

The Effects of Strategic Subsidies under FTA with ROO *

by

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This version: June, 2007

Abstract

This paper builds a model of Free Trade Area (FTA) that imposes Rules of Origin (ROO) under asymmetric oligopoly. Following the existing literature, we also consider ROO to be a protectionist device. Whereas, we show that the level of ROO in protecting the domestic industry is weakened if a subsidy policy is available to the other countries. In such a situation, the government of the final good exporter within the FTA chooses a positive production tax and this brings about a lower level of ROO, so that a less restrictive FTA is reached.

Key words: Rules of Origin (ROO), Free Trade Area (FTA), Subsidy

JEL classification: F12, F13, F15

*I would like to thank Yuji Fujinaka, Kaoru Ishiguro, Toru Kikuchi and Noritsugu Nakanishi for helpful comments. I am very grateful to Seiichi Katayama for his valuable comments on an earlier version of this paper. Also, an earlier draft of this paper was presented at the Japanese Economic Association Annual Spring Meeting, June 2-3 2007, Osaka Gakuin University. I wish to acknowledge the precious suggestions and comments of Naoto Jinji. Any remaining errors are, of course, my own responsibility.

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1 Introduction

In regional trade blocks, rules are needed to judge whether a product is considered ‘domestic’ (produced inside the block) in order to be qualified for free trade among member countries (Lopez-de-Silanes et al., 1996). Rules of Origin (ROO) are rules that define the origin of a product by setting a minimum ratio of domestic (or intra-block produced) intermediate goods or parts used to produce the product. This aspect of domestic content provision is mainly represented by mechanisms of Local Content Requirement (LCR), an important feature of ROO.

In an important contribution in the context of LCR, Lahiri and Ono (1998, 2003) analyzed the effects of LCR in a model of asymmetric oligopolistic setting and provided a summary of the basic implications derived from such protectionist policy. In their analysis, producers of the final good in the foreign country must satisfy a minimum level of LCR to supply the good to the market of the host country when both are sources of the homogeneous intermediate good. When the LCR is not satisfied, a tariff is imposed. Therefore, if the productivity in the production of the intermediate good in a member country is lower than that of the other member country in an FTA (i.e., the price of the intermediate good is higher), ROO function as a protectionist device for the less efficient country.

Many studies on FTA with ROO focus on the protectionist nature of ROO and exclusively examine the effects of introducing and tightening ROO on the economy.¹ Krueger (1993) points out, using numerical examples, that ROO can possibly protect the U.S. auto and textile industries in NAFTA. Falvey and Reed (2002) analyzed the effects of ROO over third countries focusing on the commercial policy aspect, where the country that exclusively imports final goods (the third country) applies the ROO. Lopez-de-Silanes et al. (1996) argues through a simulation that the enforcement of ROO causes anti-competitive and rent-shifting effects when the final good market

¹The literature on FTA with ROO has mainly focused on the issue of LCR and the generally adopted analytical framework is the Local Content Protection model. Three different definitions of ROO are found in the existing literature on FTA with ROO that focuses on the issue of LCR. These are cost (or price) based definition (Ju and Krishna, 2005), value added based definition (Krueger, 1993; Falvey and Reed, 2002) and physical content based definition (Lopez-de-Silanes et al., 1996). Krishna and Krueger (1995) compared the results of cost based with price based definition. However, Ishikawa et al. (2005) omitted the direct effects or mechanism of ROO in the intermediate good market. They exclusively focused on a situation that resulted from the presence of ROO in the final good market, and compared consumer surpluses, profits and the welfare of countries inside and outside the FTA under the absence of ROO and the presence of ROO.

is oligopolistic.

The existing literature only analyzes the effects of introduction and tightening of ROO. It is an excessive simplification, however, to assume that other members in the FTA have no other policy instruments available to offset the effects of increased protection. If the market of a member country is relatively large, the final good producers of other member countries are likely to have ROO unilaterally imposed on their products. Then, without any government intervention, industries in other member countries are forced to accept disadvantageous conditions. In this situation, it is natural to think of other policy instruments that these countries may possess. If member and non-member countries are able to influence other countries' level of ROO, it may decline. Following Lopez-de-Silanes et al. (1996) we examine these two effects under oligopolistic competition but find that the situation above is possible under certain conditions, with non-cooperative government interaction playing a key role.

