On Strategic Trade Policies in the Three-Country Model: Endogenous Timing and its Economic Interpretation*

by

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Abstract
This paper explains why a government with the lesser number of firms chooses its trade policy first and provides a subsidy to home firms, whereas a government with the larger number of firms moves second and imposes a tax on domestic firms in the three-country model. This paper also extends the Brander and Spencer (1985) result that the unilateral intervention equilibrium is replicated by the Stackelberg duopoly in an economy with multiple firms in each country. This replication enables us to show that bilateral sequential intervention induces a more concentrated market structure.

Keywords: Three-country model, endogenous timing, number of firms
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1. Introduction

The "three-country" trading model, in which imperfectly competitive firms located in two countries export their products to the third market, was originated by Brander and Spencer (1985). Using this framework, many researchers have examined various topics. For instance, Krishna and Thursby (1989) and Van Long and Soubeyran (1997) considered how the curvature of demand curves and the difference in the number of firms between two exporting countries affect the level of an export subsidy. Cooper and Riezman (1991) and Hwang and Schulman (1993) introduced demand uncertainty, and analyzed policy choices between an export subsidy and an export quota. Qiu (1994) incorporated asymmetric information of a firm's cost function, and examined the effect of this incomplete information on the optimal level of an export subsidy. Neary (1994) analyzed the optimal level of an export subsidy if the distribution problem that a government faces involves a policy cost.

The timing of bilateral intervention is assumed to be simultaneous in these papers. We then can raise the following question. "Does the simultaneous policy decision by each government constitute an equilibrium outcome in the three-country model?" To our knowledge, few studies have investigated this problem. Arvan (1991) constructed an international oligopoly model where each firm engages in Cournot competition, and demand uncertainty prevails in the market. Each government not only set its subsidy level but also chooses the timing of this policy, that is, moving first or second. He introduced "a second mover advantage" so that one government can avoid demand uncertainty by observing the rival's action. He showed that the sequential move emerges as an equilibrium phenomenon, depending on the magnitude of uncertainty as well as the difference in the number of firms between two export countries. Shivakumar (1993) added an export quota as a policy instrument. He proved that a sequential equilibrium also can appear and that each government is inclined to prefer an export quota associated with some level of demand uncertainty. Ohkawa, Okamura and Tawada (2002) examined an endogenous timing game in the three-country model without uncertainty. By utilizing Theorem 5 in Hamilton and Slutsky (1990) they established that a government with fewer firms chooses a first mover and subsidizes its home firms, while the government associated with the larger number of firms becomes a second mover and imposes an export tax on its firms. Their conclusion indicates that the sequential equilibrium depends on the sign of a government's reaction function’s slope, and relies on the difference in the number of firms between two export countries.

However, they did not succeed in properly explaining why the difference in the number of firms causes this result. While few researches have tackled this issue, Krishna and Thursby (1991) showed that whether a government subsidizes or taxes depends on the difference in the number of firms if governments act simultaneously, but did not analyze the case of sequential moves. Arvan (1991) explained the response of one government to an increase in the rival’s subsidy rates by examining a shift of the reaction function with respect to national outputs. But this work did not clarify the relationship between the sign of a reaction function’s slope and the difference in the number of firms. The purpose of this paper is to provide a comprehensive and consistent explanation of why the difference in the number of firms generates the sequential move equilibrium.

We also examine what kind of equilibrium with no intervention is equivalent to the sequential or simultaneous equilibrium outcome. Brander and Spencer (1985) investigated a unilateral intervention where only one country subsidizes its single firm, while another country does not intervene. They showed that the resulting equilibrium could be described as a Stackelberg equilibrium without any government intervention, in which the subsidized firm acts as a leader, while the other firm becomes a follower with no intervention. We will examine their result by incorporating the timing of policy determination, and multiple operating firms, in each exporting country. This replication enables us to clarify the effects of timing on the market structure and the mode of competition.

Finally we examine the validity of quasi-free trade. Hwang and Schulman (1993) established that one country sets its subsidy/tax to zero at the equilibrium. They referred to this as quasi-free trade. We will also point out that their result crucially depends on whether each government simultaneously intervenes in the market or not. We will show that quasi-free trade cannot be an equilibrium when each government selects not only its subsidy/tax level but also the timing of its policy determination.

