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Upstream ownership and export policy reversal

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Abstract

This note shows that upstream ownership can reverse the standard result in strategic trade policy. In a vertically related market, we demonstrate that partial ownership weakens vertical rent extraction and turns export taxation into export subsidization under discriminatory pricing. Under uniform pricing, ownership strengthens the incentive to subsidize exports and may lead to the exit of the foreign firm. These results highlight the importance of ownership structure in determining trade policy.

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1. Introduction

Strategic trade policy shows that governments can use export subsidies or tariffs to shift profits under imperfect competition (Brander and Spencer, 1985; Eaton and Grossman, 1986). When vertical relationships are introduced, however, policy outcomes are affected by upstream pricing. In particular, Bernhofen (1997) shows that export subsidies may be absorbed by an upstream monopolist through higher input prices, leading to vertical rent leakage and, under discriminatory pricing, export taxation.

In vertically related industries, policy outcomes may also depend on multi-country interactions (Yanase and Kawabata, 2008). This note revisits this framework by introducing partial upstream ownership. When the home country holds a share of the upstream firm, part of upstream profits is internalized in domestic welfare.

We show that ownership weakens rent extraction and can reverse the standard policy result. Under discriminatory pricing, export taxation may be replaced by export subsidization when the ownership share is sufficiently-high. Under uniform pricing, ownership further strengthens the incentive for export subsidies and may lead to the exit of the foreign firm.

The remainder of the paper is organized as follows. Section 2 presents the model. Section 3 characterizes the equilibrium. Section 4 concludes.

2. The Model

We consider a third-market model with one upstream firm and two downstream firms located in the home and foreign countries. The upstream firm supplies a homogeneous intermediate input to both downstream firms. One unit of input is required to produce one unit of output, and no additional costs are incurred.

Inverse demand in the third market is given by $p = A - b(z_h + z_f)$, where p denote price, z_h and z_f denote the outputs of the home and foreign firms, respectively.

The upstream firm supplies an intermediate input to both downstream firms at prices w_h and w_f . One unit of input is required to produce one unit of output, and no additional costs are incurred. The profit functions of the home and foreign firms are therefore given by:

$$\pi_h = (p - w_h)z_h \tag{1}$$

$$\pi_f = (p - w_f)z_f \tag{2}$$

Production follows a one-to-one input requirement, so that one unit of the final good requires one unit of the intermediate input. The upstream firm produces the input at a constant marginal cost k . We assume $A - k > 0$ to ensure positive output.

To guarantee an interior solution, the demand intercept is sufficiently large relative to marginal costs and policy instruments. For sufficiently large subsidies, a corner solution may

arise in which one downstream firm exits the market.

The upstream firm's profit function is given by:

$$\pi_u = (w_h - k)z_h + (w_f - k)z_f \quad (3)$$

Only the home government implements a per-unit export policy. Let s_h denote the policy instrument, where $s_h > 0$ represents a subsidy and $s_h < 0$ a tax.

The corresponding profit functions are:

$$\pi_h = (p - w_h + s_h)z_h \quad (4)$$

$$\pi_f = (p - w_f)z_f \quad (5)$$

The home government implements a per-unit export policy for its domestic firm, while the foreign government remains inactive. Social welfare in the home country consists of domestic firm profit, policy expenditure, and a share of upstream profit. Specifically, the home country holds a partial ownership share $\alpha \in (0,1)$ in the upstream firm, so that a fraction of upstream profit is internalized in domestic welfare.

$$SW_h = \pi_h - s_h z_h + \alpha \pi_u \quad (6)$$

$$SW_f = \pi_f \quad (7)$$

The game is solved by backward induction. In the final stage, downstream firms choose outputs. In the second stage, the upstream firm sets input prices. In the first stage, the home government chooses its export policy to maximize domestic welfare. The subgame perfect Nash equilibrium is derived by backward induction.

