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Abstract

We investigate government subsidy policies in which a home firm and a foreign firm choose to strategically set prices or quantities in a third market. We show that even though each firm can earn higher profits under Cournot competition than under Bertrand competition regardless of the nature of goods, choosing Bertrand competition is the dominant strategy for both firms. This can lead each firm to face a prisoners' dilemma in equilibrium. We also show that from the aspects of governments under subsidy regime, Cournot competition is more efficient than Bertrand competition when the goods are substitutes, and vice versa when the goods are complements. However, trade liberalization such as via free trade agreements brings about a change in the competition mode from Bertrand competition to Cournot competition if goods are substitutes. On the other hand, if goods are complements, there are no such a change in the competition mode and Bertrand competition prevails the market. Hence, a move toward free trade among countries increases not only profits of firms but also the welfare of both countries irrespective of the nature of goods.
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1 Introduction

The analysis of strategic trade policy has attracted much attention since the beginning of the 1980s. As is often the case in an international trade, the theory of strategic export policy for oligopolies started with a pioneering work by Brander and Spencer (1985). In their model, a domestic government first decides upon an export subsidy, and then a domestic firm and a foreign firm compete in a third market. Brander and Spencer (1985) showed that an export subsidy was optimal under Cournot competition, whereas Eaton and Grossman (1986) demonstrated that an export tax was optimal under Bertarnd competition on the third market[1]. Recently, Clarke and Collie (2003) analysed the welfare effects

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[1]For more detailed discussion of subsidy policy, see Dixit and Kyle (1985), Horstmann and Markusen (1986), Cooper and Riezman (1989), Brainard and Martimort (1997), Hwang and Mai (2007), and Brander (1995) and references therein.

of free trade in the Bertrand competition with product differentiation. The main stream focuses on extensions and generalizations of Brander and Spencer (1985) and Eaton and Grossman (1986). Among them are de Meza (1986), Bandyopadhyay (1997), Neary and Leahy (2000), Collie and de Meza (2003), Clarke and Collie (2006).

Although previous works considered strategic export policy, the existing literature on international trade paid relatively little attention to the endogenous choice of strategic variables for prices or quantities with subsidy or tax regime. In fact, since our issue was addressed in the industrial organization context, the potential impact of government subsidy policy was not theoretically incorporated. Key paper in this area includes Singh and Vives (1984). They were the first to analyze this issue and to show, from the standpoint of consumer surplus and social welfare, that Bertrand competition is more efficient than Cournot competition regardless of the nature of goods. They also showed that when goods are substitutes, Cournot equilibrium profits are higher than Bertrand equilibrium profits, and vice versa, when goods are complements. In the industrial organization context, many strands of the literature have produced an array of extensions and generalizations of the analysis in Singh and Vives (1984). For example, one strand that focuses on extensions and generalizations of their study, Dastidar (1997), Qiu (1997), Lambertini (1997), Hackner (2000), and Zanchettin (2006) reveals counter-results based on the original framework by allowing for a wider range of cost and demand asymmetries.

Under the framework of the strategic trade policies, with comparisons of Bertrand and Cournot competition, the only exceptions, to the best of the authors' knowledge, are Cheng (1988), Bagwell and Staiger (1994), Maggi (1996), Schroeder and Tremblay (2014) and Ghosh and Pal (2014) where the endogenous choice of strategic variables is not provided[2]. Cheng (1988) derived the optimal tariff and production subsidy under Cournot and Bertrand competition with differentiated products and showed that the optimal tariff is lower under Bertrand competition than under Cournot competition. Moreover, Maggi (1996) showed that *capacity* subsidy is generally a welfare improving policy regardless of the competition mode and Bagwell and Staiger (1994) indicated that R&D subsidies might also be the best policy in both Cournot and Bertrand setups. Schroeder and Tremblay (2014) investigated the welfare effect of an export subsidy/tax in the third market, where the home government chooses subsidy and other countries are assumed to be policy inactive by considering all strategic possibilities (Cournot versus Bertrand versus Bertrand-Cournot versus Cournot-Bertrand). Finally, Ghosh and Pal (2014) analyzed strategic trade policy in differentiated network goods oligopoly only comparing Cournot versus Bertrand competition. The present paper fills this gap. Thus, we address how the endogenous choice of strategic variables for prices or quantities affects social welfare and firm's profit when a home firm and a foreign firm compete in a third market, comparing the strategic trade policies with free trade. Notably, the present study differs from previous ones that do not consider the endogenous choice of strategic variables for prices or quantities in a third market with strategic export policy.

The main result of our paper is that regardless of the nature of goods, even though each firm can earn higher profits under Cournot competition than under Bertrand competition, choosing Bertrand competition is the dominant strategy for home and foreign firms when both firms export to a third-country market with strategic trade policies. A higher (less) export subsidy (tax) forces both firms

[2]Kikuchi (1998) explored how optimal export policies are affected by the nature of competition mode (Cournot or Bertrand) with a home firm only under subsidy regime.

to be aggressive in determining the output, which leads to be higher output and lower price under choosing price variable regardless of what the rival firm chooses competition mode. Thus, each firm prefers choosing price variable to choosing quantity variable regardless of the nature of goods. However, this leads, in equilibrium, each firm to face a prisoners' dilemma regardless of the nature of goods (except for the case where goods are highly complement). This intuition is as follows. Since the effect on a higher price with lower output under Cournot competition dominates the effect on a lower price with a higher output under Bertrand competition, each firm could obtain higher profit under Cournot competition than under Bertrand competition.

We also show that from the aspects of governments under subsidy or tax regime, Cournot competition is more efficient than Bertrand competition when the goods are substitutes, and vice versa when the goods are complements. For this, from the aspects of firms, the equilibrium could be Pareto superior (inferior) with government's intervention of subsidy policy when the goods are substitutes (complements). However, from the free trade equilibrium, it is straightforward to verify that the dominant strategy for firms is to choose Cournot competition when the goods are substitutes, and vice versa when the goods are complements. Hence, trade liberalization among countries may cause a shift in the competition mode from Bertrand-type to Cournot-type competition especially when goods are substitutes and that Bertrand model should be used more in the analysis of strategic trade policy. Finally, comparing the equilibrium outcomes in the presence of optimal trade policies with that under free trade, if the goods are complements, the contract mode does not change as trade liberalization progresses and thus Bertrand competition prevails markets (i.e., both countries' welfare would be better off if they could cooperate so as to achieve the free trade regime). On the other hand, if goods are substitutes, we find that firms' equilibrium profits increase by the regime shift from Bertrand to Cournot competition due to the trade liberalization. Consequently, as to welfare change due to the regime shift of competition mode, a move toward free trade among countries increases not only profits of firms but also the welfare of both countries irrespective of the nature of goods.

The paper is organized as follows. Section 2 outlines the third-market model. Section 3 analyzes market equilibrium with competition mode under subsidy regime. Section 4 determines choice of competition mode under subsidy regime. Section 5 analyzes the effect of free trade, considering subsidy regime. Section 6 concludes.