The rest of our paper is organized as follows: In section 2, we formulate a simple three-country model, incorporating a government in each country, and consider a strategic trade policy game with endogenous timing. The sub-game perfect Nash equilibrium of this game will be derived. In section 3, we provide a comprehensive explanation of why our results constitute an equilibrium. In addition, we show that the equilibrium under unilateral or bilateral intervention can be equivalent to the Stackelberg equilibrium under free trade. The final section will be devoted to concluding remarks.

2. The Model of a Policy Timing Game

We consider a trading economy consisting of two exporting countries (the first and second countries) and one importing country (the third country), which was introduced in Brander and Spencer (1985). In the exporting country *i*, *i*=1, 2, n_i firms produce a commodity and export it to the third country. Each firm in the exporting countries provides a homogeneous product. We assume that each firm has an identical cost function with constant marginal cost *c* and no fixed cost, so that $c(q) = cq$, where *q* is the output of each firm. No consumption exists in the exporting countries. In the importing country, no firms operate and consumers can purchase only the imported product. The inverse demand function of the third country is assumed to be $p = p(Q) = A - Q$, where *p* is the market price, *Q* is the demand for the product and *A* expresses the market size assumed to be larger than *c*.

The government in each of the exporting countries chooses an export policy. They give (impose) an export subsidy (tax) to their home firms in the form of a specific subsidy (tax), s_i, *i*=1, 2. The government in the importing country is a passive player. That is, it does not intervene in the domestic market.

We consider a policy game played by the two governments and examine its sub-game perfect equilibrium. We assume that each government determines not only the level of its export subsidy/tax but also the timing of its policy instrument s_i. The timing of the government intervention is endogenously determined and the level of the subsidy/tax is then set according to the determined timing.

We consider a game with three stages. At the first stage, each exporting government simultaneously announces a "first move" or a "second move", concerning the timing of any announced level of its subsidy/tax rate. If both governments have the same timing (first or second), then they set their subsidy/tax rates at the same time. In other words, the timing is simultaneous. If the governments differ in their timing, say, the first government moves first and the second government moves second, then after observing the first government's action, the second government sets its policy. In this case the timing is said to be sequential. At the second stage, given the timing of the export subsidy (tax) determined at the previous stage, each government chooses its subsidy/tax rate to maximize its national welfare consisting of total profit net of the subsidy (tax).

At the third stage, given the levels of the subsidy/tax rates determined at the previous stage, all firms in both countries provide product to the third country to maximize their gross profit in a quantity-setting Cournot competition.

Let us derive the sub-game perfect equilibrium by using backward induction. We begin with the third stage sub-game. A representative firm located in country *i* determines its output q_i to maximize its profit $\pi_i = p(Q)q_i - cq_i + s_i q_i$ with the given subsidies. The first order condition of this maximization problem is

$$p'(Q)q_i + p(Q) - c + s_i = 0, \tag{1a}$$

or

$$(n_i + 1)q_i + n_j q_j = A - c + s_i, \quad i, j = 1, 2. \tag{1b}$$

The symmetric equilibrium output level of each firm and the total output, $Q = n_1 q_1 + n_2 q_2$, are obtained from (1b),

$$q_i = q_i(s_i, s_j) = \frac{1}{N}\left[a - n_j s_j + (n_j + 1)s_i\right], \tag{2}$$

$$Q = Q(s_i, s_j) = \frac{1}{N}\left[(N-1)a + n_1 s_1 + n_2 s_2\right], \tag{3}$$

where $a = A - c > 0$ and $N = n_1 + n_2 + 1$. The associated profit of each firm becomes a function of the subsidies. That is

$\pi_i = \pi_i(s_i, s_j)$.

We proceed to examine the second stage. Two possible cases should be considered at this stage: (1) Each government simultaneously sets its level of subsidy (tax). (2) One government moves first (chooses its subsidy/tax rate). After observing this rate, the other government chooses its subsidy/tax. In this case, one government plays a leader role, while the other is a follower. The national welfare function of government *i*, W_i, consists of the sum of the home firm's profit and the government's net revenue, so that

$$W_i = W_i(s_i, s_j) = n_i(\pi_i - s_i q_i). \tag{4}$$

We consider the simultaneous move case. The government *i* sets its rate s_i to maximize national welfare, given the other country's subsidy s_j and foreseeing the third stage equilibrium $q_i(s_i, s_j)$, $i, j = 1, 2.$ It solves the following problem:

