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von

Peter Welzel

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# Strategic Trade Policy with Internationally Owned Firms

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**Abstract**

The consequences of international firm ownership for strategic trade policy are examined both in a general and in a simple linear model of an international duopoly with two governments using production subsidies as policy instruments. At first sight, the case for strategic trade policy seems to be weakened, because international ownership reduces a government's incentive for rent-shifting. Closer inspection shows, however, that there are ownership structures leading to optimal policies which induce the duopolists to behave more collusively. This tends to resolve the conflict between national and international rationality in a policy game with retaliation and makes strategic trade policy look more attractive.

Keywords: strategic trade policy, international investment

JEL-classification: F13, F21

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# 1 Introduction

Strategic trade policy to shift rents in international oligopolies has been examined in numerous papers since the seminal work of Spencer and Brander (1983) and Brander and Spencer (1985). The policy recommendations arising from this literature are now well-understood and have become part of the thinking in international economics. The standard rent-shifting model is built around a duopoly whose producers are located in different countries. By including the national firm's profits in a country's welfare function, however, these specifiations abstract from the fact that firm ownership can be spread across national borders.

Since international investment is an important characteristic of today's world economy, we should not ignore that part of a firm's profits are transferred abroad to foreign owners. This note therefore examines the consequences of international firm ownership on the design of optimal strategic trade policy. At first sight, the case for policy intervention seems to be weakened, because international ownership reduces a government's incentive for rent-shifting. While this conjecture is confirmed by the analysis, closer inspection also shows that there are other effects of interest. As has been known since the very first papers in the field, strategic trade policy leads to prisoners' dilemma-type situations when both governments hosting an international duopoly are actively pursuing rent-shifting policies. With international ownership, however, there exist ownership structures which imply optimal policies that lead to more collusive equilibria compared to the no-policy case. This, in fact, resolves the collective dilemma among the two policy-setting governments. It will be shown that for specific ownership structures the policy game among governments can even induce the duopolists to behave such that they generate the collusive market outcome.

The note is organized as follows: In section 2 the effects of international ownership on optimal policies to shift rents are examined in a general framework. Section 3 employs a linear specification to work out the results in more detail and identify ownership structures leading to full collusion. Section 4 sums up.

## 2 General Model

Consider the most basic setup in the strategic trade policy literature with two producers located in countries 1 and 2, respectively, and selling a homogeneous output in a third country. Firms in this international duopoly are assumed to play a Cournot game in quantities. Each of them maximizes its profit function $\pi_i = p(x_1 + x_2)\, x_i - c_i(x_i) + s_i x_i$, where $p(x_1 + x_2)$ denotes the inverse demand, $x_i$ is firm $i$'s output, $c_i(x_i)$ its cost function, and $s_i$ a per unit production subsidy paid by government $i$. Throughout this note, I use $i, j \in \{1,2\}$, and $(i,j) \in \{(1,2),(2,1)\}$. Let $x = x_1 + x_2$, $p' = dp/dx < 0$, $\partial c_i/\partial x_i > 0$, and $\partial^2 c_i/\partial x_i^2 \geq 0$. Given $(s_1, s_2)$, a Cournot–Nash equilibrium in the duopolists' subgame requires

$$\frac{\partial \pi_i}{\partial x_i} = p'x + p - \frac{dc_i}{dx_i} + s_i \stackrel{!}{=} 0, \qquad \forall i. \tag{1}$$

Since there is no domestic consumption in country $i$, national welfare in this framework is usually measured by producer $i$'s profit minus the total subsidy paid by government $i$, i.e., $w_i(s_i) = \pi_i(s_i) - s_i x_i$. With domestic individuals partially owning the foreign firm, and foreigners partially owning the domestic firm, however, the definition of national welfare has to be modified. Denote by $e_i \in [0,1]$ the share of firm $i$ owned by citizens of country $i$. A share $(1 - e_i)$ is then owned by country $j$, i.e., higher values of $(1 - e_i)$ represent a higher degree of internationalization of ownership.[1] Profits $\pi_i$ are paid to the owners in proportion to the stake they hold in firm $i$. Therefore, only $e_i \pi_i$ of producer $i$'s profit remains in country $i$. On the other hand, country $i$'s welfare $w_i$ is increased by a transfer $(1 - e_j)\pi_j$ of foreign profits. From government $i$'s perspective, national welfare can then be written as

$$w_i(s_i) = e_i \pi_i(s_i) - s_i x_i + (1 - e_j)\pi_j(s_i). \tag{2}$$

Notice an assumption implicit in this specification: International firm ownership is not modelled as cross-ownership among the producers, but as dispersed ownership among individuals of countries 1 and 2. Therefore, it affects only the governments' welfare maximization problems, but does not alter profit