3. Market Equilibrium Analysis

3.1 Equilibrium in the Final-Good Market Stage

Using backward induction, we solve the final-good market equilibrium by letting the home and foreign firms choose output levels to maximize profits. The first-order conditions derived from eqs. (4) and (5) yield the equilibrium outputs z_h and z_f .

$$z_h = \frac{A + 2s_h + w_f - 2w_h}{3b} \text{ and } z_f = \frac{A - s_h - 2w_f + w_h}{3b} \quad (8)$$

3.2 Equilibrium in Discriminatory Pricing of the Intermediate Good

We first consider discriminatory pricing by the upstream firm. When markets are segmented and arbitrage is limited, the upstream firm sets firm-specific input prices.

Solving the upstream firm's problem yields equilibrium prices w_h and w_f , which depend on the home government's policy. Substituting these prices into the downstream firms' output choices gives equilibrium outputs z_h and z_f .

The optimal intermediate-good prices w_h and w_f are obtained from the first-order conditions of π_u .

$$w_h = \frac{1}{2}(A + k + s_h) \text{ and } w_f = \frac{1}{2}(A + k) \quad (9)$$

At the policy stage, the home government chooses the export policy s_h to maximize domestic welfare, which includes downstream profits, policy costs, and a share of upstream profits.

Taking the first-order derivatives of the welfare functions with respect to s_h yields the first-order conditions:

$$\frac{\partial SW_h}{\partial s_h} = \frac{A-k+2s_h}{9b} - \frac{A-k+4s_h}{6b} + \alpha \frac{A-k+2s_h}{6b} = 0 \quad (10)$$

In eq. (10), the first and second terms represent the profit-shifting effect and the subsidy-expenditure (or tax-revenue) effect, respectively. The third term captures the intermediate-good expansion effect, reflecting a vertical feedback mechanism. Specifically, a subsidy raises final-good demand, which in turn increases the demand for intermediate goods and enhances domestic welfare.

The optimal policy is given by:

$$s_h^{HD} = -\frac{(A-k)(1-3\alpha)}{8-6\alpha} > 0 \text{ for } \alpha > \frac{1}{3}$$

which implies that export subsidization arises when $\alpha > \frac{1}{3}$.

Lemma 1. Under discriminatory pricing, the equilibrium policy, prices, outputs, and profits are well-defined. In particular, the optimal policy switches from export taxation to export subsidization when the ownership share exceeds a threshold, $\alpha > \frac{1}{3}$.

The intuition is that ownership internalization reduces vertical rent extraction. When the home country holds a share of upstream profits, part of the benefit from increased input demand is internalized. This weakens the incentive for rent extraction through higher input prices and shifts the optimal policy toward export subsidization.

3.3 Equilibrium in Uniform Pricing of the Intermediate Good

We next consider uniform pricing, where the upstream firm sets a common input price for both downstream firms.

Solving the upstream firm's problem yields an optimal uniform price that depends on the home government's policy. Substituting this price into downstream output decisions gives the equilibrium outputs.

Maximizing π_u with respect to the intermediate-good price w yields the optimal uniform price charged to both downstream firms:

$$w = \frac{1}{4}(2(A + k) + s_h) \quad (11)$$

Comparing eqs. (9), and (11) shows that, under discriminatory pricing, the upstream firm sets firm-specific prices based on each downstream firm's derived demand. In contrast, under uniform pricing, a common price is determined by the aggregate demand conditions.

At the policy stage, the home government chooses the export policy to maximize domestic welfare. The optimal policy is given by:

$$s_h^{HU} = \frac{2(A-k)(1+6\alpha)}{35-6\alpha} > 0 \quad (12)$$

implying that export subsidization is always optimal under uniform pricing.

Substituting eq. (12) into eq. (8), we obtain

$$z_h^{HU} = \frac{(A-k)(7+6\alpha)}{b(35-6\alpha)} \text{ and } z_f^{HU} = \frac{(A-k)(5-6\alpha)}{b(35-6\alpha)} > 0.$$

It follows that $z_f^{HU} > 0$, when $\alpha < \frac{5}{6}$, implying that both firms remain active in the third-country market. When $\alpha = \frac{5}{6}$, $z_f^{HU} = 0$, so the foreign firm is exactly at the exit threshold. By contrast, when $\alpha > \frac{5}{6}$, $z_f^{HU} < 0$, indicating that the foreign firm is driven out of the market.

