Consumer-hurting competition in an international upstream market

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August 31, 2023

Abstract

In standard oligopoly theory, an increase in the number of firms makes market competition keener, decreases the product price, and increases consumer surplus. In practice, competition authorities and practitioners cherish competition, and have the clear-cut belief that "competition enhances consumer welfare." However, we offer a different perspective on the effect of competition on consumer welfare. In vertically related markets with an import tariff, we show that an increase in the number of upstream firms can reduce the consumer surplus and total surplus of the final-good importing country. Upstream competition may harm consumers.

Key words: Upstream competition; Import tariff; Consumer surplus; Vertically related markets

JEL classification: F12; F13; L13

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1 Introduction

Competition authorities and practitioners undoubtedly cherish competition, and have the clear-cut belief that "competition enhances consumer welfare." For example, Joaquín Almunia[1] said on the importance of competition: "Our objective is to ensure that consumers enjoy the benefits of competition, a wider choice of goods, of better quality and at lower prices. But competition does not only deliver benefits for consumers. It also delivers benefits for business and the economy as a whole" (Competition and consumers: The future of EU competition policy, 2010, p. 4). This assertion is not baseless. In standard oligopoly theory, market power decreases as the number of firms increases, and the higher the number of firms, the lower the prices and the higher consumer surplus (Motta, 2004, p. 51). Hence, we could consider that the promotion of competition caused by an increase in the number of firms enhances consumer welfare.

In this paper, we offer a different perspective against such a belief. When we consider an import tariff in a vertically related market, an increase in the number of upstream input suppliers may *reduce* consumer surplus and total surplus; that is, the promotion of competition does not always enhance consumer welfare.

We consider an international vertical production structure that comprises n upstream input suppliers that engage in homogeneous price competition and two downstream final-good exporting firms that supply differentiated goods. These two final-good exporting firms are located in a foreign exporting country without a final-good market and pay a tariff when they supply their products to the final-good importing country. Upstream, m input suppliers belong to the final-good importing country, and $n - m$ input suppliers belong to a country other than the final-good importing country and final-good exporting country. In this environment, we show that if the number of input suppliers n increases in the case $m > 1$, the consumer and total surpluses of the final-good importing country decrease.

[1] Vice-president and commissioner for competition, European Commission 2010–2014.

This result depends on an increase in the unit cost of the final-good exporting firms. The unit cost of the final-good exporting firm equals the sum of the input price and tariff. An increase in the number of input suppliers lowers the input price, whereas it tends to raise the tariff level. When $m > 1$, because the tariff rising effect is dominant, the unit cost of the final-good exporting firm increases as the number of input suppliers increases. This makes final-good exports lower, and hence, consumer surplus smaller. Furthermore, because the reduction effect of the consumer surplus is dominant, the total surplus in the final-good importing country also decreases.

We extend the benchmark model to two cases. One is the case in which the upstream market is a homogeneous quantity competition and the other is the case in which a downstream oligopolist exists in the final-good importing country. In both two cases, we obtain a similar result to that obtained in the benchmark case. Hence, we can claim that our model has certain robustness.

It tends to be considered that the promotion of competition enhances consumer welfare; however, we prove that this is not always true under vertically related markets. This point is a contribution of our study. Additionally, it is important that the promotion of competition can hurt consumers in a realistic case such that final-good producers purchase inputs from an international market. Our result depends on the optimal tariff policy of the final-good importing country. Hence, it may be necessary for competition authorities to confer with their governments to ease the negative effect of the tariff policy on consumer welfare.

