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Tariff induced dumping

in the intermediate-good market

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Abstract

The aim of this paper is, firstly, to study under which conditions dumping occurs in a vertically related market, secondly, to investigate the effects of a tariff on an intermediate-good, and lastly, to consider whether the country suffering from dumping has an incentive to impose anti-dumping duty or not. The novelty of this paper is as follows: under the Bernhofen type model, dumping occurs only when the intermediate-good industry plays as Stackelberg leader to the final-good industry, and the import tariffs on the intermediate-good may cause dumping. Therefore, the best way to prevent dumping is the abolition of tariffs.

1. Introduction

During the last decade, instances of anti-dumping petitions and anti-dumping duties on international goods, such as semiconductors, flat panel displays and stainless steel products, have been increasing rapidly.

As result of this, a considerable number of studies have been made on the effects of some policies on a vertically related market model based on the development of the theory of imperfect competition (for example, Spencer & Jones [1992] and Ishikawa & Spencer [1996] etc.). The model of dumping in the intermediate-good market and the effects of anti-dumping duties in a vertically related market has been studied by Bernhofen [1995]. Ishikawa & Spencer [1996](an extension of Brander & Spencer [1986]), point out that export subsidies on the final-good producers playing Cournot competition influence the intermediate-good price. The cost differential between the final-good producers playing Cournot competition is shown to cause dumping in the intermediate-good markets in the Bernhofen [1995] model.

In both the Ishikawa & Spencer [1996] and Bernhofen [1995] models, the intermediate-good industry plays as Stackelberg leader for the final-good industry. However, from the theoretical point of view, it is worth studying a version where the final-good industry plays as Stackelberg leader.

Added to these, although Brander & Spencer [1984] have already studied a model where tariff policies are imposed on the foreign final-good monopolist, it is also worth while analyzing the case in which the intermediate-good producer is a monopolist in a vertically related market model.

Regarding the other Bernhofen [1995] type model, it is possible to consider that dumping occurs due to other reasons, for instance, dumping would be caused if there was a levy on import tariffs on the intermediate-good. In such a situation, it is necessary to abolish import tariffs in order to prevent the occurrence of dumping. However, this is not to deny that the countries suffering from dumping may have an incentive to impose anti-dumping duties.

The aim of this paper is to analyze comprehensively the conditions in which dumping occurs in the intermediate-good market, to consider the effects of anti-dumping duties, and to

study whether the country suffering from dumping has an incentive to impose anti-dumping duty or not.

Before turning to the analysis, we must make clear our definition of dumping[1]. According to Article 6 of the GATT 1994 and Agreement on Implementation of Article 6 of the GATT, dumping is defined as price discrimination between national markets and price setting less than marginal cost or average cost. That is, there are two kinds of dumping. The former is classified into the third type price discrimination by the monopolist[2]. In the oligopolistic model, reciprocal dumping between duopolists in Cournot competition by Brander & Krugman [1983] is widely known. In the latter, there are two cases. In the first case, dumping may occur *ex post*, when a producer faces some uncertainty making a decision. For example, Ethier [1982] shows that dumping might occur when a firm makes an employment policy, when it is faced with an uncertainty of product price. Davies & MacGuiness [1982] point out that the risk neutral monopolist in a small country facing an uncertainty in the international price could export goods at less than marginal cost *ex post*. Secondly, dumping could occur in the case where a firm intends to maximize profit with regard to the long term. For example, Gruenspecht [1988] focuses on ' forward pricing' in the semiconductor industry. He shows that since Cournot competitive duopolist's higher production levels at the first stage contribute to a reduction in marginal cost at the second stage, they might supply goods at a price less than marginal cost at the first stage.

In this paper, we will concentrate on the first definition of dumping, that is , international price discrimination.

In section 2 we describe the model structure, i.e. vertically related markets characterized by Cournot oligopolists. In section 3, we analyze under which conditions dumping occurs in the intermediate-good markets in the case where the intermediate-good industry plays as a Stackelberg leader for the final good industry; the effects of an import tariff; and whether the country suffering from dumping has an incentive to levy anti-dumping duty or not. In section 4, we consider the case in which the intermediate-good producer is a monopolist. In section 5, we analyze the case in which the final-good industry plays as

[1]Excellent consideration to anti-dumping law is Deardorff [1990] for example.

[2]See Varian [1987] for example.

Stackelberg leader for the intermediate-good industry. Section 6 is concluding remarks.