In our oligopolistic setting with two member countries and one non-member country, the tightening of ROO deteriorates the cost structure of the other member country's firm and improves the position of the firm in the imposing country. It decreases, however, the consumer surplus due to an increase in the price of the final good caused by the fall in overall productivity within the FTA. Thus, the ROO imposing country faces a trade-off between an increase in domestic profits and a decrease in consumer surplus. We mainly focus on the case that other countries can provide a production subsidy that has the opposite effects of ROO. Particularly, if the other member country is the first-mover, there is a one-to-one relation between the level of ROO and the production subsidy so that a fall (raise) in subsidy (production tax) can make the level of ROO decrease.

This non-cooperative subsidization is one of the main topics of strategic trade policy. Brander and Spencer (1985) and Eaton and Grossman (1986) provided very famous studies on rent-shifting effects due to strategic subsidization. Eaton and Grossman (1986) showed that the optimal policy is quite the reverse between Cournot and Bertrand competition. The lack of robustness of this result induced a series of studies on the determination of the optimal policy (subsidy or tax) in third-country market models. Neary (1994) showed that when the social cost of export subsidy exceeds unity, subsidies are optimal only for low values of social cost of public funds. In the same framework, Leahy and Montagna (2001) examined the case where the cost structure of domestic firms differs. Moreover, the market demand function is important. Bandyopadhyay (1997) indicates that demand elasticities and cost asymmetry are important determinants of optimal trade policies. Long and

Soubeyran (1997) pointed out that the relation between the Harfindall index of concentration and the elasticity of the slope of the demand curve is important determinant.

The literature on optimal trade policy examines the case for the third-country market model as Eaton and Grossman (1986), who showed that the optimal subsidy rate of the exporting country may be negative when there is price (Bertrand) competition. However, this tax policy depends not only on some individual conditions but also on the model structure. In this paper, we assume the simplest form of FTA, which is an extension of the third-country market model. Moreover, we show that tax policy occurs even if a non-member (outside) country strategically provides subsidies.

The remainder of this paper is organized as follows. In section 2, we formulate the model and derive the results of comparative statics at the final stage of the game. Section 3 examines the FTA member's intervention under asymmetric policy competition between the country that imposes ROO and the outside country. We conclude this paper with section 4.

2 The Model

Suppose that an FTA is consisted of two countries, A and B . Only country A has the final good market and we label the country outside the FTA (or non-member) as O . In country A , the final good is produced by using only a domestically produced intermediate good, because a sufficiently high specific tariff t_m is imposed to the imported intermediate good (produced in country O).² In country B (hereafter the FTA member), however, its domestic firm faces ROO and chooses a mixed proportion of intermediate goods produced in country A and O , because it does not possess an intermediate good industry. In country A and O , the intermediate good industries produces under perfect competition.

The market inverse demand function in country A is defined by³

$$p = p(D); \quad p'(D) < 0, \quad \forall D \geq 0 \quad \text{such that } p(D) > 0,$$

²Namely, that is $k^a > k^o$ and $k^a < k^o + t_m$, where k^a (k^o) is the price of the intermediate good in country A (O).

³Assume that consumers in country A have the same quasi-linear utility. We define this utility as $u(y, D) \equiv y + \nu(D)$, where $\nu'(\cdot) > 0$ and $\nu''(\cdot) \leq 0$ are satisfied. Thus, the consumer's utility maximization problem is defined by $\max_{y, D} \{y + \nu(D) \mid y + pD = E\}$, where y and E are, respectively, the numeraire good and income. The utility maximization problem yields $p = \nu'(D)$. It is well known that this relation implies an inverse demand, so we represent this function as $p = p(D)$.

where D and p represent, respectively, the demand and consumer prices. Consider an asymmetric oligopolistic market consisted of three firms. Each firm, denoted by i , $i \in N = \{a, b, o\}$, is located in country i . Let x^i denote the output of firm i . Thus, $D = X$ holds (X is industry output and is defined by $X \equiv \sum_{i \in N} x^i$). Also assume that firms cost functions have the same form, but each firm's marginal (average) cost c^i is constant and different. Hence, the cost function of each firm i is defined by $c^i(x^i) \equiv c^i x^i$, $c^i > 0$, $i \in N$. We assume that one unit of the intermediate good is required to produce one unit of the final good. Thus, the net profits of firm b and o , respectively, are

$$\pi^b \equiv (p(X) - (c^b(\delta) - s^b)) x^b, \quad \pi^o \equiv (p(X) - (k^o - s^o) - t_x) x^o, \quad (1)$$

