\tilde{c}_F (\sigma) = c^0_F - \sigma_F + \ell' (\sigma)$, the equilibrium output can be rewritten as $q^*_i (\sigma) = q^*_i (\tilde{c}_H (\sigma), \tilde{c}_F (\sigma))$. Differentiating with respect to $\sigma_k (k = H, F)$ yields

$$\frac{\partial q^*_H (\sigma)}{\partial \sigma_H} = \frac{\partial q^*_H}{\partial \sigma_H} + \frac{\partial q^*_H}{\partial \sigma_F} \frac{\partial \ell'}{\partial \sigma_H} = - \frac{5}{9 P'} > 0, \quad \frac{\partial q^*_F (\sigma)}{\partial \sigma_H} = \frac{\partial q^*_F}{\partial \sigma_H} \left( \frac{\partial \ell'}{\partial \sigma_F} - 1 \right) = \frac{2}{9 P'} < 0,$$

$$\frac{\partial q^*_H (\sigma)}{\partial \sigma_H} = \frac{\partial q^*_H}{\partial \sigma_H} + \frac{\partial q^*_H}{\partial \sigma_F} \frac{\partial \ell'}{\partial \sigma_F} = \frac{1}{9 P'} < 0, \quad \frac{\partial q^*_F (\sigma)}{\partial \sigma_F} = \frac{\partial q^*_F}{\partial \sigma_F} \left( \frac{\partial \ell'}{\partial \sigma_F} - 1 \right) = \frac{4}{9 P'} > 0.$$

As shown in Wei (2010a), the owner’s managerial delegation affects the equilibrium output in two ways: the direct effect and the indirect effect through tariff imposition. Due to the latter indirect effect, both the home firm and the foreign firm’s managerial delegation makes the output change smaller compared to the case without government intervention.

### 5.2 Contract Stage Equilibrium

Each firm’s objective function in the first stage is rewritten as follows:

$$U^*_H (\sigma; k) = U_H (q^*_H (\sigma), q^*_F (\sigma), \ell' (\sigma); k)$$

$$\pi^*_F (\sigma) = \pi_F (q^*_F (\sigma), q^*_H (\sigma), \ell' (\sigma)).$$

For the home semi-public firm, the FOC is given by

$$\frac{\partial U^*_H (\sigma; k)}{\partial \sigma_H} = \frac{\partial U_H}{\partial q^*_H} \frac{\partial q^*_H}{\partial \sigma_H} + \frac{\partial U_H}{\partial q^*_F} \frac{\partial q^*_F}{\partial \sigma_H} + \frac{\partial U_H}{\partial \ell'} \frac{\partial \ell'}{\partial \sigma_H}$$

$$= \left[ - kQ P' - \sigma_H \right] \frac{\partial q^*_H}{\partial \sigma_H} + \left( - kQ P' + k + q_H P' \right) \frac{\partial q^*_F}{\partial \sigma_H} + k q_F \frac{\partial \ell'}{\partial \sigma_H}.$$

The above FOC can be decomposed into three effects. The first item in (20) shows the excess competition effect of managerial delegation. The second item represents the marginal gain due to the rent-shifting effect. The third item shows the home welfare loss due the import tariff imposition.

The optimal owner’s subsidy equivalent for the home firm can be derived as follows.

$$\sigma^*_H = -\frac{7k + 2}{10 - k} q_H P' > 0,$$

where the superscript O denotes the equilibrium results under Case O. The domestic owner’s subsidy equivalent is positive, i.e., $\sigma^*_H > 0$. That is, the payoff gain effects outweigh the loss.
ones. Home owner designs a subsidy equivalent contract.