Our paper is related to two strands in the literature. One is for studies on the relationship between competition and consumer welfare (Deltas et al., 2012; Dinda and Mukherjee, 2014; Mukherjee and Sinha, 2019; and Wang and Mukherjee, 2012) and the other is for studies on the effects of the optimal tariff under a vertical production chain (Ara and Ghosh, 2016; Ishikawa and Lee, 1997; and Lahiri and Ono, 1999).[2] Using the Hotelling model, Deltas et al. (2012)

[2]Moreover, Takauchi (2011) considered the tariff policy of a final-good importing country within a free trade

showed that collusion (i.e., restriction of competition) can benefit consumer welfare. Dinda and Mukherjee (2014) demonstrated that an increase in the number of firms can reduce consumer surplus under the optimal tax/subsidy policy, quoting empirical evidence such that a new entry increases the price and reduces consumer welfare. Mukherjee and Sinha (2019) showed that, in a third-market model, a cartel between two exporting firms may enhance consumer welfare in the third market. Wang and Mukherjee (2012) showed that, in a nationalized monopoly market, the entry of private firms hurts consumers. Although these researchers respectively considered the relationship between competition and consumer welfare using different models, they did not consider an upstream market. Different from these researchers, we consider an upstream market.

Ara and Ghosh (2016) considered a tariff policy in the case in which a foreign country specializes in intermediate-good production and the home country specializes in final-good production. Ishikawa and Lee (1997) examined the effects of tariffs in both upstream and downstream markets. Lahiri and Ono (1999) considered an optimal tariff policy when producers and sellers are different. Although these researchers considered vertical production structures, they did not consider price competition in the upstream market; hence, their models differ substantially from ours.

This paper is organized as follows: In Section 2, we offer a benchmark model and in Section 3, we present the analysis results. In Section 4, we discuss and extend the benchmark model. In Section 5, we conclude the paper.

2 Model

In the model, two countries exist: final-good importing and exporting countries. Hereafter, we call the final-good importing country the final-good importer. Here, for better understanding, the final-good importer has no final-good producers and mainly imports foreign final goods. In

area.

Section 4, we relax this assumption and argue the case in which the final-good importer has a final-good oligopolist. The final-good importer imposes a common trade policy, t, on the final-good exporting firms (e.g., if $t > 0$, it denotes a specific tariff; and if $t < 0$, it denotes an import subsidy). The final-good exporting country has no final-good markets; however, it has two final-good exporting firms: A and B. These firms export horizontally differentiated goods to the final-good importer and they face the trade policy.

In the upstream market, $n(> 2)$ input suppliers exist and they engage in a homogeneous price competition: m input suppliers belong to the final-good importer, and $n - m$ input suppliers are located in a country other than the final-good importer and final-good exporting country.

To produce one unit of the final good, firms A and B use one unit of input. The inverse market demand function of the final-good importer is given by $p_i = 1 - q_i - bq_j$, $i \neq j$, $i, j = A, B$, where p_i and q_i are the price and quantity supplied by firm i ($i = A, B$), respectively, and $b \in [0, 1)$ represents the degree of product substitutability. The profit of firm i ($i = A, B$) is $\Pi_i \equiv (p_i - r - t)q_i$, where r is the input price. For simplicity, we omit transportation costs.

Let the input price offered by supplier k ($k \in \{1, \ldots, n\}$) be r_k, supplier k's individual demand be x_k, and total demand be $q_A + q_B$. Because each final-good exporting firm purchases the lowest input, the individual demand of input supplier k is $x_k = [q_A(r^l) + q_B(r^l)]/h$ if the supplier offers the lowest price $r_k = r^l$. Note that, h is the number of input suppliers that offer the lowest price. When input supplier k offers a higher price than r^l, its demand is zero: $x_k = 0$. To obtain explicit solutions, we assume that the production cost of input supplier k is $(\lambda/2)x_k^2$, where $\lambda > 0$ is production efficiency.[3] The profit of input supplier k ($\in \{1, \ldots, n\}$) is $\pi_k \equiv r_k x_k - (\lambda/2)x_k^2$.[4]

[3]This type quadratic cost function was frequently used in previous studies. See, for example, the studies by Dastidar (1995), Delbono and Lambertini (2016b), Gori et al. (2014), Mizuno and Takauchi (2020, 2022), and Takauchi and Mizuno (2022).

[4]In the real world, several manufacturing firms' technology can be decreasing returns to scale. For example, using the aggregate data of 34 manufacturing industries in the U.S., Basu and Fernald (1997) found that a typical industry appears to have decreasing returns to scale.

