Strategic Managerial Delegation in a Reciprocal Trade Industry

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Abstract

This note examines the implications of the separation of ownership and management based on a reciprocal markets model. We consider horizontal product differentiation in an international duopoly with symmetric cost functions. We find that in the presence of managerial delegation, both countries' governments have a weaker incentive to tax foreign imports and the price dumping margins become smaller.

1 Introduction

Intra-industry trade was first discussed by Brander[1], and Brander and Krugman [3] later developed a reciprocal trade model and revealed reciprocal dumping in segmented markets. Dixit[5] extended the model to examine the governments' strategic trade policies in oligopolistic industries and examined the rent-shifting effects of the strategic policy implementation. As shown by Brander and Spencer[2], strategic export subsidization induces the domestic firm to become a Stackelberg leader under quantity competition, thus improving its own welfare. Similarly to strategic trade policy, rent-shifting effects can also be found in the strategic managerial delegation model first examined by Fershtman and Judd [6] and Sklivas [7]. They considered a model in which owners offer incentive contracts to their managers, who then compete in quantities under oligopolistic competition. The model clarified that delegating a manager with distorted objective functions also diverts the firm to act as a Stackelberg leader under quantity competition.

However, few studies have linked the similarity between strategic subsidization and managerial delegation. Das[4] analyzed strategic managerial delegation involving international trade policies in both quantity and price settings. Wei[8] reexamined the model in Das[4] and discussed the nature of the equivalent strategic behavior between government trade policy and managerial delegation under duopolistic competition.

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In this note, we examine the owner's subsidization effect hidden in the managerial delegation as in Wei[8], but extend to a reciprocal markets model with product differentiation. We show that the subsidy-equivalent result is satisfied in segmented markets. We also find that the presence of managerial delegation provides both countries' governments with a weaker incentive to tax foreign imports and furthermore, the price dumping margins become smaller.

The rest of the paper proceeds as follows. In section 2, we describe a three-stage government-owner-manager game in a reciprocal trade industry setting. In section 3, we first derive the optimal outputs in segmented markets. In section 4, we examine the equilibrium results in the case without managerial delegation. We then proceed to examine the results in the case with managerial delegation and compare them to show the role of managerial delegation in the next section. Concluding remarks are provided in the last section.

2   Model Setting

We consider a model of a reciprocal trade industry with two countries, domestic and foreign. Each country has one firm producing an imperfect substitute good, which is supplied them to both countries' markets; these markets are segmented from each other as in Dixit [5]. The domestic firm produces good x and the foreign firm produces good y.

2.1   Demand

The aggregate or representative utility functions of the domestic and foreign countries are defined as the following symmetric quasi-linear functions:

$$U(x, y; z) = a(x + y) - \frac{x^2 + y^2}{2} - \gamma xy + z,$$

$$U^*(x^*, y^*, z^*) = a(x^* + y^*) - \frac{x^{*2} + y^{*2}}{2} - \gamma x^* y^* + z^*,$$

where $a > 0$. $x(x^*)$ and $y(y^*)$ denote the consumption of imperfect substitute goods and $z(z^*)$ denotes the consumption of a numeraire competitive good in the domestic (foreign) country.

$\gamma \in (0, 1)$ represents the degree of substitutability between the two goods, x and y. An increase in γ reduces product differentiation. When $\gamma = 0$, product differentiation is sufficiently large, and then each firm acts as a monopolist in the markets. When $\gamma = 1$, the two goods are perfect substitutes (homogeneous). We exclude these two special cases in this note.

Utility maximization subject to the budget constraint yields the following inverse demand functions in the two countries:

$$p_x = a - x - \gamma y, \qquad\qquad p_y = a - y - \gamma x, \qquad\qquad (1)$$

$$p_x^* = a - x^* - \gamma y^*, \qquad\qquad p_y^* = a - y^* - \gamma x^*, \qquad\qquad (2)$$

where $p_x(p_x^*)$ is the domestic (export) price of the domestic firm's good x. Similarly, $p_y^*(p_y)$ is the foreign (export) price of the foreign firm's good y. It is assumed that a is large enough to ensure that each firm finds it profitable to sell in both markets.