2. The model

We consider a three country model with a home country, a foreign country and the rest of the world. Both the home country and the foreign country are assumed to have an industry consisting of one intermediate-good producer (IGP) and one final-good producer (FGP), respectively. The industry is supposed to be so small that any other sectors in the economy of each country and the rest of the world are not influenced by any change in it. So partial equilibrium analysis is appropriate. Although it may be said that this situation is at variance with reality, it becomes a policy benchmark as an approximation to the real world.

The FGPs make the same kind of products and compete in a Cournot game in the final-good market of the rest of the world (in which there is supposed to be no consumer for the final-good either in the home or foreign country). The FGPs face the linear demand curve; $p(Z)=a-bZ$, where Z is the level of consumption and we define $a>b>0$. The FGP in country i (i=Home (H) or Foreign (F)) installs one intermediate-good and uses the unit cost c_i to make one final-good. c_i is assumed to be small enough for a. The home and foreign intermediate-goods are made on the specific order of home and foreign FGPs respectively (but using the same kind of parts). So the home and the foreign intermediate-good markets are segmented and no arbitrage occurs. We assume that no entry and no potential entry occurs. The governments of both countries impose import tariffs on intermediate-goods. Figure 1 helps to define these assumptions.

The profit functions of the home and foreign FGPs are represented as follows.

$$(1) \qquad \pi_i = \left\{ p(Z) - c_i - r^i \right\} y^i \qquad (i,j = H,F;\ i \neq j)$$

where y^i denotes outputs of the home (y^H) and foreign (y^F) FGPs and $Z=y^H+y^F$ which implies that all consumption is supplied by the home and foreign FGPs. The prices of the home and foreign intermediate-goods can be denoted by r^H and r^F, respectively.

$$(2) \qquad \pi_i^m = r^i m_i^i + r^j m_i^j - w_i\left(m_i^i + m_i^j\right) - t^j m_i^j \qquad (i,j = H,F;\ i \neq j)$$

where w_i (i=H,F) is the unit cost to make 1 unit of the home (foreign) intermediate-good and

t^H (t^F) is the specific import tariff (if its value is positive) or specific import subsidy (if its value is negative) on the intermediate-good that the home (foreign) government imposes. We assume $a>c_i+w_i$ (i=H,F), and the levels of these policies are sufficiently low for the intermediate-good to be tradeable.

Finally, we define home and foreign welfare functions.

(3) $W^i=\pi_i+\pi_i^m+t^i m_j^i \quad (i,j=H,F;\ i\neq j)$

We can suppose there to be three patterns of intermediate-goods' supply. Firstly where the home and foreign IGPs supply both domestically and for export, secondly where one IGP delivers to the domestic market and for export and the other supplies the domestic market, and thirdly where only one IGP supplies both intermediate-good markets.

3. When IGPs have bargaining power in the intermediate-good market

In this section, we consider a model consisting of a three stage game: firstly governments decide their tariff rates, secondly the IGPs decide the domestic supply and export under Cournot competition in the home and foreign intermediate-good markets, taking import tariffs as given, and lastly FGPs decide their production levels under Cournot competition taking the supply of intermediate-good as given.

3-1. Conditions of dumping in the intermediate-good market

Suppose that r^H and r^F are exogeneously given for the FGPs because home and foreign IGPs play as Stackelberg leaders. m_H^H (m_H^F) and m_F^H (m_F^F) are quantities of supplies of the home (foreign) IGPs to the home and foreign market, respectively. Note that $m_H^H+m_F^H=y^H$ and $m_H^F+m_F^F=y^F$ as mentioned previously.

We assume that home and foreign FGPs choose y^H and y^F to maximize their profits taking r^H and r^F as given. Hence we obtain the following equation from the first order conditions for profit maximization.

(4) $y^i=\left\{a-2r^i+r^j-c_i\right\}/3b \quad (i,j=H,F;\ i\neq j)$

Arranging (4) for r^i, we have:

(5) $r^i = a - 2by_i - by_j - c_i \quad (i,j = H,F;\ i \neq j)$

As the marginal costs of IGPs are constant, the IGPs can decide the quantities they will supply to the home and foreign intermediate-good markets independently. We assume the IGPs choose quantities of domestic supply and export to maximize their profits respectively, taking the quantities from their rival in each market as given, in which case the following equations are obtained from the first order conditions for profit maximization from substituting equation (5) into (2).