$$\underset{s_i}{\text{Max.}} W_i(s_i, s_j), \text{ given } s_j. \tag{5}$$

The first order condition for the problem (5) is given by

$$[p(Q)-c]\frac{\partial Q_i}{\partial s_i} + p'(Q)Q_i\left(\frac{\partial Q_i}{\partial s_i} + \frac{\partial Q_j}{\partial s_i}\right) = 0, \tag{6a}$$

where $Q_i = n_i q_i$. The first term in (6a) shows a positive marginal welfare change due to a country's output expansion, which is called the *output expansion effect*. The second term shows a negative marginal welfare change from a market price reduction, called the *price reduction effect*. From (6a), we can derive a reaction function for government *i* with respect to each subsidy level

$$s_i = r_i(s_j) = -\frac{n_j(n_j - n_i + 1)}{2n_i(n_j + 1)} \cdot s_j + \frac{(n_j - n_i + 1)}{2n_i(n_j + 1)} a, \; i, j = 1,2. \tag{6b}$$

We can obtain the equilibrium levels of s_1^C and s_2^C by solving the equations (7b). The resulting levels of the national welfares W_1^C and W_2^C are obtained by substituting s_1^C and s_2^C into the welfare function, that is, $W_i^C = W_i(s_i^C, s_j^C)$.

Let us investigate the sequential move case. Suppose that government *i* is a leader, while government *j* is a follower. The government *i* sets its subsidy level *i* optimally, taking account of its rival's response $s_j = r_j(s_i)$. It solves

$$\max_{s_i} W_i = W_i\left(s_i, r_j(s_i)\right), \tag{7}$$

that results in the optimal subsidy level s_i^L. The optimal subsidy of the follower government *j* and the resulting welfare levels of both countries are calculated by

$s_j^F = r_j(s_i^L)$, $W_i^L = W(s_i^L, s_j^F)$, and $W_j^F = W(s_i^L, s_j^F)$.

Finally, we return to the first stage. Each government chooses the first move or the second. In table 1, the 2×2 matrix game shows this situation, from which we derive a sub-game perfect equilibrium:

Result 1 (Proposition 1 in Ohkawa, Okamura, and Tawada (2002)): We assume that $n_1 \le n_2$ without loss of generality.

(1) The case where $n_1 = n_2 = n$.

The timing is simultaneous. Each government subsidizes its home firms at the rate of $\frac{a}{n(2n+3)}$.

(2) The case where $n_2 = n_1 + 1$.

The timing of any decision is indeterminate in the sense that country 2 becomes indifferent between being a leader or a follower. The government of country 1 subsidizes its home firms at the rate of $\frac{a}{n_1(n_1+2)}$, while the optimal strategy of country 2 is nonintervention.

(3) The case where $n_2 > n_1 + 1$.

The timing is sequential. The government of country 1 acts as a leader and subsidizes its home firms at the rate of $\frac{a}{n_1(n_1+2)}$, while the government of country 2 acts as a follower and imposes a tax on its home firms at the rate of $\frac{(n_1+1-n_2)a}{2n_2(n_1+2)}$.

3. The Main Results

From now on, we call the country in which a smaller (larger) number of firms exists as a small (large) country. Result 1 shows that the small country's government becomes a leader and has an incentive to subsidize its home firms, while the large country's government adopts a follower role and imposes a tax on its home firms. Arvan (1991) obtained similar results but did not clearly explain why these outcomes occur.

We will explain why these results occur at the equilibrium. To do so, we have to answer two following questions: (i) why does the large (small) country's government apply a subsidy (tax)? (ii) why does the large (small) country's government act as a follower (leader)? We now tackle with the first question (i).

The national welfare W_i is rewritten as

$$W_i = P(Q)Q_i - cQ_i . \qquad (8)$$

Differentiating (8) with respect to s_i, yields the condition for the optimal subsidy (tax) rate.

