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Export cartel and consumer welfare*

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Abstract: The purpose of this paper is to show that export cartels are not necessarily harmful for consumers in the importing countries. Using the strategic trade policy model of Brander and Spencer (1985a), we show that, contrary to the harmful effect, product-market cooperation benefits consumers by affecting the trade policies. We further show that consumers in the importing countries are affected adversely if cooperation is among the governments of the exporting countries, instead of the exporting firms.

Key Words: Consumer surplus; Cooperation; Export cartel; Strategic trade policy

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Export cartel and consumer welfare

1. Introduction

During 1990s, both the USA and the European Union successfully prosecuted more than forty international export cartels (Levenstein et al., 2004). International export cartel is a serious concern for many developing countries. Many countries provide exemptions to export cartels either explicitly or implicitly.[1] The prosecutions of such export cartels are rather limited due to the lack of international coordination between antitrust agencies. In this context, various scholars have expressed concerns about the impact of such international cartels on the importing countries.

More generally, cooperation among the competing firms raises serious scepticism among economists, policy makers and legal experts. For instance, it is believed that, in the absence of significant synergic benefits, the firms' gains from cooperation come at the expense of the consumers (Farrell and Shapiro, 1990), and create concerns for the antitrust authorities. However, this view generally ignores non-production activities of the firms such as innovation (Jacquemin and Slade, 1989). The Schumpeterian view suggests that cooperation among the competing firms may benefit the consumers by creating positive effects on innovation (Schumpeter, 1943). However, there are also concerns about the adverse effects of firms' cooperation on innovation (Arrow, 1962). More recent concern about the adverse effects of firms' cooperation on innovation can be found in Gilbert and Sunshine (1995), Gilbert and Tom (2001) and Gilbert (2006a).[2]

[1] See Levenstein and Suslow (2005 and 2007).

[2] The DOJ/FTC annual reports to Congress show that between 1990 and 1994, the agencies allege adverse innovation effects in about 3% of the merger challenges, while from 1995 to 1999, the concern about the adverse innovation effects has risen to 18% of the merger challenges, and between 2000 to 2003, the concern has increased to 38% of the merger challenges (Gilbert, 2006b).

While there is controversy about the beneficial effects of product-market cooperation on innovation, recent works show that there exist other channels through which product-market cooperation create positive effects on the consumers. Symeonidis (2008) and Mukherjee (2010) show that product-market cooperation may benefit the consumers in the presence of input market imperfection. While the focus of Symeonidis (2008) was on firm-specific input suppliers, Mukherjee (2010) considered the situation where all firms need to buy some critical inputs, such as labour, from an industry-wide input supplier.

In this paper, we show a new beneficial effect of product-market cooperation on the consumers. We show that even if the firms are not engaged in innovation and there is no input market imperfection, product-market cooperation among the firms may make the consumers better off in the presence of strategic trade policies. Hence, we show that export cartel may create positive effects on the consumers in the importing country.

Using the strategic trade policy model of Brander and Spencer (1985a) with two exporting countries and an importing country, we examine whether cooperation among the exporters is necessarily bad for the consumers in the importing country. We show that consumers in the importing country may be better off under higher product-market cooperation among the foreign exporters in the presence of strategic trade policies of the exporting countries. On the one hand, higher product-market cooperation tends to reduce consumer surplus by increasing product-market concentration. On the other hand, higher product-market cooperation tends to increase consumer surplus by increasing export subsidies. We show that the latter effect can dominate the former effect to create a favourable impact on the consumers following higher product-market cooperation. Hence, cooperation among the exporters or

international export cartel is not necessarily bad for the importing countries in the presence of strategic trade policies.

We also investigate the effect of cooperation among the governments of the exporting countries on the consumers. We show that the consumers in the importing country can be worse off if the cooperation is between the governments of the exporting countries. Hence, the favourable effect of higher product-market cooperation on the consumers reduces with higher cooperation among the governments of the exporting countries. We show that our results hold under different types of product-market competition, viz., quantity and price competition.

Increased cooperation among the exporting countries makes the consumers in the importing country worse off since it reduces each country's incentive for stealing business from the firm of the other country, and increases the incentive for restricting outputs towards the collusive level. This motivation induces the countries to increase the export tax as the degree of cooperation among the countries increases, which, in turn, restricts the total outputs of the firms and makes the consumers in the importing country worse off.

Our paper can be related to some other recent papers looking at the implications of export cartels. In a different context with cross hauling trade, Deltas et al. (2012) also established the consumer welfare enhancing collusion but for entirely different reason. The advantage of collusion in their analysis stems from the "home market principle", which gives the cartel members preference for supplying their home markets.[3] Bhattacharjea (2004) and Levenstein et al. (2004) respectively discussed the significance of international export cartel for the developing countries

[3] See also Motta (2004) and Harrington (2006) for the "home market principle".

and for the export cartel among the firms from the same country. However, neither of these papers addressed the questions raised in this paper.

The remainder of the paper is organised as follows. Section 2 describes the model and shows the results under quantity competition. Section 3 extends the analysis in several directions including price competition. Section 4 concludes. We show our results with a general demand function in the *Appendix*.

2. Quantity competition

We consider a model similar to Brander and Spencer (1985a). Assume that there are two foreign countries, country 1 and country 2. Each country has one firm. Call the firms in countries 1 and 2 as firm 1 and firm 2 respectively. Assume that the firms sell their products in another country, called domestic country. The inverse market demand function in the domestic country is $P = 1 - q$. We will show in the *Appendix* that our results will hold for a general demand function. We normalise the marginal costs of production of both firms to zero, for simplicity. Assume that the foreign countries are engaged in strategic trade policies and provide subsidies (taxes, if the variable is negative) to their own firms.