We consider the following three stage game. In the first stage, the final-good importer chooses the level of trade policy t. In the second stage, each input supplier k decides its price. In the third stage, the final-good exporting firm decides its exports. Because multiple Nash equilibria (range of price) appear in the second stage of the game, we use the subgame perfect Nash equilibrium with the payoff-dominance criterion as the equilibrium concept.[5] The game is solved by backward induction.

3 Results

In the third stage of the game, each final-good exporting firm decides its export to maximize profit. The first-order conditions (FOCs) for profit maximization are $1 - 2q_A - bq_B - r - t = 0$ and $1 - bq_A - 2q_B - r - t = 0$. These FOCs yield the following third-stage export:

$$q_i(r,t) = \frac{1-r-t}{2+b}, \quad i = A, B.$$

In the second stage, input suppliers decide their prices. According to Dastidar (1995),[6] if oligopolists have a convex cost, the Nash equilibria in a homogeneous price competition among them have an interval $[\underline{r}, \overline{r}]$. The lower input price $\underline{r}$ is derived from the following condition:

$$\pi_k(r,t;n) \equiv r\left(\frac{q_A(r,t)+q_B(r,t)}{n}\right) - \frac{\lambda}{2}\left(\frac{q_A(r,t)+q_B(r,t)}{n}\right)^2 \geq 0.$$

The upper input price $\overline{r}$ is derived from the following condition:

$$\pi_k(r,t;n) \geq \pi_k(r,t;1) \equiv r\left(q_A(r,t)+q_B(r,t)\right) - \frac{\lambda}{2}\left(q_A(r,t)+q_B(r,t)\right)^2,$$

where $\pi_k(r,t;1)$ is the monopoly profit of input supplier k.

Furthermore, the collusive input price r_{col} (which maximizes industry profit) is derived from

[5] This concept is often used. For example, see the studies by Cabon-Dhersin and Drouhin (2014, 2020), Mizuno and Takauchi (2020, 2022), and Takauchi and Mizuno (2022).

[6] Dastidar (1995)-type price competition is often used in many studies. See, for example, the studies by Cabon-Dhersin and Drouhin (2014, 2020), Delbono and Lambertini (2016a, b), Gori et al. (2014), Mizuno and Takauchi (2020, 2022), and Takauchi and Mizuno (2022).

$\mathrm{argmax}_r\, \pi_k(r, t; n)$. These prices becomes

$$\underline{r} = \frac{\lambda(1-t)}{(b+2)n+\lambda}, \quad \overline{r} = \frac{\lambda(n+1)(1-t)}{n(b+\lambda+2)+\lambda}, \quad r_{col} = \frac{(1-t)((b+2)n+2\lambda)}{2((b+2)n+\lambda)}. \tag{1}$$

The above (1) yields Lemma 1.

Lemma 1. *(i)* $\underline{r} < \overline{r}$. *(ii)* $r_{col} > \overline{r}$ *iff* $\lambda < \dfrac{(2+b)n}{n-1}$.

Proof. (i) Simple algebra yields $\overline{r} - \underline{r} = \frac{(b+2)\lambda n^2(1-t)}{(bn+\lambda+2n)(bn+\lambda+\lambda n+2n)} > 0$. (ii) From (1), we obtain

$$r_{col} - \overline{r} = \frac{(b+2)n(1-t)(bn+\lambda-\lambda n+2n)}{2(bn+\lambda+2n)(bn+\lambda+\lambda n+2n)}.$$

By solving $r_{col} - \overline{r} > 0$ with respect to λ, we obtain Part (ii). □

To ensure $r_{col} > \overline{r}$, we require the following.

Assumption 1. $\lambda < \dfrac{(2+b)n}{n-1}$.

In the first stage, the final-good importer decides t to maximize its total surplus:

$$W \equiv CS + \sum_{k=1}^{m} \pi_k + t(q_A + q_B), \tag{2}$$

where $CS = (q_A^2 + 2bq_Aq_B + q_B^2)/2$ is consumer surplus. From (2) and the second-stage outcomes, the optimal import policy t^* becomes

$$t^* = \frac{\lambda(1-2m+n)+n}{n(b+2\lambda+3)-2\lambda(m-1)}. \tag{3}$$

Note that "$*$" denotes the equilibrium outcome.