Lemma 1: Irrespective of being a leader or follower, the optimal rate s_i is given by

$$s_i = p'Q_i \cdot \frac{dQ_j}{dQ_i} + p'Q_i\left(1-\frac{1}{n_i}\right). \qquad (9a)$$ [1]

Krishna and Thursby (1991) showed this result when each government moves simultaneously. This lemma also means that the optimal formula is invariant even though the timing of the game becomes sequential. They referred to the first term in (9) as the *strategic distortion* and the second as the *terms of trade distortion*. If a quantity-setting Cournot competition prevails in the product market, the strategic distortion effect works to provide a subsidy to each firm, while the terms of trade distortion effect induces the government to impose a tax. Note that the strategic distortion effect consists of a part of the output expansion effect, and the terms of trade distortion effect consists of both the rest of the output expansion effect and the price reduction effect. With linear demand and cost functions, the optimal rate is reduced to

$$s_i = Q_i \cdot \frac{n_j}{n_j+1} + Q_i\frac{(1-n_i)}{n_i}. \qquad (9b)$$

The optimal formula shows that if the number of firms in country i is sufficiently small compared to that of the other country $(n_i < n_j + 1)$, then the strategic distortion effect dominates the terms of trade distortion effect. It implies that the government of

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[1] See Appendix A for the proof.

country i has an incentive to subsidize its home firms. Conversely, in the case that $n_i > n_j + 1$, the terms of trade distortion effect exceeds the strategic distortion effect and the government imposes a tax. In other words, the small (large) country's government subsidizes (imposes a tax on) its firms. Roughly speaking, the small (large) country's government is mainly concerned with its firms' output expansion (contraction) in order to shift the rival firms' rents through a strategic interaction to protect itself from the price reduction.

We turn our attention to the examination of (*ii*). Let us consider the slope of country i's reaction function $s_i = r_i(s_j)$. Differentiating the optimal condition $\partial W_i / \partial s_i = 0$ yields the slope as

$$r_i'(s_j) = \frac{ds_i}{ds_j} = -\left(\frac{\partial^2 W_i}{\partial s_i \partial s_j}\right) \bigg/ \left(\frac{\partial^2 W_i}{\partial s_i{}^2}\right) \tag{10}$$

Because the denominator in the RHS of (10) is negative, the sign of $\frac{\partial^2 W_i}{\partial s_i \partial s_j}$ determines the sign of $r_i'(s_j)$. It also means a change in country i's marginal welfare resulting from a change in the rival country's subsidy rate. From the optimal condition (6a), with linear demand and cost assumptions, this term is given by

$$\frac{\partial^2 W_i}{\partial s_i \partial s_j} = n_i p' \frac{\partial q_i}{\partial s_i}\frac{\partial Q}{\partial s_j} + n_i p' \frac{\partial Q}{\partial s_i}\frac{\partial q_i}{\partial s_j}. \tag{11}$$

The first term in the RHS of (11) means that the marginal output expansion effect deteriorates through a price reduction caused by the rival's subsidy. Its sign is negative. We call this the *deteriorating effect of output expansion*. The second term becomes positive and shows that the marginal price reduction effect is softened by the decrease in each firm's output in country i. This is caused, through strategic interaction between country i's firms and the rival's ones, by the rival's subsidy. We name this the *relaxing effect of price reduction*. Therefore, if the former effect dominates the latter, then the sign of the slope of the reaction function is negative. Otherwise, it is positive. Equation (11) can be transformed into

$$\frac{\partial^2 W_i}{\partial s_i \partial s_j} = -\frac{n_i n_j}{N^2}(n_j + 1) + \frac{n_i n_j}{N^2} \cdot n_i. \tag{12}$$

Then, from (12) we derive

Lemma 2: $r_i'(s_j) < (>) 0$ if $n_i < (>) n_j + 1$.

Equation (12) reveals that whether the deteriorating or relaxing effect dominates depends on the magnitudes of $\partial q_i / \partial s_i \left(= (n_j + 1)/N\right)$ and $\partial Q / \partial s_i$ $\left(= n_i(\partial q_i/\partial n_i) + n_j(\partial q_j/\partial n_i) = n_i/N\right)$ in a linear demand and cost model, because $\left|\partial Q / \partial s_j\right| = \left|\partial q_i / \partial s_j\right| = n_j/N$. Suppose that country *i* is a large country, implying that $n_i > n_j + 1$ holds. We can image an extreme case where no firms exist in the rival country *j*. In this case, because $\partial Q / \partial s_i$ exceeds $\partial q_i / \partial s_i$, the relaxing effect dominates the deteriorating one. As pointed out before, a large country is concerned about a decrease in rents because of a low market price rather than its increase through the strategic interaction. The situation where the relaxing effect is dominant provides room for a large country to decrease its tax level. That is why the reaction function of the country *i*'s government slopes upwardly.