We consider the following game. At stage 1, countries 1 and 2 simultaneously determine the per-unit export subsidies/taxes given to respective firms. At stage 2, both firms choose their outputs simultaneously, and the profits are realised. We solve the game through backward induction.[4]

[4] A natural reaction in the context of export subsidy used by foreign governments is some countervailing duty or import tariff used by the importing country. In the presence of import tariff, it is easy to see that the welfare of the importing country would improve further which would reinforce our results derived in this paper. To clearly focus on the interaction of strategic trade policy and welfare of the importing country, we keep the import tariff out of our analysis (i.e., kept at zero). For some analysis of import tariff in the context of export subsidy used by exporting countries, see, Collie (1994) and Qiu (1995).

Given the export subsidies s_1 and s_2 provided by countries 1 and 2 to firms 1 and 2 respectively, firms 1 and 2 maximise the following expressions respectively to determine their outputs

$$\underset{q_1}{Max}(1-q+s_1)q_1+\alpha(1-q+s_2)q_2 \tag{1}$$

$$\underset{q_2}{Max}(1-q+s_2)q_2+\alpha(1-q+s_1)q_1. \tag{2}$$

The term $\alpha \in [0,1]$ is the "coefficient of cooperation", as introduced by Cyert and deGroot (1973), and later used by others such as Symeonidis (2000 and 2008), Mukherjee (2010) and Escrihuela-Villar (2012). It captures firm's behaviour towards cooperation in the product market. If $\alpha = 0$, the maximisation problem reduces to the standard non-cooperative Cournot maximisation problem, while $\alpha = 1$ implies that the firms are interested in joint profit maximisation. The intermediate values of α show imperfect or partial cooperation among the firms.

Like Cyert and deGroot (1973), Symeonidis (2000 and 2008) and Mukherjee (2010), we believe that the use of α is the easiest way to capture firm's cooperative behaviour. It can be justified by referring to some implicit dynamic models of collusion, where the reduced-form representation of the dynamic game represents the product-market competition subgame of our paper. As mentioned in Symeonidis (2000 and 2008), what justifies the use of α as a reduced-form competition parameter is its properties in the final-stage subgame; ceteris paribus, the equilibrium price, price-cost margin, and profit in the final goods market increases and the equilibrium outputs fall as α increases (i.e., cooperation increases or competition falls).

It is well-known from the "folk theorem" that if the discount factors are very high (i.e., the economic agents are sufficiently patient), any combination of outcomes can be sustained as the collusive outcome, thus creating the problems of multiplicity

of equilibria. However, attention has been paid to find the unique collusive outcome. For example, in the case of symmetric oligopoly models, symmetric and Pareto optimal equilibrium is often considered as the 'focal point' (Kreps, 1990 and Chang, 1991). Hence, if the discount factor in the implicit dynamic models of collusion is very high, $\alpha = 1$ is a reasonable parameter for our analysis. And a fall in α from 1 corresponds to the case of a lower discount factor, creating partial cooperation (see, e.g., Chang, 1991 and Escrihuela-Villar, 2008 and 2012, for partial collusion).

There are more satisfactory theories to resolve the problem of multiplicity of equilibria. A way to find the critical discount factor is the "balanced temptation" criterion suggested by Friedman (1971). According to this criterion, the cartel adjusts the output quotas of the firms so that all firms have the same incentive to defect from the cartel. Bae (1987), which assumed that the prices are determined to maximise joint profits, considered the "balanced temptation" equilibrium with the Pareto optimality condition restricted to the set of sustainable cartels for asymmetric duopoly, and found the "best sustainable equilibrium". Harrington (1991) finds the unique collusive outcome by considering Nash bargaining solution from the set of sustainable equilibria which helps to overcome the weaknesses in the selection criterion of Bae (1987). Using a duopoly with heterogeneous firms, Verboven (1997) shows that the equilibrium at which both firms are just indifferent between colluding and defecting is the enforceable collusive agreement that is likely to prevail. For some other papers considering dynamic models of collusion, one may refer to Collie (1993), Rothschild (1999), Collie (2004) and Escrihuela-Villar (2012) for collusion among asymmetric cost firms, and Chang (1991), Escrihuela-Villar (2008 and 2012) for partial collusion. Appealing to this literature, we consider that the parameter α is the

reduced-form representation of an implicit dynamic collusive game following government policies that generates a unique collusive outcome among the firms.

The parameter α may have an alternative interpretation. It can capture the situations with different "conjectural variations", incorporating a wide range of competition. Brander and Spencer (1985b), which use a conjectural variation model to show the relationship between free entry and partial collusion in a convenient structure, mention that "the value of the conjectural variation, which is associated with a particular price and industry output given the number of firms, is interpreted as a proxy for or a representation of the level of tacit (or explicit) collusion in the industry. Alternatively, even with tacit collusion, the conjectural variation, λ [their notation], may be the literal expectation held by firms. If λ exceeds 1, each firm expects to be punished if it raises output, in the sense that the rest of the industry will also raise output. Tacit partial collusion can be maintained if such expectations are held." In our analysis, the parameter α captures the collusive behaviour among the firms that had been captured by the conjectural variation parameter, λ, in Brander and Spencer (1985b). Hwang (1984) and Chang and Sugeta (2004) analyse respectively the welfare effects of intra-industry trade and the optimal trade policy in a vertical structure in a unified model of different competition captured by conjectural variations.

Although the use of the conjectural variation parameter to reflect collusion is useful, we acknowledge that it is a simple static representation of a complex dynamic analysis. However, Kalai and Stanford (1983) show that a family of constant conjectural variations can be maintained as stable and credible equilibria of an infinitely repeated game. Friedman and Mezzetti (2002) consider a dynamic model with bounded rationality to provide a logically consistent interpretation of conjectural

variation. In a symmetric quantity-setting oligopoly, Escrihuela-Villar (2015) shows that the solutions generated from conjectural variations model and from a model with "coefficient of cooperation" are equivalent.

Since the purpose of our paper is to show the effects of cooperation, we consider α as an exogenous parameter, although we show the implications of endogenous cooperation in subsection 3.1. The exogeneity of α may be justified if significant changes in the intensity of competition is the outcome of exogenous institutional changes such as the introduction of effective cartel policy (Symeonidis, 2000 and 2008).