The following lemma characterizes the equilibrium.

Lemma 2. Under uniform pricing, export subsidization is always optimal. Moreover, when the ownership share is sufficiently high ($\alpha > \frac{5}{6}$), the foreign firm may exit the market.

Under uniform pricing, the upstream firm cannot discriminate across downstream firms, so vertical rent extraction is limited. Ownership internalization further increases the incentive to expand downstream output through export subsidies. As a result, subsidization is always optimal, and sufficiently high ownership may drive the foreign firm out of the market.

The following proposition summarizes the results.

Proposition 1.

Consider a vertically related market in which the upstream firm is partially owned by the home country.

- (i) Under discriminatory pricing, export subsidization arises when $\alpha > \frac{1}{3}$, reversing the standard result of export taxation.
- (ii) Under uniform pricing, export subsidization is always optimal. Moreover, the foreign firm remains active when $\alpha < \frac{5}{6}$ and exits the market when $\alpha > \frac{5}{6}$.

The mechanism is driven by ownership internalization. When the home country holds a share of upstream profits, export subsidies increase not only downstream profits but also upstream returns. This weakens vertical rent extraction and creates a positive feedback effect through input demand.

This effect can overturn the standard result under discriminatory pricing, leading to export subsidization, while under uniform pricing, where rent extraction is limited, ownership further strengthens the incentive to subsidize exports and may drive the foreign firm out of the market.

Under discriminatory pricing, although part of upstream profit is internalized, the upstream firm can still extract rents through price discrimination. This creates an input cost disadvantage for the foreign firm, leading it to adopt an export tax, while the home country's incentive to subsidize exports remains positive when $\alpha > \frac{1}{3}$.

Under uniform pricing, the upstream firm cannot discriminate across markets, eliminating rent extraction through differential pricing. As a result, downstream expansion benefits both countries without adverse input distortions, making export subsidies optimal for the home country. Moreover, when $\alpha > \frac{5}{6}$, the exit of the foreign firm further strengthens the home country's incentive to subsidize exports.

Table I summarizes the main results. In contrast to Bernhofen (1997), where discriminatory pricing leads to export taxation due to vertical rent extraction, we find that sufficiently high upstream ownership ($\alpha > \frac{1}{3}$) reverses the policy outcome toward export subsidization.

The underlying mechanism is ownership internalization. By allowing the home country to capture part of upstream profits, ownership weakens vertical rent extraction and alters policy incentives, shifting the direction of optimal trade policy toward export subsidization.

Table I Comparison of Optimal Export Policies under Different Pricing Regimes: Bernhofen (1997) versus This Paper

	Price Discrimination	Uniform Pricing
Bernhofen (1997)	$s_h^{HD} = \frac{-(A-k)}{8} < 0$	$s_h^{HU} = \frac{4(A-k)}{70} > 0$
This Paper	$s_h^{HD} = \frac{-(A-k)(1-3\alpha)}{8-6\alpha} > 0$ for $\alpha > \frac{1}{3}$	$s_h^{HU} = \frac{2(A-k)(1+6\alpha)}{35-6\alpha} > 0$

4. Conclusion

This note shows that upstream ownership is a key determinant of optimal trade policy in vertically related markets. By introducing partial ownership, we demonstrate that ownership internalization weakens vertical rent extraction and can reverse the standard policy result.

In particular, export taxation may be replaced by export subsidization under discriminatory pricing, while ownership strengthens the case for export subsidies under uniform pricing. Ignoring ownership structure may therefore lead to incomplete conclusions regarding optimal trade policy.