where $s^j \geq 0$, $j = b, o$ denotes the production subsidy given by the government J ($= B, O$) to firm j ($= b, o$) and t_x is a fixed external tariff imposed to the outside country. Following Lahiri and Ono (1998, 2003), the marginal (average) cost of firm b becomes

$$c^b(\delta) \equiv \delta k^a + (1 - \delta)k^o, \quad k^a > k^o, \quad (2)$$

where δ is the ROO level imposed by country A 's government. Also, it belongs to the open interval $(0, 1)$. The net profit of firm a is given by

$$\pi^a \equiv (p(X) - k^a) x^a, \quad (3)$$

where k^a is the price of the intermediate good in country A . As defined by equation (2), we assume that $k^a > k^o$, that is the intermediate good industry in country A is less efficient.

First, we focus on the effects of each parameter, δ , s^o and s^b at the final stage. From equations (1)–(3), the first-order profit maximization conditions become

$$0 = p(X) + p'(X)x^a - k^a, \quad (4)$$

$$0 = p(X) + p'(X)x^b - (c^b(\delta) - s^b), \quad (5)$$

$$0 = p(X) + p'(X)x^o - (k^o - s^o) - t_x. \quad (6)$$

Using assumption $p'' = 0$ and equations (4)–(6), we obtain lemma 1.

Lemma 1. *Suppose that the market inverse demand function is linear. Then, from equations (4)–(6), we obtain the results of comparative statics on firms' output x^i , industry output X , profits π^i and consumer surplus CS at the final stage as summarized in table 1 and 2.*

Table 1 inserts here

From the above comparative statics, we can easily find that the scale of change of outputs due to ROO tightening depends on the difference between the price of the intermediate good inside and outside the FTA, that is $\Delta k \equiv k^a - k^o > 0$.⁴ Therefore, the effects of tightening ROO on firms' output increases with Δk . Moreover, we can point out that the enforcement of ROO causes a deterioration of productivity within the FTA. Thus, we can easily find that ROO brings about opposite effects in country *A*. Since tightening ROO deteriorates the cost structure of firm *b*, output x^b decreases. If the other firms do not change outputs, the price of the oligopolistic good raises. Thus, the other firms try to increase profit and output increases. This is a rent-shifting effect due to the enforcement of ROO. However, at the same time this effect decreases total output and increases consumer price, and as a result it leads to a decrease of consumer surplus. This effect is anti-competitive (loss in productivity).

Table 2 inserts here

An increase in the production subsidy for firm j ($= b, o$) leads to a rent shift from the other firms to firm j . However, this differs from an increase in the level of ROO. Since it brings about an increase in total output, so that consumer surplus rises. Thus, production subsidy brings about a competitive effect. This point crucially differs from the effects of the tightening ROO.

Here, we point out that a change of industry output due to a change in the parameters is easily verified using the argument presented by Bergstrom and Varian (1985). They show that in an ordinary Cournot competition, firms' total output do not depend on the distribution of marginal cost across firms.⁵

Remark. *Summing the firms' FOCs (equations (4)–(6)), we obtain the following identity $3p(X(\mathcal{D})) + p'(X(\mathcal{D})) \cdot X(\mathcal{D}) = \mathcal{D}$, where $\mathcal{D} \equiv (1 + \delta)\Delta k + k^o + t_x - (s^b + s^o)$. That is, industry output X depends only on the value of \mathcal{D} . We define this functional relation as $X = X(\mathcal{D})$. Particularly, $\partial X / \partial \delta = \Delta k / \vartheta$, $\partial X / \partial s^j = -1 / \vartheta$, where $\vartheta \equiv 4p' + p''X$ and $j = b, o$.*

⁴To avoid the case “not meets ROO”, hereafter we assume that the difference in the intermediate goods prices $\Delta k \equiv k^a - k^o$ is sufficiently small.

⁵See Bergstrom and Varian (1985), pp.715, example 1.

3 The FTA member's intervention

Let us consider the following three-stage game: Stage 1: The FTA member (ROO-imposed country) chooses the level of production subsidy s^b . Stage 2: The governments of country A and O independently and simultaneously chooses the levels of policy variable. The government of country A chooses the level of $\delta \in (0, 1)$ and the government of country O chooses the level of production subsidy s^o . Stage 3: Each firm independently and simultaneously chooses the output level. We use the subgame perfect Nash equilibrium (hereafter SPNE) as the equilibrium concept. The game is solved using backward induction. A SPNE in this game is a strategy combination such that $\{s^b, \delta(s^b), s^o(s^b), x^i(\delta(s^b), s^o(s^b), s^b)\}$, $\forall i \in N$.