We assume that there are no side payments between the firms, and each firm chooses the product-market variable (i.e., output or price depending on the quantity or price competition respectively) to maximise the objective functions (1) and (2).[5] When the costs are asymmetric due to different levels of subsidies, in the absence of side payments, only some range of cooperation parameter α is sustainable. The more symmetric are the subsidies, the larger is the range of α that is sustainable. The case of $\alpha = 1$ is sustainable under the symmetric case. Since the firms and the governments are symmetric, we focus on the symmetric equilibrium for $\alpha = 1$.

The equilibrium outputs of firms 1 and 2 can be found respectively as

$$q_1^* = \frac{1-\alpha+2s_1-s_2(1+\alpha)}{(1-\alpha)(3+\alpha)} \quad \text{and} \quad q_2^* = \frac{1-\alpha+2s_2-s_1(1+\alpha)}{(1-\alpha)(3+\alpha)}. \tag{3}$$

We assume that the subsidies/taxes are such that the outputs shown in (3) are positive for $\alpha < 1$. We will see that this is true with the equilibrium subsidies/taxes. Since the firms and the governments are symmetric, we focus on the symmetric equilibrium for

[5] See, e,g., Bain (1948) and Harrington (1991) for objections towards side payments.

$\alpha = 1$, implying that, in the absence of side payments, the equilibrium outputs with symmetric subsidies/taxes (i.e., $s_1^* = s_2^* = s^*$) will be $q_1^* = q_2^* = q^* = \frac{1+s^*}{4}$ for $\alpha = 1$.

The total output is

$$q^* = \frac{2 + s_1 + s_2}{(3+\alpha)}. \tag{4}$$

The price of the product is $p = \frac{(1+\alpha - s_1 - s_2)}{(3+\alpha)}$.

It is immediate from (4) that, for given s_1 and s_2, the total output will reduce with higher α. However, if the countries choose their trade policies strategically, α will affect s_1 and s_2, and, as we will see, it will have significant impact on the outputs.

The profits of firms 1 and 2 are respectively

$$\pi_1 = (p + s_1)q_1 = \frac{(1+\alpha+2s_1+\alpha s_1 - s_2)(1-\alpha+2s_1 - s_2(1+\alpha))}{(1-\alpha)(3+\alpha)^2} \tag{5}$$

$$\pi_2 = (p + s_2)q_2 = \frac{(1+\alpha+2s_2+\alpha s_2 - s_1)(1-\alpha+2s_2 - s_1(1+\alpha))}{(1-\alpha)(3+\alpha)^2}. \tag{6}$$

Note that welfare of an exporting country is given by "the profit of that country's firm minus the subsidy amount". Hence, welfare of countries 1 and 2 can be obtained, respectively, as

$$W_1 \equiv \pi_1 - s_1 q_1 = pq_1 = \frac{(1+\alpha - s_1 - s_2)(1-\alpha+2s_1 - s_2(1+\alpha))}{(1-\alpha)(3+\alpha)^2}$$

$$W_2 \equiv \pi_2 - s_2 q_2 = pq_2 = \frac{(1+\alpha - s_1 - s_2)(1-\alpha+2s_2 - s_1(1+\alpha))}{(1-\alpha)(3+\alpha)^2}.$$

The exporting countries may also cooperate and the *i*th exporting country, $i = 1,2$, determines subsidy to maximise its own welfare plus welfare of the *j*th country, $j = 1,2$ and $i \neq j$, weighted by $\delta \in [0,1]$, i.e., determining s_i to maximise

$W_i + \delta W_j$. If $\delta = 1$, it represents full cooperation among the governments, while $\delta = 0$ means that countries maximize their own welfare non-cooperatively. If $\delta \in (0,1)$, it represents imperfect cooperation among the governments. Lie firms, the easy way to show the implications of cooperation among the countries is to compare $\delta = 0$ to $\delta = 1$. Like the parameter α, the intermediate values of $\delta \in (0,1)$ can be justified by appealing to an implicit dynamic game of collusion or conjectural variations among the governments. Like α, we consider δ as an exogenous parameter, although we show the implications of endogenous δ in subsection 3.1. The exogeneity of δ can be justified due to exogenous institutional changes such as economic integration. Like the firms, we do not consider side payments among the governments.

Country 1 determines its subsidy to maximise $W_1 + \delta W_2$, or

$$\underset{s_1}{Max} \frac{[1+\alpha-s_1-s_2][(1-\alpha+2s_1-s_2(1+\alpha))+\delta(1-\alpha+2s_2-s_1(1+\alpha))]}{(1-\alpha)(3+\alpha)^2}. \qquad (7)$$

Similarly country 2 determines its subsidy to maximise $W_2 + \delta W_1$, or

$$\underset{s_2}{Max} \frac{[1+\alpha-s_2-s_1][(1-\alpha+2s_2-s_1(1+\alpha))+\delta(1-\alpha+2s_1-s_2(1+\alpha))]}{(1-\alpha)(3+\alpha)^2}. \qquad (8)$$

The equilibrium export subsidies can be found as

$$s_1^* = s_2^* = \frac{-1-3\alpha+\delta(2+\alpha+\alpha^2)}{-5+\alpha+\delta(1+3\alpha)}. \qquad (10)$$

We get that $s_1^* = s_2^* = \frac{1+3\alpha}{5-\alpha}$ for $\delta = 0$ and $s_1^* = s_2^* = \frac{-1+\alpha}{4}$ for $\delta = 1$. Further, $s_1^* = s_2^* = \frac{-1+2\delta}{-5+\delta}$ for $\alpha = 0$ and $s_1^* = s_2^* = 1$ for $\alpha = 1$. We also get that $s_1^* = s_2^* = \frac{(1+\alpha)^2}{5+3\alpha}$ for $\delta = \alpha$.

There are some interesting observations which are in order. First, if $\alpha = 0$, i.e., under non-cooperation among the firms, the countries set subsidies for $\delta < \frac{1}{2}$ and the subsidy falls with respect to δ. However, the countries impose tax for $\delta > \frac{1}{2}$ and the tax increases with δ. The reason for this is as follows. As discussed in Brander and Spencer (1985a), the "business stealing motive" is the rationale for providing export subsidies. However, this motive disappears for higher degree of cooperation among the exporting countries; instead the collusive behaviour becomes more important for higher degree of cooperation among the exporting countries. Hence, the exporting countries impose export tax to create more collusive product-market outcome if the degree of cooperation among the exporting countries is high.