2.2 Production

For simplicity, we assume that both firms' outputs are produced at a constant marginal cost, c. Using the inverse demand functions in (1) and (2), the profit functions of the two firms are defined as

$$\pi(\mathbf{x}, \mathbf{y}, t) = \pi_D(x, y) + \pi_F(x^*, y^*, t^*) = (p_x - c)x + (p_x^* - c - t^*)x^*,$$
$$\pi^*(\mathbf{y}, \mathbf{x}, t) = \pi_D^*(y^*, x^*) + \pi_F^*(y, x, t) = (p_y^* - c)y^* + (p_y - c - t)y,$$

where $t(t^*)$ is the specific import tariff imposed by the domestic (foreign) government. Because of the existence of segmented markets, both firms' profits can be divided into two parts: profit in the domestic market, represented by the subscript D, and profit in the foreign market, represented by F.

2.3 Managerial Delegation

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 profits and sales as in Fershtman and Judd [6] and Sklivas [7]. Because the markets are segmented, the contract terms (weighted-average terms) are different between the domestic and foreign markets. As for the domestic owner, we denote β_D as the contract term for sales in the domestic market and β_F for exports to the foreign market.

The incentive contract function for the domestic manager is

$$m = \beta_D\, \pi_D(x, y) + (1 - \beta_D)p_x x + \beta_F \pi_F(x^*, y^*, t^*) + (1 - \beta_F)p_x^* x^*$$
$$= (a - x - \gamma y - \beta_D c)x + [a - x^* - \gamma y^* - \beta_F(c + t^*)]x^*. \tag{3}$$

We term the owner's subsidy equivalent, which is defined as the difference between the effective cost and real cost as in Wei[8]. ϕ_D is denoted as the owner's subsidy equivalent in the contract for the domestic market and ϕ_F as that for the foreign market including the import tariff:

$$\phi_D(\beta_D) := c - \beta_D c = c(1 - \beta_D) \qquad , \qquad \phi_F(\beta_F, t^*) := (c + t^*)(1 - \beta_F). \tag{4}$$

As shown in Wei[8], the defining owner's subsidy (or tax) equivalent is convenient to clarify the role of strategic managerial delegation. By manipulating an incentive contract, the owner can divert the manager's objective from pure profit maximization to attain the subsidization (or taxation) objective. In a third market model as in Brander and Spencer[2], managerial delegation makes the firms realize the outputs under the governments' export (production) subsidization. That is, the owner's subsidy equivalent takes the role of government subsidization under oligopolistic competition.

Using the definitions in (4), we rewrite (3) as the following two parts:

$$m = M_D(x, y, \phi_D) + M_F(x^*, y^*, t^*, \phi_F)$$
$$= \pi_D(x, y) + \phi_D x + \pi_F(x^*, y^*, t^*) + \phi_F x^*$$
$$= (a - x - \gamma y - c + \phi_D)x + (a - x^* - \gamma y^* - c - t^* + \phi_F)x^*$$

In this note, we examine the segmented owner's subsidy equivalents in a reciprocal trade industry. ϕ_D acts as the production subsidy and ϕ_F acts as the export subsidy as in Dixit[5]. However, differently from Dixit[5], the objection functions used to determine the owners' subsidy equivalents do not include consumers' utilities.

The corresponding contract function for the foreign manager is

$$m^* = M_D^*(y^*, x^*, \phi_D^*) + M_F^*(y, x, t, \phi_F^*)$$
$$= \pi_D^*(y, x) + \phi_D^* y^* + \pi_F^*(y, x, t) + \phi_F^* y$$
$$= (a - y^* - \gamma x^* - c + \phi_D^*)y^* + (a - y - \gamma x - c - t + \phi_F^*)y,$$

where

$$\phi_D^*(\beta_D^*) := c(1 - \beta_D^*) \qquad , \qquad \phi_F^*(\beta_F^*, t) := (c + t)(1 - \beta_F^*).$$

Following Das[4], we explore a three-stage government-owner-manager game. In the first stage, each country's government simultaneously determines the country-specific import tariff rate (t, t^*). In the second stage, each owner delegates a manager and designs its optimal managerial contract for both domestic and foreign markets $(\beta_D, \beta_F, \beta_D^*, \beta_F^*)$. In the third stage, each manager decides the production quantity (x, x^*, y, y^*) by competing à la Cournot with product differentiation in the two segmented markets. We solve the game by backward induction.