The timing of decisions on intervention is problematic. Since the result of a 'less restrictive' FTA is strongly dependent on the timing of the game, we focus on the above situation and show that a less restrictive FTA is reached (namely, a level of δ decreases) if the first mover is an FTA member (ROO-imposed country).

We have already examined the characteristics of the Cournot-Nash equilibrium output and the market condition at the final stage, so that we will start the analysis from stage 2.

Stage 2. Policy competition between government A and O

Country A 's social welfare is assumed to be the sum of producers' and consumers' surpluses, $\pi^a + \text{CS}$, and input cost of both the domestic firm and firm b paid to country A , $k^a x^a + \delta k^a x^b$, and tariff revenue, $t_x x^o$.⁶ This input revenue $k^a x^a + \delta k^a x^b$ is the motive to impose a positive δ .

The objective function of each government is respectively denoted by the social welfare, W^A and W^O .⁷ Governments solve the following problem

$$\begin{aligned} \max_{\delta \in [0,1]} W^A(\delta, s^o, s^b) &\equiv \max_{\delta \in [0,1]} \pi^a + k^a x^a + \delta k^a x^b + \text{CS} + t_x x^o \quad \text{and} \\ \max_{s^o \geq 0} W^O(\delta, s^o, s^b) &\equiv \max_{s^o \geq 0} \pi^o - s^o x^o, \end{aligned} \tag{7}$$

⁶This definition is the same as that used by Lahiri and Ono (1998), who assume unemployment. We also assume that unemployment in country A . However, we assume that there is no unemployment and the intermediate good is produced under perfect competition in the outside country. Thus, the input cost of the domestic firm and firm b paid to the outside country, $(1 - \delta)k^o x^b + k^o x^o$, is not considered.

⁷These social welfares (function) are strictly concave with respect to policy parameter. Thus, the level of the imposed policy is positive. We show that this feature holds. See Appendix.

where $CS \equiv \int_0^X \nu'(Q)dQ - p(X)X = \nu(X) - p(X)X$.

We assume that production subsidy dollars and profit dollars are treated as equivalent.⁸ Then, using the results of lemma 1, the FOCs for the problem (7) become

$$\begin{aligned} 0 &= -p' \Delta k \cdot X - \Delta k \cdot p + p' \Delta k \cdot x^a + 4p' k^a x^b + 3k^a \Delta k \cdot \delta - t_x \Delta k \quad \text{and} \\ 0 &= -3p - p' x^o + 3k^o + 3t_x. \end{aligned} \quad (8)$$

From equation (8), the policy reaction function for each government is obtained: $\delta = \varphi^A(s^o; s^b)$ and $s^o = \varphi^O(\delta; s^b)$. Thus, the Nash equilibrium level of δ and subsidy s^o are represented by $\delta = \varphi^A(s^o; s^b)$ and $s^o = \varphi^O(\delta; s^b)$. Assuming $\delta \in (0, 1)$, equation (8) yields

$$\frac{\partial \varphi^A}{\partial s^o}(s^o; s^b) = -\frac{(7k^a - 3k^o)}{(7k^a + k^o)3\Delta k} < 0 \quad \text{and} \quad \frac{\partial \varphi^O}{\partial \delta}(\delta; s^b) = \frac{\Delta k}{3} > 0. \quad (9)$$

This result is summarized in lemma 2.

Lemma 2. (i) *The government A's (O's) reaction curve has a downward (upward) slope that does not depend on s^b .* (ii) *The slope of government A's reaction curve increases (decreases) due to an increase in the price k^a of the intermediate good inside the FTA if $(\mu + 4k^o)^2/(\mu - 6k^o)\mu > (<)$ $1/2$, where $\mu \equiv 7\Delta k$.* (iii) *A sufficient condition for an equilibrium to be asymptotically stable is satisfied, i.e., $|\partial \varphi^A / \partial s^o| |\partial \varphi^O / \partial \delta| < 1$, for all $\Delta k > 0$.*

Government A considers both the domestic market and firm a , and it decreases the level of δ when the rival government raises the subsidy. This behavior (strategic substitutes) implies that government A emphasizes the market rather than the domestic firm and, as a result, productivity improves within the FTA. Government O, however, considers only firm o . Thus, it increases the level of subsidy and improves its own position when the rival government raises δ . Hereafter, we focus on a situation where the reaction curves cross each other and the equilibrium level of δ belongs to $(0, 1)$.