(6) $m_i^i = \left\{a - c_i - w_i\right\} / 4b - m_j^i / 2 - m_j^j / 2 - m_j^j / 4 \quad (i,j = H,F;\ i \neq j)$

(7) $m_i^j = \left\{a - c_i - w_i - t^j\right\} / 4b - m_j^j / 2 - m_i^i / 2 - m_j^i / 4 \quad (i,j = H,F;\ i \neq j)$

Solving equations (6) and (7), we obtain the equilibrium outputs of the intermediate-good:

(8) $m_i^{iE} = \left\{\left(a - c_i - w_i\right) + \left(c_j - c_i\right) + \left(w_j - w_i\right) + 2t^i + 2t^j\right\} / 9b \quad (i,j = H,F;\ i \neq j)$

(9) $m_j^{jE} = \left\{\left(a - c_i - w_i\right) + \left(c_j - c_i\right) + \left(w_j - w_i\right) - t^i - 4t^j\right\} / 9b \quad (i,j = H,F;\ i \neq j)$

where superscript letter E denotes the equilibrium. We assume that the levels of tariff rate are sufficiently low for intermediate-goods to be tradable, $\left(a - c_i - w_i\right) + \left(c_j - c_i\right) + \left(w_j - w_i\right)$ is definitely positive and the values of (8) and (9) must be positive $(i,j = H,F;\ i \neq j)$. Note that these values represent numerators of home and foreign intermediate-good equilibrium outputs under free trade (in the sense that there is no governmental intervention in international trade) respectively.

We can get the quantity of total supply for the home intermediate-good market from m_H^{HE} plus m_F^{HE}, and for the foreign market from m_H^{FE} plus m_F^{FE}:

(10) $y^{iE} = \left\{\left(a - c_i - w_i\right) + \left(a - c_j - w_j\right) - 2t^i + t^j\right\} / 9b \quad (i,j = H,F;\ i \neq j)$

y^{iE} is the equilibrium output of the FGP in country i $(i,j=H,F;\ i \neq j)$.

Substituting (10) into (5) yields the equilibrium market price of intermediate-good in country i:

$$(11) \quad r^{iE} = \left\{ a - 2c_i + c_j + w_i + w_j + t^i \right\} / 3 \quad (i,j = H,F;\ i \neq j)$$

which implies that the import tariff (subsidy) makes the domestic price of the intermediate-good under the equilibrium higher (lower) than the price under free trade, but the export price does not change.

Supposing $p(Z)=a-bZ$ and $Z=y_H+y_F$, from equations (2) and (10), we have the equilibrium price of the final-good:

$$(12) \quad p^E = \left\{ 5a + 2c_H + 2c_F + 2w_H + 2w_F + t^H + t^F \right\} / 9$$

Note that the equilibrium final-good price is influenced by the import tariff or subsidy policies on intermediate-goods. That is, if any import tariffs (subsidies) are imposed, then the final-good price becomes higher (lower) than the price under free trade.

We can get the equilibrium profits of the home and foreign final- and intermediate-goods π_i^E, π_i^{mE} (i = H, F) by substituting the equilibrium outputs and prices into the profit functions.

Dumping is defined as when domestic price is higher than export price "at the same level of trade, normally at ex-factory level and in respect of sales made at as nearly as possible the same time."[3], that is $r^i > r^j - t^j$ (i,j = H,F; i ≠ j) in this model. By substituting inequality (11) into the condition of dumping, we have:

$$(13) \quad r^{iE} - \left(r^{jE} - t^j \right) = \left(c_j - c_i \right) + \left(t^i + 2t^j \right) / 3 > 0 \quad (i,j = H,F;\ i \neq j)$$

The difference of r^j and $r^j - t^j$ is said to be the dumping margin.

Now, we consider what happens when the home IGP dumps. Substituting i to H and j to F, we obtain:

$$(13') \quad r^{HE} - \left(r^{FE} - t^F \right) = \left(c_F - c_H \right) + \left(t^H + 2t^F \right) / 3 > 0$$

[3]Article 2.4 in Agreement on implementation of articles VI of the GATT 1994. Another case of dumping is defined as when a firm sets the price at less than average cost within an extended period of time.

Proposition 1:

(i) When $t^H \leq 0$ and $t^F \leq 0$, the necessary condition that home IGP dumps is $c_H < c_F$.