For the foreign firm, the FOC is given by

\[
\frac{\partial \pi_F^*(Q)}{\partial \sigma_F} = \frac{\partial \pi_F}{\partial q_F} \frac{\partial q_F^*}{\partial \sigma_F} + \frac{\partial \pi_F}{\partial q_H} \frac{\partial q_H^*}{\partial \sigma_F} + \frac{\partial \pi_F}{\partial t} \frac{\partial t^*}{\partial \sigma_F} = -\sigma_F \frac{\partial q_F^*}{\partial \sigma_F} + q_F P(Q) \frac{\partial q_H^*}{\partial \sigma_F} - q_F \frac{\partial t^*}{\partial \sigma_F},
\]

where the first two items show the negative excess competition effect and the positive rent-shifting effect. However, the third item shows the profit loss due to tariff imposition. Increasing \(\sigma_F\) expands foreign firm’s production and thus increases its tariff expenses.

The optimal foreign firm’s owner’s subsidy equivalent can be derived as follows:

\[
\sigma_F^* = \frac{1}{4} q_F P^* < 0.
\]

The foreign owner designs a tax equivalent contract, i.e., \(\sigma_F^* < 0\). Subsidy equivalent contract not only expands the production but also increases the tariff expenses; the sum of the profit loss outweighs the profit gain. Therefore, the foreign owner designs a tax equivalent contract to reduce its production as in Wei (2010a).

**Proposition 2** The foreign owner designs a tax equivalent contract, i.e., \(\sigma_F^* < 0\) if owners play Stackelberg leaders against the home government. This result is independent of the degree of nationalization.

The above result shows that no matter whether the home firm is nationlized or privatized, foreign firm’s owner always designs an incentive contract to reduce its output when the owners move first.

The home government’s optimal tariff in the equilibrium is given by

\[
t^* = -q_F P^* - \frac{4(1-k)}{10-k} q_F P^* > 0.
\]

Needless to say that \(T^O := t^* - \sigma_F^* > 0\). The effective tariff rate to the foreign firm is always positive. Also, the effective tariff rate is higher than the one in Case G, i.e., \(T^O > T^G\).
6 Summary

We summarize the equilibrium results in the three cases under linear demand function in Appendix. For simplicity, we normalize the foreign firm’s unit cost to zero, i.e., $c_k^F = 0$.

6.1 Optimal Tariff Results

In view of the results in Appendix A.1 and Figure 3, we have the following proposition relating to the optimal tariff rates.

**Proposition 3** $t^N > t^O > t^G$ holds when $k = 0$ and $t^G > t^O > t^N$ holds when $k = 1$.

When $k$ is small, privatization leads to the lower supply of product and higher market price. The presence of managerial delegation weakens the importing country’s tax incentive since the resource allocation effect becomes smaller under managerial delegation. Therefore, $t^G$ is the highest. As to $t^G$ and $t^O$, when the owners move first against home government, the government sets the tariff rate without considering its effects on the firms’ managerial delegation decisions, thus $t^O > t^G$ holds. Meanwhile, when increasing $k$, nationalization expands output and reduces the foreign product. The presence of managerial delegation strengthens the government’s tax incentive since the tariff revenue effect becomes larger under managerial delegation. Thus, although increasing $k$ reduces both $t^N$ and $t^O$, $t^O > t^N$ holds when $k$ is large. Note that $t^G$ is increasing in $k$ when $k$ is large enough, so under full nationalization $t^G > t^O > t^N$ holds.

**Lemma 1** Under symmetric cost condition, $t^G = t^O = t^N = 0$ when $k = 1$. The home firm produces under marginal cost pricing and the foreign firm does not enter the market.

When the home firm is fully nationalized, it produces at the marginal-cost pricing. The foreign firm does not enter the market, so the home government does not need to impose tariff. This result is quite familiar in the literatures of mixed oligopoly.

6.2 Owner’s Subsidy Equivalent Results

As for the foreign owner’s subsidy equivalent, it is evident that $\sigma^G_k > \sigma^O_k$ holds since $\sigma^O_k < 0$. However, as for the home owner’s subsidy equivalent, we get the following result shown in Appendix A.2 and Figure 4.