2 The Model

Following Brander and Spencer (1985), we use the third-market model of international trade under oligopolistic competition. We analyze the market for a differentiated good that is produced by two firms (firm 1 and 2), each located in a different country, i.e., country 1 and country 2. These firms compete in a third-country market, i.e., all of their output is exported to a third-country market[3]. The inverse demand functions for good i can be written as follows:

$$p_i = 1 - x_i - bx_j; i, j = 1, 2 \text{ and } i \neq j, \tag{1a}$$

[3]The third-country market assumption implies that consumer surplus does not enter the home country's welfare function and this allows us to focus on the strategic interaction between the firms in the international oligopoly.

where p_i and x_i are firm i's price and quantity respectively. And the parameter $b(\in(-1,1))$ denotes the type of interaction (substitutability or complementarity) between good i and good j. That is, the goods are substitutes, independent, or complements according to whether b is positive, zero, or negative, respectively. The corresponding direct demand function is given by

$$x_i = \frac{1 - b - p_i + bp_j}{1 - b^2}; i, j = 1, 2 \text{ and } i \neq j. \tag{1b}$$

Without loss of generality, we assume zero marginal production costs. Let s_i be the exports subsidy per unit of output received by firm i. Then the exporting firm's profits are given by

$$\pi_i = (p_i + s_i)x_i; i, j = 1, 2. \tag{2}$$

As there is no domestic consumption, welfare of country i, denoted W_i, consists only of the profits of firm minus the loss of the subsidy:

$$W_i = \pi_i - s_i x_i;\ i, j = 1, 2. \tag{3}$$

This study considers the case where each firm can make two types of binding contracts with consumers, the price contract and the quantity contract, as described by Singh and Vives (1984). In order to endogenize whether firms choose the price contract or the quantity contract, we consider a three-stage game. In the first stage, each firm determines whether to adopt the price contract or the quantity contract as a strategic variable. Since each firm has two strategic variables, there are basically three possible subgames: both choose quantity contracts (quantity-quantity game), both choose price contracts (price-price game), and one firm (firm 1) chooses the price contract while the other firm (firm 2) chooses quantity contract (price-quantity game)[4]. In the second stage, after observing the mode of competition determined in the first stage, two governments simultaneously set the optimal tax/subsidy to maximize its social welfare. In the third stage, each exporting firm chooses its quantity or price simultaneously in order to maximize its profits.

3 Market Equilibriums in the Second and Third Stages

Following the backward induction method, we first solve the firms' profit maximization problem under each subgame.

[The quantity-quantity game]
This is basically Cournot simultaneous game. In this case the problem of firm $i(i = 1, 2)$ in the third stage is $\max_{x_i} \pi_i(x_i, x_j; s_i)$, which yields its quantity reaction function as $R_i^C(x_j; s_i) = (1 - bx_j + s_i)/2$ where the superscript 'C' denotes the Cournot competition. We find that $R_i^C(x_j; s_i)$ is negatively (positively) related to x_j in the quantity space, if b is positive (negative). By solving the system of the two reaction functions, we get equilibrium prices, quantities, and profits under Cournot competition

[4] Because firms i and j are symmetric in terms of their cost structure, both the (price-quantity) game and (quantity-price) game produce the same results.

mode as a function of s_i and s_j;

$$p_i^C(s_i, s_j) = \frac{2 - b - (2 - b^2)s_i - bs_j}{4 - b^2}, \quad x_i^C(s_i, s_j) = \frac{2 - b - bs_j + 2s_i}{4 - b^2}, \tag{4}$$

$$\pi_i^C(s_i, s_j) = \pi_i[x_i^C(s_i, s_j), x_j^C(s_i, s_j); s_i] = \left[x_i^C(s_i, s_j)\right]^2. \tag{5}$$

Substituting these equilibrium prices and quantities into the welfare expression we get

$$W_i^C(s_i, s_j) = \pi_i[x_i^C(s_i, s_j), x_j^C(s_i, s_j); s_i] - s_i x_i^C(s_i, s_j). \tag{6}$$

Therefore, in the second stage, the problem of each government can be written as $\max_{s_i} W_i^C(s_i, s_j)$. Differentiate W_i^C with respect to s_i to get:

$$\frac{dW_i^C}{ds_i} = \frac{d\pi_i}{dx_j}\frac{dx_j^C}{ds_i} - s_i\frac{dx_i^C}{ds_i} = \frac{b^2}{4 - b^2}x_i^C - \frac{2s_i}{4 - b^2}(> 0 \text{ when } s_i = 0), \tag{7}$$

where the term $d\pi_i/dx_j$ in the second part of the equation represents the effects of the rival firm's market action (here, it is quantity change) on the home firm's profits and dx_i^C/ds_i is the equilibrium output change of the rival firm caused by an export subsidy while the second term $s_i(dx_i^C/ds_i)$ represents the subsidy payments increase due to the home firm's output change caused by export subsidy. The key finding is that, irrespective of whether goods are substitutes or complements, the combined term $(d\pi_i/dx_j)(dx_j^C/ds_i)$, the cross effect of export subsidy on profits via rival's output change, is positive. This implies that, in the neighborhood of free trade ($s_i = 0$), the cross effects of export subsidy are greater than the subsidy payments, and thus, a marginal increase in the subsidy increases the social welfare. Setting $dW_i^C/ds_i = 0$ to obtain the reaction function of the government yields $s_i(s_j) = [b^2(2-b) - b^3 s_j]/4(2-b^2)$. Because of symmetry, i.e., $s_i = s_j = s$, the optimal subsidy in the Cournot competition is given by

$$s_i^C = s_j^C = s^C = \frac{b^2}{4 + 2b - b^2} > 0. \tag{8}$$

Substituting the equilibrium value of export subsidy, Eq. (8), into equations from Eq. (4) to Eq. (6) we get the equilibrium prices, quantities, profits and social welfare in the Cournot competition mode. The following lemma is immediate.

Lemma 1. *Suppose that both firms engage in Cournot competition in a third-country market. Nash subsidy equilibrium is characterized by positive export subsidies in both exporting countries. The equilibrium outputs, prices, firms' profits and social welfare are, respectively, as follows.*

$$x_i^C = \frac{2}{4 + 2b - b^2}, \quad p_i^C = \frac{2 - b^2}{4 + 2b - b^2}, \tag{9a}$$

$$\pi_i^C = \frac{4}{(4 + 2b - b^2)^2}, \quad W_i^C = \frac{2(2 - b^2)}{(4 + 2b - b^2)^2}. \tag{9b}$$

[The price-price game]

Now, we consider the case of Bertrand type competition in the product market. In this case, given the competition mode determined in the first stage, Bertrand competition, in the second stage of the game each government chooses export subsidy/tax level as the strategic variable and in the final stage each firm engage in simultaneous price competition to maximize its profits.