To ensure positive equilibrium values, we make the following assumption.[7]

Assumption 2. $m < m_0 \equiv \dfrac{2\lambda + n(b+2\lambda+3)}{2\lambda}$.

The final-good export is

$$q_i^* = \frac{n}{n(b+2\lambda+3)-2\lambda(m-1)} > 0, \quad i = A, B.$$

[7] The second-order (sufficient) condition for welfare maximization is satisfied provided Assumption 2 holds.

The profit of the final-good exporting firm is $\Pi_i^* = (q_i^*)^2$.

The input price is

$$\overline{r}^* = \frac{\lambda(n+1)}{n(b+2\lambda+3) - 2\lambda(m-1)}. \tag{4}$$

The profit of input supplier k is

$$\pi_k^* = \frac{2\lambda n}{[n(b+2\lambda+3) - 2\lambda(m-1)]^2} \quad \text{for all } k \in \{1, \ldots, n\}.$$

From (3), we establish Proposition 1.

Proposition 1. *(i) Suppose that $m < (\lambda + \lambda n + n)/2\lambda$. The optimal trade policy of the final-good importer is a tariff, that is, $t^* > 0$. (ii) Suppose that $m = (\lambda + \lambda n + n)/2\lambda$. The optimal trade policy of the final-good importer is free trade, that is, $t^* = 0$. (iii) Suppose that $m > (\lambda + \lambda n + n)/2\lambda$. The optimal trade policy of the final-good importer is an import subsidy, that is, $t^* < 0$.*

Proof. From (2), the critical value $t^* = 0$ is $m = (\lambda + \lambda n + n)/2\lambda$. This value is smaller than m_0, that is, $m_0 - (\lambda + \lambda n + n)/2\lambda = (2n + bn + \lambda + n\lambda)/2\lambda > 0$. Hence, Proposition 1 holds. □

The logic behind Proposition 1 is as follows: When the number of domestic input suppliers m is large, it is important for the final-good importer to expand input demand. Because the size of input demand depends on the volume of the final-good exports, it is optimal to enhance the profit of the domestic input suppliers by expanding input demand because of the increase of final-good exports. Hence, to improve final-good exports, the final-good importer offers an import subsidy.

When the number of domestic input suppliers is small, input demand is not important for the final-good importer. Because the profit of the input supplier is relatively small compared with the total surplus, it is not desirable from the welfare viewpoint to protect input suppliers. Hence, it is optimal to impose a tariff on the final-good exporting firms to gain tariff revenue.

Lemma 2. *(i) The optimal trade policy of the final-good importer, t^*, decreases as m increases. (ii-a) If $m = 0$, t^* decreases as n increases. (ii-b) If $m \geq 1$, t^* increases as n increases.*

Proof. By differentiating (3) with respect to m and n, we obtain

$$\frac{\partial t^*}{\partial m} = -\frac{2\lambda(n(b+\lambda+2)+\lambda)}{[n(b+2\lambda+3)-2\lambda(m-1)]^2} < 0,$$
$$\frac{\partial t^*}{\partial n} = \frac{\lambda(b(2m-1)+2(\lambda+2)m-1)}{[n(b+2\lambda+3)-2\lambda(m-1)]^2}.$$

These imply Lemma 2. □

Lemma 3. *(i) The input price, $\overline{r}^*$, increases as m increases. (ii) $\overline{r}^*$ decreases as n increases.*

Proof. By differentiating (4) with respect to m and n, we obtain

$$\frac{\partial \overline{r}^*}{\partial m} = \frac{2\lambda^2(n+1)}{[n(b+2\lambda+3)-2\lambda(m-1)]^2} > 0.$$
$$\frac{\partial \overline{r}^*}{\partial n} = -\frac{\lambda(b+2\lambda m+3)}{[n(b+2\lambda+3)-2\lambda(m-1)]^2} < 0.$$

Hence, Lemma 3 holds. □

We consider that m increases. Then, the final-good importer attempts to protect its domestic input suppliers through promoting final-good imports, that is, by enhancing input demand. Hence, the level of trade policy t^* decreases. Because input suppliers raise their prices according to the expanded input demand, the input price increases and the profit of the input suppliers also increases.