Second, if $\delta = 0$, i.e., under no cooperation among the governments of the exporting countries, the subsidy level goes up with α. This happens since higher cooperation among the exporting firms increases the marginal benefit from export subsidies. Hence, the export subsidies increase with higher degree of cooperation among the exporting firms.

Using the equilibrium subsidies, we get the total output as

$$q^* = \frac{2(-2+\delta+\alpha\delta)}{(-5+\alpha+\delta+3\alpha\delta)}. \qquad (11)$$

Since consumer surplus in the importing country is given by $\frac{q^{*2}}{2}$, it is enough for us to see the effects of product-market cooperation on the total exports to determine the effect of cooperation on the consumers in the importing country.

If $\delta = 0$, we get from (11) that $q^* = \frac{4}{(5-\alpha)}$, suggesting that if α increases, the total output sold in the importing country increases, thus making the consumers in

the importing country better off. Higher α creates two effects. On the one hand, as shown in (4), given the subsidies, higher product-market cooperation reduces total output. On the other hand, it follows from (10) that if $\delta = 0$, higher product-market cooperation increases subsidies. It follows from (11) that the latter effect dominates the former effect, and higher product-market cooperation increases total output and makes the consumers in the importing country better off.

It is interesting to note that the effect of cooperation among the governments of the exporting countries may have an opposite effect on the consumers compared to the situation where cooperation is among the firms. It follows from (11) that if $\alpha = 0$, we get $q^* = \frac{(-4+2\delta)}{(-5+\delta)}$. In this situation, higher cooperation among the governments of the exporting countries reduces subsidies and the total output, thus making the consumers in the importing country worse off.

We summarise the above discussion in the following proposition.

Proposition 1: (a) *If the exporting countries do not cooperate to set the trade policies, higher cooperation among the exporting firms (i.e., higher α) increases export subsidies and total exports, leading to higher consumer surplus in the importing country.*

(b) If the exporting firms do not cooperate, as the degree of cooperation among the government of the exporting countries increases (i.e., δ increases), it decreases export subsidies and total exports, leading to a fall in consumer surplus in the importing country.

As indicated in the introduction, the reason for Proposition 1(a) is as follows. Increased product-market cooperation tends to reduce consumer surplus by increasing

product-market concentration, but it also tends to increase consumer surplus by increasing export subsidies. We show that the latter effect can dominate the former effect to create a favourable impact on the consumers in the importing country.

As indicated in the introduction, the reason for Proposition 1(b) is as follows. As the degree of cooperation among the exporting countries increases, the incentive for "business stealing" reduces and the incentive for restricting outputs towards the collusive level increases. This motivation induces the countries to increase the export tax as the degree of cooperation among the countries increases. However, higher tax rates following higher cooperation among the governments of the exporting countries restrict the total outputs of the firms and make the consumers in the importing country worse off.

The above analysis shows that cooperation among the exporting firms and cooperation among the exporting governments have significantly different impacts on the consumers (and therefore, on welfare) of the importing country. It is immediate that if both the governments as well as firms cooperate, the effects on consumers will depend on the degrees of cooperation among the government and the firms. As a special case, one can easily see the implications of $\alpha = \delta$ from our analysis. To avoid repetition, we do not go into the details of this case.

We have considered a linear demand function for the above analysis. However, we show in the *Appendix* that our results hold for a general demand function.

3. Extensions

In this section, we extend the above analysis in different directions.

3.1. Endogenous cooperation

We have considered in the above analysis that cooperation among the firms and that of among the governments are exogenously given. If we allow the firms and the governments to determine the degree of cooperation that maximise the profits of the firms and welfare of the exporting countries, we can find by maximising each profit and by maximising each welfare with respect to the corresponding cooperation parameters that each firm as well as each government will prefer full cooperation. In this situation, there will be zero subsidy/tax and the total output will be $\frac{1}{2}$. Hence, cooperation among the governments will make the consumers of the importing country worse off compared to non-cooperation among the governments, irrespective of non-cooperation and cooperation among the firms.[6]

3.2. Positive production costs

We have considered zero production costs in Section 2 for simplicity. We show here that our results hold even if there are positive production costs. Assume that the marginal costs of both firms are *c*, with $0 < c < 1$ so that the outputs of both firms are positive. Straightforward calculations will show that the equilibrium subsidies are $s_1^* = s_2^* = s^* = -\frac{(-1+c)\left(-1-3\alpha+\left(2+\alpha+\alpha^2\right)\delta\right)}{-5+\alpha+\delta+3\alpha\delta}$ and the equilibrium total output is $q^* = -\frac{2(-1+c)(-2+\delta+\alpha\delta)}{-5+\alpha+\delta+3\alpha\delta}$. We get that $\frac{\partial q^*(\delta=0)}{\partial\alpha} = \frac{4(1-c)}{(5-\alpha)^2} > 0$ and $\frac{\partial q^*(\alpha=0)}{\partial\delta} = \frac{-6(1-c)}{(5-\delta)^2} < 0$, which provides results like Proposition 1.

[6] If there is no cooperation among the government (i.e., $\delta = 0$), the firms prefer full cooperation (i.e., $\alpha = 1$).