**Proposition 4** $\sigma^O_H < \sigma^G_H$ holds only when home firm’s unit cost is large and $k$ is small enough. Otherwise, the opposite results holds.
In the most cases, home owner’s subsidy equivalent in case G is larger than the one in Case O. When government moves first, import tariff always increase home owner’s subsidy equivalent. However, when the owners move first, increasing home owner’s subsidy equivalent lowers government’s tariff imposition incentive. So the home owner’s subsidy incentive becomes weaker.

### 6.3 Equilibrium Output Results

In view of the results in Appendix A.3-A.4 and Figure 5-6, we have the following results for the equilibrium outputs.

**Lemma 2** Foreign product in Case G, i.e., $q_{F}^{G}$ is always the largest among the three cases. When $k$ is small, $q_{F}^{H} > q_{F}^{O}$ holds and when $k$ is large, $q_{F}^{O} > q_{F}^{N}$ holds.

Since $q_{F}^{G} > q_{F}^{O}$ in most cases, the foreign firm produces the largest output in Case G. As to $q_{F}^{N}$ and $q_{F}^{O}$, we can say that when $k$ is small (large), the presence of managerial delegation reduces (increases) the foreign product.

For home firm’s product, the ranking in the three cases is complex, but the following result holds.

**Lemma 3** When the home firm is fully nationalized, $q_{H}^{N} > q_{H}^{O} > q_{H}^{G}$ holds.

Note the above result is the reverse ranking for the foreign products when the home firm is fully nationalized.

### 6.4 Profit and Welfare Analysis under Symmetric Cost Condition

Next, we examine the firms’ profits and home country’s welfare normalizing $c_{H}^{O} = c_{F}^{O} = 0$ shown in Appendix A.5 and Figure 7-9. Although the ranking of home products in the three cases is ambiguous, the home profit always yields $\pi_{H}^{G} > \pi_{H}^{O} > \pi_{H}^{N}$ independent of $k$. Home firm yields the largest profit when the owners move first. However, for the foreign firm’s profit, $\pi_{F}^{G}$ is the largest one and the comparison of $\pi_{F}^{O}$ and $\pi_{F}^{N}$ is dependent of the value of $k$. Thus, we can say that the presence of separation of ownership and management reduces the foreign firm’s profit.

Since consumer surplus captures a large portion of home country’s welfare, total output result $Q_{H}^{G} > Q_{H}^{O} > Q_{H}^{N}$ leads to home country’s welfare ranking as $W_{H}^{G} > W_{H}^{O} > W_{H}^{N}$. Home country yields the highest welfare under case G wherein home government moves first and the lowest welfare under Case N with no managerial delegation.

Summarizing the above results, we get the following proposition.
Proposition 5 The presence of separation of ownership and management increases the home country's welfare and reduces the foreign firm’s profit independent of \( k \).

Furthermore, it is shown that the move advantage of the home government and firm owners affects their payoffs. Given the separation of ownership and management, when the home government moves first, the home country’s welfare improves. When the firm owners move first, the home firm’s profit always increases, but the foreign firm’s profit increases only when \( k \) is small.

Proposition 6 Given the separation of ownership and management, the home government and home owner prefer to behave as the first mover independent of \( k \), while the foreign owner prefers only when \( k \) is small.

7 Concluding Remarks
This paper examines the government’s import tariff policy with the separation of ownership and management in an international mixed duopoly model when a home firm is partially nationalized. With public ownership, the presence of separation of ownership and management weakens the home government’s tariff imposition incentive if the degree of public ownership is low. When increasing the degree of public ownership, nationalization expands output and reduces the foreign product. This leads the government to strengthen its tariff imposition incentive. Meanwhile, the result that the presence of separation of ownership and management improves home welfare and reduces the foreign firm’s profit is always satisfied in spite of public ownership.