When n increases, because the international upstream market becomes more competitive, input price r falls ((ii) of Lemma 3). By contrast, this reduction in the input price reduces the profit of the input suppliers. Therefore, if the input supplier exists in the final-good importer, its total surplus can decrease because of the increase of n. Then, to prevent a decrease in the total surplus, the final-good importer attempts to gain revenue from the trade policy through a rise in the level of trade policy. Therefore, t^* increases as n increases ((ii) of Lemma 2).

By substituting equilibrium outcomes into the definition of consumer surplus and (2), we obtain equilibrium consumer and total surpluses:

$$CS^* = \frac{(b+1)n^2}{[n(b+2\lambda+3)-2\lambda(m-1)]^2}, \quad W^* = \frac{n}{n(b+2\lambda+3)-2\lambda(m-1)}. \tag{5}$$

From (5), we establish Proposition 2.

Proposition 2. *(i) If $m = 0$, consumer and total surpluses increase as n increases. (ii) If $m = 1$, consumer and total surpluses do not change as n increases. (iii) If $m > 1$, consumer and total surpluses decrease as n increases.*

Proof. By differentiating (5) with respect to n, we obtain

$$\frac{\partial CS^*}{\partial n} = -\frac{4(b+1)\lambda(m-1)n}{[n(b+2\lambda+3)-2\lambda(m-1)]^3},$$
$$\frac{\partial W^*}{\partial n} = -\frac{2\lambda(m-1)}{[n(b+2\lambda+3)-2\lambda(m-1)]^2}.$$

These imply Proposition 2. □

To consider Proposition 2, we set Lemma 4.

Lemma 4. *(i) If $m = 0$, the unit cost of the final-good exporting firm, $\overline{r}^* + t^*$, decreases as n increases. (ii) If $m = 1$, $\overline{r}^* + t^*$ does not change as n increases. (iii) If $m > 1$, $\overline{r}^* + t^*$ increases as n increases.*

Proof. By differentiating $\overline{r}^* + t^*$ with respect to n, we obtain

$$\frac{\partial(\overline{r}^* + t^*)}{\partial n} = \frac{2(b+2)\lambda(m-1)}{[n(b+2\lambda+3)-2\lambda(m-1)]^2}.$$

This implies Lemma 4. □

If the unit cost of the final-good exporting firms, $\overline{r}^* + t^*$, increases because of an increase in the number of input suppliers n, final-good exports decrease (Lemma 4). Then, because final-good exports decrease, consumer surplus decreases. The effect of a decrease in consumer surplus is dominant; hence, the total surplus also decreases (Proposition 2).

We consider the "$m = 0$" case. The level of trade policy decreases and the input price falls because of an increase in the number of input suppliers (Lemmas 2 and 3). Hence, the unit cost of final-good exporting firms always decreases as n increases.

When $m = 1$, the level of trade policy increases as n increases. Because n increases, the upstream market becomes competitive and the input price lowers. Then, each input supplier's profit also decreases. By raising the burden of the trade policy, the final-good importer tries to compensate for the profit reduction of its domestic input supplier. In this case, because the reduction of the input price is canceled out by the increase in the level of trade policy, the unit cost does not change, even if n increases. Hence, an increase in n does not affect consumer and total surpluses.

When $m > 1$, because the effect of an increase in the level of trade policy dominates the effect of a fall in the input price due to an increase in n, the unit cost increases as n increases. Therefore, an increase in n reduces both consumer and total surpluses.

4 Discussion and extension

4.1 Upstream quantity competition

Does the upstream competition mode change our main result? To answer this, we introduce homogeneous quantity competition in the upstream market. With the exception of quantity competition in the upstream market, the model is the same as that in the previous section.