[1] In order to stick as closely as possible to the original rent-shifting argument, it is assumed that citizens of the third country do not hold equity in firms 1 or 2.

maximization of the firm as might be the case with minority equity holdings among the producers. If government $i$ designs a strategic trade policy to shift rents, its optimal choice of $s_i$ is defined by

$$\begin{aligned}\frac{dw_i}{ds_i} &= e_i\left(\frac{\partial\pi_i}{\partial x_i}\frac{dx_i}{ds_i}+\frac{\partial\pi_i}{\partial x_j}\frac{dx_j}{ds_i}+\frac{\partial\pi_i}{\partial s_i}\right)-x_i-s_i\frac{dx_i}{ds_i}+\\ &\qquad +(1-e_j)\left(\frac{\partial\pi_j}{\partial x_i}\frac{dx_i}{ds_i}+\frac{\partial\pi_j}{\partial x_j}\frac{dx_j}{ds_i}\right)\\ &= e_i\frac{\partial\pi_i}{\partial x_j}\frac{dx_j}{ds_i}-(1-e_i)\,x_i-s_i\frac{dx_i}{ds_i}+(1-e_j)\,\frac{\partial\pi_j}{\partial x_i}\frac{dx_i}{ds_i}\\ &\stackrel{!}{=} 0, \qquad (3)\end{aligned}$$

where the duopolists' first-order conditions (1) were used. $dx_i/ds_i$ and $dx_j/ds_i$ which describe the effects of a change in government $i$'s policy parameter $s_i$ on the duopoly equilibrium can be calculated by implicit differentiation of the system of equilibrium conditions (1). Stability ensures that $dx_i/ds_i > 0$ and $dx_j/ds_i < 0$ (cf. Dixit, 1986). Write $dx_j/ds_i$ as $(dx_j/dx_i)(dx_i/ds_i) = a_j\,(dx_i/ds_i)$, where $a_j < 0$ denotes the slope of duopolist $j$'s Cournot reaction curve in $(x_1, x_2)$-space, sometimes called firm $j$'s "actual response" to marginal changes in $i$'s output. Solving for the optimal subsidy yields

$$s_i^* = e_i a_j\frac{\partial\pi_i}{\partial x_j}-(1-e_i)\,x_i\frac{1}{dx_i/ds_i}+(1-e_j)\,\frac{\partial\pi_j}{\partial x_i} \qquad (4)$$

Compare this to

$$\tilde{s}_i = a_j\frac{\partial\pi_i}{\partial x_j} > 0 \qquad (5)$$

which is the standard result without international ownership ($e_i = e_j = 1$). With $e_i, e_j < 1$ three effects working towards a lower optimal subsidy $s_i^*$ can be identified:

1. Due to $e_i < 1$, the first term in (4) captures the fact that country $i$ only partially benefits from the increased market share of firm $i$. Part of the duopoly rent shifted by strategic trade policy from firm $i$ to $j$ is transferred to foreign shareholders of firm $i$.

2. The second term represents the marginal subsidy payment that leaks to country $j$. Whereas government $i$ carries the full cost of the subsidy program, domestic owners of producer $i$ receive only a share $e_i$ of the subsidy through increased profits.

3. Finally, country $i$'s welfare is negatively affected by reduced profits of firm $j$ which are due to the shift of market share and duopoly rent in favor of producer $i$. This is captured by the third term in (4).

Whereas the second is a direct effect, the first and the third are indirect effects of changes of the duopoly equilibrium caused by the subsidy program (cf. Dixit, 1986). All three effects, however, unambiguously reduce government $i$'s incentive to implement a subsidy, i.e., for all $e_i < 1$ we have

$$s_i^* < \tilde{s}_i. \tag{6}$$

Note that the presence of international ownership can even lead to a reversal of the usual policy prescription for strategic trade policy. For the case of an international Cournot duopoly, Spencer and Brander (1983) and Brander and Spencer (1985) found the optimal production subsidy to be positive. Inspection of (4) shows, however, that for a low value of $e_i$ and/or a low value of $e_j$, $s_i^*$ may turn out to be a negative number. It is then optimal for government $i$ to tax its national producer, inducing it to behave "less aggressively" in the output game. The intuition is quite simple: With $e_i$ being low, relatively little of the rent shifted from firm $j$ to firm $i$ increases country $i$'s welfare. At the same time, the unfavorable direct effect becomes more important for country $i$, since a large part of the subsidy payment ends up in the profit share of foreign owners. Furthermore, the damage done to producer $j$ by government $i$'s subsidy weighs more heavily in $i$'s welfare calculation, if $e_j$ is low.