Next, we examine a change in direction of policy variables of both government A and O due to a change in s^b . These solutions δ and s^o to equations $\delta = \varphi^A(\cdot)$ and $s^o = \varphi^O(\cdot)$ depend on s^b . Thus,

⁸For example, see Brander (1995). In some literature, however, subsidy dollars and profit dollars are not treated as equivalent. For example, Neary (1994) assumed that a weight is attached to value of subsidy payment, which exceeds unity.

these solutions can be written as $\delta = \delta(s^b)$, $\delta \in (0, 1)$ and $s^o = s^o(s^b)$, $s^o > 0$. Differentiating the system (8) with respect to s^b , we have

$$\begin{pmatrix} (7k^a + k^o) 3\Delta k & 7k^a - 3k^o \\ -\Delta k & 3 \end{pmatrix} \begin{pmatrix} d\delta/ds^b \\ ds^o/ds^b \end{pmatrix} = \begin{pmatrix} 3m \\ -1 \end{pmatrix},$$

where $m = 3k^a + k^o$. Solving this system with respect to $d\delta/ds^b$ and ds^o/ds^b respectively, the change direction of each equilibrium value is represented by

$$\frac{d\delta}{ds^b} = \frac{17k^a + 3k^o}{(35k^a + 3k^o)\Delta k} > 0, \quad \frac{ds^o}{ds^b} = -\frac{6k^a}{35k^a + 3k^o} < 0. \quad (10)$$

Thus, from equation (10), we obtain the following lemma 3.

Lemma 3. *The equilibrium level of δ increases, but the equilibrium level of s^o decreases due to an increase in the subsidy s^b of the FTA member.*

Furthermore, differentiating the governments' reaction functions $\delta(s^b) = \varphi^A(s^o(s^b); s^b)$ and $s^o(s^b) = \varphi^O(\delta(s^b); s^b)$ with respect to s^b at equilibrium, we have

$$\frac{d\delta}{ds^b}(s^b) = \frac{\partial \varphi^A}{\partial s^o}(s^o; s^b) \frac{ds^o}{ds^b}(s^b) + \frac{\partial \varphi^A}{\partial s^b}(s^o; s^b), \quad (11)$$

$$\frac{ds^o}{ds^b}(s^b) = \frac{\partial \varphi^O}{\partial \delta}(\delta; s^b) \frac{d\delta}{ds^b}(s^b) + \frac{\partial \varphi^O}{\partial s^b}(\delta; s^b). \quad (12)$$

Without loss of generality, let us assume that s^b decreases. Equations (11) and (12) indicate that a change in the equilibrium value due to a change in s^b can be decomposed into a direct and an indirect effect ($\partial \varphi^A/\partial s^b$ and $\partial \varphi^O/\partial s^b$). We have already found that $d\delta/ds^b > 0$, $ds^o/ds^b < 0$ (by lemma 3), $\partial \varphi^A/\partial s^o < 0$ and $\partial \varphi^O/\partial \delta > 0$ (by lemma 2). Thus, the signs of the second term of the right-hand side of (11) and (12) are determined, which allows us to determine the direction of the shift for the reaction curves.

Corollary. *From equations (11), (12) and lemma 2-4, we have*

$$\frac{\partial \varphi^A}{\partial s^b} = \frac{105(k^a)^2 + 44k^a k^o + 3(k^o)^2}{(7k^a + k^o)(35k^a + 3k^o)\Delta k} > 0 \quad \text{and} \quad \frac{\partial \varphi^O}{\partial s^b} = -\frac{1}{3} < 0.$$

Figure 1 inserts here

Figure 1 shows the shift direction of the reaction curves due to a decrease in s^b (or an increase in tax). Suppose that only line A shifts leftward first ($A \rightarrow \bar{A}$). In this case, the new equilibrium point is ‘g’ if line O does not move. However, country O ’s welfare decreases considerably, because δ and s^o decrease at point ‘g’ (from lemma 1). Thus, government O shifts up (increase s^o) line O to improve social welfare ($O \rightarrow \bar{O}$).