3.3. Asymmetric costs

We have derived Proposition 1 under the assumption that the firms have symmetric costs, which are assumed to be zero for simplicity. We will show in this section that Proposition 1 holds even if the firms differ in costs. Assume that the marginal cost of firm 1 is *0* while the marginal cost of firm 2 is *c*, with $0 < c < \frac{1}{6}$ so that the outputs of both firms are positive. Straightforward calculation will show that the equilibrium subsidies/taxes are

$$s_1^* = \frac{(-1+\delta)\left(-1-3\alpha+\left(2+\alpha+\alpha^2\right)\delta\right)+2c\left(1-\alpha+(3+\alpha)\delta-(1+\alpha)^2\delta^2\right)}{(-1+\delta)(-5+\alpha+\delta+3\alpha\delta)},$$

$$s_2^* = \frac{c(3+\alpha)(1+\delta)(-1+\alpha\delta)+(-1+\delta)\left(-1-3\alpha+\left(2+\alpha+\alpha^2\right)\delta\right)}{(-1+\delta)(-5+\alpha+\delta+3\alpha\delta)}.$$

The equilibrium total outputs are $q^* = \frac{2-c+s_1^*+s_2^*}{3+\alpha} = \frac{(2-c)(2-\delta-\alpha\delta)}{(5-\alpha-\delta-3\alpha\delta)}$. We get that $\frac{\partial q^*(\delta=0)}{\partial\alpha} = \frac{2(2-c)}{(5-\alpha)^2} > 0$ and $\frac{\partial q^*(\alpha=0)}{\partial\delta} = \frac{-3(2-c)}{(5-\delta)^2} < 0$, which provides results like Proposition 1.

3.4. Producers in the importing country

We have derived Proposition 1 in a model like Brander and Spencer (1985a) where the importing country has no producers. We will show the implications of producers in the importing country in this subsection. To do this, we consider cooperation among the exporting firms only. However, there is no cooperation between the

exporting and import competing firms. We also assume that the firms are symmetric in cost.

Straightforward calculation will show that the equilibrium subsidies/taxes are $s_1^* = s_2^* = \frac{-1+\delta+\alpha(-2+\delta+\alpha\delta)}{-4+\alpha+3\alpha\delta}$ and the equilibrium total outputs are $q^* = \frac{3+\alpha+s_1^*+s_2^*}{4+2\alpha} = \frac{7-\alpha-\delta-5\alpha\delta}{2(4-\alpha-3\alpha\delta)}$. We get that $\frac{\partial q^*(\delta=0)}{\partial\alpha} = \frac{3}{2(4-\alpha)^2} > 0$ and $\frac{\partial q^*(\alpha=0)}{\partial\delta} = -\frac{1}{8} < 0$, which provides results like Proposition 1.

It is easy to understand that if the markets are segmented and the exporting countries impose trade policies, our results will not be affected even if there are consumers in the exporting countries. This happens because, due to segmented markets and constant marginal costs, the amount of exports and the trade policies will not be affected by the sell in the exporting countries.

3.5. Price competition

We have assumed in the previous section that the firms compete in quantities. The purpose of this section is to show that the results shown in Proposition 1 hold even under price competition. Hence, our results are robust with respect to the type of product-market competition.

Like Section 2, we assume that the foreign firms 1 and 2 sell their products to the domestic country. However, we assume in this section that firms 1 and 2 compete in prices with horizontally differentiated products. The inverse market demand function for the *i*th firm is

$$P_i = 1 - q_i - \gamma q_j,\ i = 1,2 \text{ and } i \neq j. \tag{12}$$

The term $\gamma \in [0,1]$ shows the degree of product differentiation with $\gamma = 0$ implying isolated products and $\gamma = 1$ implying perfect substitutes. We will concentrate on $\gamma \in (0,1)$ to avoid the well-known Bertrand paradox that occurs for $\gamma = 1$ and to create product-market competition between the firms that occurs for $\gamma > 0$. We normalise the marginal costs of production of both firms to zero, for simplicity. Assume that both foreign countries are engaged in strategic trade policies and provide subsidies (taxes, if the variables are negative) to their own firms.

We consider a game similar to Section 2. At stage 1, countries 1 and 2 simultaneously determine the per-unit export subsidies/taxes given to the respective firms. At stage 2, both firms choose their prices simultaneously, and the profits are realised. We solve the game through backward induction.

The inverse market demand function (12) gives the following demand function for the *i*th firm

$$q_i = \frac{1-\gamma-P_i+\gamma P_j}{1-\gamma^2},\ i=1,2 \text{ and } i \neq j. \tag{13}$$

Given the export subsidies s_1 and s_2 provided by countries 1 and 2 to firms 1 and 2 respectively, firms 1 and 2 maximise the following expressions respectively to determine their prices

$$\underset{P_1}{Max}(P_1+s_1)\left(\frac{1-\gamma-P_1+\gamma P_2}{1-\gamma^2}\right)+\alpha(P_2+s_2)\left(\frac{1-\gamma-P_2+\gamma P_1}{1-\gamma^2}\right) \tag{14}$$

$$\underset{P_2}{Max}(P_2+s_2)\left(\frac{1-\gamma-P_2+\gamma P_1}{1-\gamma^2}\right)+\alpha(P_1+s_1)\left(\frac{1-\gamma-P_1+\gamma P_2}{1-\gamma^2}\right), \tag{15}$$

where, as before, $\alpha \in [0,1]$ shows the firms' cooperative behaviour in the product market.

The equilibrium prices of firms 1 and 2 can be found as

$$P_1^* = \frac{(-1+\gamma)(2+\gamma+\alpha\gamma)-(-2+\alpha(1+\alpha)\gamma^2)s_1+(\gamma-\alpha\gamma)s_2}{-4+(1+\alpha)^2\gamma^2}$$ and

$$P_2^* = \frac{(-1+\gamma)(2+\gamma+\alpha\gamma)-(-2+\alpha(1+\alpha)\gamma^2)s_2+(\gamma-\alpha\gamma)s_1}{-4+(1+\alpha)^2\gamma^2}$$ respectively.

Given the equilibrium prices P_1^* and P_2^*, the problem of the *i*th country is to determine s_i to maximise

$$W_i + \delta W_j = [(P_i^* + s_i)q_i^* - s_i q_i^*] + \delta[(P_j^* + s_j)q_j^* - s_j q_j^*] = P_i^* q_i^* + \delta P_j^* q_j^*, \qquad (16)$$

where $i = 1,2$ and $i \neq j$, and as before, $\delta \in [0,1]$ shows the degree of cooperation among the governments of the exporting countries.