This paper further investigates how the move orders of government and firms affect their payoffs in view of public ownership. Given the separation of ownership and management, when the home government moves first, the home country’s welfare increases, whereas when the firm owners move first, the home firm’s profit increases and the foreign firm is dependent on the degree of public ownership. That is, the home government and home owner prefer to behave as a Stackelberg leader, but the foreign owner is ambiguous. The foreign owner prefers to act as a follower when the degree of public ownership is high. This result clarifies that the home firm’s state ownership affects the foreign firm’s behavior.
Appendix

A Summarized Results

We use a linear inverse demand function as \( P(Q) = a - Q \). For simplicity, \( c_H = c \) and \( c_F \) normalizes to 0. We assume \( a > 2c \) to ensure that the market demand is sufficiently large. Without this assumption, the home firm produces nothing when privatized in the duopolistic competition. The equilibrium results in the three cases are shown as below.

Under Case N

\[
\begin{align*}
  \tau^N &= \frac{(3 - 5k + 2k^2)a + (2 - k)kc}{9 - 8k + 2k^2} > 0 \\
  q^N_H &= \frac{(4 - k)a - (6 - 4k + k^2)c}{9 - 8k + 2k^2}, \quad q^N_F = \frac{(1 - k)a + (3 - 3k + k^2)c}{9 - 8k + 2k^2}
\end{align*}
\]

Under Case G

\[
\begin{align*}
  \tau^G &= \frac{(10 - 19k + 9k^2)a + (11 - 5k)kc}{40 - 44k + 17k^2} > 0 \\
  \sigma^G_H &= \frac{(12 - 2k + 3k^2)a - (24 - 18k + 13k^2)c}{40 - 44k + 17k^2} > 0, \quad \sigma^G_F = \frac{(2 - k - k^2)a + (16 - 21k + 10k^2)c}{40 - 44k + 17k^2} > 0 \\
  T^G &= \tau^G - \sigma^G = \frac{(4 - 5k)(2(1 - k)a - (4 - 3k)c)}{40 - 44k + 17k^2} >= 0 \\
  q^G_H &= \frac{(24 - 22k + 11k^2)a - (48 - 52k + 25k^2)c}{40 - 44k + 17k^2}, \quad q^G_F = \frac{2(2 - k - k^2) + 2c(16 - 21k + 10k^2)}{40 - 44k + 17k^2}
\end{align*}
\]

Under Case O

\[
\begin{align*}
  \tau^O &= \frac{52a(1 - k) + 4c(1 + 8k)}{178 - 97k} > 0 \\
  \sigma^O_H &= \frac{(2 - 7k)(9a - 13c)}{178 - 97k} > 0, \quad \sigma^O_F = \frac{4a(1 - k) + (14 - 5k)}{178 - 97k} < 0 \\
  T^O &= \tau^O - \sigma^O_H = \frac{56a(1 - k) + 9(2 + 3k)c}{178 - 97k} > 0 \\
  q^O_H &= \frac{(9a - 13c)(10 - k)}{178 - 97k}, \quad q^O_F = \frac{16a(1 - k) + 4c(14 - 5k)}{178 - 97k}
\end{align*}
\]
A.1 $\bar{t}^N$ vs. $\bar{t}^O$ vs. $t^O$

Through some tedious computations, we derive

\[ t^N - t^O = \frac{(30 - 81k + 98k^2 - 63k^3 + 16k^4)a - (19 - 5k - 16k^3 + 7k^4)kc}{(9 - 8k + 2k^2)(40 - 44k + 17k^2)} \]
\[ t^N - t^O = \frac{3(22 - 99k + 107k^2 - 30k^3)a - (36 - 100k + 124k^2 - 33k^3)c}{(178 - 97k)(9 - 8k + 2k^2)} \]
\[ t^O - t^O = \frac{(-300 + 16k + 273k^2 + 11k^3)a - (160 - 854k + 617k^2 + 59k^3)c}{(178 - 97k)(40 - 44k + 17k^2)} \]

Define:

\[ A(k) \triangleq \frac{30 - 81k + 98k^2 - 63k^3 + 16k^4}{(19 - 5k - 16k^3 + 7k^4)k} \]
\[ B(k) \triangleq \frac{3(22 - 99k + 107k^2 - 30k^3)}{36 - 100k + 124k^2 - 33k^3} \]
\[ C(k) \triangleq \frac{-300 + 16k + 273k^2 + 11k^3}{160 - 854k + 617k^2 + 59k^3} \]