In the reverse case ($n_i < n_j + 1$), we can envisage that a single firm operates in country *i* and that many firms operate in country *j*. The deteriorating effect caused by the rival's tax rate cut dominates the relaxing effect because $Q_i = n_i q_i$ is larger than $n_2 > n_1 + 1$. The small country is interested in shifting the rent from its rival's firms. This condition, that the deteriorating effect dominates, allows for a small country to decrease the subsidy rate. Therefore, the reaction function of a small country becomes downwardly sloping.

We assume that country 1 is small and its reaction function is downwardly sloping, while country 2 is large and its reaction function is upwardly sloping. If both countries move simultaneously or if country 1 is a small country and a follower, the marginal welfare of country 1 with respect to the subsidy is

$$\frac{dW_1}{ds_1} = \frac{\partial W_1(s_1, s_2)}{\partial s_1}, \text{ for given } s_2. \qquad (13)$$

On the other hand, if country 1's government acts as a leader, the welfare is

$$\frac{dW_1}{ds_1} = \frac{\partial W_1(s_1, r_2(s_1))}{\partial s_1} = \frac{\partial W_1}{\partial s_1} + \frac{\partial W_1}{\partial s_2} \cdot r_2{}'(s_1). \tag{14}$$

The second term on the RHS of (14) shows an additional marginal effect on the welfare that the first-mover country can acquire through its rival's response to its subsidy change. Note that

$$\frac{\partial W_i}{\partial s_j} = n_i(p-c)\frac{\partial q_i}{\partial s_j} + n_i p' q_i \frac{\partial Q}{\partial s_j} < 0. \tag{15}$$

Equation (15) indicates that each country suffers from a welfare loss if the rival country increases its subsidy (decreases its tax). In other words, each country favors a lower subsidy (higher tax) imposed by the rival country.

Suppose that both countries choose the second move. Does the small country have an incentive to deviate? Substituting the optimal outcome (s_1^C, s_2^C) in the simultaneous move case into the RHS of (14), the first term is null and the second term is negative because of Lemma 2 and (15). This implies that, by the first move and a decrease in its subsidy rate, the small country's government can raise the level of its welfare more than in the case of the simultaneous move. The large country's tax rate (negative subsidy rate) increases because $r_2{}'(s_1) > 0$. It increases the market price because of output reduction. This is beneficial for the small country. Therefore, this small country has an incentive to deviate from a strategy of moving second.

Conversely, consider that both countries move first. Suppose that the small country deviates and that the large country's government acts as a leader. The rival's marginal benefit is given by

$$\frac{dW_2}{ds_2} = \frac{\partial W_2}{\partial s_2} + \frac{\partial W_2}{\partial s_1} \cdot r_1{}'(s_2) \tag{16}$$

Evaluating the RHS of (16) at the simultaneous move equilibrium, it is found to be positive because the first and second terms on the RHS of (16) are positive from the fact that $r_1{}'(s_2) < 0$. The large country decreases its tax rate (increases its negative subsidy), which induces the small country to reduce the subsidy. It is harmful for the small country to be a follower from (15). So the small country does not deviate.

This shows that moving first constitutes a dominant strategy for the small country 1. Knowing this dominant strategy, country 2 reacts. If country 2 moves second, it can gain as a result of the price increment. This country, then, chooses to move second. This fact means that both countries can reduce their production-expanding subsidy (tax) levels, which pushes the market price up. Then, we establish

Proposition 1: Suppose that country 1 is small, while country 2 is large. Both countries can implicitly collude in the sense that they can enjoy a higher market price than the price realized in the simultaneous move case.

The endogenous timing of policy determination benefits both countries in this case. This collusive behavior can be a policy coordination.

We examine the case where $n_1 = n_2 = n$. Each government always subsidizes its home firms, because the strategic distortion dominates the terms of trade distortion. If country 2 moves second, country 1 can increase its welfare and set a higher subsidy rate than that with a simultaneous move. The subsidy rate set by country 2 decreases, because $r_2'(s_1) < 0$ and the deteriorating effect of output expansion dominates the relaxing effect. The government of country 1 chooses to move first, because it can set a higher subsidy than its rival. If country 2 moves second, then country 1 tries to move first. In this case, moving first becomes a dominant strategy for each country and the result is a simultaneous move. In other words, a coordination failure occurs from the standpoint of a policy coordination about the subsidy/tax levels, because both governments have the first-mover advantage.