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Appendix 1. Equilibrium in Discriminatory Pricing of the Intermediate Good

Using backward induction, we solve the final-good market equilibrium by letting the home and foreign firms choose output levels to maximize profits. The first-order conditions derived from eqs. (4) and (5) yield the equilibrium outputs z_h and z_f .

$$z_h = \frac{A+2s_h+w_f-2w_h}{3b} \text{ and } z_f = \frac{A-s_h-2w_f+w_h}{3b} \quad (8)$$

We next determine the upstream firm's pricing decision. When intermediate-good markets are segmented and arbitrage is limited, price discrimination may arise. Accordingly, the upstream firm is assumed to set discriminatory prices. Substituting eq. (8) into eq. (3) gives:

$$\pi_u = \frac{(w_h-k)(A+2s_h+w_f-2w_h)}{3b} + \frac{(w_f-k)(A-s_h-2w_f+w_h)}{3b} \quad (A1)$$

The optimal intermediate-good prices w_h and w_f are obtained from the first-order conditions of π_u .

$$w_h = \frac{1}{2}(A+k+s_h) \text{ and } w_f = \frac{1}{2}(A+k) \quad (9)$$

These results indicate that both the intermediate-good prices and the upstream firm's revenues depend on the home government's policy. Substituting eq. (9) into eq. (8) then yields the equilibrium outputs of the home and foreign downstream firms.

$$z_h(s_h) = \frac{A-k+2s_h}{6b} \quad (A2)$$

$$z_f(s_h) = \frac{A-k-s_h}{6b} \quad (A3)$$

At the policy stage, the home government chooses trade policy to maximize social welfare, SW_h . Substituting eq. (9) and (A2)–(A3) into eq. (6) yields the corresponding welfare function:

$$SW_h = \pi_h - s_h z_h + \alpha \Pi_u$$

$$= \frac{(A-k+2s_h)^2}{36b} - \frac{(A-k+2s_h)s_h}{6b} + \alpha \frac{((A-k)^2 + s_h(A-k+s_h))}{6b} \quad (A4)$$

Taking the first-order derivatives of the welfare functions with respect to s_h yields the first-order conditions:

$$\frac{\partial SW_h}{\partial s_h} = \frac{A-k+2s_h}{9b} - \frac{A-k+4s_h}{6b} + \alpha \frac{A-k+2s_h}{6b} = 0 \quad (10)$$

Solving eq. (10) yields:

$$s_h^{HD} = -\frac{(A-k)(1-3\alpha)}{8-6\alpha} > 0 \text{ for } \alpha > \frac{1}{3}$$

Let HD denote the equilibrium in which the upstream firm is partially owned by the home country and adopts discriminatory pricing.

The SPNE under discriminatory pricing with partial upstream ownership is given by:

$$\begin{aligned} s_h^{HD} &= -\frac{(A-k)(1-3\alpha)}{8-6\alpha}, \quad z_h^{HD} = \frac{A-k}{b(8-6\alpha)}, \quad z_f^{HD} = \frac{3(A-k)(1-\alpha)}{4b(4-3\alpha)}, \\ z^{HD} &= \frac{(A-k)(5-3\alpha)}{4b(4-3\alpha)}, \quad p^{HD} = \frac{1}{4} \left(3A + k - \frac{A-k}{4+3\alpha} \right), \quad w_h^{HD} = \frac{7A+9k-3(A+3k)\alpha}{16-12\alpha}, \quad w_f^{HD} = \frac{A+k}{2}, \\ \pi_u^{HD} &= \frac{(A-k)^2(19-3\alpha(8-3\alpha))}{8b(4-3\alpha)^2}, \quad \pi_h^{HD} = \frac{(A-k)^2}{4b(4-3\alpha)^2}, \quad \pi_f^{HD} = \frac{9(A-k)^2(1-\alpha)^2}{16b(4-3\alpha)^2}, \\ SW_h^{HD} &= \frac{(A-k)^2(1+\alpha(4-3\alpha))}{8b(4-3\alpha)}, \quad SW_f^{HD} = \frac{9(A-k)^2(1-\alpha)^2}{16b(4-3\alpha)^2}. \end{aligned}$$

