

# Import tariff upstream versus export tax downstream: are they welfare equivalent?

*Hisashi Hokari*<sup>†</sup>, *Hong Hwang*<sup>‡</sup> and *Hiroshi Ohta*<sup>§</sup>

<sup>†</sup>Shukutoku University, School of Business and Communication, Japan,

<sup>‡</sup>National Taiwan University, Department of Economics, Taiwan,

<sup>§</sup>Aoyama Gakuin University, Department of International Economics, SIPEB, Japan

## Abstract

Along the lines of the strategic trade policy inquiry under vertical structures we show that two rival governments may select different rates of export subsidies and import tariffs respectively upon their own industries even if their marginal costs are identical. Moreover, regardless of any combination of these policy instruments optimally introduced, we show that each nation's welfare level will remain the same and higher than that under free trade with no trade policy at all.

## Keywords

Strategic trade policy, vertical structure, import tariff, export subsidy

## 1. INTRODUCTION

Over the last decade and a half, strategic trade policy has become one of the hottest issues in international trade, not only in academic, but also in political debates. Brander and Spencer (1985) initiated the academic controversies. Their paper presents a model that shows export subsidy as an optimal trade policy under Cournot competition. It also demonstrates the immanence of prisoner's dilemma as a result of a trade war between two exporting nations, making each nation worse-off than it would be under free trade. In sharp contrast, Eaton and Grossman (1986) show that export tax is optimal under Bertrand competition.

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### Address for Correspondence

Hisashi Hokari, School of Business and Communication, Shukutoku University, 1150-1 Fujikubo, Miyoshi-machi, Iruma-gun, Saitama, 354-8510, Japan.

Spencer and Jones (1991, 1992) take the initiative in incorporating vertical structure into strategic trade policy arguments in the following manner. A vertically integrated home firm supplies the home market with a final good produced from a key intermediate good either produced by itself or imported from a foreign vertically integrated rival firm that can produce it at a lower cost than can the home firm. The foreign vertically integrated firm also utilizes its own intermediate good and produces a final good only to export to the home market. Taking into account the possibility of vertical foreclosure *a la* Salop and Scheffman (1983, 1987), Spencer and Jones (1991) demonstrate that the optimal export policy for the foreign government is either to tax both intermediate and final goods of its own vertically integrated firm, or to subsidize both of them, or not to intervene at all. Each result is shown to depend on the sign of the difference in profit margins from its intermediate and final products. On the other hand, Spencer and Jones (1992) find that whether the home importing government should provide a subsidy or impose a tariff on the imported intermediate goods depends on the supply conditions for the input.

As an important extension along these lines, Bernhofen (1997) presents the following models of strategic trade policies in vertically related industries. The industries under consideration consist of one monopolistic input supplier located in a third country and two downstream producers importing the intermediate goods to produce an identical final good for export to another third country. The two downstream governments provide export subsidy in order to assist their own firms competing in quantity (*a la* Cournot). The paper concludes that multiple subgame perfect Nash equilibria can exist contingent upon upstream pricing regimes (discriminatory pricing or uniform pricing).

Extending further along these lines, Hokari and Ohta (2001) allow the upstream pricing regime to be determined endogenously. In their five-stage game with two additional stages of 'pre-play communication' incorporated into Bernhofen's three-stage game, the two governments provide export subsidies while the monopolist practices uniform pricing under a unique subgame perfect Nash equilibrium. Moreover they also show that without such 'pre-play communication' stages, the two governments should impose export tax and the monopolist should employ discriminatory pricing.<sup>1</sup> In that equilibrium, also of unique subgame Nash, each nation's welfare becomes larger than that under free trade. This result is in sharp contrast with the original Brander and Spencer conclusion. Helpman and Krugman (1989) also confirm that, under Bertrand competition, each nation's welfare in equilibrium becomes larger with mutual interventions by export tax than it would with no intervention. (Refer to Helpman and Krugman, 1989, and Brander, 1995, for excellent surveys of strategic trade policy models.)