The equilibrium export subsidies are

$$s_1^* = s_2^* = -\frac{(-1+\gamma)\gamma[\gamma+2\delta+\alpha(-2+(1+\alpha)\gamma^2(\alpha-\delta)+\gamma(-1+(-1+\alpha)\delta))]}{(-1+\alpha\gamma)[4+\gamma(-2-2\alpha\delta+\alpha(1+\alpha)\gamma^2(1+\delta)-\gamma(1+\alpha+2\alpha^2+\delta-\alpha\delta))]}. \qquad (17)$$

Consumer surplus is $CS = \frac{(q_1^*)^2 + 2\gamma q_1^* q_2^* + (q_2^*)^2}{2}$ and due to the symmetric equilibrium values (using $q_1 = q_2$), it reduces to $CS = (q_1^*)^2(1+\gamma)$. Given the equilibrium values, we get that

$$CS = \frac{[2+\gamma(-(1+\alpha^2)\gamma+(1+\alpha)(-1+\alpha\gamma^2)\delta)]^2}{(1+\gamma)[4+\gamma(-2-2\alpha\delta+\alpha(1+\alpha)\gamma^2(1+\delta)-\gamma(1+\alpha+2\alpha^2+\delta-\alpha\delta))]^2}. \qquad (18)$$

To show the effects of export cartel on the consumers (and the welfare of the importing country), assume that $\delta = 0$, i.e., there is no cooperation among the countries 1 and 2, but the degree of cooperation among firms 1 and 2 is α.

We get that

$$s_1^*(\delta=0)=s_2^*(\delta=0)=s^*(\delta=0)=-\frac{(-1+\gamma)\gamma[\gamma+\alpha(-2+\gamma(-1+\alpha(1+\alpha)\gamma))]}{(-1+\alpha\gamma)[4+\gamma(-2-(1+\alpha+2\alpha^2)\gamma+\alpha(1+\alpha)\gamma^2)]}$$

and $CS(\delta=0)=\frac{[-2+(1+\alpha^2)\gamma^2]^2}{(1+\gamma)[-4+\gamma(2+\gamma(1+\alpha+2\alpha^2-\alpha(1+\alpha)\gamma))]^2}$.

Proposition 2: *Assume that there is cooperation among the firms only.*

(a) There exists α*, say* $\alpha^* \in [0,1]$*, such that the equilibrium export policy is to tax (subsidise) the exporters for* $\alpha \in [0,\alpha^*]$ *(*$\alpha \in [\alpha^*,1]$*).*

(b) Consumers in the importing country are better off with higher cooperation among the exporters, i.e., with higher α*.*

Proof: (a) We get that $s^*(\delta=0)<(>)0$, i.e., it is export tax (subsidy), at $\alpha=0$ ($\alpha=1$). We also find that $\frac{\partial s^*(\delta=0)}{\partial\alpha}>0$ for $\alpha\in[0,1]$, suggesting that there exists $\alpha=\alpha^*\in[0,1]$ such that $s^*(\delta=0)<(>)0$ for $\alpha\in[0,\alpha^*]$ ($\alpha\in[\alpha^*,1]$).

(b) We get that $\frac{\partial CS(\delta=0)}{\partial\alpha}>0$ for $\alpha\in[0,1]$. ■

In contrast to the existing result (Eaton and Grossman, 1986), Proposition 2(a) shows that export subsidy can be the equilibrium trade policy under price competition. The reason for the above result is as follows. It is well-known from the previous work (Eaton and Grossman, 1986) that, under price competition, a less aggressive pricing strategy of a firm induces its competitors to adopt a less aggressive pricing strategy, since prices behave like "strategic complements". This competition reducing motive induces the exporting countries to impose export taxes if the firms do not cooperate in the product-market. However, if the firms start cooperating in the

product market, the incentive for reducing competition weakens. As a result, if the degree of product-market cooperation among the firms increases, it reduces the government's incentive for charging export taxes. If the degree of cooperation among the firms is significant, the governments prefer to subsidise the firms.

We get that $\frac{\partial s^*(\delta=0)}{\partial \alpha} > 0$, i.e., subsidy increases with higher cooperation among the firms. This benefit from cooperation dominates the negative effect of cooperation, viz., higher product-market concentration, and the consumers in the importing country are better off under higher cooperation among the exporters.

Let us now see the implications of cooperation among the governments of the exporting countries only, i.e., $\alpha = 0$ and $\delta \in [0,1]$.

We get that $s_1^*(\alpha=0) = s_2^*(\alpha=0) = s^*(\alpha=0) = -\frac{(1-\gamma)\gamma(2\delta+\gamma)}{[4-2\gamma-(1+\delta)\gamma^2]} < 0$, suggesting that the exporting countries impose export taxes. We also get that $CS(\alpha=0) = \frac{[2-\gamma(\gamma+\delta)]^2}{(1+\gamma)[4-\gamma(2+\gamma+\gamma\delta)]^2}$. We further find that $\frac{\partial s^*(\alpha=0)}{\partial \delta} < 0$ and $\frac{\partial CS(\alpha=0)}{\partial \delta} < 0$, suggesting that higher cooperation among the governments of the exporting countries increases taxes and also makes the consumers in the importing country worse off.

We summarise the above discussion in the following proposition.

Proposition 3: *If the exporters do not cooperate but the governments of the exporting countries cooperate, higher degree of cooperation among the exporting countries increases export tax and makes the consumers in the importing country worse off.*

As the degree of cooperation among the exporting countries increases, the incentive for "business stealing" reduces and the incentive for restricting outputs towards the collusive level increases. This motivation induces the countries to increase the export tax as the degree of cooperation among the countries increases. However, higher tax rates following higher cooperation among the government of the exporting countries restrict the total outputs of the firms and make the consumers in the importing country worse off.

Since consumer surplus depends on the total output for a given degree of product differentiation, following the analysis in the *Appendix* for quantity competition, it can be shown that our results under price competition hold for a general demand function. We skip this analysis to avoid repetition.