From the third-stage exports of final-good exporting firms, $q_i(r,t)$ for $i = A, B$, we obtain $q_A(r,t) + q_B(r,t) = Y = \sum_{k=1}^{n} y_k$, where y_k is the output of each input supplier k and Y denotes the aggregate outputs. By solving $q_A(r,t) + q_B(r,t) = Y$ with respect to r, we obtain $r = [2 - 2t - (2+b)Y]/2$. Because the profit of input supplier k ($\in \{1, \ldots, n\}$) is $\pi_k^C \equiv ry_k - (c/2)y_k^2$, the second-stage input price becomes $r(t) = \frac{(1-t)(b+2c+2)}{b(n+1)+2(c+n+1)}$. Using $r(t)$ and second-stage outcomes, the welfare maximizing trade policy becomes

$$t^{C*} = \frac{n(b+2c+n+2) - 2m(b+c+2)}{n(b(n+2)+4c+3n+4) - 2m(b+c+2)}, \tag{6}$$

where "C" denotes upstream Cournot competition.

From (6), Proposition 3 holds.

Proposition 3. *Suppose that the international upstream market is a homogeneous quantity competition. I. Let $n < 3$. (i) If $m < \frac{n(b+2c+n+2)}{2(b+c+2)}$, the optimal trade policy of the final-good importer is a tariff, that is, $t^{C*} > 0$. (ii) If $m = \frac{n(b+2c+n+2)}{2(b+c+2)}$, the optimal trade policy of the final-good importer is free trade, that is, $t^{C*} = 0$. (iii) If $m > \frac{n(b+2c+n+2)}{2(b+c+2)}$, the optimal trade policy of the final-good importer is an import subsidy, that is, $t^{C*} < 0$.*

II. Let $n > 3$. The optimal trade policy of the final-good importer is a tariff, that is, $t^{C*} > 0$.

Proof. From (6), by solving the inequality $t^{C*} \geq 0$ with respect to m, we obtain $m \leq \frac{n(b+2c+n+2)}{2(b+c+2)}$. Because $n - \frac{n(b+2c+n+2)}{2(b+c+2)} = \frac{(2+b-n)n}{2(c+b+2)}$, $t^{C*} < 0$ can appear if $n < 3$. These imply Proposition 3. □

The logic behind Proposition 3 is relatively intuitive. The relaxation in upstream competition gives the final-good importer the incentive to protect domestic input suppliers through expanding input demand weaker. Hence, for the final-good importer, the incentive to gain tariff revenue becomes stronger. As a result, the final-good importer can offer an import subsidy only when the number of upstream firms is small.

The equilibrium input price is

$$r^{C*} = \frac{n(b+2c+2)}{n(b(n+2)+4c+3n+4) - 2m(b+c+2)}. \tag{7}$$

The equilibrium welfares are

$$CS^{C*} = \frac{(b+1)n^4}{[n(b(n+2)+4c+3n+4)-2m(b+c+2)]^2},$$
$$W^{C*} = \frac{n^2}{n(b(n+2)+4c+3n+4)-2m(b+c+2)}. \tag{8}$$

From (8), we establish Proposition 4.

Proposition 4. *Suppose that the international upstream market is a homogeneous quantity competition. (i) If* $m > \frac{n(b+2c+2)}{2(b+c+2)}$*, consumer and total surpluses decrease as n increases. (ii) If* $m = \frac{n(b+2c+2)}{2(b+c+2)}$*, consumer and total surpluses do not change as n increases. (iii) If* $m < \frac{n(b+2c+2)}{2(b+c+2)}$*, consumer and total surpluses increase as n increases.*

Proof. By differentiating (8) with respect to n, we obtain

$$\frac{\partial CS^{C*}}{\partial n} = \frac{4(b+1)n^3[n(b+2c+2)-2m(b+c+2)]}{[n(b(n+2)+4c+3n+4)-2m(b+c+2)]^3},$$
$$\frac{\partial W^{C*}}{\partial n} = \frac{2n[n(b+2c+2)-2m(b+c+2)]}{[n(b(n+2)+4c+3n+4)-2m(b+c+2)]^2}.$$

From the numerator of the equations, $\text{sign}\{\partial CS^{C*}/\partial n\} = \text{sign}\{\partial W^{C*}/\partial n\} = \text{sign}\{n(b+2c+2)-2m(b+c+2)\}$. Moreover, $n - \frac{n(b+2c+2)}{2(b+c+2)} = \frac{n(b+2)}{2(b+c+2)} > 0$. Hence, $\partial CS^{C*}/\partial n <(>)0$ if $m >(<) \frac{n(b+2c+2)}{2(b+c+2)}$. □