The problem of firm i in the third stage is $\max_{p_i} \pi_i(p_i, p_j; s_i)$, which yields its firm i's price response function as $R_i^B(p_j; s_i) = (1 - b + bp_j - s_i)/2$ where the superscript 'B' denotes the Bertrand competition. The response function $R_i^B(p_j; s_i)$ is upward (downward) sloping in the price space, if b is positive (negative). By solving the system of the two reaction functions, we obtain equilibrium prices, quantities, and profits under the Bertrand competition mode as a function of s_i and s_j;

$$p_i^B(s_i, s_j) = \frac{(2+b)(1-b) - bs_j - 2s_i}{4 - b^2}, \quad x_i^B(s_i, s_j) = \frac{(2+b)(1-b) + s_j(2-b^2) - bs_i}{(1-b^2)(4-b^2)}, \tag{10}$$

$$\pi_i^B(s_i, s_j) = \pi_i[p_i^B(s_i, s_j), p_j^B(s_i, s_j); s_i] = \left[x_i^B(s_i, s_j)\right]^2, \tag{11}$$

$$W_i^B(s_i, s_j) = \pi_i[p_i^B(s_i, s_j), p_j^B(s_i, s_j); s_i] - s_i x_i^B(s_i, s_j). \tag{12}$$

Analogously to the Cournot case, in the second stage, each government chooses s_i to maximize its social welfare $W_i^B(s_i, s_j)$. Differentiating $W_i^B(s_i, s_j)$ with respect to s_i gives

$$\frac{dW_i^B}{ds_i} = \frac{d\pi_i}{dp_j}\frac{dp_j^B}{ds_i} - s_i\frac{dx_i^B}{ds_i} = \frac{-b^2(p_i^B + s_i)}{(1-b^2)(4-b^2)} - s_i\frac{2-b^2}{(1-b^2)(4-b^2)} (< 0 \text{ when } s_i = 0), \tag{13}$$

where the first term $(d\pi_i/dp_j)(dp_j^B/ds_i)$ in the second expression of the equation represents the cross effects of export subsidy on the profits via rival firm's price change, and the second term $s_i(dx_i^B/ds_i)$ represents the subsidy payments increase due to the home firm's output change caused by export subsidy. Regardless of the nature of goods, the cross effect of export subsidy on profits is negative under Bertrand competition mode.

Apparently, the social welfare of country i is decreasing in export subsidies s_i at free trade, i.e., $[dW_i^B/ds_i]_{s_i=0} < 0$, indicating that a marginal decrease in the subsidy (i.e., marginal increase in export tax) will increase welfare. The first-order conditions for both governments define the two reaction functions in the policy space, i.e., $s_i(s_j) = -[b^2(1-b)(2+b) + b^3 s_j]/4(2-b^2), i, j = 1, 2; i \neq j$. Solving these two reaction functions simultaneously yields

$$s_i^B = s_j^B = s^B = \frac{-b^2(1-b)}{4 - 2b - b^2} < 0, \tag{14}$$

which is consistent with the finding of Eaton and Grossman (1986) in the sense that export tax is an optimal trade policy in Bertrand competition.

Clearly, the Cournot and Bertrand differ in detail. As is well known, outputs are typically strategic substitutes under Cournot competition, giving rise to an incentive to subsidize. On the other hand, prices are typically strategic complements under Bertrand competition, giving rise to an incentive to tax exports. In our paper, we confirm the above results hold true irrespective of whether goods are substitutes ($b > 0$) or complements ($b < 0$).

Substituting s^B of Eq. (14) into Eqs. (10) to (12), we can obtain the equilibrium prices, quantities, firms' profits, and welfare under the Bertrand competition when optimal trade policies are introduced by the both governments. The following lemma is immediate.

Lemma 2. *Suppose that both firms engage in Bertrand competition in a third-country market. Nash equilibrium in a trade policy game is characterized by negative export subsidies, i.e., export tax, in both exporting countries. The equilibrium output, price, firms' profit and social welfare are given by*

$$x_i^B = \frac{2-b^2}{(1+b)(4-2b-b^2)},\ p_i^B = \frac{2(1-b)}{4-2b-b^2}, \tag{15a}$$

$$\pi_i^B = (1-b^2)(x_i^B)^2 = \frac{(1-b)(2-b^2)^2}{(1+b)(4-2b-b^2)^2}, W_i^B = p_i^B x_i^B = \frac{2(1-b)(2-b^2)}{(1+b)(4-2b-b^2)^2}. \tag{15b}$$

[The quantity-price game]

Consider the case where, in the first stage, the firm i chooses the quantity while the rival firm chooses price as their strategic variables for product market competition. So, the modes of product market competition are asymmetric. Although there are two possible games, (quantity-price) game and (price-quantity) game, in this regime, it is sufficient to analyze either of these two cases of asymmetric competition, because firms are otherwise identical. In the quantity-price game, the demand functions the firm i and firm j face are given by $p_i = 1-b+bp_j-(1-b^2)x_i$ and $x_j = 1-bx_i-p_j$ respectively. We can rewrite the problems of firms i in the third stage as $\max_{x_i} \pi_i(x_i, p_j; s_i)$ while that of firm j as $\max_{p_j} \pi_j(x_i, p_j; s_j)$, respectively[5].

From the first-order conditions, $d\pi_i/dx_i = 0$ and $d\pi_j/dp_j = 0$, we get the reaction function $R_i^Q(p_j, s_j) = (1-b+bp_j+s_i)/2(1-b^2)$ for firm i and $R_j^P(x_i, s_j) = (1-bx_i-s_j)/2$ for firm j. Clearly, it holds that $\partial R_i^Q/\partial p_j > 0(<0)$ and $\partial R_j^P/\partial x_i < 0(>0)$ if $b > 0(<0)$. Therefore, in an asymmetric competition mode, the quantity-setting firm i perceives that x_i and p_j are strategic complements, while the price-setting firm j perceives those variables as strategic substitutes if $b > 0$, and vice versa if $b < 0$. Solving the system of the two reaction functions in the asymmetric competition mode, we obtain the third stage equilibrium outputs, prices and profits as functions of s_i and s_j;

$$x_i^Q(s_i, s_j) = \frac{2-b+2s_i-bs_j}{4-3b^2}, \quad p_i^Q(s_i, s_j) = \frac{(2-b)(1-b^2)-bs_j(1-b^2)-s_i(2-b^2)}{4-3b^2}, \tag{16}$$

$$x_j^P(s_i, s_j) = \frac{(2+b)(1-b)-bs_i+s_j(2-b^2)}{4-3b^2}, \quad p_j^P(s_i, s_j) = \frac{(2+b)(1-b)-2s_j(1-b^2)-bs_i}{4-3b^2}, \tag{17}$$

$$\pi_i^Q(s_i, s_j) = \pi_i[x_i^Q(s_i, s_j), p_j^P(s_i, s_j); s_i], \quad \pi_j^P(s_i, s_j) = \pi_j[p_j^P(s_i, s_j), x_i^Q(s_i, s_j); s_j], \tag{18}$$

$$W_i^Q(s_i, s_j) = \pi_i^Q(s_i, s_j) - s_i x_i^Q(s_i, s_j), \quad W_j^P(s_i, s_j) = \pi_j^P(s_i, s_j) - s_j x_j^P(s_i, s_j), \tag{19}$$

where superscript 'P' and 'Q' denote the price-setting firm and the quantity-setting firm, respectively, in the asymmetric competition mode. In the second stage of the game, the optimization problems of respective governments are as $\max_{s_i} W_i^Q(s_i, s_j)$ for country i and $\max_{s_j} W_j^P(s_i, s_j)$ for country j.