Stage 1. The FTA member’s intervention

Now let us consider the move of the FTA member. At this stage, the FTA member selects an optimal level of subsidy (or tax). We define the FTA member’s social welfare as being equivalent to the net exporter of the final good. Thus, the government’s objective function is defined by

$$W^B(s^b) \equiv \pi^b - s^b x^b.$$

Differentiating this welfare function with respect to s^b , we obtain the following FOC

$$\frac{\partial W^B}{\partial s^b} = (p - \delta \Delta k - k^o) \xi + p' x^b \zeta - x^b \Delta k \cdot \left(\frac{d\delta}{ds^b} \right) = 0,$$

where

$$\xi \equiv \frac{\partial x^b}{\partial \delta} \left(\frac{d\delta}{ds^b} \right) + \frac{\partial x^b}{\partial s^o} \left(\frac{ds^o}{ds^b} \right) + \frac{\partial x^b}{\partial s^b} = -\frac{60k^a}{(35k^a + 3k^o)4p'} > 0, \quad (13)$$

$$\zeta \equiv \frac{\partial X}{\partial \delta} \left(\frac{d\delta}{ds^b} \right) + \frac{\partial X}{\partial s^o} \left(\frac{ds^o}{ds^b} \right) + \frac{\partial X}{\partial s^b} = -\frac{12k^a}{(35k^a + 3k^o)4p'} > 0. \quad (14)$$

Using conditions (13), (14) and (5) (namely, $0 = p + x^b p' - \delta \Delta k - k^o + s^b$), the following relation is derived

$$\frac{60k^a s^b - (5k^a + 3k^o)4x^b p'}{(35k^a + 3k^o)4p'} = 0. \quad (15)$$

By equation (15), the optimal subsidy (tax) is implicitly defined. Therefore, optimal subsidy (tax) formula for the government B is

$$s^b = \frac{(5k^a + 3k^o)x^b p'}{15k^a} < 0. \quad (16)$$

Thus, equation (16) presents:

Proposition 1. *Under the presence of ROO, the optimal policy for the FTA member is tax.*

The above claim is verified in the following way. When the tax rate equals to zero (that is $s^b = 0$), by equation (15), the social welfare of FTA member is denoted by

$$\left. \frac{\partial W^B}{\partial s^b} \right|_{s^b=0} = -\frac{(5k^a + 3k^o)x^b}{35k^a + 3k^o} < 0.$$

As referred first, we assume that Δk is sufficiently small and $x^b > 0$ holds. By increasing the tax level from zero, under this condition, the FTA member can improve social welfare.

This intuition is the following. The higher the productivity in firm b is, the larger the damage brought about by ROO. The government B knows it beforehand, so that it carries out a productivity-reducing policy. It is preferable to government B decrease the volume of exports of firm b and earns tax revenues ($-s^b x^b > 0$). Thus, the optimal policy for the government B becomes tax.

Finally, let us examine that the influence of government B 's tax policy gives to country O . By rearranging equation (8) and using equation (6), we obtain the following optimal subsidy formula for the government O .

$$s^o = -\frac{2p'x^o}{3} > 0. \quad (17)$$

Considering the conditions for maximizing firms' profits and national welfare, we have

$$\begin{aligned} \frac{\partial W^O}{\partial s^b} &= p'x^o\zeta + (p - k^o - t_x)\eta, \\ &= \frac{-(41k^a + 3k^o)x^op' - (35k^a + 3k^o)s^o}{(35k^a + 3k^o)2p'}, \end{aligned} \quad (18)$$

where

$$\eta \equiv \frac{\partial x^o}{\partial \delta} \left(\frac{d\delta}{ds^b} \right) + \frac{\partial x^o}{\partial s^o} \left(\frac{ds^o}{ds^b} \right) + \frac{\partial x^o}{\partial s^b} = \frac{1}{2p'} < 0. \quad (19)$$

Substituting the optimal subsidy formula (17) into the equation (18), the following relation holds

$$\frac{\partial W^O}{\partial s^b} = -\frac{(53k^a + 3k^o)x^o}{3(35k^a + 3k^o)} < 0.$$

Thus, from lemma 3 and proposition 1, we obtain the following proposition.

Proposition 2. *Under the presence of ROO, the social welfare of country O improves when compared to the case of non-intervention ($s^b = 0$), because government B chooses a tax policy.*

4 Conclusion

In this paper, we focus on the effects of the FTA member's subsidy policy under the presence of ROO. We showed that if the ROO-imposed country is the first-mover, it is possible that this country can make the level of δ decrease when compared to a situation of non-intervention ($s^b = 0$).

Many other studies on FTA with ROO focus on the protectionist nature of ROO but only examine the effects of tightening ROO on the economy. But, considering the possibility of government intervention by other countries, we pointed out that the protectionist nature of ROO that causes anti-competitive and rent-shifting effects may possibly be mitigated.