From the comparative-static properties of the rent-shifting model it is well-known that a production subsidy makes the duopoly equilibrium more competitive, whereas a production tax shifts the equilibrium towards collusion. If only government $i$ uses strategic trade policy, country $j$ suffers a welfare loss from reduced sales at a lower price, whereas consumers in the importing third country are better off due to an improvement in their terms of trade. If both governments are active, countries $i$ and $j$ end up at lower welfare levels compared to a situation with no policy, provided that producers are not too dissimilar. In both cases, the consequences of international ownership of firms targeted by strategic trade policy can be seen from a new angle. Since international ownership implies lower subsidy levels, the negative terms of trade effect that accompanies normal strategic trade policy and works in the opposite direction of the favorable rent-shifting effect is reduced. If, for example, in the

case of two policy–setting governments, the ownership structure represented by $e_1$ and $e_2$ is such that optimal subsidies turn out to be negative, total output of the good decreases, and strategic trade policy leads to a more collusive instead of a more competitive market outcome. This, however, suggests that international firm ownership is a device to avoid the well-known prisoners' dilemma situation the two policy–setting governments are in.

To see that with international ownership optimal strategic trade policy can help overcome the conflict between national and international rationality faced by governments 1 and 2, and can even generate the collusive duopoly equilibrium, consider briefly the problem of maximizing the joint welfare of countries 1 and 2. Aggregating $w_1$ and $w_2$ yields a welfare function

$$w = w_1(s_1) + w_2(s_2) = \pi_1(s_1) - s_1 x_1 + \pi_2(s_2) - s_2 x_2. \tag{7}$$

Maximization with respect to $s_i$ leads to first–order conditions

$$\frac{dw}{ds_i} = \frac{\partial \pi_i}{\partial x_j} a_j - s_i + \frac{\partial \pi_j}{\partial x_i} - s_j a_j \stackrel{!}{=} 0, \qquad \forall i. \tag{8}$$

Solving the system (8) for $s_1$ and $s_2$ yields subsidies maximizing aggregate welfare $w$:

$$\hat{s}_i = \frac{\partial \pi_j}{\partial x_i} < 0. \tag{9}$$

Both $\hat{s}_1$ and $\hat{s}_2$ are negative. Maximization of aggregate welfare calls for output taxes. It is easily verified that the use of $\hat{s}_1$ and $\hat{s}_2$ induces firms 1 and 2 to behave such that they end up at the collusive duopoly equilibrium.[2]

The question then is whether governments choosing their optimal subsidies independently in a Cournot–Nash game prior to the producers' game could end up setting policy parameters such that the collusive duopoly equilibrium is reached. For $e_1 = e_2 = 1$ this will definitely not be the case (cf. Brander and Spencer, 1985, Eaton and Grossman, 1986). As soon as $e_1, e_2 < 1$, however, governments take into account at least some of externality caused by their policy. For a special case where $e_1 = e_2 = 1/2$, and $c_1(\cdot) = c_2(\cdot) = c(\cdot)$ one

[2]A fully collusive duopoly game can be modelled by using conjectural variations $\alpha_i = x_j/x_i$ (see, e.g., Dixit, 1986). The duopolists' first–order conditions under these conjectures are identical to the first–order conditions that arise when firms play Cournot and governments pay subsidies $\hat{s}_i$.

can see immediately that the policy equilibrium leads to a collusive market outcome. Due to the full symmetry in this case, national welfare (2) can be written as

$$w_i = \frac{1}{2}\left(px_i - c(x_i)\right) + \frac{1}{2}\left(px_j - c(x_j)\right). \tag{10}$$

From (7) aggregate welfare is given by

$$w = \left(px_i - c(x_i)\right) + \left(px_j - c(x_j)\right). \tag{11}$$

Maximization of (10) with respect to $x_i$, however, leads to the same first–order conditions as the maximization of (11). Therefore, the collusive outcome is reached in the trade policy equilibrium.