[5]Note that the specific form of profit functions of firm i and firm j are asymmetric depending on control variable that each firm chooses. Profit function of quantity-setting firm i is given by $\pi_i(x_i, p_j; s_i) = (p_i + s_i)x_i$ where $p_i = p_i(x_i, p_j)$ is firm i's indirect demand function, and firm i chooses x_i for any given p_j to maximize π_i. On the other hand, profit function of price-setting firm is $\pi_j(x_i, p_j; s_j) = (p_j + s_j)x_j$ where $x_j = x_j(p_j, x_i)$ is firm j's direct demand function, and firm j determines p_j given to maximize π_j.

Differentiating $W_i^Q(W_j^P)$ with respect to $s_i(s_j)$ gives

$$\frac{dW_i^Q}{ds_i} = \frac{d\pi_i}{dp_j}\frac{dp_j^P}{ds_i} - s_i\frac{dx_i^Q}{ds_i} = \frac{-b^2}{4-3b^2}x_i^Q - \frac{2s_i}{4-3b^2}(< 0 \text{ when } s_i = 0), \tag{20a}$$

$$\frac{dW_j^P}{ds_j} = \frac{d\pi_j}{dx_i}\frac{dx_i^Q}{ds_j} - s_j\frac{dx_j^P}{ds_j} = \frac{b^2}{4-3b^2}x_j^P - s_j\frac{2-b^2}{4-3b^2}(> 0 \text{ when } s_j = 0). \tag{20b}$$

It is noteworthy that the cross effects of export subsidy on firm's profits, the term $(d\pi_i/dp_j)(dp_j^P/ds_i)$ in Eq. (20a), are negative if the corresponding firm competes in terms of quantity taking the rival's price as given, while those effects, the term $(d\pi_j/dx_i)(dx_i^Q/ds_j)$ in Eq. (20b), are positive if the corresponding firm competes in terms of price taking the rival's quantity as given. And this holds true irrespective of the nature of goods.

Note that $[dW_i^Q/ds_i]_{s_i=0} < 0$ and $[dW_j^P/ds_j]_{s_j=0} > 0$, implying that under asymmetric competition mode, it is optimal for the government to induce the price-setting (quantity-setting) firm to be more (less) aggressive in the product market by providing subsidy (imposing tax) on their exports. The intuitive explanation is as follows. If the price-setting firm makes an aggressive behavior, for example, by price cutting, then the quantity-setting rival firm responds by producing less in the market. For any given price level, lower output of rival leads to higher profits of the price-setting firm. On the other hand, if the quantity-setting firm makes a less aggressive behavior in the market, for example, by reducing its sales, then the price-setting rival firm responds by charge a higher price. For any given output level, higher price setting of rival firm leads to higher profit of the quantity-setting firm.

Solving these two problems simultaneously, i.e., $dW_i^Q/ds_i = 0$ and $dW_j^P/ds_j = 0$, we get the optimal subsidy/tax level of each country under asymmetric modes of product market competition as follows[6].

$$s_i^Q = \frac{-b^2(1-b)(4+2b-b^2)}{16-20b^2+5b^4} < 0, \quad s_j^P = \frac{b^2(4-2b-b^2)}{16-20b^2+5b^4} > 0. \tag{21}$$

By comparing s_i^Q and s_j^P in Eq. (21) with s^B in Eq. (14) and s^C in Eq. (8), we obtain that

$$\mid s_i^Q \mid - \mid s^B \mid = \frac{4b^4(1-b)(2-b^2)}{(4-2b-b^2)(16-20b^2+5b^4)} > 0, \tag{22a}$$

$$s_j^P - s^C = \frac{4b^4(2-b^2)}{(4-2b-b^2)(16-20b^2+5b^4)} > 0. \tag{22b}$$

Proposition 1. *Suppose that a home and a foreign firm both export to a third-country market. The optimal trade policy in a Cournot (Bertrand) competition mode is export subsidy (tax); i.e.,* $s^C > 0$ *and* $s^B < 0$. *In an asymmetric competition mode, the optimal trade policy for the price-setting firm is export subsidy while that for the quantity-setting firm is export tax; i.e.,* $s^Q < 0$ *and* $s^P > 0$. *Furthermore, the magnitude of export subsidy (tax) in an asymmetric competition is greater than that in a Cournot (Bertrand) competition; i.e.,* $s^P > s^C$ *and* $\mid s_i^Q \mid > \mid s^B \mid$.

[6] From the respective first order condition, we can obtain the reaction function of each government in the policy space; i.e., $s_i(s_j) = -[b^2(2-b) + b^3 s_j]/4(2-b^2)$ for country i and $s_j(s_i) = [b^2(2+b)(1-b) - b^3 s_i]/4(1-b^2)(2-b^2)$ for country j.

Substituting s_i^Q and s_j^P in Eq. (21) into Eqs. (16) to (19), we obtain the equilibrium prices, quantities, profits, and social welfare when optimal trade policies are introduced by the governments in this competition mode. The following lemma is immediate.

Lemma 3. *Suppose that firms differ in terms of their strategic variables for the product market competition. That is, with regard to firm's choice of strategic variables, one firm chooses price and the other chooses quantity. In this asymmetric competition mode, if optimal trade policies as in Eq. (21) are introduced by the governments, then the equilibrium output, price, firms' profit and social welfare are given by*

$$x_i^Q = \frac{2(1-b)(4+2b-b^2)}{16-20b^2+5b^4}, \quad x_j^P = \frac{(2-b^2)(4-2b-b^2)}{16-20b^2+5b^4}, \tag{23a}$$

$$p_i^Q = \frac{(1-b)(2-b^2)(4+2b-b^2)}{16-20b^2+5b^4}, \quad p_j^P = \frac{2(1-b^2)(4-2b-b^2)}{16-20b^2+5b^4}, \tag{23b}$$

$$\pi_i^Q = (1-b^2)(x_i^Q)^2 = \frac{4(1-b)^2(1-b^2)(4+2b-b^2)^2}{(16-20b^2+5b^4)^2}, \ \pi_j^P = (x_j^P)^2 = \frac{(2-b^2)^2(4-2b-b^2)^2}{(16-20b^2+5b^4)^2}, \tag{24a}$$

$$W_i^Q = x_i^Q p_i^Q = \frac{2(1-b)^2(2-b^2)(4+2b-b^2)^2}{(16-20b^2+5b^4)^2}, \ W_j^P = x_j^P p_j^P = \frac{2(1-b^2)(2-b^2)(4-2b-b^2)^2}{(16-20b^2+5b^4)^2}. \tag{24b}$$

Comparing the equilibrium outcomes under three possible competition modes given in Lemmas 1, 2, and 3, we obtain the following Lemma.