(ii) when $c_H \geq c_F$, the necessary conditions that home IGP dumps is $t^H > 0$ or $t^F > 0$ (tariff induced dumping).

Proof:

(i) If $t^H \leq 0$ and $t^F \leq 0$, the second term on the right hand side of inequality (13') becomes negative. So $c_H < c_F$ is the necessary condition that home IGP dumps.

(ii) if $c_F < c_H$, the first term on the right hand side of the equation (13') is negative. So the necessary condition for home IGP to dump is $t^H > 0$ or $t^F > 0$. Q.E.D.

Corollary

(i) Under free trade or when the tariff rates are small enough to be negligible, $c_H < c_F$ is a necessary and sufficient condition for the home IGP to dump (Bernhofen [1995]).

(ii) When $c_H = c_F$, the necessary and sufficient condition for home IGP to dump is $t^H > 0$ or $t^F > 0$.

Proof.

(i) If $t^H = t^F = 0$, the inequality (13') becomes

(13") $r^{HE} - \left(r^{FE} - t^F\right) = c_F - c_H$.

iff $c_H < c_F$, the IGP in country H dumps (Bernhofen [1995]).

(ii) iff $c_H = c_F$, we obtain

(13"') $r^{HE} - \left(r^{FE} - t^F\right) = \left(t^H + 2t^F\right)/3 > 0$

When $t^H > 0$ or $t^F > 0$, the value of dumping margin of (13"') is positive. Q.E.D.

Notice that the foreign IGP also dumps in case (ii) (reciprocal dumping[4]) iff the value of the second term on the right hand side is larger than c_H-c_F. In case (ii), import tariff or tariffs cause dumping. The higher the tariff rate on the intermediate-good import, the

[4]See Brander & Krugman [1983].

larger the dumping margin of IGP or IGPs. When $t^H \le 0$ and $t^F \le 0$ (case 1), the IGP may dump in the home country that has an FGP using low cost technology.

3-2. Does government have an incentive to impose anti-dumping duty on intermediate-good imports?

A foreign country that imports a dumped intermediate-good can impose an anti-dumping duty not greater than the amount of the dumping margin. We define that anti-dumping duty as a specific tariff and the value of the dumping margin is $r^{HE} - \left(r^{FE} - t^F\right)$.

We begin by examining the effects when only one government increases import tariffs marginally.

Substituting from equations (8) to (12) into (3), the equilibrium welfare of country i is represented as follows:

$$\begin{aligned} \partial W_F / \partial t^F &= \partial \pi_F^E / \partial t^F + \partial \pi_F^{mE} / \partial t^F + t^F\left(\partial m_H^{FE} / \partial t^F\right) + m_H^{FE} \\ &= -\left(4y_F^E / 9\right) + \left\{2m_F^{FE} / 3 + \left(c_H - c_F\right) / 9b\right\} - 4t^F / 9b + m_H^{FE} \\ &= \left[\left(3m_H^{FE} + 2y_F^E\right) - \left\{\left(c_F - c_H\right) + 4t^F\right\} / b\right] / 9 \end{aligned} \tag{14}$$

where

$$\partial \pi_F^E / \partial t^F = -4y_F^E / 9 < 0. \tag{15}$$

$$\partial \pi_F^{mE} / \partial t^F = 2m_F^{FE} / 3 + \left(c_H - c_F\right) / 9b \tag{16}$$

As shown in equation (15), the profit of the foreign FGP decreases.

Next, we investigate equation (16). The first term on the right hand side ($2m_F^{FE} / 3$) is definitely positive. But the second term ($\left(c_H - c_F\right) / 9b$) seems to be ambiguous. Remembering Proposition 1, in case (i), $\left(c_H - c_F\right) / 9b < 0$, the value of $\partial \pi_F^{mE} / \partial t^F > 0$ iff $2m_F^{FE} > \left(c_F - c_H\right) / 3b$. It means that the smaller the cost differential of FGPs (equal to the

dumping margin), the more the profit of foreign IGP improves. In case (ii), the second term on the right hand side in equation (16) is non-negative, the profit of the foreign IGP increases.

As the value on the left hand side is definitely positive, $\partial W_F / \partial t^F \gtreqless 0$ iff

$3m_H^{FE} + 2y_F^E \gtreqless \left\{ (c_F - c_H) + 4t^F \right\} / b$. The left hand side of this inequality is definitely positive.