4. Conclusion

Cooperation among the final goods producers are generally believed to hurt consumers at the expenses of higher profits of the firms. We show that this conclusion may not hold true in a world with strategic trade policies. In a strategic trade model of Brander and Spencer (1985a), we show that, contrary to the traditional harmful effect, product-market cooperation among the firms increases consumer surplus through its favourable effect on the trade policies. Hence, cooperation among the exporters is not necessarily bad for the importing countries in the presence of strategic trade policies. Thus, our analysis raises some pertinent questions regarding the harmful effect of international export cartel.

We also show that the consumers in the importing country are affected adversely if the cooperation is among the governments of the exporting countries,

instead of the exporting firms. Our results hold under different types of product-market competition, viz., quantity and price competition.

Appendix

We show here that the results shown in Proposition 1 can hold under a general demand function. Assume that the demand function is given by $P(q)$ with $P' < 0$ and $P'' \leq 0$, where $q = q_1 + q_2$. We will assume here that the firms compete in quantities. Since consumer surplus depends on the total output for a given degree of product differentiation, similar procedure can be followed to show that our results under price competition hold for a general demand function. However, we skip the analysis under price competition to avoid repetition.

A: Cooperation among the firms only under quantity competition: Consider the case where cooperation is among the firms only. Firm i maximises $G_i \equiv \pi_i + \alpha\pi_j = (P + s_i)q_i + \alpha(P + s_j)q_j$, to determine its output, where *i, j = 1, 2*, $i \neq j$, $\alpha \in [0,1]$ and π_i is the profit of firm *i*. The equilibrium outputs are given by

$$\frac{\partial G_i}{\partial q_i} \equiv G_{iq_i} = P + s_i + q_i P' + \alpha q_j P' = 0, \; i, j = 1, 2, \; i \neq j. \qquad \text{(A1)}$$

We have $G_{iq_iq_i} < 0$, $G_{jq_jq_j} < 0$, $G_{iq_iq_j} < 0$, $G_{jq_jq_i} < 0$, $G_{iq_iq_i} < G_{iq_iq_j}$, $G_{jq_jq_j} < G_{jq_jq_i}$ and $G_{iq_iq_i}G_{jq_jq_j} > G_{iq_iq_j}G_{jq_jq_i}$ for $\alpha < 1$.

The total output is given by

$$G_{1q_1} + G_{2q_2} = 2P + s_1 + s_2 + (1+\alpha)qP' = 0 . \qquad \text{(A2)}$$

Differentiating (A2) with respect to α, we get that $\frac{dq}{d\alpha} = \frac{-\left(\frac{ds_1}{d\alpha} + \frac{ds_2}{d\alpha}\right) - qP'}{2P' + (1+\alpha)(P' + qP'')}$. If $\frac{ds_1}{d\alpha} = \frac{ds_2}{d\alpha} = 0$, i.e., cooperation among the firms does not affect government policies, we get that $\frac{dq}{d\alpha} = \frac{-qP'}{2P' + (1+\alpha)(P' + qP'')} < 0$, which is in line with the usual belief that higher cooperation among the firms reduces total output and therefore, consumer surplus, since consumer surplus is positively related to total output. Hence, higher cooperation among the firms can increase total output only if $\left(\frac{ds_1}{d\alpha} + \frac{ds_2}{d\alpha}\right) > 0$.

We will now see that $\frac{ds_1}{d\alpha} > 0$ and $\frac{ds_2}{d\alpha} > 0$. Welfare of country i is $W_i(s_i, s_j, \alpha) = \pi_i - s_i q_i$, $i, j = 1, 2,\ i \neq j$. The equilibrium subsidies are given by

$$\frac{\partial W_i(s_i, s_j, \alpha)}{\partial s_i} \equiv W_{is_i}(s_i, s_j, \alpha) = (P + s_i)q_{is_i} + q_i P'(q_{is_i} + q_{js_i}) - s_i q_{is_i} = 0 \qquad \text{(A3)}$$

or $\quad -\alpha q_j P' q_{is_i} + q_i P' q_{js_i} - s_i q_{is_i} = 0$, (due to (A1)), $\qquad$ (A3')

with $i,\ j\ =\ 1,\ 2,\ i \neq j$, $W_{is_i s_i} < 0$, $W_{js_j s_j} < 0$, $W_{is_i s_j} < 0$, $W_{js_j s_i} < 0$, $W_{is_i s_i} < W_{is_i s_j}$, $W_{js_j s_j} < W_{js_j s_i}$ and $W_{is_i s_i} W_{js_j s_j} > W_{is_i s_j} W_{js_j s_i}$

Differentiating (A3) with respect to α, we get the following two equations

$$W_{1s_1 s_1} \frac{ds_1}{d\alpha} + W_{1s_1 s_2} \frac{ds_2}{d\alpha} = -W_{1s_1 \alpha} \qquad \text{(A4)}$$

$$W_{2s_2 s_1} \frac{ds_1}{d\alpha} + W_{2s_2 s_2} \frac{ds_2}{d\alpha} = -W_{2s_2 \alpha} . \qquad \text{(A5)}$$

Solving (A4) and (A5), we get that $\frac{\partial s_1}{\partial \alpha} = \frac{-W_{2s_2s_2}W_{1s_1\alpha} + W_{1s_1s_2}W_{2s_2\alpha}}{W_{1s_1s_1}W_{2s_2s_2} - W_{1s_1s_2}W_{2s_2s_1}} > 0$, since $W_{1s_1s_1}W_{2s_2s_2} > W_{1s_1s_2}W_{2s_2s_1}$, $W_{1s_1\alpha} = -q_1P'q_{1s_1} = -q_2P'q_{2s_2} = W_{2s_2\alpha} > 0$ (from (A3'), due to symmetry and $q_{is_i} > 0$ from (A1)), $W_{2s_2s_2} = W_{1s_1s_1}$ (due to symmetry) and $W_{1s_1s_2} > W_{1s_1s_1}$. Similarly, we can get that $\frac{\partial s_2}{\partial \alpha} > 0$. Hence, in the presence of strategic trade policies, higher cooperation among the firms increases export subsidies and may increase the total output, thus benefitting the consumers.