Lemma 4. *There are three different types as competition modes depending on the choice of strategic variable: Cournot, Bertrand and asymmetric competition mode. If optimal trade policies are introduced under each potential modes, then the following relationship holds among equilibrium values under each competition mode.*

$$\begin{aligned} &x_i^Q < x_i^C < x_i^B < x_i^P, \text{ and } p_i^B < p_i^P < p_i^Q < p_i^C \text{ if } b > 0, \\ &x_i^C < x_i^Q < x_i^P < x_i^B, \text{ and } p_i^P < p_i^B < p_i^C < p_i^Q \text{ if } b < 0. \end{aligned} \tag{25}$$

With regard to above rankings about equilibrium outputs and prices, two points are noteworthy. The first point is that Singh and Vives (1984)'s ranking of equilibrium outputs and prices under Cournot and Bertrand competition hold true even in the presence of optimal trade policies by both countries, i.e., $x_i^C < x_i^B$ and $p_i^B < p_i^C$. Firms have less capacity to raise prices above marginal cost in Bertrand competition, because, in a standard oligopoly setting, firms perceive a higher elasticity of demand under Bertrand competition than under Cournot competition. Although optimal trade policy such as export subsidy (resp. tax) under Cournot (resp. Bertrand) competition changes the outputs and prices, those policies do not change the rankings of free trade equilibrium outputs and prices under Cournot and Bertrand competition modes, implying that quantities are lower and prices higher in Cournot than in Bertrand competition irrespective of the nature of goods.

The second point is that, comparing equilibrium outputs and prices under asymmetric competition with those under Cournot or Bertrand competition, $x_i^C < x_i^P$ and $p_i^P < p_i^C$ hold if optimal trade policy is export subsidy while $x_i^Q < x_i^B$ and $p_i^B < p_i^Q$ hold if optimal trade policy is export tax. The intuition is as follows. The firm receives greater subsidy when it chooses price rather than quantity taking as given the rival's quantity; $s_i^C < s_i^P$, which leads to higher output and lower price, that is, $x_i^C < x_i^P$ and $p_i^P < p_i^C$. A higher export subsidies forces firm to be more aggressive in determining the output level. On the other hand, the firm is levied greater tax when it chooses quantity rather than price taking as given rival's price; $\mid s_i^B \mid < \mid s_i^Q \mid$. This leads to less output and higher price when it chooses quantity in the asymmetric mode compared with choosing price in Bertrand competition mode, that is, $x_i^Q < x_i^B$ and $p_i^B < p_i^Q$.

For the analysis of endogenous choice of contract mode in the next section, we define $\Delta x_i^{P|Q}$ and $\Delta x_i^{P|P}$ as follows:

$$\Delta x_i^{P|Q} (\equiv x_i^P - x_i^C) = \frac{b^4(4-b^2)}{(4+2b-b^2)(16-20b^2+5b^4)} > 0, \tag{26a}$$

$$\Delta x_i^{P|P} (\equiv x_i^B - x_i^Q) = \frac{b^4(4-3b^2)}{(1+b)(4+2b-b^2)(16-20b^2+5b^4)} > 0, \tag{26b}$$

where $\Delta x_i^{P|Q}$ denotes firm i's output change through shifting its strategic variable from quantity to price given that rival firm, firm j, chooses quantity as its strategic variable. Similarly, $\Delta x_i^{P|P}$ shows a change in the output of firm i through shifting its strategic variable from quantity to price given that rival firm chooses price as a strategic variable. Apparently, both $\Delta x_i^{P|Q}$ and $\Delta x_i^{P|P}$ are positive from Lemma 4. Because firms are otherwise identical, it holds that $\Delta x_i^{P|Q} = \Delta x_j^{Q|P}$ and $\Delta x_i^{P|P} = \Delta x_j^{P|P}$.

4 The Choice of Competition Mode in the First Stage

We now discuss the choice at the first stage. Table 1, by regarding firms' payoffs as their profits, summarizes the game in this stage, where both firms have two strategies with regard to their contract mode: quantity (Cournot) and price (Bertrand).

Table 1: The Firms' Choice of Competition Mode

$i \setminus j$	Quantity	Price
Quantity	π_i^C, π_j^C	π_i^Q, π_j^P
Price	π_i^P, π_j^Q	π_i^B, π_j^B

Since firms are symmertic, we can easily see that $\pi_i^C = \pi_j^C, \pi_i^B = \pi_j^B, \pi_i^Q = \pi_j^Q$ and $\pi_i^P = \pi_j^P$. From the table, we have

$$\Delta \pi_i^{P|Q} (\equiv \pi_i^P - \pi_i^C) = (x_i^P + x_i^C)(x_i^P - x_i^C) = (x_i^P + x_i^C)\Delta x_i^{P|Q} > 0, \tag{27a}$$

$$\Delta \pi_i^{P|P} (\equiv \pi_i^B - \pi_i^Q) = (1-b^2)(x_i^B + x_i^Q)(x_i^B - x_i^Q) = (1-b^2)(x_i^B + x_i^Q)\Delta x_i^{P|P} > 0. \tag{27b}$$

where $\Delta \pi_i^{P|Q}$(resp. $\Delta \pi_i^{P|P}$) denotes profit change of firm $i (i = 1, 2)$ through shifting its strategic variable to price from quantity, given that rival firm chooses quantity (resp. price) as its strategic variable. Thus, the signs of both $\Delta \pi_i^{P|Q}$ and $\Delta \pi_i^{P|P}$ are positive from Eqs. (26a) and (26b). From Eqs. (27a) and (27b), the following proposition is immediate.

Proposition 2. *Suppose that a home and a foreign firm both export to a third-country market under either the export subsidy or tax. In this case, choosing a Bertrand strategy is the dominant strategy for both firms irrespective of the nature of the products and thus the Nash equilibrium of firms' choice of competition mode is (price, price), i.e., Bertrand competition.*

Proposition 2 is straightforward from Lemma 4. Suppose that the rival firm (for example, firm j) chooses quantity as a strategic variable. In this case, firm i receives greater subsidy by choosing price variable rather than choosing the quantity as its rival; $s_i^C < s_i^P$, which leads to higher output of firm i compared to the case of choosing the quantity. That is, $x_i^C < x_i^P$. Since profits are positively related to output in equilibrium, this implies that $\pi_i^C < \pi_i^P$. Suppose that, on the contrary, the rival firm j chooses price as a strategic variable. In this case, firm i can pay lower export tax by choosing price variable like its rival rather than by choosing the quantity; $s_i^Q < s_i^B < 0$; leading to higher output of firm i compared to the case of choosing the quantity, i.e., $x_i^Q < x_i^B$. Since profits are positive function of output in equilibrium, $\pi_i^Q < \pi_i^B$ holds. Thus, each firm prefers choosing price variable to choosing quantity variable irrespective of whether goods are substitutes or complements.