In case (i) where $c_F > c_H$ and $t^F \leq 0$, the value on the right hand side of the inequality is positive. If the dumping margin $(c_F - c_H)$ is not so high, foreign, $\partial W_F / \partial t^F > 0$. In case (ii) where $c_F \leq c_H$ and $t^H > 0$, if t^H is not so high, $\partial W_F / \partial t^F > 0$.

Suppose that the optimal tariff for a foreign country is positive. The foreign government has an incentive to impose a tariff until import tariff on the intermediate-good is equal to or less than the optimal rate.

Letting $\partial W_F / \partial t^F = 0$, the optimal tariff for the foreign country represented by t^{F*} becomes

$$(17) \quad t^{F*} = \left\{ 9b\left(3m_H^{F0} + 2y_F^0\right) + 9\left(c_H - c_F\right) - t^H \right\} / 52$$

where superscript 0 denotes outcomes under free trade.
In cases of (i) and (ii), the optimal tariff is positive if

$$(18) \quad 3m_H^{F0} + 2y_F^0 > \left(c_F - c_H\right) / b + t^H / 9b$$

Now let us consider the conditions for the optimal tariff to be positive. In case (i) where $c_F > c_H$ and $t^H \leq 0$, if the dumping margin $(c_F - c_H)$ is not high, foreign output and derived demand of the intermediate-good of the FGP are large enough to affect inequality (18). In case (ii) where $c_F \leq c_H$ and $t^H > 0$, the value on the right hand side is negative, so the optimal tariff rate is positive if t^H is small enough [5].

[5]Ishikawa & Spencer(1996) analyze that optimal import tariff on an intermediate-good in a similar industrial structure to our model but consisting of many firms (no entry) where only the home FGPs import intermediate-good. In this case, the optimal tariff is positive iff the home IGP's profit and tariff revenue increase by import tariff.

Suppose that the optimal tariff for a foreign country is positive. The foreign government has an incentive to impose a tariff until import tariff on the intermediate-good is equal to or less than the optimal rate.

4. When home IGP is a monopolist

4-1. The model

Assume that only the home IGP producer (monopolist) supplies the intermediate-good to both FGPs: $y^H = m_H^H$ and $y^F = m_H^F$. We can suppose 2 cases of monopoly, the first is where the home IGP is a natural monopolist: $r^{HM} < w^F$ and $r^{FM} < w^F$ and the second is where the home IGP deters entry of a foreign IGP[6]. For simplicity, we assume that no entry and no potential entry occurs.

From the first order condition for profit maximization of the home IGP, we obtain the following equations.

(19) $$m_H^H = \left(a - c_H - w_H\right) / 4b - m_H^F / 2$$

(20) $$m_H^F = \left(a - c_F - w_H - t^F\right) / 4b - m_H^H / 2 .$$

Equations (19) and (20) define the equilibrium monopoly output levels m_H^{HM} and m_H^{FM}.

(21) $$m_H^{HM} = \left\{\left(a - c_H - w_H\right) + \left(c_F - c_H\right) + t^F\right\} / 6b = y^{HM}$$

(22) $$m_H^{FM} = \left\{\left(a - c_F - w_H\right) + \left(c_H - c_F\right) - 2t^F\right\} / 6b = y^{FM}$$

Substituting equations (21) and (22) into (11), we can derive the home and foreign intermediate-good prices respectively.

(23) $$r^{HM} = \left(a - c_H + w_H\right) / 2$$

(24) $$r^{FM} = \left(a - c_F + w_H + t^F\right) / 2$$

[6]Brander & Spencer (1984) analyze a model of entry deterrence.

The final-good price is therefore:

$$(25)\quad p^M = \left(4a + c_H + c_F + 2w_H + t^F\right)/6$$

4-2. Conditions of dumping in the intermediate-good market

The condition under which the home IGP dumps is as follows.

$$(26)\quad r^{HM} - \left(r^{FM} - t^F\right) = \left(c_F - c_H\right) + t^F/2 > 0$$

Suppose the intermediate-good supplier is a monopolist. In this case the condition under which the monopolist dumps is $r^{HM} - \left(r^{FM} - t^F\right) = \left(c_F - c_H\right) + t^F/2 > 0$. This shows that $c_F > c_H$ is a necessary condition for the home IGP to dump when $t^F \le 0$. When $c_F \le c_H$, a positive import tariff by the foreign country is a necessary condition for the home IGP to dump (tariff induced dumping).