An interesting question therefore arises: can the two downstream governments improve their welfare by introducing an import tariff as an additional policy instrument? The present paper attempts to answer this question. Insofar as Hokari and Ohta's contention is valid, then we may expect an import tariff as another means to extract rents from the monopolist, which is a more direct means than is an export tax. The optimal export tax may then be smaller with an import tariff than it would be without an import tariff; and, moreover, it may vanish when the import tariff is large enough.

Such expectations as above are valid under assumptions such as linearity of demand and constant marginal costs, as we find the following.<sup>2</sup>

- (1) Even though the marginal costs of the two downstream firms are assumed identical, their governments may select different rates of export subsidies and import tariffs.
- (2) Even if each nation is allowed to use both export subsidy and import tariff as trade policy instruments, its welfare level remains the same as that when only export subsidy is available. Moreover, its welfare level is also the same as that when only an import tariff is available.
- (3) Moreover, each nation's welfare level is the same whatever instrument it may select, namely, export subsidy, import tariff or a combination thereof.

The rest of this paper proceeds as follows. Section 2 extends the Bernhofen (1997) model by introducing an import tariff as an additional policy instrument of downstream government. Section 3 concludes the paper with our new findings.

## 2. THE MODEL

We consider the following three-stage, complete-information game. In the first stage, exporting country  $i$  ( $i = h, f$ ;  $h$  stands for home and  $f$  for foreign) sets up its export subsidy (tax, if it is negative) level  $s_i$  to its own downstream firm and specific import tariff (subsidy, if it is negative) rate  $t_i$  to the monopolistic input supplier located in a third country, given country  $j$ 's subsidy and tariff rates ( $j = h, f, j \neq i$ ). It does so, given also each country's appreciation of the overall effect of market interventions on the monopolist's wholesale prices and the two downstream firms' outputs supplied to another third country. In the second stage, the upstream supplier sets forth its wholesale prices  $w_i$  (charged for firm  $i$ ) and  $w_j$  (charged for firm  $j$ ), given the knowledge about the influence – its own pricing has on the downstream firms' decisions. And finally, in the third stage, the downstream firm  $i$  determines its final good output  $z_i$  for export in the third country, given firm  $j$ 's output  $z_j$ .

This game is solved by backward induction as usual in the literature. In the third stage, which is the same as Bernhofen's (1997) third stage, firm  $i$  decides  $z_i$  ( $i = h, f$ ) to maximize its profit, given firm  $j$ 's output ( $j = h, f, j \neq i$ ):

$$\max_{z_i} \pi_i = pz_i - (w_i - s_i)z_i = (a - bZ - w_i + s_i)z_i \quad (1)$$

where  $p = a - bZ$  ( $Z = z_i + z_j$ ) is the third country's inverse demand function. The first-order conditions for equation (1) of the two firms yield the following equilibrium outputs:

$$z_i = \frac{a - 2(w_i - s_i) + (w_j - s_j)}{3b} \quad (i, j = h, f; j \neq i) \quad (2)$$

In the second stage, the monopolistic input supplier faces the following optimal problem:<sup>3</sup>

$$\max_{w_i, w_j} \pi^M = (w_i - t_i - k)z_i + (w_j - t_j - k)z_j \quad (i, j = h, f; j \neq i) \quad (3)$$

where  $k$  is the unit cost at which the monopolist produces the intermediate good. Arranging the first-order conditions for equation (3) yields the following equilibrium wholesale prices:

$$w_i = \frac{1}{2}(a + k + s_i + t_i) \quad (i = h, f) \quad (4)$$

Finally, in the first stage, exporting country  $i$  maximizes its national welfare, given country  $j$ 's trade policies:

$$\begin{aligned} \max_{s_i, t_i} W_i &= \pi_i - s_i z_i + t_i z_i = (a - bZ + t_i - w_i)z_i \\ &= \frac{1}{36b} [a - k - 4(s_i - t_i) - (s_j - t_j)] [(a - k + 2(s_i - t_i) - (s_j - t_j))] \end{aligned} \quad (5)$$