The model examined in this section has not been fully solved in the sense that the conditions (4) for optimal strategic trade policies still involved endogenous variables. While this is common practice in the literature, it prevents us from arriving at a general proposition concerning the feasiblity of the collusive duopoly solution in the trade policy equilbrium. In the next section a simple linear specification of the model is used to explicitly derive solutions for policy parameters and market outcomes.

Two remarks conclude this section: Notice firstly that the result in (4) is easily generalized to a specification with conjectural variations as proxies of different forms of duopolistic competition. For details see the Appendix. Secondly, the apparent relevance of ownership parameters $\epsilon_1$ and $\epsilon_2$ as facilitating devices for jointly optimal trade policies suggests that governments might want to influence the ownership structure of the two firms in the model. In particular, there is an incentive for governments to promote some international firm ownership. Given the dispersed ownership structure assumed here, this incentive for governments does not arise from the fact that international ownership per se makes the duopoly more collusive as would be the case with minority equity holdings among the firms (cf. Reynold and Snapp, 1986). Instead, it is the effect on optimal strategic trade policies which makes international ownership attractive in the model. Values of $e_i < 1$ commit governments to less aggressive rent–shifting policies which reduces the collective dilemma situation they are in. While a thorough analysis of this point is beyond the scope of the present model, one could still think of an additional stage 0 of the game, where governments choose policies such as taxes or conditions for direct foreign investment

in order to promote international ownership. If governments understand the prisoners' dilemma they face when determining strategic trade policies on the following stage 1, they should want to create favorable conditions for direct investment among countries 1 and 2.

# 3 A Linear Example

A linear model with inverse demand $p = \gamma - \beta x$ and constant marginal costs normalized to 1 for both firms is considered. Assume $x < \gamma/\beta$, $\beta > 0$, and $\gamma > 1$. Let $e_1, e_2 \in [0,1]$, i.e., both firms can be internationally owned. Solving the two-stage game backwards[3] results in optimal subsidies

$$s_i^* = \frac{(1-\gamma)(12e_j(e_i-1) - 16e_i + 15)}{4e_1(3e_2-5) - 20e_2 + 33}. \tag{12}$$

The subsidies (12) imply the following equilibrium outputs in the duopolists' game:

$$x_i = \frac{2(1-\gamma)(2e_j-3)}{\beta(4e_1(3e_2-5) - 20e_2 + 33)}. \tag{13}$$

Finally, the welfare levels are

$$w_i = \frac{2(1-\gamma)^2(3-2e_i)\left(8e_j^2 + 4e_j(e_i-7) - 4e_i + 21\right)}{\beta(4e_1(3e_2-5) - 20e_2 + 33)^2}. \tag{14}$$

Consider table 1 for some comparative static properties:

| | | | |
|---|---|---|---|
| $s_i^*$ | $ds_i/de_i > 0$ | $ds_i/de_j > 0$ | |
| $x_i, x$ | $dx_i/de_i > 0$ | $dx_i/de_j < 0$ | $\partial x/\partial e_i > 0$ |
| $w_i, w$ | $dw_i/de_i > 0$ | $dw_i/de_j < 0$ | $\partial w/\partial e_i$ ? |

Table 1: Comparative statics of the linear example

[3]Details of the calculations are available from the author upon request.

An increase in foreign ownership $1 - \epsilon_i$ causes both subsidies to decrease due to the three effects outlined earlier. For moderate values of international ownership subsidies turn out to be negative. In the symmetric case, for example, $(1 - e_1) = (1 - e_2) > 1/6$ is sufficient for taxation instead of subsidization. Output $x_i$ is an increasing function of $e_i$, and a decreasing function of $e_j$. Total output $x$ increases in both ownership parameters. Inspection of the partial derivatives of $w_i$ with respect to ownership parameters shows that $w_i$ increases in $e_i$ and decreases in $e_j$. No unambiguous results can be derived for the effects of changes in $e_i$ on aggregate welfare $w = w_1 + w_2$. $\partial w/\partial e_i$ is positive (negative) as long as the sum $e_1 + e_2$ is relatively low (high). In the symmetric case $e_1 = e_2 < (>)1/2$ is sufficient for a positive (negative) effect on $w$.