In the upstream quantity competition, we also find a similar feature of the unit cost in the final-good exporting firms with price competition. From (6) and (7), we find

$$\frac{\partial(r^{C*}+t^{C*})}{\partial n} = \frac{2(b+2)n[2m(b+c+2)-n(b+2c+2)]}{[n(b(n+2)+4c+3n+4)-2m(b+c+2)]^2}.$$

This equation yields the critical value $\frac{n(b+2c+2)}{2(b+c+2)}$, and hence, we find a similar comparative statics result with price competition in the welfares (Proposition 4).

4.2 Final-good importer with a downstream oligopolist

We introduce a downstream firm located in the final-good importer in our model. For simplicity, we consider homogeneous quantity competition (i.e., $b = 1$) in the final-good market. Hence, the inverse market demand of the final good is $p = 1 - q_H - q_A - q_B$. We assume that $\lambda < 8n/(3n-3) \equiv \bar{\lambda}_{ho}$, which guarantees that the collusive input price is larger than the highest price in the Nash equilibria in the upstream market. Additionally, we suppose that $m < (2n\lambda + n\lambda)(10n + \lambda + n\lambda)/(4n\lambda) \equiv m_{ho}$, which is the second-order condition in the first stage.

By applying a similar calculation to that in the previous section, we derive the optimal trade policy:

$$t^*_{ho} = \frac{n[-6\lambda m + 6n + 5\lambda(1+n)]}{\lambda^2 + 2\lambda n(\lambda - 2m + 6) + (\lambda^2 + 12\lambda + 20)\, n^2}.$$

By considering the sign of t^*_{ho}, we obtain the following proposition.

Proposition 5. *Suppose that one downstream firm exists in the importing country and all downstream firms produce a homogeneous product and compete in quantity. (i) If* $m < \frac{6n+5\lambda(1+n)}{6\lambda} \equiv m^t_{ho}$*, the optimal trade policy of the final-good importer is a tariff, that is,* $t^*_{ho} > 0$*. (ii) If* $m = m^t_{ho}$*, the optimal trade policy of the final-good importer is free trade, that is,* $t^*_{ho} = 0$*. (iii) If* $m > m^t_{ho}$*, the optimal trade policy of the final-good importer is an import subsidy, that is,* $t^*_{ho} < 0$.

Proof. The sign of t^*_{ho} only depends on the terms in the numerator: $-6\lambda m + 6n + 5\lambda(1+n)$. Note that the denominator is positive because the second-order condition in the first stage must be satisfied. By solving $-6\lambda m + 6n + 5\lambda(1+n) > 0$ for m, we obtain the following inequality:

$$m < \frac{6n + 5\lambda(1+n)}{6\lambda} \equiv m^t_{ho}.$$

Additionally, a comparison of m^t_{ho} and m_{ho} always yields $m_{ho} > m^t_{ho}$, which implies Proposition 5.□

Taking into account the presence of a downstream firm located in the importing country, the final-good importer chooses to impose a tariff when the number of input suppliers located in the final-good importer is small. Because this result is consistent with Proposition 1, the intuition behind both is shared.

Next, we consider the effect of n on the consumer and total surpluses. In equilibrium, consumer and total surpluses are as follows:

$$CS_{ho}^{*} = \frac{2n^2(\lambda + (\lambda+6)n)^2}{[\lambda^2 + 2\lambda n(\lambda - 2m + 6) + (\lambda^2 + 12\lambda + 20)n^2]^2},$$

$$W_{ho}^{*} = \frac{2n(\lambda m + 4n)}{\lambda^2 + 2\lambda n(\lambda - 2m + 6) + (\lambda^2 + 12\lambda + 20)\, n^2}.$$