In a duopoly setting, Singh and Vives (1984) showed that choosing the quantity (price) is a dominant strategy for each firm if the goods are substitute (complements). We obtain a quite different results from Singh and Vives (1984) when optimal trade policies are introduced by both countries. In our model, where both countries introduce optimal trade policy, choosing a price contract is a dominant strategy for both firms irrespective of whether goods are substitutes or complements. These results indicate that the introduction of trade policy by governments may change the competition mode from Cournot to Bertrand when goods are substitutes, and that Bertrand model should be used more in the strategic trade policy model.

However, here, we should note that the endogenously determined Bertrand competition is not Pareto superior compared to Cournot competition. From Eqs. (9b) and (15b), we get

$$\begin{aligned} &\pi_i^C - \pi_i^B = \frac{b^2}{\Psi}(64 - 96b^2 + 8b^3 + 40b^4b^5 - 5b^6 + b^7) > (<)0 \\ &\Leftrightarrow b \in (-0.9732, 1)[b \in (-1, -0.9732)]. \end{aligned} \tag{28}$$

where $\Psi \equiv (1+b)(4+2b-b^2)^2(4-2b-b^2)^2 > 0$. Above Eq. (28) suggests that if goods are not sufficiently close complement, that is, $b \in (-0.9732, 1)$, then $\pi_i^C > \pi_i^B$ holds. Consequently, from the aspects of both firms, the endogenous determination of contract, Bertrand competition, might be Pareto inferior regardless of the nature of goods. In other words, if $b \in (-0.9732, 1)$, each firm faces prisoner's dilemma situation irrespective of whether goods are substitutes or complements. However, if $b \in (-1, -0.9732)$, then $\pi_i^C < \pi_i^B$, implying endogenously determined Bertrand-type price competition is Pareto superior and prisoner's dilemma does not occur. The following proposition is immediate.

Proposition 3. *Suppose that a home and a foreign firm produce differentiated goods and export to a third-country market under either the export subsidy or tax. (i) In this case, choosing a Bertrand strategy is the dominant strategy for both firms irrespective of the nature of the products and thus the Nash equilibrium of firms' choice of competition mode is (price, price), i.e., Bertrand competition. (ii) If goods are not sufficiently close complement, i.e., $b \in (-0.9732, 1)$, then the prisoner's* *dilemma situation arises. That is, firms i and j are both better off if they choose Cournot competition instead of Bertrand competition. On the other hand, if goods are sufficiently close complement, i.e.,* $b \in (-1, -0.9732)$*, then Bertrand competition is Pareto superior and thus prisoner's dilemma does not occur.*

Next, we consider the welfare effects of contract mode choice. Comparing the equilibrium outcomes under Bertrand competition with that under Cournot-type quantity competition, from Eqs. (9b) and (15b), we get

$$W_i^C - W_i^B = 4(2 - b^2)b^5\Psi^{-1} > (< 0) \text{ iff } b > (<)0, \tag{29}$$

implying that social welfare is larger (resp. smaller) in Cournot competition than in Bertrand competition if goods are substitutes (resp. complements). This is quite straightforward considering that social welfare equals firm's operating profits[7] in the absent of domestic consumption, i.e., $W_i = p_i x_i$. The intuitive explanation is as follows.

Suppose that goods are independent, i.e., $b = 0$. In this case, each firm has a monopoly position in its product market and thus no interaction occur between firms. And the pursuit of private profits by the monopolist coincides with welfare maximization, implying that optimal trade policy is free trade. In a monopoly position, profit maximizing prices are the same whether it is determined in terms of price or quantity; $p_i^C = p_i^B$, implying $W_i^C = W_i^B$.

Now suppose that goods are not independent. We confirmed from Eq. (25) that $p_i^B < p_i^C$ holds irrespective of the nature of goods. For firms, if goods are substitutes (i.e., $b > 0$) low prices mean low profitability, and Cournot profits are larger than Bertrand profits, implying that $W_i^B < W_i^C$. However, if goods are complements (i.e., $b < 0$), the story differs. Since lower prices extend the market size, firm's operating profits could be larger under Bertrand competition than under Cournot competition, implying that $W_i^B > W_i^C$

Combining Eq. (29) and Proposition 3 provides following Table 2, which summarizes the relationship among the nature of goods, endogenously determined competition mode, firms' profits and social welfare.

Table 2: The relationship among good's nature, competition mode, profits and welfare

Nature of goods	Endogenous competition mode	Optimal trade policy	Firms' profits	Social welfare
$b \in (0, 1)$ substitutes	Bertrand	Export subsidy	$\pi_i^B < \pi_i^C$ Prisoner's dilemma	$W_i^B < W_i^C$
$b \in (-0.9732, 0)$ complements	Bertrand	Export tax	$\pi_i^B < \pi_i^C$ Prisoner's dilemma	$W_i^B > W_i^C$
$b \in (-1, -0.9732)$ highly complements	Bertrand	Export tax	$\pi_i^B > \pi_i^C$ No Prisoner's dilemma	$W_i^B > W_i^C$

[7]In usual, operating profits means sales revenue net of production costs. However, in our model, since marginal production costs are assumed to be zero, firm's operating costs equal its revenue.

5 The Effects of Free Trade

Now, let us turn to the case where both country i and country j do not use any trade policies, that is, $s_i = s_j = 0$. For example, this is the case where all the three countries form a free trade agreement. In this case, the second stage of choosing optimal trade policy is ruled out from the original model, and thus the game is transformed into two-stage game. In the first stage each firm simultaneously decide whether to compete in terms of price or in terms of quantity and, in the final stage, depending on the mode of competition chosen in the first stage, firms engage in product market competition to maximize its profits. Basically, except for social welfare, this model coincides with Singh and Vives (1984), where social welfare consists of consumer surplus as well as producer surplus.

Substituting $s_i = s_j = 0$ into Eqs. (4), (5), and (6) for Cournot competition, Eqs. (10), (11), and (12) for Bertrand competition, and Eqs. (16), (17), (18), and (19) for asymmetric competition, we obtain the free trade equilibrium outcomes under each competition mode. Table 3 below provides the market equilibriums under each competition mode. The free trade equilibriums are distinguished by "$\wedge$".