The FTA member's optimal policy is tax, which occurs due to the following reason. The social welfare of the FTA member is equivalent to firm b 's profit so that the social welfare improves when the level of δ decreases. But there is a positive correlation between δ and the member's subsidy (or tax) as shown in lemma 3. Because of this, by decreasing (increasing) subsidy dollars (tax rate), the FTA member improves national welfare. Thus, by optimizing the tax level, the FTA member can maximize national welfare.

Our result is very simple, but it depends on the following central assumptions: (i) timing of the game (e.g., the first mover is the ROO-imposed country (FTA member)); (ii) asymmetric policy competition between government A and O ; (iii) the inverse market demand function in country A is linear ($p'' = 0$). Of course, our model is not necessarily applicable to a general consideration of FTAs with ROO. Considering the possibility of a strategic behavior of the FTA member, however, a less restrictive FTA may be reached.

Appendix: Proof of strict concavity

Following Lahiri and Ono (1998), we define country A 's social welfare as

$$W^A \equiv \pi^a + k^a x^a + \delta k^a x^b + CS + t_x x^o.$$

This welfare function is strictly concave with respect to δ . We show that this property holds.

$$\begin{aligned} W^A(\delta, s^o, s^b) \equiv & \nu(X(\delta, s^o, s^b)) - p(X(\delta, s^o, s^b)) \cdot X(\delta, s^o, s^b) + \delta k^a \cdot x^b(\delta, s^o, s^b) \\ & + p(X(\delta, s^o, s^b)) \cdot x^a(\delta, s^o, s^b) + t_x \cdot x^o(\delta, s^o, s^b), \end{aligned}$$

Differentiating the above welfare function with respect to δ , we have

$$W_{\delta}^A = -X \frac{\Delta k}{4} - p \frac{\Delta k}{4p'} + x^a \frac{\Delta k}{4} + k^a x^b + \delta k^a \frac{3\Delta k}{4p'} - t_x \frac{\Delta k}{4p'}$$

$$W_{\delta\delta}^A = -\frac{\Delta k}{4} \frac{\Delta k}{4p'} - \frac{\Delta k}{4} \frac{\Delta k}{4p'} - \frac{\Delta k}{4} \frac{\Delta k}{4p'} + k^a \frac{6\Delta k}{4p'} = \frac{3(8k^a - \Delta k)\Delta k}{16p'} < 0.$$

Thus, the welfare function of country A, $W^A(\delta, s^o, s^b)$, is strictly concave. Next, we verify that country O's social welfare is strictly concave. Country O's social welfare is defined by

$$W^O \equiv \pi^o - s^o x^o = p(X)x^o - k^o x^o - t_x x^o.$$

This function can be rewritten as

$$W^O(\delta, s^o, s^b) \equiv p(X(\delta, s^o, s^b)) \cdot x^o(\delta, s^o, s^b) - (k^o + t_x)x^o(\delta, s^o, s^b).$$

Differentiating the above welfare function with respect to s^o , we have

$$W_s^O = -p \frac{3}{4p'} - p' x^o \frac{1}{4p'} - (k^o + t_x) \frac{3}{4p'}$$

$$W_{ss}^O = -p' \frac{3}{4p'} \frac{\partial X}{\partial s^o} - \frac{1}{4} \frac{\partial x^o}{\partial s^o} = \frac{3}{16p'} + \frac{3}{16p'} = \frac{3}{8p'} < 0.$$

The welfare function of country O, then, $W^O(\delta, s^o, s^b)$, is strictly concave. **Q.E.D.**

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Table 1: Output changing

	x^a	x^b	x^o	X
δ	$-\frac{\Delta k}{4p'} > 0$	$\frac{3\Delta k}{4p'} < 0$	$-\frac{\Delta k}{4p'} > 0$	$\frac{\Delta k}{4p'} < 0$
s^o	$\frac{1}{4p'} < 0$	$\frac{1}{4p'} < 0$	$-\frac{3}{4p'} > 0$	$-\frac{1}{4p'} > 0$
s^b	$\frac{1}{4p'} < 0$	$-\frac{3}{4p'} > 0$	$\frac{1}{4p'} < 0$	$-\frac{1}{4p'} > 0$

Table 2: Rent-shifting and anti-competitive effects

	π^a	π^b	π^o	CS
δ	$-\frac{f^a \Delta k}{4p'} > 0$	$\frac{3f^b \Delta k}{4p'} < 0$	$-\frac{f^o \Delta k}{4p'} > 0$	$-\frac{X \Delta k}{4} < 0$
s^o	$\frac{f^a}{4p'} < 0$	$\frac{f^b}{4p'} < 0$	$-\frac{3f^o}{4p'} > 0$	$\frac{X}{4} > 0$
s^b	$\frac{f^a}{4p'} < 0$	$-\frac{3f^b}{4p'} > 0$	$\frac{f^o}{4p'} < 0$	$\frac{X}{4} > 0$

((i)) In these table, the combination π^a and δ denote $\left(\frac{\partial \pi^a}{\partial \delta}\right)$.