3   Firms' Optimal Outputs and Exports

We first derive the optimal outputs and exports of the domestic and foreign firms. Because the markets are segmented, the Cournot-Nash industry equilibrium is given by the following equations:

$$\frac{\partial M_D(.)}{\partial x} = a - 2x - \gamma y - c + \phi_D = 0 \qquad , \qquad \frac{\partial M_F(.)}{\partial x^*} = a - 2x^* - \gamma y^* - c - t^* + \phi_F = 0, \quad (5)$$
$$\frac{\partial M_D^*(.)}{\partial y^*} = a - 2y^* - \gamma x^* - c + \phi_D^* = 0 \qquad , \qquad \frac{\partial M_F^*(.)}{\partial y} = a - 2y - \gamma x - c - t + \phi_F^* = 0.$$

By simultaneously solving the above first-order conditions (FOCs), we obtain the optimal domestic sales and exports in the two markets:

$$x = X(\phi_D, \phi_F^*, t) = \frac{1}{D}[2(a - c + \phi_D) - \gamma(a - c - t + \phi_F^*)],$$

$$y = Y(\phi_D, \phi_F^*, t) = \frac{1}{D}[2(a - c - t + \phi_F^*) - \gamma(a - c + \phi_D)],$$

$$x^* = X^*(\phi_F, \phi_D^*, t^*) = \frac{1}{D}[2(a - c - t^* + \phi_F) - \gamma(a - c + \phi_D^*)],$$

$$y^* = Y^*(\phi_F, \phi_D^*, t^*) = \frac{1}{D}[2(a - c + \phi_D^*) - \gamma(a - c - t^* + \phi_F)],$$

where $D = 4 - \gamma^2 > 0$. The equilibrium domestic and export prices in the third stage can be written as $p_x = P_x(\phi_D, \phi_F^*, t), p_x^* = P_x^*(\phi_D^*, \phi_F, t^*)$ and $p_y = P_y(\phi_D, \phi_F^*, t), p_y^* = P_y^*(\phi_D^*, \phi_F, t^*)$.

4   Without Managerial Delegation

Before proceeding to the second stage, we first examine the case without managerial delegation. The optimal outputs are determined by pure profit maximization: $\phi_D = \phi_F = \phi_D^* = \phi_F^* = 0$.

The equilibrium price difference between the two markets is shown below.

$$P_x^*(t^*) - P_x(t) = \frac{(2 - \gamma^2)t^* - \gamma t}{D} < t^*, \tag{6}$$

$$P_y(t) - P_y^*(t^*) = \frac{(2 - \gamma^2)t - \gamma t^*}{D} < t.$$

which shows reciprocal dumping as in Brander and Krugman [3].

In view of the FOCs for pure profit maximization, we have $\frac{\partial \pi_D}{\partial x} = a - 2x - \gamma y - c = 0$; then, $\pi_D = (a - x - \gamma y - c)x = x^2$ holds. The equilibrium profit functions can be written as the following simple forms:

$$\Pi(t, t^*) = \Pi_D(t) + \Pi_F(t^*) = X(t)^2 + X^*(t^*)^2,$$

$$\Pi^*(t^*, t) = \Pi_D^*(t) + \Pi_F^*(t^*) = Y^*(t^*)^2 + Y(t)^2.$$

Each country's government decides the optimal import tariff to maximize its welfare. The welfare function is constituted as the sum of consumption surplus, production surplus and tariff revenue (government surplus). The domestic country's welfare function is

$$W(t, t^*) = U(X(t), Y(t)) - P_x(t)X(t) - P_y(t)Y(t) + \Pi_D(t) + \Pi_F(t^*) + tY(t)$$

Differentiating with t yields[1]

$$\frac{\partial W(t, t^*)}{\partial t} = -x\frac{\partial P_x(t)}{\partial t} - y\frac{\partial(P_y - t)}{\partial t} + 2x\frac{\partial X(t)}{\partial t} + t\frac{\partial Y(t)}{\partial t}.$$

Since

$$\frac{\partial^2 W(t, t^*)}{\partial \gamma \partial t} = -\frac{\partial X}{\partial \gamma}\frac{\partial P_x(t)}{\partial t} - x\frac{\partial^2 P_x(t)}{\partial \gamma \partial t} - \frac{\partial Y}{\partial \gamma}\frac{\partial(P_y - t)}{\partial t} + 2\frac{\partial X}{\partial \gamma}\frac{\partial X(t)}{\partial t} + 2x\frac{\partial^2 X}{\partial \gamma \partial t} = 0,$$

the optimal import tariff is independent of γ, the degree of substitutability of the goods.