Its first-order conditions and the relevant first-order conditions of country  $j$  reveal the optimal combination of trade policies:<sup>4</sup>

$$t_i^* - s_i^* = \frac{a - k}{7} \quad (i = h, f, a > k) \quad (6)$$

Substituting this back into equation (2), we obtain the following equilibrium output:

$$z_i^* = \frac{a - k}{7b} \quad (i = h, f) \quad (7)$$

Therefore, the total market output is:

$$Z^* = \frac{2(a - k)}{7b} \tag{8}$$

Given equation (6), the welfare level of country  $i$  under optimal intervention becomes  $W_i^* = 2(a - k)^2/49b$  which is larger, as readily expected, than the one under free trade:  $W_i^* > W_i^F = (a - k)^2/36b$ .<sup>5</sup>

The outcomes we have derived have the following two implications. First, despite the assumed identical technologies for the two nations so that their marginal costs are identical, their export subsidy-cum-import tariff rates in equilibrium are nevertheless not necessarily identical.<sup>6</sup> What causes this model to yield such an intriguing result? To answer this question, we rewrite equation (6) as follows:

$$t_i^* = \frac{a - k}{7} + s_i^* \quad (i = h, f, a > k) \tag{9}$$

Substituting this into equation (4) yields:

$$w_i^* = \frac{1}{2} \left( a + k + 2s_i^* + \frac{a - k}{7} \right) \quad (i = h, f) \tag{10}$$

Thus, each firm's *effective* marginal cost always becomes:

$$MC_i = w_i^* - s_i^* = \frac{1}{2} \left( \frac{8a + 6k}{7} \right) = \frac{4a + 3k}{7} \quad (i = h, f) \tag{11}$$

This provides the following profound insight:

The monopolist's optimal policy is to set up its wholesale price so as to equalize the two firms' effective marginal costs.

This upstream pricing scheme reveals the underlying reason why the two nations can adopt various export subsidy-cum-import tariff rates in equilibrium. That is, the upstream monopolist can be a perfect absorber of even asymmetric trade policies of the two downstream governments.

The second implication of our analysis is that, in equilibrium, the welfare levels of the two countries under consideration remain the same despite the assumed enlargement of their political instruments, that is, even if they can use an import tariff in addition to an export subsidy. It implies that all the three trade policy combinations of export subsidy, import tariff and export subsidy-cum-import tariff are equivalent in this model.<sup>7</sup> Combining this result and the relation of  $W_i^* > W_i^F$  yields the following proposition.

### Proposition

If two countries bilaterally exercise trade policies in vertically related industries under the assumptions of linearity of demand function and constant marginal costs, then<sup>8</sup>

$$W_i^* = W_i^{S^*} = W_i^{T^*} > W_i^F \quad (i = h, f)$$

where  $W_i^*$  is the welfare level of country  $i$  when it chooses an export subsidy-cum-import tariff regime,  $W_i^{S^*}$  is the welfare level of country  $i$  choosing an export subsidy regime,  $W_i^{T^*}$  is the welfare level of country  $i$  choosing an import tariff regime and  $W_i^F$  is the welfare level of country  $i$  under free trade.<sup>9,10</sup>

In connection with the argument above, Ishikawa and Spencer (1999) also consider an optimal combination of policies consisting of an import tariff to a foreign intermediate good, a production subsidy to a domestic intermediate good and an export subsidy to a domestic final good under vertical Cournot oligopolies (*a la* Greenhut and Ohta, 1979, Salinger, 1988, etc). In their model, domestic and foreign final-good producers supply the same product to a third country by either buying an intermediate good from domestic firms or importing it from foreign firms.<sup>11</sup> They show that the optimal combination of production subsidy and the import subsidy targeted for the intermediate goods provides higher welfare to the domestic country than does the optimal export subsidy for the final goods alone.