Table 3: Equilibrium Values under Free Trade($s_i = s_j = 0$)

Cournot	Bertrand	Asymmetric Competition
$\hat{x}_i^C = \hat{p}_i^C = \frac{1}{2+b}$	$\hat{x}_i^B = \frac{1-b}{2-b}, \quad \hat{p}_i^B = \frac{1}{(1+b)(2-b)}$	$\hat{x}_i^Q = \frac{2-b}{4-3b^2}, \quad \hat{x}_j^P = \frac{(1-b)(2+b)}{4-3b^2}$ $\hat{p}_i^Q = \frac{(2-b)(1-b^2)}{4-3b^2}, \quad \hat{p}_j^P = \frac{(1-b)(2+b)}{4-3b^2}$
$\hat{\pi}_i^C = \hat{W}_i^C$ $= (\hat{x}_i^C)^2 = \frac{1}{(2+b)^2}$	$\hat{\pi}_i^B = \hat{W}_i^B = (1-b^2)(\hat{x}_i^B)^2$ $= \frac{1-b}{(1+b)(2-b)^2}$	$\hat{\pi}_i^Q = \hat{W}_i^Q = (1-b^2)(\hat{x}_i^Q)^2 = \frac{(1-b^2)(2-b)^2}{(4-3b^2)^2}$ $\hat{\pi}_j^P = \hat{W}_j^P = (\hat{x}_j^P)^2 = \frac{(1-b)^2(2+b)^2}{(4-3b^2)^2}$

We can easily confirm the well-known Singh and Vives (1984)'s rankings of equilibrium outcomes under different competition modes. From the free trade equilibrium, we obtain the following lemma.

Lemma 5. *Suppose that the economies are in free trade ($s_i = s_j = 0$). It follows from the Table 3 that $\hat{\pi}_i^P < \hat{\pi}_i^B < \hat{\pi}_i^Q < \hat{\pi}_i^C$ and $\hat{W}_i^P < \hat{W}_i^B < \hat{W}_i^Q < \hat{W}_i^C$ hold if goods are substitutes ($b > 0$), while $\hat{\pi}_i^Q < \hat{\pi}_i^C < \hat{\pi}_i^P < \hat{\pi}_i^B$ and $\hat{W}_i^Q < \hat{W}_i^C < \hat{W}_i^P < \hat{W}_i^B$ hold if goods are complements ($b < 0$). In addition, in the two-stage game it is a dominant strategy for firm i to choose the quantity (price) contract if the goods are substitutes (complements).*

Lemma 5 implies that, in a free trade situation, Cournot competition is a dominant strategy for Nash equilibrium if goods are substitutes, while Bertrand competition is that if goods are complements. We confirmed in Proposition 2 that, in the presence of optimal trade policies by governments, firms choose Bertrand competition in both substitutable and complementary good market. Considering above arguments, the trade liberalization among countries might bring about the shift in the competition mode between firms depending on the nature of goods. Following proposition is immediate.

Proposition 4. *Trade liberalization such as via free trade agreements brings about a change in the competition mode from Bertrand competition to Cournot competition if goods are substitutes. However, if goods are complements, there are no such a change in the competition mode and thus Bertrand-type* *price competition prevails the market.*

Proposition 4 implies that trade liberalization among countries may cause a shift in the competition mode from Bertrand-type to Cournot-type competition especially when goods are substitutes and that Bertrand model should be used more in the analysis of strategic trade policy when goods are differentiated.

Next, let us look at the welfare effects of trade liberalization. Comparing the equilibrium outcomes in the presence of optimal trade policies with that under free trade, we obtain the following Proposition.

Proposition 5. *A move toward free trade among countries increases not only profits of firms but also the welfare of both countries irrespective of the nature of goods. That is,*

$$\hat{\pi}_i^C > \pi_i^B \text{ and } \hat{W}_i^C > W_i^B \text{ if } b > 0,$$
$$\hat{\pi}_i^B > \pi_i^B \text{ and } \hat{W}_i^B > W_i^B \text{ if } b < 0.$$

Proof: It follows from Eq. (15b) and Table 3 that

$$\hat{\pi}_i^C - \pi_i^B = \frac{b^2(8+4b-11b^2-3b^3+3b^4+b^5)}{(1+b)(2+b)^2(4-2b-b^2)^2}, \quad \hat{W}_i^C - W_i^B = \frac{(4-b-b^2)^2}{(1+b)(2+b)^2(4-2b-b^2)^2},$$

which are positive if $b \in (0,1)$. In addition, from the same equation and table, we obtain that

$$\hat{\pi}_i^B - \pi_i^B = \frac{(1-b)(8-4b-3b^2+b^3)b^2}{(2-b)^2(4-2b-b^2)^2}, \quad \hat{W}_i^B - W_i^B = \frac{-(1-b)(4-3b)b^3}{(1+b)(2-b)^2(4-2b-b^2)^2}.$$

which are positive if $b \in (-1,0)$. Q.E.D.

Proposition 5 can be explained as follows. Suppose that goods are complements. In this case, the contract mode does not change as trade liberalization progresses and thus Bertrand competition prevails markets. Moreover, when government intervention is allowed, Nash equilibrium in a trade policy game is export tax in Bertrand competition. Since trade liberalization (removal of export tax) increases firms' output, the firms' equilibrium profits, which is a positive function of output in equilibrium, also increases due to the trade liberalization (i.e., $\hat{\pi}_i^B > \pi_i^B$). In usual, trade policy game involves a prisoner's dilemma. In a non-cooperative game in which governments move simultaneously, the dominant strategy in a Bertrand competition for each government is to impose a tax on its exports. Consequently, at the Nash equilibrium, both countries use strategic trade policy by imposing an export tax. However, both countries would be better off if they could cooperate so as to achieve the free trade regime, i.e., $\hat{W}_i^B > W_i^B$.

Next, suppose that goods are substitutes. In this case, the contract mode shifts from Bertrand to Cournot competition as trade liberalization progresses. We have already found that $\hat{\pi}_i^B > \pi_i^B$ holds irrespective of the nature of goods. In addition, according to Singh and Vives (1984)'s rankings on equilibrium profits under Cournot and Bertrand regime, $\hat{\pi}_i^B < \hat{\pi}_i^C$ holds if goods are substitutes (Lemma 5). Considering these two inequalities, we find that firms' equilibrium profits increase by the regime shift from Bertrand to Cournot competition due to the trade liberalization, i.e., $\hat{\pi}_i^C > \pi_i^B$.

As to welfare change due to the regime shift of competition mode, we have already found from Eq. (29) that, if goods are substitutes, then the welfare in Cournot competition is greater than that in Bertrand, i.e., $W_i^B < W_i^C$. Trade policy game in terms of export subsidy also involves a prisoner's dilemma. The dominant strategy for each government in a Cournot competition is to subsidize its exports, implying that at the Nash equilibrium both countries use export subsidy as a strategic trade policy. However, both countries would be better off if they could cooperate so as to achieve the free trade regime, i.e., $W_i^C < \hat{W}_i^C$. Considering these two inequalities, we find that if the goods are substitutes, countries' welfare increase by the regime shift from Bertrand to Cournot competition due to the trade liberalization, i.e., $W_i^B < \hat{W}_i^C$.