Examine next which combinations of $\epsilon_1$ and $e_2$ lead to a maximum level of aggregate welfare $w$. The first-order conditions $\partial w/\partial e_i = 0$ for a maximum imply

$$e_i = \frac{4e_j - 3}{4(e_j - 1)} \tag{15}$$

which yields an infinite number of $(e_1, e_2)$-combinations.[4] Substitution of (15) into $w$ given by the sum of (14) over $i$ yields an aggregate welfare level $w = (\gamma - 1)^2 / (4\beta)$ which is identical to aggregate welfare $\hat{w}$ under full collusion. There are an infinite number of pairs $(e_1, e_2)$ which meet (15) and yield a collusive market outcome. However, for such an outcome to result from the governments' policy game, a minimum extent of international ownership is required. For $\epsilon_1 = 1$, for example, the fully collusive equilibrium cannot be reached. Since $e_i \in [0, 1]$ has to hold the $e_i$ in (15) are required to be in the interval $[0, 3/4]$, i.e., at least 25% of each firm have to be owned by foreign shareholders.

Ownership structures obeying (15) ensure collective rationality for countries 1 and 2 as a whole. However, there is no guarantee that the outcome of the policy game is individually rational for each of the two countries. Consider figure 1 for the intuition. Let $x_1(x_2)$ and $x_2(x_1)$ be the reactions curves of firm 1 and 2, respectively, if $s_1 = s_2 = 0$ and the ownership structure is such that (15) holds. The corresponding no-policy equilibrium in $(x_1, x_2)$-space is reached in point N with welfare levels $w_1$ and $w_2$. In a linear Cournot duopoly

[4] For all $(e_1, e_2)$ from (15) the Hessian matrix turns out to be negative semidefinit. Therefore, (local) maxima of $w$ are given by (15).

model the collusive equilibria can be found on the line going through A and B. Only for those equilibria on the line segment from A to B, however, both countries are better off than in the no-policy equilibrium point N.

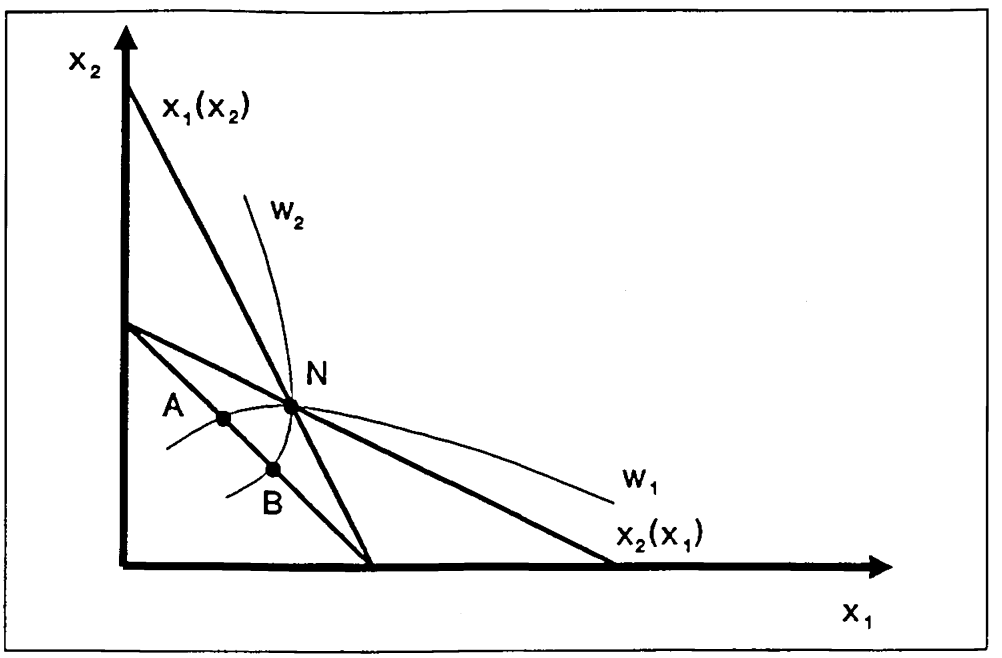


Figure 1: Collective and individual rationality

To determine whether such individually rational equilibria exist, and what restrictions they impose on $\epsilon_1$ and $\epsilon_2$, note that welfare levels without strategic trade policy are given by $w_i^n = [(\epsilon_i - \epsilon_j + 1)(\gamma - 1)^2]/(9\beta)$. Substituting $e_j$ from (15) into $w_i$ and $w_i^n$, and calculating the difference between welfare with policy and welfare without policy leads to

$$\Delta = -\frac{(\gamma - 1)^2 (8\epsilon_i^3 - 20\epsilon_i^2 + 19\epsilon_i - 6)}{36\beta (2\epsilon_i - 3)(\epsilon_1 - 2)}. \tag{16}$$