4-3. Does government have an incentive to impose an AD duty on imports?

When the home IGP is a monopolist, the foreign country's welfare is as the follows.

$$(27)\quad W^{FM} = \pi_F^M + t^F m_H^{FM}$$

We obtain the welfare change of the foreign country by differentiating equation (27) with respect to t^F.

$$\begin{aligned}(28)\quad \partial W^{FM}/\partial t^F &= \partial \pi_F^M/t^F + m_H^{FM} + t^F\left(\partial m_H^{FM}/t^F\right)\\ &= -\left\{\left(a - c_F - w_H\right) + \left(c_H - c_F\right) - 2t^F\right\}/9b + \left\{\left(a - c_F - w_H\right) + \left(c_H - c_F\right) - 4t^F\right\}/6b\\ &= \left\{\left(a - c_F - w_H\right) + \left(c_H - c_F\right) - 8t^F\right\}/18b\end{aligned}$$

where

$$(29)\quad \partial \pi_F^M/t^F = -\left\{\left(a - c_F - w_H\right) + \left(c_H - c_F\right) - 2t^F\right\}/9b < 0$$

because $\left\{\left(a-c_F-w_H\right)+\left(c_H-c_F\right)-2t^F\right\}$ has the same numerator value of y_F^M as shown in equation (22) which must be positive. Next we focus on the effects of changes by t^F on the tariff revenue.

$$(30)\quad m_H^{FM}+t^F\left(\partial m_H^{FM}/t^F\right)=\left\{\left(a-c_F-w_H\right)+\left(c_H-c_F\right)-4t^F\right\}/6b$$

whose value depends on the level of t^F, (30) could be positive if the level of t^F is low enough. So $\partial W^{FM}/\partial t^F$ can be positive at some tariff rates where the tariff revenue is greater than the reduction of the FGP's profit.

The country suffering dumping has an incentive to impose an import tariff on the intermediate-good monopolist.

Setting $\partial W^{FM}/\partial t^F=0$, we obtain the optimal tariff rate.

$$(31)\quad t^{FM*}=m_H^{F0}/36b>0$$

because m_H^{F0} is denoted as the output of the foreign FGP under free trade which must be positive.

The conclusion that a positive import tariff is optimal for the foreign monopolist has been already analyzed by Brander & Spencer (1981) who construct a linear demand function for the final-good, a constant marginal cost for the foreign FGP and a specific import tariff. In this case, the tariff revenue by extracting foreign monopoly rent offsets the loss of consumer surplus[7]. We obtain a similar result in the model where the consumer is the FGP competing under Cournot competition with a rival in the third country's market.

5. When FGPs have bargaining power in the intermediate-good market

In this chapter, we consider a model consisting of a three stage game: governments decide their tariff rates first, secondly FGPs decide production under Cournot competition taking import tariffs as given and lastly IGPs decide their production levels taking the home

[7]Generally, iff the demand curve is flatter than the marginal revenue curve, the optimal tariff on the foreign monopolist is positive (see Brander & Krugman [1989]).

and foreign prices of the intermediate-good as given.

In this case, firstly we analyze the situation where the IGPs decide their production levels with the intermediate-good prices as given. The first order conditions for profit maximization of IGPs are as follows.

(32) $r^i = w_i \ (i = H,F)$

(33) $r^j = w_i + t^j \ (i,j = H,F; i \neq j)$

Then respective FGPs problems are as follows.

(34) $r^i = \min\left(w_i, w_j + t^j\right) \quad (i,j = H,F; i \neq j)$.

From (34) and using the equations (1), FGPs decide equilibrium outputs[8].

Proposition 2:

Dumping never occurs in an intermediate-good market when FGPs have bargaining power in the intermediate-good markets.

Proof:

There are two cases where intermediate-good trade can occur. The first case is $w_i < w_i + t^j < w_j \quad (i,j = H,F; i \neq j)$. So $r^i = w_i$ and $r^j = w_i + t^j \quad (i,j = H,F; i \neq j)$.

In this case, the IGP in country i is the only supplier to the home and foreign FGPs.

The second case is $w_j = w_i + t^j \quad (i,j = H,F; i \neq j)$ where $w_j > w_i$. In this case, the IGP in country i supplies the home and foreign intermediate-good markets. Assume that when $w_j = w_i + t^j$, the home and foreign IGPs share just half of the intermediate-good demand of the FGP in country j. So the IGP in country j supplies the domestic intermediate-good market.