6 Concluding Remarks

Incorporating the third-market model into strategic export policy, we have demonstrated the endogenous choice of strategic variables for prices or quantities. Unlike the industrial organization context, we have suggested that choosing Bertrand competition is the dominant strategy for both firms regardless of the nature of goods, which faces a prisoners' dilemma where both countries are worse off in Bertrand competition in subsidy regime than under Cournot competition (except for the case where goods are highly complement). However, from the perspective of the government, Cournot competition is more efficient than Bertrand competition when the goods are substitutes, and vice versa when the goods are complements. These results may provide economic implications that from the aspects of firms, the equilibrium could be Pareto superior (inferior) with government's intervention of subsidy policy when the goods are substitutes (complements). Moreover, we find that trade liberalization such as via free trade agreements brings about a change in the competition mode from Bertrand competition to Cournot competition if goods are substitutes. However, if goods are complements, there are no such a change in the competition mode and thus Bertrand competition prevails the market. Hence, even though a home firm and a foreign firm choose to strategically set prices or quantities in a third market, a move toward free trade among countries increases not only profits of firms but also the welfare of both countries irrespective of the nature of goods.

We conclude by discussing the limitations of our paper. We have used the simplifying assumption that one home and one foreign firm are symmetric. By making this assumption, we do not take into account any cost or demand difference that may arise from the subsidy regime that occurs between one home firm and one foreign firm. Moreover, in this paper, it is assumed that symmetric subsidies or taxes occur in equilibrium. However, there can be existed in the international trade that the optimal domestic response to a foreign export subsidy is to retaliate with (partial) countervailing duties. If countervailing duties and import tariffs are set in different ways and for different purposes, we need to re-examine the relationship between countervailing duties, foreign export subsidies and import tariffs under imperfect competition (e.g. Collie, 1991; Wang, 2004). Finally, we did not extend our results by considering nonlinear demand structures. The extension of our model in these directions is left for future research.

References

[1] Bagwell, K. and R. W. Staiger, 1994, "The Sensitivity of Strategic and Corrective R&D Policy in Oligopolistic Industries," *Journal of International Economics* 36,133-150.

[2] Bandyopadhyay, S., 1997,"Demand Elasticities, Asymmetry and Strategic Trade Policy," *Journal of International Economics* 42, 167-177.

[3] Blonigen, B. A. and Y. Ohno, 1998, "Endogenous Protection, Foreign Direct Investment and Protection-building Trade," *Journal of International Economics* 46, 205-227.

[4] Brainard, L. and D. Martimort, 1997, "Strategic Trade Policy with Incompletely Informed Policymakers," *Journal of International Economics* 42, 33-65.

[5] Brander, J. A., 1995, "Strategic Trade Policy," in G. Grossman and K. Rogoff, eds. *The Handbook of International Economics* Vol. 3, North-Holland, pp. 1395-1455.

[6] Brander, J. A. and B. J. Spencer, 1987, 'Foreign Direct Investment with Unemployment and Endogenous Taxes and Tariffs," *Journal of International Economics* 22, 257-279.

[7] Brander, J. A. and B. J. Spencer, 1985, "Export Subsidies and International Market Share Rivalry," *Journal of International Economics* 18, 83-100.

[8] Cheng, L. K., 1988, "Assisting Domestic Industries under International Oligopoly: The Relevance of the Nature of Competition to Optimal Policies," *American Economic Review* 78, 746-758.

[9] Clarke, R. and D. Collie, 2008, "Welfare in the Nash Equilibrium in Export Taxes under Bertrand Duopoly," *Bulletin of Economic Research* 60, 183-189.

[10] Clarke, R. and D. Collie, 2006, "Export Taxes under Bertrand Duopoly," *Economics Bulletin* 6, 1-8.

[11] Clarke, R. and D. Collie, 2003, "Product Differentiation and the Gains from Trade under Bertrand Duopoly," *Canadian Journal of Economics* 36, 658-673.

[12] Collie, D., 1991, "Export Subsidies and Countervailing Tariffs," *Journal of International Economics* 31, 309-324.

[13] Collie, D. and D. de Meza, 2003, "Comparative Advantage and the Pursuit of Strategic Trade Policy," *Economics Letters* 81, 279-283.

[14] Cooper, R. and R. Riezman, 1989, "Uncertainty and the Choice of Trade Policy in Oligopolistic Industries," *Review of Economic Studies* 56, 129-140.

[15] Dastidar, K. G., 1997, "Comparing Cournot and Bertrand in a Homogenous Product Market," *Journal of Economic Theory* 75, 205-212.

[16] de Meza, D., 1986, "Export Subsidies and High Productivity: Cause or Effect?," *Canadian Journal of Economics* 19, 347-350.

[17] Dixit, A. K. and A. S. Kyle, 1985, "The Use of Protection and Subsidies for Entry Promotion and Deterrence," *American Economic Review* 75, 139-152.

[18] Eaton, J. and G. M. Grossman, 1986,"Optimal Trade and Industrial Policy under Oligopoly," *Quarterly Journal of Economics* 101, 383-406.

[19] Ghosh. A. and R. Pal. 2014, "Strategic Trade Policy for Network Goods Oligopolies," Indira Gandhi Institute of Development Research, WP-2014-039.

[20] Hackner, J., 2000, "A Note on Price and Quantity Competition in Differentiated Oligopolies," *Journal of Economic Theory* 93, 233-239.

[21] Horstmann, I. J. and J. R. Markusen, 1986, "Up the Average Cost Curve: Inefficient Entry and the New Protectionism," *Journal of International Economics* 20, 225-247.

[22] Hwang, H. and C. Mai, 2007, "Optimal Technology Subsidies vs Export Subsidies: A Strategic Approach," *Asia-Pacific Journal of Accounting and Economics* 14, 111-126.

[23] Kikuchi, T., 1998, "Strategic Export Policy in a Differentiated Duopoly: A Note," *Open Economies Review* 9, 315-325.

[24] Konishi, H., K. Saggi and S. Weber, 1999, "Endogenous Trade Policy under Foreign Direct Investment," *Journal of International Economics* 49, 289-308.

[25] Lambertini, L., 1997, "Prisoners' Dilemma in Duopoly (Super) Games,"*Journal of Economic Theory* 77; 181-191.

[26] Maggi. G., 1996, "Strategic Trade Policies with Endogenous Mode of Competition," *American Economic Review* 86, 237-258.

[27] Neary, J. P. and D. Leahy, 2000, "Strategic Trade and Industrial Policy towards Dynamic Oligopolies," *Economic Journal* 110, 484-508.

[28] Qiu, L. D., 1997, "On the Dynamic Efficiency of Bertrand and Cournot Equilibria," *Journal of Economic Theory* 75, 213-229.

[29] Schroeder. E. and V. J. Tremblay, 2014, "A Reappraisal of Strategic Trade Policy," mimeo, Oregon State University.

[30] Singh N. and Vives, X. 1984, "Price and Quantity Competition in a Differentiated Duopoly," *Rand Journal of Economics* 15, 546-554.

[31] Wang, Y. T., 2004, "Countervailing Duties, Foreign Export Subsidies and Import Tariffs," *Japanese Economic Review* 55, 153-161.

[32] Zanchettin, P., 2006, "Differentiated Duopoly with Asymmetric Costs," *Journal of Economics* & *Management Strategy* 15, 999-1015.