Then we get:

\[ t^N \equiv t^O \quad \iff \quad \frac{c}{a} \equiv A(k) \]
\[ t^N \equiv t^O \quad \iff \quad \frac{c}{a} \equiv B(k) \]
\[ t^O \equiv t^O \quad \iff \quad \frac{c}{a} \equiv C(k) \quad \text{if} \quad k > 0.22 \]
\[ t^O \equiv t^O \quad \iff \quad \frac{c}{a} \equiv C(k) \quad \text{if} \quad k < 0.22 \]

Depict the above results into the figure where the horizontal axis represents $k$ and the vertical axis represents $c/a$. We assume $0 < c/a < 1/2$ holds. The ranking of optimal tariff can be shown in the following figure. When $k = 0$, $t^N > t^O > t^O$, and when $k = 1$, $t^O > t^O > t^N$ is satisfied.
A.2 $\sigma_i^G$ vs. $\sigma_i^O$

It is clear that $\sigma_i^G > \sigma_i^O$ holds. However, for $\sigma_{ih}$, we get

$$\sigma_{ih}^G - \sigma_{ih}^O = \frac{2[(708 - 1624k + \cancel{1597k^2} - 681k^3)\alpha - (1616 - 4014k + \cancel{3811k^2} - 1404k^3)c]}{(178 - 97k)(\cancel{40} - 44k + 17k^2)}$$

Define:

$$D(k) \overset{def}{=} \frac{708 - 1624k + \cancel{1597k^2} - 681k^3}{1616 - 4014k + \cancel{3811k^2} - 1404k^3}$$

Then we plot the following result in Figure 4.

$$\sigma_{ih}^G - \sigma_{ih}^O \gtrless 0 \iff \frac{c}{a} \gtrless D(k)$$
A.3 \( q_H^N \) vs. \( q_H^G \) vs. \( q_H^O \)

We derive

\[
\begin{align*}
q_H^N - q_H^G &= \frac{(-56 + 174k - 211k^2 + 115k^3 - 22k^4)a + (192 - 428k + 419k^2 - 192k^3 + 33k^4)c}{(9 - 8k + 2k^2)(40 - 44k + 17k^2)} \\
q_H^N - q_H^O &= \frac{(-98 + 235k - 155k^2 + 18k^3)a + (102 + 137k - 202k^2 + 71k^3)c}{(9 - 8k + 2k^2)(178 - 97k)} \\
q_H^G - q_H^O &= \frac{2(336 - 962k + 1083k^2 - 457k^3)a - 4(836 - 1918k + 1678k^2 - 551k^3)c}{(178 - 97k)(40 - 44k + 17k^2)}
\end{align*}
\]

Define:

\[
\begin{align*}
E(k) &\overset{\text{def}}{=} \frac{56 - 174k + 211k^2 - 115k^3 + 22k^4}{192 - 428k + 419k^2 - 192k^3 + 33k^4} \\
F(k) &\overset{\text{def}}{=} \frac{98 - 235k + 155k^2 - 18k^3}{102 + 137k - 202k^2 + 71k^2} \\
G(k) &\overset{\text{def}}{=} \frac{336 - 962k + 1083k^2 - 457k^3}{2(836 - 1918k + 1678k^2 - 551k^3)}
\end{align*}
\]
Then we get the following results.

\[ q_N^* \cong q_H^G \iff \frac{c}{a} \cong E(k) \]
\[ q_N^* \cong q_H^G \iff \frac{c}{a} \cong F(k) \]
\[ q_H^G \cong q_H^G \iff \frac{c}{a} \cong G(k) \]

The ranking of home firm’s output can be shown in the following figure. When \( k = 0 \), there are three rankings dependent on the value of \( \frac{c}{a} \). However, when \( k = 1 \), \( q_N^* > q_H^G > q_H^G \) is always satisfied.