This is positive for $e_i < \overline{e_i} \approx 0.62$ which in turn implies $e_j > \underline{e_j} \approx 0.34$. Due to the symmetry of the model we can conclude that given the ownership structure (15), the policy equilibrium is individually and collectively rational for governments 1 and 2, if $\epsilon_i \in [0.34, 0.62]$. The requirement that both countries be better off compared to the no-policy case therefore further restricts the parameter space for the $\epsilon_i$'s. As suggested before, there is an incentive for governments to create a certain degree of international ownership in order to

make strategic trade policy work in a more favorable way. They would then also have to solve a distribution problem by deciding on a particular point on the line segment from A to B.

# 4 Conclusion

In the previous sections it was shown that international ownership of firms tends to reduce the optimal subsidies designed to shift rents in an international duopoly. Subsidies derived in models without partial foreign ownership therefore have to be considered as upper bounds for the optimal subsidies in the standard rent–shifting framework. A country's equity interest in a foreign firm serves as a "hostage" to the foreign government. With international ownership going in both directions, both subsidies will be lower and the resulting equilibrium will be more collusive than in the standard case. One can even imagine ownership structures that lead to output taxes and to a fully collusive outcome of the duopoly game. International firm ownership therefore provides an escape route from the conflict between national and international rationality in strategic trade policy games with retaliation. Note that a similar escape does not exist in the traditional analysis of an optimal tariff with retaliation, since countries do not share their tariff revenues.

Effects of cross ownership on duopoly equilibria have recently been examined in the industrial organization literature. Reynold and Snapp (1986) found that partial equity interests lead to more collusion. The spirit of the present note is related to a paper by Macho–Stadler and Verdier (1991) who examined the design of incentive contracts between owners and managers of duopolistic firms. Whereas the aim of their work is different, they employ a formally very similar framework of what could be called the strategic design of principal–agent contracts when agents act in an oligopolistic environment.

Since this paper aimed at presenting the basic argument in the simplest framework of a rent–shifting model, a number of aspects such as domestic consumption, more than one firm per country, or entry were not considered. From the strategic trade policy literature the effects that arise from generalizing the model in these directions are well–understood. Domestic consumption in countries 1 and 2, for example, calls for taking account of consumer surplus

in the welfare function and for higher subsidy rates because they are now also used to correct for the domestic market distortion. Notice finally that welfare maximization as analyzed above always focussed on countries 1 and 2, either separately or jointly. The importing country was left out from our welfare analysis. This should not tempt us to forget that due to the collusive nature of the solution under international ownership setups which proved optimal for countries 1 and 2 make country 3 suffer a welfare loss.

# Appendix

Given some newly gained respectability of conjectural variations as proxies to model different kinds of oligopolistic interaction (see Dockner, 1992), it may be worthwhile to extend (4) to the case of non-Cournot conjectures. Denote by $\alpha_i = (dx_j/dx_i)^e$ and $\alpha_j = (dx_i/dx_j)^e$ the conjectures held by producer $i$ and $j$, respectively. Performing government $i$'s maximization as above yields a straightforward generalization of the result from Eaton and Grossman (1986) to the case of international ownership:

$$s_i^* = \epsilon_i (a_j - \alpha_i) \frac{\partial \pi_i}{\partial x_j} - (1 - \epsilon_i) x_i \frac{1}{dx_i/ds_i} + (1 - \epsilon_j)(a_i - \alpha_j) \frac{\partial \pi_j}{\partial x_i} a_j \quad \text{(A.1)}$$

(A.1) again includes three effects of $\epsilon_i, \epsilon_j < 1$. There are two indirect effects working through the changes of equilibrium profits of the firms, and the direct effect of the subsidy payment being partially transferred abroad. As is well-known from Dixit (1986), the directions of the indirect effects depend on the signs of $a_j - \alpha_i$ and $a_i - \alpha_j$, respectively, i.e., the difference between actual and expected reactions.

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