By differentiating these surpluses with respect to n, we obtain the following derivatives:

$$\frac{\partial CS_{ho}^{*}}{\partial n} = \frac{4\lambda n(\lambda + (\lambda+6)n)\left[m\left(-4\lambda n^2 - 24n^2\right) + \lambda^2\left(n^2 + 2n + 1\right) + \lambda\left(12n^2 + 12n\right) + 52n^2\right]}{[\lambda^2 + 2\lambda n(\lambda - 2m + 6) + (\lambda^2 + 12\lambda + 20)\, n^2]^3},$$

$$\frac{\partial W_{ho}^{*}}{\partial n} = \frac{2\lambda(\lambda + (\lambda+6)n)[-\lambda m(n-1) - 2n(3m-4)]}{[\lambda^2 + 2\lambda n(\lambda - 2m + 6) + (\lambda^2 + 12\lambda + 20)\, n^2]^2} < 0.$$

We define the following threshold values:

$$m_{ho}^{CS} \equiv \frac{\lambda^2 + \left(\lambda^2 + 12\lambda + 52\right) n^2 + 2\lambda(\lambda+6)n}{4(\lambda+6)n^2}, \quad m_{ho}^{W} \equiv \frac{8n}{(\lambda+6)n - \lambda}.$$

Then, we obtain the result of the comparative statics as follows.

Proposition 6. *Suppose that one downstream firm exists in the importing country and all downstream firms produce a homogeneous product and compete in quantity. (i) Consumer surplus decreases with n if $m > m_{ho}^{CS}$; and total surplus decreases with n if $m > m_{ho}^{W}$. (ii) Consumer surplus does not change with n if $m = m_{ho}^{CS}$; and total surplus does not change with n if $m = m_{ho}^{W}$. (iii) Consumer surplus increases with n if $m < m_{ho}^{CS}$; and total surplus increases with n if $m < m_{ho}^{W}$.*

Proof. First, we consider the effect of n on CS_{ho}^{*}. From the second-order condition in the first stage, the denominator of $\partial CS_{ho}^{*}/\partial n$ is positive. Then, the sign of $\partial CS_{ho}^{*}/\partial n$ only depends on the terms in the numerator. Hence, we solve $\partial CS^*_{ho}/\partial n < 0$ for m and obtain $m > m^{CS}_{ho}$. By comparing m^{CS}_{ho} and m_{ho}, we obtain the first part of the proposition.

Next, we consider the effect of n on W^*_{ho}. The sign of $\partial W^*_{ho}/\partial n$ only depends on the terms in the numerator. Hence, we solve $\partial W^*_{ho}/\partial n < 0$ for m and obtain $m > m^W_{ho}$. By comparing m^W_{ho} and m_{ho}, we obtain the second part of the proposition. □

We can confirm that Proposition 6 is consistent with Proposition 2. Thus, the intuition behind Proposition 6 is the same as that behind Proposition 2.

5 Conclusion

In this paper, we considered a final-good importer with upstream input suppliers, and showed that upstream competition can reduce consumer and total surpluses in the final-good importer. In international upstream markets, the input price falls as the number of input suppliers increases. By contrast, if the input supplier exists in the final-good importer, the level of its trade policy increases as the number of input suppliers increases. The unit cost of the final-good exporting firms is the sum of the level of trade policy and input price. When the number of input suppliers increases, the input price falls, but the level of trade policy rises. Hence, an increase in the number of input suppliers has conflicting effects. If the final-good importer has an input supplier, as the cost-increasing effect is dominant, an increase in the number of input suppliers increases the cost of final-good exporting firms and reduces their export volumes. Because imports of the final good decrease and the price increases, consumer surplus decreases. Furthermore, the final-good exporting firms become less efficient; hence, the total surplus also decreases. When (i) upstream competition is quantity and (ii) an oligopolist exists in the final-good importer, this result essentially holds.

Competition authorities and practitioners usually emphasize competition. However, it is not necessarily desirable for consumers and the entire economy to enhance competition rashly. Our contribution is that we found that an increase in the number of upstream firms (competition enhancing) may cause such an undesirable result.

Our analysis is limited to the "one importing country case." Therefore, extending our model to a two-way two-country trade model may be fruitful. However, this topic is beyond the scope of our analysis and remains an issue for future research.

Acknowledgements

We thank Noriaki Matsushima for his helpful comments. We thank Edanz (https://jp.edanz.com/ac) for editing a draft of this manuscript. All errors are our own.

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