Our result supports the basic GATT's and WTO's principles. According to the principles, member countries should lower import tariff rates and refrain from the use of export subsidies. Our results have shown that an export subsidy needs to be banned ( $s_i = 0$ ) to accomplish a low level of import tariff rate in vertically related markets. Moreover, the profit of each country's downstream firm remains unchanged as long as its national trade policies combination is set forth pursuant to equation (6). However, a firm normally prefers an export subsidy to an export tax. Given this, a legislator would tend to select the former rather than the latter if his/her purpose is to win the next election. As long as its level is calculated by equation (6), such a selfish decision is not against national interest. Note especially that the larger the  $s_i$ , the higher the  $w_i$  according to equation (10). Therefore, if the firm fails fully to appreciate the causality mentioned above, it may even consider higher  $s_i$  to be beneficial when facing intensive competition with higher  $w_i$ , which is caused in fact by higher  $s_i$  set forth by its own government. Accordingly, if a legislature acts strategically and each government can set a non-zero  $s_i$ , a very high  $t^*$ -cum-high  $s^*$  could then take place in equilibrium.

The proposition also bears the following policy implication. Since export taxes are unconstitutional in the US, import tariffs can be used to achieve the same result as export taxes.<sup>12</sup> This view would be consistent with our

interpretation based on theory of public choice to regard legislators as ‘political entrepreneurs’, who with the next election in mind would never prefer an unpopular export tax to a popular import tariff.

In a similar framework, Bernhofen (1997) concluded that the downstream government should impose a tax on its final good export if the intermediate good market is price-discriminated by the foreign monopolistic supplier. This result does not necessarily hold if the downstream government is equipped with an additional policy instrument such as an import tariff on an intermediate good as assumed in our model. In this case, it is quite straightforward to show that the optimal policy of the downstream government could be an export subsidy on the final good together with an import tariff on an intermediate good. We shall use a numerical example to demonstrate this possibility. Let  $a = 100$ ,  $b = 1$  and  $k = 2$ . According to the solutions of numerical examples summarized in Table 1, the downstream government can use export tax alone (case 2, which is also the case examined by Bernhofen, 1997), import tariff alone (case 4) or export subsidy cum import tariff (case 5) to achieve the same optimal level of output, price and welfare. The last case shows that the optimal policy could be a subsidy on

Table 1 Numerical example ( $a = 100$ ,  $b = 1$  and  $k = 2$ )

Case	1	2	3	4	5
$s_i^*$	- 28 (export tax)	- 14 (export tax)	- 7 (export tax)	0	14 (export subsidy)
$t_i^*$	- 14 (import subsidy)	0	7 (import tariff)	14 (import tariff)	28 (import tariff)
$w_i^*$	30	44	51	58	72
$MC_i$	58	58	58	58	58
$z_i^*$	14	14	14	14	14
$Z$	28	28	28	28	28
$p$	72	72	72	72	72
$W_i^*$	392	392	392	392	392

The symbols in the table, from above, denote:

$s_i^*$  ( $i = h, f$ ); downstream (home or foreign) country’s export subsidy level

$t_i^*$  ( $i = h, f$ ); downstream (home or foreign) country’s import tariff level

$w_i^*$  ( $i = h, f$ ); intermediate-good price charged for downstream firm  $i$

$MC_i$  ( $i = h, f$ ); effective cost of downstream firm  $i$

$z_i^*$  ( $i = h, f$ ); downstream firm  $i$ ’s optimal output

$Z$ ; final good supplied to the third country

$p$ ; final-good price

$W_i^*$  ( $i = h, f$ ); downstream (home or foreign) country’s welfare level

export if it is accompanied by a properly measured import tariff on an intermediate good. This result can serve as an extension to Bernhofen (1997).

### 3. CONCLUSIONS

In a model of vertically related industries *a la* Bernhofen (1997) with one domestic firm, which imports from a foreign monopolistic supplier an intermediate good to produce the final good supplied exclusively to a third country, we have tried to rank the efficacy of the following three policy combinations of export subsidy, import tariff and export subsidy-cum-import tariff. We find that all three policy combinations turn out to be equivalent in their welfare levels. This finding has the following policy implications. Insofar as export taxes are illegal as in the US, import tariffs can be used to achieve the same result as export taxes. This view is also consistent with our interpretation – on theory of public choice that regards legislators as ‘political entrepreneurs’. Given their desire to win their next election, they would never prefer an unpopular export tax to a popular import tariff. Moreover, our finding also supports the GATT and WTO principle to reduce import tariff rates on condition that export subsidies should be prohibited ( $s_i = 0$ ).