To maximize national welfare, we derive the following result:

$$t = \frac{\gamma}{2}x + y > 0, \qquad t^* = \frac{\gamma}{2}y^* + x^* > 0,$$

which yields the equilibrium tariff without managerial delegation:

$$T = T^* = \frac{a - c}{3}.$$

The equilibrium outputs for both markets can be shown as follows:

$$X = Y^* = \frac{2(3 - \gamma)(a - c)}{3D} \qquad , \qquad X^* = Y = \frac{(4 - 3\gamma)(a - c)}{3D}. \tag{7}$$

Each firm has a lower market share in its export market than its domestic sales market i.e., $X(= Y^*) > X^*(= Y)$.

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[1] The second-order condition (SOC) is satisfied as $\frac{\partial^2 W(t,t^*)}{\partial t^2} = -\frac{\partial X(t)}{\partial t}\frac{\partial P_x(t)}{\partial t} - \frac{\partial Y(t)}{\partial t}\frac{\partial(P_y - t)}{\partial t} + 2\left[\frac{\partial X(t)}{\partial t}\right]^2 + \frac{\partial Y(t)}{\partial t} = \frac{-3}{D} < 0.$

5   With Managerial Delegation

Next, we examine the case with managerial delegation. We use superscript $\frown$ to indicate the equilibrium under managerial delegation. In view of the Nash-equilibrium results in the third-stage, both firms' owners design optimal incentive contracts for their managers. For the domestic owner, we have

$$0 = \frac{\partial \Pi_D(.)}{\partial \phi_D} = \frac{\partial M_D}{\partial y}\frac{\partial Y(.)}{\partial \phi_D} - \phi_D\frac{\partial X(.)}{\partial \phi_D} = \frac{\gamma^2 x - 2\phi_D}{D},$$

$$0 = \frac{\partial \Pi_F(.)}{\partial \phi_F} = \frac{\partial M_F}{\partial y^*}\frac{\partial Y^*(.)}{\partial \phi_F} - \phi_F\frac{\partial X^*(.)}{\partial \phi_F} = \frac{\gamma^2 x^* - 2\phi_F}{D}.$$

Solving the above FOCs, we find that each firm's owner designs an incentive contract to subsidize both domestic sales and export sales:

$$\phi_D = \frac{\gamma^2 x}{2} > 0 \qquad , \qquad \phi_F = \frac{\gamma^2 x^*}{2} > 0. \tag{8}$$

The corresponding results from the FOCs are satisfied for the foreign owner:

$$\phi_D^* = \frac{\gamma^2 y^*}{2} > 0 \qquad , \qquad \phi_F = \frac{\gamma^2 y}{2} > 0. \tag{9}$$

The difference between the owner's subsidy equivalents in the two segmented markets is dependent on the output difference in the two markets:

$$\phi_D - \phi_F = \frac{\gamma^2}{2}(x - x^*) \qquad , \qquad \phi_D^* - \phi_F^* = \frac{\gamma^2}{2}(y^* - y).$$

The optimal owners' subsidy equivalents can be solved as below:

$$\begin{bmatrix} 2D - 2\gamma^2 & \gamma^3 \\ \gamma^3 & 2D - 2\gamma^2 \end{bmatrix}\begin{bmatrix} \phi_D \\ \phi_F^* \end{bmatrix} = \begin{bmatrix} \gamma^2[2(a-c) - \gamma(a-c-t)] \\ \gamma^2[2(a-c-t) - \gamma(a-c)] \end{bmatrix},$$

which yields

$$\phi_D = \Phi_D(t) = \frac{\gamma^2}{D'}[(4 - 2\gamma - \gamma^2)(a-c) + 2\gamma t],$$

$$\phi_F^* = \Phi_F^*(t) = \frac{\gamma^2}{D'}[(4 - 2\gamma - \gamma^2)(a-c) - (4 - \gamma^2)t],$$

where $D' = 16 - 12\gamma^2 + \gamma^4 = (4 + 2\gamma - \gamma^2)(4 - 2\gamma - \gamma^2) > 0$. We have $\Phi_D'(t) > 0$ and $\Phi_F^{*\prime}(t) < 0$. Since the symmetric results are satisfied for $\Phi_D^*(t^*), \Phi_F(t^*)$, the imposition of the import tariff increases the owner's subsidy equivalent for domestic sales and reduces the owner's subsidy equivalent for foreign export sales.