Why can a sequential move bring about a policy coordination? In order to answer this problem, we pay attention to the issue that bilateral government intervention generates an alteration of the market structure, and consider what market structure and competitive mode under free trade become equivalent to under government intervention. When the timing of bilateral intervention is simultaneous, each export country's welfare is

$$W_1^B = W_2^B = \frac{(n+1)a^2}{(2n+3)^2}. \qquad (17)$$

When the timing is sequential, each country's welfare is

$$W_1^B = \frac{a^2}{4(n_1+2)}, \qquad (18a)$$

$$W_2^B = \frac{(n_1+1)a^2}{4(n_1+2)^2}, \qquad (18b)$$

From (17) and (18), we establish the following:

Proposition 2: (i) When there is a difference in the number of firms among exporting countries, the outcome could be induced by a Stackelberg oligopoly with one leader and multiple followers whose number minus one is the smaller number of firms under free trade. (ii) When there is no difference, the players are Cournot oligopolists whose number minus two is the total number of firms under free trade.[2]

Proposition 2 extends Proposition 3 in Brander and Spencer (1985) to a multiple firms economy in the case of bilateral intervention. Proposition 2(i) suggests that bilateral intervention can be regarded as a partial merger policy. The small government merges all firms horizontally and makes the merged group into a Stackelberg leader, whereas the government in the large country merges some of its firms and lets the merged firms behave as Stackelberg followers. In other words, the implicit collusion caused by each exporting country's sequential move leads to a more concentrated market structure as well as a change of the competitive mode. Proposition 2(ii) means that each export country subsidizes its home firms and simultaneously generates a more competitive market structure, and does not change the competitive mode.

The number of merged firms depends not on the larger number of firms, i.e., n_2, but on the smaller number of firms, i.e., n_1 from (18). The change in the larger number of firms does not relate to the equilibrium outcome. In other words, the Cournot limit

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[2] See Appendix B for the proof.

theorem is not valid in the symmetric Cournot oligopoly with bilateral intervention, considering that each firm competes in a Cournot fashion.

Finally we consider the validity of quasi-free trade pointed out by Hwang and Schulman (1993). They examined the trade intervention game played by two exporting countries. The strategies of the government are as follows: (i) Intervention: the government provides a subsidy or imposes a tax. (ii) No intervention: the government does nothing. There exists uncertainty about the market demand. They established the following results:

Result 2 (Proposition 2 in Hwang and Schulman (1993)): Suppose that two governments choose their strategies simultaneously. Then, for any level of uncertainty the equilibrium of the game is given as follows: (a) When $n_1 = n_2$, both governments intervene. (b) When $n_1 + 1 = n_2$, both governments intervene, or only country 1's government intervenes. (c) When $n_1 + 1 < n_2 < \phi(n_1)$, only country 1 intervenes, while country 2 chooses no intervention. (d) When $\phi(n_1) < n_2$, one country intervenes while another one does not intervene and vice versa.

They showed that quasi-free trade (only one country intervenes) occurs if $n_2 > n_1 + 1$. This result, however, originates from the behavioral assumption that each government decides its policy at the same time. When the timing of policy decisions are endogenized, as we have examined, we obtain

Remark 1: Each country intervenes and quasi-free trade or unilateral intervention does not occur even though $n_2 > n_1 + 1$.

4. Concluding Remarks

Ohkawa, Okamura and Tawada (2002) constructed a three-country model in which Cournot oligopolists located in two countries export a homogenous product to the third country's market, and two exporting countries' governments intervene in the market by using an export subsidy (tax). They established that the government of the small country chooses to be a first mover and subsidizes its home firms, while the government of the large country becomes a second mover and imposes an export tax on its firms.

We have investigated the economic explanation for why this result occurs from the standpoint of the differences in the number of firms between two export countries, and concluded as follows:

(1) Irrespective of the timing, the small (large) country subsidizes (taxes) its domestic firms, because the strategic distortion dominates (does not dominate) the terms of trade distortion.