Thus, we show that if there is cooperation among the exporters only and the product-market is characterised by quantity competition, higher cooperation among the firms may benefit the consumers in the importing country if the positive effects of cooperation on subsidies are greater than the negative of cooperation on total output. Our analysis in the text with the linear demand function satisfies this condition.

B: Cooperation among the countries only under quantity competition: Now we consider the case where cooperation is among the countries only.

Firm i maximises $\pi_i = (P + s_i)q_i$, to determine its output, where *i, j = 1, 2* and $i \neq j$. The equilibrium outputs are given by

$$\frac{\partial \pi_i}{\partial q_i} \equiv \pi_{iq_i} = P + s_i + q_iP' = 0,\ i, j = 1, 2,\ i \neq j. \qquad \text{(B1)}$$

We have $\pi_{iq_iq_i} < 0$, $\pi_{jq_jq_j} < 0$, $\pi_{iq_iq_j} < 0$, $\pi_{jq_jq_i} < 0$, $\pi_{iq_iq_i} < \pi_{iq_iq_j}$, $\pi_{jq_jq_j} < \pi_{jq_jq_i}$ and $\pi_{iq_iq_i}\pi_{jq_jq_j} > \pi_{iq_iq_j}\pi_{jq_jq_i}$.

The total output is given by

$$\pi_{1q_1} + \pi_{2q_2} = 2P + s_1 + s_2 + qP' = 0. \qquad \text{(B2)}$$

Differentiating (B2) with respect to δ (which shows the degree of cooperation among the countries), we get that $\frac{dq}{d\delta} = \frac{-\left(\frac{ds_1}{d\delta} + \frac{ds_2}{d\delta}\right)}{3P' + qP''} < (>)0$ as $\left(\frac{ds_1}{d\delta} + \frac{ds_2}{d\delta}\right) < (>)0$.

Country i determines s_i to maximise $H_i(s_i, s_j, \delta) \equiv W_i(s_i, s_j, \delta) + \delta W_j(s_i, s_j, \delta) = (\pi_i - s_i q_i) + \delta(\pi_j - s_j q_j)$, where *i, j = 1, 2,* $i \neq j$ and $W_i(s_i, s_j, \delta) = (\pi_i - s_i q_i)$ is welfare of country *i*. The equilibrium subsidies are given by

$$\frac{\partial H_i(s_i, s_j, \delta)}{\partial s_i} \equiv H_{is_i}$$
$$= (P + s_i)q_{is_i} + q_i P'(q_{is_i} + q_{js_i}) - s_i q_{is_i} + \delta[(P + s_j)q_{js_i} + q_j P'(q_{is_i} + q_{js_i}) - s_j q_{js_i}] = 0 \quad \text{(B3)}$$

or $q_i P' q_{js_i} - s_i q_{is_i} + \delta(q_j P' q_{is_i} - s_j q_{js_i}) = 0$, (due to (B1)), (B3')

with *i, j = 1, 2,* $i \neq j$, $H_{is_i s_i} < 0$, $H_{js_j s_j} < 0$, $H_{is_i s_j} < 0$, $H_{js_j s_i} < 0$, $H_{is_i s_i} < H_{is_i s_j}$, $H_{js_j s_j} < H_{js_j s_i}$ and $H_{is_i s_i} H_{js_j s_j} > H_{is_i s_j} H_{js_j s_i}$

Differentiating (B3) with respect to δ, we get the following two equations

$$H_{1s_1 s_1} \frac{ds_1}{d\delta} + H_{1s_1 s_2} \frac{ds_2}{d\delta} = -H_{1s_1 \delta} \quad \text{(B4)}$$

$$H_{2s_2 s_1} \frac{ds_1}{d\delta} + H_{2s_2 s_2} \frac{ds_2}{d\delta} = -H_{2s_2 \delta}. \quad \text{(B5)}$$

Solving (B4) and (B5), we get that $\frac{\partial s_1}{\partial \delta} = \frac{-H_{2s_2 s_2} H_{1s_1 \delta} + H_{1s_1 s_2} H_{2s_2 \delta}}{H_{1s_1 s_1} H_{2s_2 s_2} - H_{1s_1 s_2} H_{2s_2 s_1}} < 0$, since $H_{1s_1 s_1} H_{2s_2 s_2} > H_{1s_1 s_2} H_{2s_2 s_1}$, $H_{1s_1 \delta} = (q_2 P' q_{1s_1} - s_2 q_{2s_1}) = (q_1 P' q_{2s_2} - s_1 q_{1s_2}) = H_{2s_2 \delta} < 0$ (from

(B3'), due to symmetry, $q_{is_i} > 0$ and $q_{js_i} < 0$ from (B1) and $\pi_{jq_jq_j} < \pi_{jq_jq_i}$),[7] $H_{2s_2s_2} = H_{1s_1s_1}$ (due to symmetry) and $H_{1s_1s_2} > H_{1s_1s_1}$. Similarly, we can get that $\frac{\partial s_2}{\partial \delta} < 0$. Hence, in the presence of strategic trade policies, higher cooperation among the governments of the exporting countries decreases export subsidies and decreases the total output, thus hurting the consumers.

Thus, we show that if only the exporting countries cooperate and the product-market is characterised by quantity competition, higher cooperation among the exporting countries is harmful for the consumers in the importing country.

[7] We can get from (B1) that $(q_j P' q_{is_i} - s_j q_{js_i}) = [-P q_{is_i} - s_j (q_{is_i} + q_{js_i})] < 0$, since $q_{is_i} = \frac{-\pi_{jq_jq_j}}{\pi_{iq_iq_i}\pi_{jq_jq_j} - \pi_{iq_iq_j}\pi_{jq_jq_i}} > 0 > q_{js_i} = \frac{\pi_{jq_jq_i}}{\pi_{iq_iq_i}\pi_{jq_jq_j} - \pi_{iq_iq_j}\pi_{jq_jq_i}}$ (obtained by taking total differentiation of (B1)) and $(q_{is_i} + q_{js_i}) > 0$ because of $\pi_{jq_jq_j} < \pi_{jq_jq_i}$.

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