Considering the dumping by the IGP in country i, it cannot dump in either case because $r^i - \left(r^j - t^j\right) = 0$. Q.E.D.

5. Concluding remarks

This paper suggests that dumping occurs in the intermediate-good market only when the intermediate-good industry plays as Stackelberg leader for the final-good industry. It is

[8]See Appendix B.

proved that the best way to prevent dumping is to abolish tariffs. Anti-dumping duties imposed on the intermediate-good will contribute to an expansion of the dumping margin. However, the country importing the intermediate-good has an incentive to impose anti-dumping duty on the intermediate-good imports around the optimal tariff rate.

Still this model needs further consideration. Firstly, dumping occurs when in one country the intermediate-good industry is a Stackelberg leader for the final-good industry, and in the other country the final-good industry is a Stackelberg leader for the intermediate-good industry, in other word, there are differences in market structure between countries. Secondly, we need to study the vertical integration between the intermediate-good producer and the final-good producer, since this paper only considers a vertically related market model.

Appendix A: Welfare change of the country having anti-dumping duty imposed

We assume the home IGP has anti-dumping duty imposed by the foreign government. The welfare change of the home country is shown as follows.

$$\begin{aligned} \partial W_H / \partial t^F &= \partial \pi_H / \partial t^F + \partial \pi_H^m / \partial t^F + t^H \left(\partial m_F^H / \partial t^F \right) \\ &= \left(2y^{HE} / 9 \right) - \left\{ 4m_H^{FE} / 3 + \left(c_H - c_F \right) / 9b \right\} - 4t^H / 9b \\ &= \left[2\left(y^{HE} - 6m_H^{FE} \right) + \left\{ \left(c_F - c_H \right) + t^H \right\} / b \right] / 9 \end{aligned} \tag{A-1}$$

where

$$\partial \pi_H / \partial t^F = 2y^{HE} / 9 > 0 \tag{A-2}$$

and

$$\partial \pi_H^m / \partial t^F = -4\left\{ m_H^{FE} + \left(c_H - c_F \right) / 3b \right\} / 3 \tag{A-3}$$

As shown in equation (A-2), the home FGP profits.

Next, we investigate equation (A-3). The first term in { } on the right hand side is

definitely positive and the second term is negative in case (i) of Theorem 1 ($t^H \leq 0$ and $t^F \leq 0$ and $c_F > c_H$) . The larger (smaller) the value of dumping margin, the smaller (larger) the amount of m_H^{F0}. As Section 3 considers the cases of reciprocal exports in the intermediate-good trade, $\partial \pi_H^m / \partial t^F < 0$ will be robust. In case (ii) of Theorem 1, $\partial \pi_H^m / \partial t^F < 0$ because $c_F \leq c_H$.

Now we consider the entire effects on the home country's welfare. If and only if

$y^{HE} < 6m_H^{FE} + \left\{ \left(c_H - c_F\right) - t^H \right\} / 2b$, $\partial W_H / \partial t^F < 0$. As

$y^{HE} - 6m_H^{FE} = -4m_H^{FE} - \left(c_F + w_F - 3t^F\right) / 3b$, $\partial W_H / \partial t^F$ can be negative. In case (i) of Theorem 1, the second term on the right hand side of this inequality is negative thus $\partial W_H / \partial t^F < 0$. In case (ii) of Theorem 1, the second term on the right hand side of this inequality is negative (positive) iff t^H is larger (smaller) than $c_H - c_F$, but this value is small enough not to affect $y^{HE} - 6m_H^{FE}$, thus we suppose $\partial W_H / \partial t^F < 0$.

B. Equilibrium output of FGPs when FGPs have bargaining power in the intermediate-good market

Each FGP is supposed to play a Cournot game by choosing profit maximizing outputs, subject to the decision of its rival, knowing the minimum price level of the IGP. Using equations (1) and (34), we obtain the reaction function of the FGP.

(B-1) $y^i = (a - c_i - r^i) - y^j/2$ $(i,j=H,F; H \neq F)$

Solving (B-1) for the optimal final-good level, we get

(B-2) $y^{iD} = \{(a - c_i - r^i) + (c_j - c_i) + (r^j - r^i)\}/3b$ $(i,j=H,F; H \neq F)$.