In a similar framework, Bernhofen (1997) concluded that the downstream government should impose a tax on its final good export if the intermediate good market is price-discriminated by the foreign monopolistic supplier. This result does not necessarily hold if the downstream government is equipped with an additional policy instrument such as an import tariff on an intermediate good. In this case, the optimal policy of the downstream government could be an export subsidy on the final good together with an import tariff on an intermediate good.

Our proposition on welfare equivalence remains robust even if the two downstream duopolists exercise their own countervailing (monopsony) power against the upstream monopolist. It is also valid even if we abandon the standard assumption in the vertical IO/trade literature that one unit of the intermediate good is transformed into one unit of the final good, and allow each downstream duopolist to make one unit of the final good from  $\alpha$  units of the intermediate good.

### NOTES

We gratefully acknowledge very helpful comments and suggestions on earlier drafts from anonymous referees, Michihiro Ohyama and Takashi Negishi with a usual disclaimer.

- 1 It may be important to note that their results form a marked contrast to this field’s conventional wisdom that export subsidy is optimal if the choice variables of exporting firms are strategic substitutes for each other: with vertical structure,



- an export tax can be optimal for downstream nations under Cournot competition.
- 2 This very simple, but well-defined model setting is sometimes employed in strategic trade policy models in vertically related industries. (See Bernhofen, 1997, Ishikawa and Lee, 1997, and so on.) It is under these simplified assumptions that we obtain the profound results to follow in the text in terms of equivalence over three policy measures.
  - 3 Hokari and Ohta (2001) demonstrate that profits under price discrimination are not necessarily higher than those under simple monopoly with no price discrimination if the industry in question involves vertically related markets. Nevertheless, it is straightforward to prove that the former is definitely higher than the latter under the current setting.
  - 4 If we assume a new policy-mix variable like  $x_i = t_i - s_i$  and differentiate equation (5) with respect to  $x_i$  instead of  $s_i$  and  $t_i$ , we can then obtain this result more straightforwardly, as an anonymous referee suggested.
  - 5 This outcome presents a striking contrast to that of the original strategic trade policy model presented by Brander and Spencer (1985). In the Brander–Spencer model, each nation is trapped in a prisoner’s dilemma and necessarily becomes worse-off under bilateral retaliation than it is under free trade.
  - 6 In this connection, Choi (1995) and Hwang *et al.* (1997) investigate the model in which one importing country imposes specific duties on two exporting firms. These two firms are located in different foreign countries and choose their optimal technologies under assumptions *a la* DeGraba (1990), that is, under linear demand and quadratic cost functions. Hwang *et al.* (1997) prove that, in equilibrium, the two firms operate at the same marginal cost even if they are asymmetric in terms of their production efficiency; that is, even if their cost functions are not identical.
  - 7 Related to this finding is Hwang *et al.* (2000) that analyses strategic trade policies in the case of successive monopolies, in contrast with our case of successive oligopolies. They also show that an export tax on a final good is a perfect substitute for an import tariff on an intermediate good.
  - 8 If we take into account the cost of public funds used to subsidize own firm as in Neary (1994), then an import tariff would be the best, as the cost of transfer is usually assumed to exceed unity.
  - 9 The proposition is valid even if we relax the standard assumption in the vertical IO/trade literature that one unit of the intermediate good is transformed into one unit of the final good and allow each downstream duopolist to make one unit of the final good from  $\alpha$  units of the intermediate good.
  - 10 The proposition is robust if the model is generalized by providing the two downstream duopolists with countervailing (monopsony) power against the upstream monopolist and letting the price of the intermediate good be solved jointly by the two parties in accordance with the Nash bargaining process in line with Dobson and Waterson (1997). We are indebted to an anonymous referee for this suggestion.
  - 11 Ours is a variant of Ishikawa–Spencer’s in the sense that there exist only one domestic and one foreign final-good producer and the monopolistic intermediate-good producer is located in a third country, not in the home or in the foreign country.
  - 12 We are indebted to an anonymous referee on this account of US constitutionality.

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