((ii)) We define that $f^a \equiv p - p'x^a - k^a$, $f^b \equiv p - p'x^b - [c^b(\delta) - s^b]$ and $f^o \equiv p - p'x^o - (k^o - s^o) - t_x$, where $f^i > 0, \forall i \in N$.

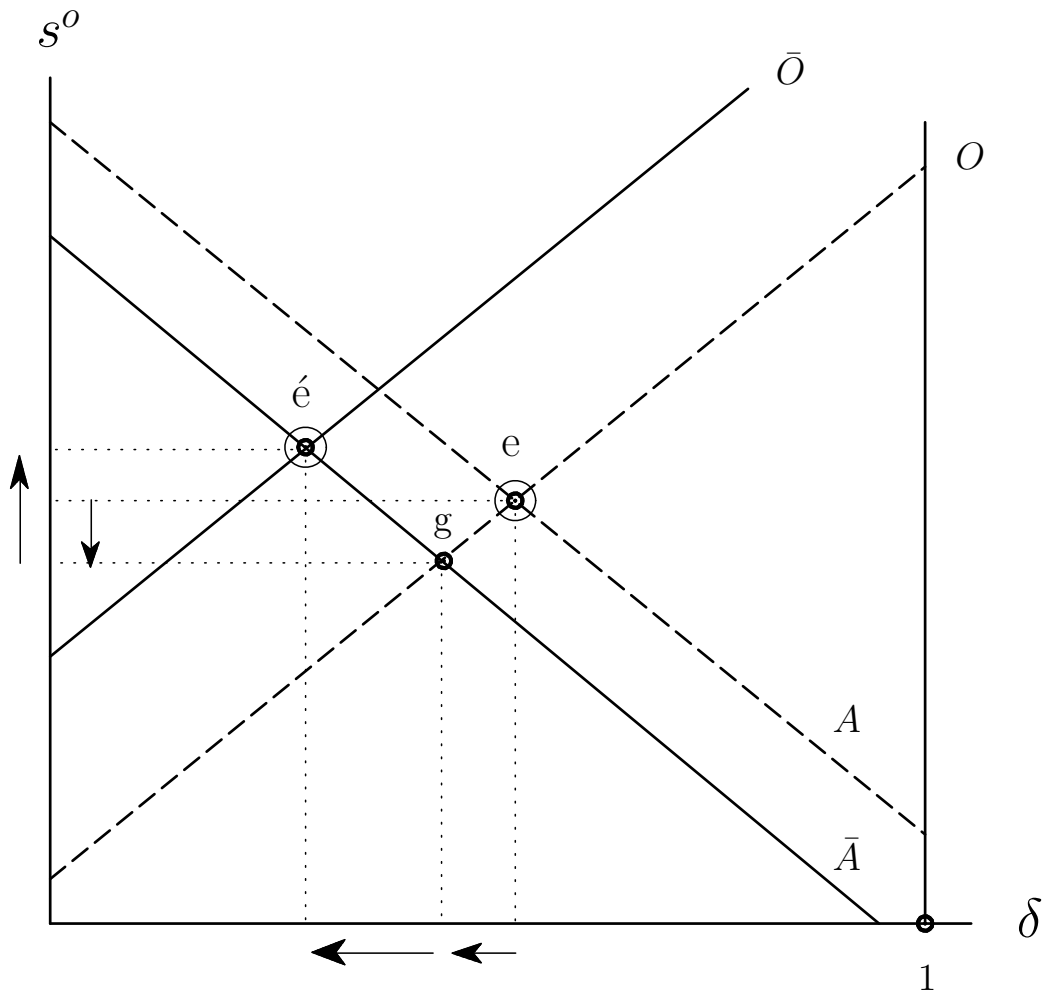


Figure 1: Shifting policy reaction curves ($s^b \downarrow$)

Line A and O represent initial position of policy reaction curves.