Appendix 2. Equilibrium in Uniform Pricing of the Intermediate Good

We next consider uniform pricing by the upstream firm. In this case, a common intermediate-good price is set, $w = w_h = w_f$. Substituting eqs. (8) into eq. (3) yields the upstream firm's profit:

$$\pi_u = \frac{(w-k)(2A-2w+s_h)}{3b} \quad (A5)$$

Maximizing π_u with respect to the intermediate-good price w yields the optimal uniform price charged to both downstream firms:

$$w = \frac{1}{4}(2(A+k) + s_h) \quad (11)$$

Comparing eqs. (9) and (11) shows that, under discriminatory pricing, the upstream firm sets firm-specific prices based on each downstream firm's derived demand. In contrast, under uniform pricing, a common price is determined by the aggregate demand conditions. Substituting eq. (11) into eq. (8) yields the equilibrium outputs z_h^* and z_f^* .

$$z_h^* = \frac{2A-2k+7s_h}{12b} \quad (A6)$$

$$z_f^* = \frac{2A-2k-5s_h}{12b} \quad (A7)$$

In this stage, the home government chooses trade policy with the objective of maximizing social welfare, SW_h . Substituting eqs. (11) and (A6)-(A7) into eq. (6) yields the social welfare function of the home country as follows:

$$SW_h = \pi_h - s_h z_h + \alpha \Pi_u = \frac{(2A-2k+7s_h)^2}{144b} - \frac{(2A-2k+7s_h)s_h}{12b} + \alpha \frac{(2A-2k+s_h)^2}{24b} \quad (A8)$$

Taking the first-order derivatives of the welfare functions with respect to s_h yields the first-order conditions:

$$\frac{\partial SW_h}{\partial s_h} = \frac{7(2A-2k+7s_h)}{72b} - \frac{2(A-k+7s_h)}{12b} + \alpha \frac{2A-2k+s_h}{12b} = 0 \quad (A9)$$

Solving eq. (A9) yields:

$$s_h^{HU} = \frac{2(A-k)(1+6\alpha)}{35-6\alpha} > 0 \quad (12)$$

Let HU denote the equilibrium in which the upstream firm is partially owned by the home country and adopts **uniform** pricing.

Substituting eq. (12) into eq. (8), we obtain

$$z_h^{HU} = \frac{(A-k)(7+6\alpha)}{b(35-6\alpha)} \text{ and } z_f^{HU} = \frac{(A-k)(5-6\alpha)}{b(35-6\alpha)} > 0.$$

It follows that $z_f^{HU} > 0$, when $\alpha < \frac{5}{6}$, implying that both firms remain active in the third-country market. When $\alpha = \frac{5}{6}$, $z_f^{HU} = 0$, so the foreign firm is exactly at the exit threshold. By contrast, when $\alpha > \frac{5}{6}$, $z_f^{HU} < 0$, indicating that the foreign firm is driven out of the market.

The SPNE under uniform pricing with partial upstream ownership, given $(\alpha < \frac{5}{6})$, is given by:

$$s_h^{HU} = \frac{2(A-k)(1+6\alpha)}{35-6\alpha}, \quad w^{HU} = k + \frac{18(A-k)}{35-6\alpha} \quad p^{HU} = A - \frac{12(A-k)}{35-6\alpha},$$

$$z_h^{HU} = \frac{(A-k)(7+6\alpha)}{b(35-6\alpha)}, \quad z_f^{HU} = \frac{(A-k)(5-6\alpha)}{b(35-6\alpha)}, \quad Z^{HU} = \frac{12(A-k)}{b(35-6\alpha)}$$

$$\pi_u^{HU} = \frac{216(A-k)^2}{b(35-6\alpha)^2}, \quad \pi_h^{HU} = \frac{(A-k)^2(7+6\alpha)^2}{b(35-6\alpha)^2}, \quad \pi_f^{HU} = \frac{(A-k)^2(5-6\alpha)^2}{b(35-6\alpha)^2},$$

$$SW_h^{HU} = \frac{(A-k)^2(1+6\alpha)}{b(35-6\alpha)}, \quad SW_f^{HU} = \frac{(A-k)^2(5-6\alpha)^2}{b(35-6\alpha)^2}.$$