The equilibrium outputs yield

$$\frac{\partial \widehat{X}(t)}{\partial t} = \frac{\partial X(.)}{\partial \phi_D}\Phi'_D(t) + \frac{\partial X(.)}{\partial \phi_F^*}\Phi_F^{*\prime}(t) + \frac{\partial X(.)}{\partial t} = \frac{4\gamma}{D'} > 0,$$

$$\frac{\partial \widehat{Y}(t)}{\partial t} = \frac{\partial Y(.)}{\partial \phi_D}\Phi'_D(t) + \frac{\partial Y(.)}{\partial \phi_F^*}\Phi_F^{*\prime}(t) + \frac{\partial Y(.)}{\partial t} = \frac{-2(4-\gamma^2)}{D'} < 0.$$

The import tariff increases domestic sales and reduces foreign exports. The negative effect on foreign exports is larger than the positive effect on domestic sales.

The price discrepancy in the two markets is

$$\widehat{P}_x^*(t^*) - \widehat{P}_x(t) = \frac{2[(4-3\gamma^2)t^* - \gamma(2-\gamma^2)t]}{D'} < t^*, \tag{10}$$

$$\widehat{P}_y(t) - \widehat{P}_y^*(t^*) = \frac{2[(4-3\gamma^2)t - \gamma(2-\gamma^2)t^*]}{D'} < t,$$

which also shows the reciprocal dumping in Brander and Spencer(1983). Given symmetric (t, t^*), we represent the domestic firm's price dumping margin in the cases with and without managerial delegation by using (6) and (10).

$$\widehat{\Delta}_{P_x}(\gamma) := \widehat{P}_x(t) - [\widehat{P}_x^*(t^*) - t] = t - \frac{1-\gamma}{2-\gamma-\frac{1}{2}\gamma^2}t = \frac{1-\frac{1}{2}\gamma^2}{2-\gamma-\frac{1}{2}\gamma^2}t, \tag{11}$$

$$\Delta_{P_x}(\gamma) := P_x(t) - [P_x^*(t^*) - t] = t - \frac{1-\gamma}{2-\gamma}t = \frac{1}{2-\gamma}t. \tag{12}$$

We can show that $\widehat{\Delta}'_{P_x}(\gamma) > 0$ and $\Delta'_{P_x}(\gamma) > 0$. An increase in production differentiation (or a decrease in the degree of substitutability γ) reduces the price dumping margin. Furthermore, $\widehat{\Delta}_{P_x} < \Delta_{P_x}$ holds, so the presence of managerial delegation reduces the price dumping margin given the exogenously determined tariff rates.[2]

Using the FOCs in (5) and (8), we can rewrite the profit function as

$$\widehat{\Pi}_D(t) = (a - x - \gamma y - c)x = (x - \phi_D)x = \left(1 - \frac{\gamma^2}{2}\right)\widehat{X}(t)^2.$$

Each country's government decides the optimal import tariff to maximize its national welfare:

$$\widehat{W}(t, t^*) = U(\widehat{X}(t), \widehat{Y}(t)) - \widehat{P}_x(t)\widehat{X}(t) - \widehat{P}_y(t)\widehat{Y}(t) + \widehat{\Pi}_D(t) + \widehat{\Pi}_F^*(t^*) + t\widehat{Y}(t).$$

Differentiating with t yields the following FOC.[3]

$$\frac{\partial \widehat{W}(t, t^*)}{\partial t} = -x\frac{\partial \widehat{P}_x(t)}{\partial t} - y\frac{\partial(\widehat{P}_y - t)}{\partial t} + 2\left(1 - \frac{\gamma^2}{2}\right)x\frac{\partial \widehat{X}(t)}{\partial t} + t\frac{\partial \widehat{Y}(t)}{\partial t}.$$

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[2]This can be explained as (t, t^*) being symmetric transport costs which are exogenous.