(2) When the large country moves first, the small country selects the first-mover policy because the small country's optimal response to the large country's subsidy is a decrease in its subsidy level, which causes a reduction of its welfare. When the large country moves second, the small country acts as a leader, because it can not only save subsidizing its firms but it can also soften the market price reduction by the increase in the large country's export tax, which is the response to the decrease in the subsidy, and then can raise the level of welfare. Therefore, moving first is beneficial for the small country.

(3) When the small country moves first, the large country always moves second, because it increases its export tax level in order to relax the price reduction, which is more harmful for the large country's welfare. Thus, the small country moves first, while the large country moves second. In other words, bilateral intervention with sequential moves is implicit collusive behavior.

(4) When there are no differences in the number of firms between two exporting countries, each country's government always subsidizes its home firms, because the strategic distortion dominates the terms of trade distortion. The timing is simultaneous, because both governments have the first-mover advantage.

We also investigate what market structure and competitive mode under free trade become equivalent to under government intervention. When the timing is sequential, the outcome could be invoked by a Stackelberg oligopoly with one leader and followers whose number minus one is the smaller number of firms under free trade. When the timing is simultaneous, they are Cournot oligopolists whose number minus two is the total number of firms under free trade. This extends the result of Brander and Spencer

(1985). The policy coordination caused by sequential move (the coordination failure caused by simultaneous move) brings about a more concentrated (competitive) market structure.

We have several suggestions for further research. First, we should try to explain endogenous sequential moves with the reciprocal dumping model pointed out by Collie (1994), which is different from the three-country model. Second, we should examine whether endogenous sequential moves are valid with more general three-country models, using general demand and cost functions. Third, by introducing firms into the third country, we could consider the relationship between market structure, which can be described by the Herfindahl Index, and the third country's welfare. Fourth, we should investigate the timing of policy determination under the three-country model with asymmetric information, namely, that each government does not know the level of unit costs correctly.

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Appendix

A. The proof of Lemma 1

In the case of simultaneous moves, (6a) can be transformed into

$$\left[p'Q_i \left(1 + \frac{dQ_j}{dQ_i} \right) + (p-c) \right] \left(\frac{\partial Q_i}{\partial s_i} \right) = 0 . \tag{1-A}$$

Substituting (1-A) into (2a) and rearranging terms yield

$$s_i = p'Q_i \frac{dQ_j}{dQ_i} + p'Q_i \left(1 - \frac{1}{n_i} \right). \tag{10}$$

Because the same first order condition of the follower as (1-A) in the sequential move game is obtained, (10) can be derived. Note that in our linear model

$$\frac{dQ_j}{dQ_i} = -\frac{n_j}{n_j + 1} . \tag{2-A}$$

In the case of sequential moves, the first order condition of the leader for the problem (8) is given by

$$p'Q_i \left[\frac{dQ_i(s_i, r_j(s_i))}{ds_i} + \frac{dQ_j(s_i, r_j(s_i))}{ds_i} \right] + (p-c) \frac{dQ_i(s_i, r_j(s_i))}{ds_i} = 0 . \tag{3-A}$$

(3-A) can be transformed into

$$\left[p'Q_i \left(1 + \frac{dQ_j}{dQ_i} \right) + (p-c) \right] \left(\frac{dQ_i}{ds_i} \right) = 0 . \tag{4-A}$$

Substituting (4-A) into (2a) and rearranging terms yield (10), because of (2-A).

Q.E.D.

B. The proof of Proposition 2

Under free trade, if one firm in country 1 acts as a leader and $m+1$ firms in country 2 act as followers, each exporting country's welfare at the Stackelberg equilibrium is as follows:

$$W_1^L = \frac{a^2}{4(m+2)} , \tag{B-1a}$$

$$W_2^F = \frac{(m+1)a^2}{4(m+2)^2} . \tag{B-1b}$$

Whereas, if all firm engage in Cournot competition under free trade, then each exporting country's welfare is given by

$$W_i^{NI} = \frac{n_i a^2}{N^2}, \quad i = 1, 2. \tag{B-2}$$

Comparing (18) and (B-1) respectively, we recognize $m = n_1$. Similarly the result that $n_1 = n_2 = n + 1$ is derived from a comparison of (17) and (B-2).

Q.E.D.

Table 1 The first stage sub-game

1 2	Move first	Move second
Move first	W_1^C, W_2^C	W_1^L, W_2^F
Move second	W_1^F, W_2^L	W_1^C, W_2^C