**Figure 5: Comparison of Home Firm’s Output**

A.4  \( q_N^* \) vs. \( q_H^G \) vs. \( q_H^G \)

We derive

\[ q_N^* - q_H^G = \frac{(4 - 34k + 55k^2 - 29k^3 + 4k^4)a - (168 - 382k + 357k^2 - 149k^3 + 23k^4)c}{(9 - 8k + 2k^2)(40 - 44k + 17k^2)} \]
\[ q_N^* - q_H^G = \frac{(34 - 3k - 63k^2 + 32k^3)a + (30 - 197k + 197k^2 - 57k^3)c}{(9 - 8k + 2k^2)(178 - 97k)} \]
\[ q_H^G - q_H^G = \frac{2(36 + 300k - 569k^2 + 233k^3)a + (1728 - 3658k + 2901k^2 - 800k^3)c}{(178 - 97k)(40 - 44k + 17k^2)} \]
Define:

\[ H(k) \overset{\text{def}}{=} \frac{4 - 34k + 55k^2 - 29k^3 + 4k^4}{168 - 382k + 357k^2 - 149k^3 + 23k^4} \]

\[ I(k) \overset{\text{def}}{=} \frac{34 - 3k - 63k^2 + 32k^3}{30 + 197k - 197k^2 + 57k^3} \]

\[ J(k) \overset{\text{def}}{=} \frac{36 + 300k - 569k^2 + 233k^3}{1728 + 3658k - 2901k^2 + 800k^3} \]

Then we get the following results.

\[ q^p \overset{\approx}{=} q^o \iff \frac{c}{a} \overset{\approx}{=} H(k) \]

\[ q^p \overset{\approx}{=} q^o \iff \frac{c}{a} \overset{\approx}{=} I(k) \quad \text{if} \quad k < 0.18 \]

\[ q^p \overset{\approx}{=} q^o \iff \frac{c}{a} \overset{\approx}{=} I(k) \quad \text{if} \quad k > 0.18 \]

\[ q^p \overset{\approx}{=} q^o \iff \frac{c}{a} \overset{\approx}{=} J(k) \]

The ranking of foreign firm’s output can be shown in the following figure. When \( k = 0 \), \( q^o_F > q^p_F \), \( q^N_F \); and when \( k = 1 \), \( q^o_F > q^p_F > q^N_F \) is always satisfied.

![Figure 6: Comparison of Foreign Firm’s Output](image-url)
A.5 Firm’s Profit and Welfare under Symmetric Cost Condition

We then normalize home firm’s marginal cost to zero. For home firm’s profit,

\[
\pi_H^N = \frac{2a^2(4 - k)(2 - 3k + k^2)}{(9 - 8k + 2k^3)^2}, \quad \pi_H^O = \frac{4a^2(3 - 5k + 2k^2)(24 - 22k + 11k^2)}{(40 - 44k + 17k^3)^2},
\]

\[
\pi_H^O = \frac{648a^2(10 - k)(1 - k)}{(178 - 97k)^2}.
\]

![Figure 7: Comparison of Home Firm's Profit](image)

For foreign firm’s profit,

\[
\pi_F^N = \frac{a^2(1 - k)^3}{(9 - 8k + 2k^3)^2}, \quad \pi_F^O = \frac{2a^2(-2 + k + k^2)}{(40 - 44k + 17k^3)^2}, \quad \pi_F^O = \frac{320a^2(1 - k)^3}{(178 - 97k^3)^2}.
\]

For Home country’s welfare,

\[
W_H^N = \frac{a^2(7 - 4k)}{2(9 - 8k + 2k^3)^3}, \quad W_H^O = \frac{a^2(36 - 3k + 13k^2)}{2(40 - 44k + 17k^3)^3},
\]

\[
W_H^O = \frac{3a^2(8620 - 7628k + 1195k^2)}{2(178 - 97k^3)}.
\]
Figure 8: Comparison of Foreign Firm’s Profit

Figure 9: Comparison of Home Country’s Welfare

REFERENCE


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