[3]The SOC is satisfied as $\frac{\partial^2 \widehat{W}(t,t^*)}{\partial t^2} = -\frac{\partial \widehat{X}(t)}{\partial t}\frac{\partial \widehat{P}_x(t)}{\partial t} - \frac{\partial \widehat{Y}(t)}{\partial t}\frac{\partial[\widehat{P}(t)_y - t]}{\partial t} + 2\left(1 - \frac{\gamma^2}{2}\right)\left[\frac{\partial \widehat{X}(t)}{\partial t}\right]^2 + \frac{\partial \widehat{Y}(t)}{\partial t} = \frac{-4(3-\gamma^2)}{D'} < 0.$

With simple manipulation, we have

$$t = \frac{\gamma(2 - \gamma^2)}{4 - \gamma^2}x + \frac{2 - \gamma^2}{2}y \qquad , \qquad t^* = \frac{\gamma(2 - \gamma^2)}{4 - \gamma^2}y^* + \frac{2 - \gamma^2}{2}x^*.$$

Solving for the above equations, we have the symmetric optimal tariff:

$$\widehat{T} = \widehat{T}^* = \frac{(2 - \gamma^2)(a - c)}{2(3 - \gamma^2)},$$

which is dependent on the degree of product substitutability γ. We can show that $\partial\widehat{T}/\partial\gamma = \frac{-\gamma(a-c)}{(3-\gamma^2)^2} < 0$, which means that an increase in the degree of substitutability (or a decrease in production differentiation) reduces the tariff rate.

Comparing the equilibrium tariff in the case of managerial delegation with the case without, we have

$$\widehat{T} - T = \frac{-\gamma^2}{6(3 - \gamma^2)} < 0. \tag{13}$$

With managerial delegation, each country's government has a weaker incentive to tax foreign imports, i.e., $\widehat{T} < T$. Because managerial delegation has a rent-shifting effect under oligopolistic competition, the incentive to further implement strategic trade policy is dampened. In view of (11) and (12), the price dumping margin becomes even smaller with the lower import tariff rate under managerial delegation.

Result 1. *Managerial delegation dampens the governments' incentives to tax the foreign imports and further reduces the price dumping margin between the markets.*

Note that a decrease in the degree of substitutability γ reduces the tariff discrepancy in (13), $\frac{\partial|\widehat{T}-T|}{\partial\gamma} > 0$. Particularly, when $\gamma = 0$, the two optimal import tariffs are equivalent regardless of whether there is managerial delegation or not, i.e., $T = \widehat{T}$. This is because, under monopoly, firm owners have no incentive to delegate a manager to increase the market shares (see $\phi_D = \phi_F = 0$ in (8)).

For the owners' subsidy equivalents in the equilibrium, we have

$$\widehat{\phi_D} = \widehat{\phi_D^*} = \frac{\gamma^2(4 - \gamma^2)(3 - \gamma - \gamma^2)(a - c)}{(3 - \gamma^2)D'} > 0, \tag{14}$$

$$\widehat{\phi_F} = \widehat{\phi_F^*} = \frac{\gamma^2(16 - 12\gamma - 8\gamma^2 + 4\gamma^3 + \gamma^4)(a - c)}{2(3 - \gamma^2)D'} > 0, \tag{15}$$

which means that $\beta_D, \beta_F, \beta_D^*, \beta_F^* < 1^4$. The above equations also show that $\widehat{\phi_D} > \widehat{\phi_F}$.

Result 2. *Each firm's owner provides a positive subsidy in its managerial contract. The owner's subsidy equivalent in the domestic sales market is larger than in the foreign exports market.*

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[4]For $\widehat{\phi_F}$, it can be shown that $16 - 12\gamma - 8\gamma^2 + 4\gamma^3 + \gamma^4 = (12 - 4\gamma^2)(1 - \gamma) + 4(1 - \gamma^2) + \gamma^4 > 0$.

Comparing the equilibrium outputs in the case of managerial delegation with the case without, we have the following result for $\gamma \in (0, 1)$.

$$\widehat{X} > X \qquad \forall \gamma \qquad , \qquad \widehat{Y} \gtreqqless Y \qquad \text{if and only if} \qquad \gamma \lesseqqgtr \hat{\gamma},$$

where $\hat{\gamma} \in (0, 1)$ satisfies $64 - 72\hat{\gamma} - 24\hat{\gamma}^2 + 33\hat{\gamma}^3 + \hat{\gamma}^4 - 3\hat{\gamma}^5 = 0$. [5]

The owners subsidization with managerial delegation does not always increase the firms' foreign exports. When the goods are homogeneous, the foreign exports decrease.