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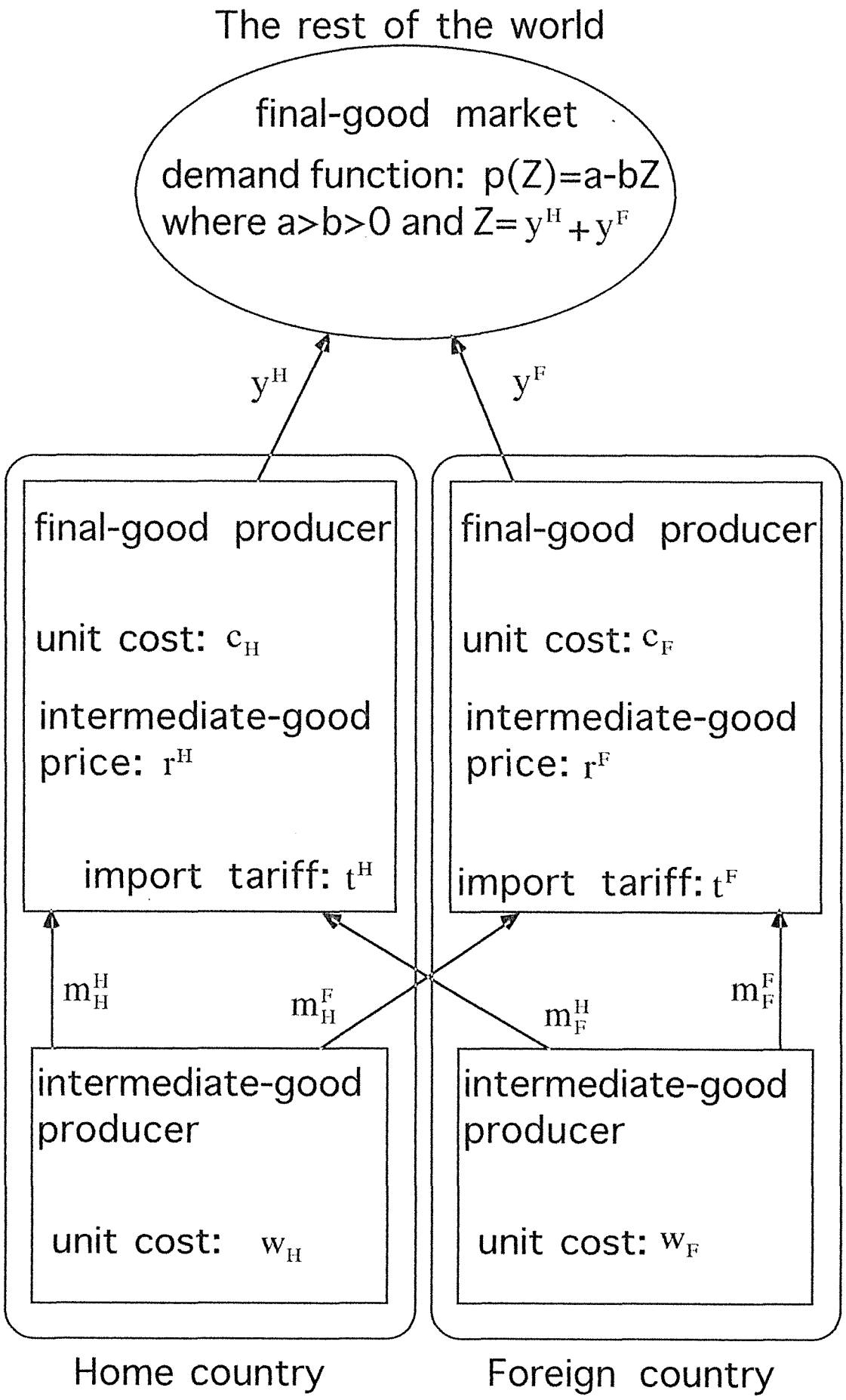
Figure 1


The rest of the world
final-good market
demand function: p(Z)=a-bZ
where a>b>0 and Z= $y^H + y^F$
y^H
y^F
final-good producer
unit cost: c_H
intermediate-good price: r^H
import tariff: t^H
final-good producer
unit cost: c_F
intermediate-good price: r^F
import tariff: t^F
m_H^H
m_H^F
m_F^H
m_F^F
intermediate-good producer
unit cost: w_H
intermediate-good producer
unit cost: w_F
Home country
Foreign country

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