Result 3. *With managerial delegation, each firm's domestic sales always increase, whereas its foreign exports may decrease dependent on γ. When γ is large enough closing to 1, the foreign exports decrease.*

6 Conclusions

This note extends Wei[8] by using a reciprocal trade model in an international duopoly, and reexamines the implications of the separation of ownership and management with import tariff policy when the markets are segmented. We consider horizontal product differentiation and symmetric costs. We find that in the presence of managerial delegation, both countries' governments have a weaker incentive to tax foreign imports and the price dumping margins become smaller.

This note does not consider an integrated market. Since the markets are segmented, it adopts a simplification by setting the segmented owner's subsidy equivalent in the different markets. It is challenging to consider the uniform owner's subsidy equivalent and examine the changes to both markets. In addition, this note does not consider asymmetric cost functions. The symmetric assumption simplifies the analysis, but has few implications on the cost difference. All the above limitations are challenges for future research.

Appendix

In view of (14) and (15), $\widehat{\phi}_D > \widehat{\phi}_F$ holds. By using (8) and (9), we have $\widehat{X}(= \widehat{Y}^*) = 2\widehat{\phi}_D/\gamma^2$ is larger than $\widehat{X}^* = \widehat{Y} = 2\widehat{\phi}_F/\gamma^2$. Each firm has a lower market share in its export market than its domestic sales market.

Using (7) and (14)(15) , we compare the equilibrium outputs in the case of managerial delegation with the case without as below. For the domestic sales, we have

$$\begin{aligned}
\widehat{X} - X &\propto \frac{(4 - \gamma^2)(3 - \gamma - \gamma^2)}{(3 - \gamma^2)D'} - \frac{3 - \gamma}{3D} \\
&\propto 3(4 - \gamma^2)^2(3 - \gamma - \gamma^2) - (3 - \gamma)(3 - \gamma^2)[(4 - \gamma^2)^2 - 4\gamma^2] \\
&= 12\gamma^2(3 - \gamma - \gamma^2) - \gamma^3[(4 - \gamma^2)^2 - 4\gamma^2] \\
&\propto 12(3 - \gamma - \gamma^2) - \gamma[(4 - \gamma^2)^2 - 4\gamma^2] \\
&= (28 - 12\gamma^2)(1 - \gamma) + (8 - \gamma^5) > 0,
\end{aligned}$$

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[5]See appendix for proof details.

which shows that $\widehat{X} > X$ for all γ. For the foreign exports, we have

$$\widehat{Y} - Y \propto \frac{16 - 12\gamma - 8\gamma^2 + 4\gamma^3 + \gamma^4}{(3 - \gamma^2)D'} - \frac{4 - 3\gamma}{3D}$$

$$= \frac{\gamma(9 + \gamma - 3\gamma^2)}{3(3 - \gamma^2)D} + \frac{4\gamma(\gamma^2 + \gamma - 3)}{(3 - \gamma^2)D'}$$

$$\propto (9 + \gamma - 3\gamma^2)(16 - 12\gamma^2 + \gamma^4) + 12(4 - \gamma^2)(3 - \gamma - \gamma^2)$$

$$\propto 64 - 72\gamma - 24\gamma^2 + 33\gamma^3 + \gamma^4 - 3\gamma^5$$

Define $\mu(\gamma) := 64 - 72\gamma - 24\gamma^2 + 33\gamma^3 + \gamma^4 - 3\gamma^5$, which shows that $\mu'(\gamma) = -72 - 48\gamma + 99\gamma^2 + 4\gamma^3 - 15\gamma^4 = -(72 + 99\gamma)(1 - \gamma) - \gamma(21 - 4\gamma^2) - 15\gamma^4 < 0 \; \forall \gamma \in (0, 1)$, and $\mu(0) > 0, \mu(1) < 0$. Then $\hat{\gamma} \in (0, 1)$ exists and satisfies $\mu(\hat{\gamma}) = 0$. We have

$$\widehat{Y} \gtreqless Y \qquad \Longleftrightarrow \qquad \mu(\gamma) \gtreqless 0 \qquad \text{if and only if} \qquad \gamma \lesseqgtr \hat{\gamma}$$

Since $\mu(\gamma)$ is monotonically decreasing with $\gamma \in (0, 1)$, we can infer that $\hat{\gamma}$ is very large closing to 1.

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