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Export subsidies and endogenous market structures: Some neglected issues

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**Export Subsidies and
Endogenous Market Structures:
Some Neglected Issues**

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A. Introduction

Governments may use export subsidies not only to shift foreign producer rents to the home country, but also to enforce foreign market exit.¹ This is due to the fact, that export subsidies may not only lower foreign producer rents, but make them become negative. If this happens, the market is no longer attractive for the foreign producers.²

Section B of this paper will investigate the conditions under which the home country should deter foreign market entry rather than pursue a rent shifting policy. It also evaluates optimizing subsidy levels for the deterred and accommodated entry case. Section C shows in a simple welfare analysis, that export subsidization does not always lead to an inferior situation for the production sector as a whole. Section D finally derives equilibrium market structures for the situation where home and foreign countries are both subsidizing their exports. The analysis of the optimal subsidy choices by both countries shows that a symmetric subsidy equilibrium exists only for certain demand and cost characteristics. I also give one example for a non-symmetric equilibrium, where the domestic export subsidy is high enough to deter foreign market entry.

¹The rent shifting idea goes back to Brander/Spencer (1985). For an overview and discussion, see for instance Siebert (1988), Helpman/Krugman (1989) and Bletschacher/Klodt (1992).

²While rent shifting has been discussed extensively, the literature on entry deterrence through export subsidization is rather small. Horstmann/Markusen (1992) discuss some general characteristics of strategic trade policy with an endogenous market structure, also including multinational corporations. Rauscher (1990) investigates the use of subsidies to promote domestic entry. Dixit/Kyle (1985) deal with the use of protection and subsidies to deter or promote entry but allow government only to decide between the binary choices full protection versus free trade and full fixed cost subsidisation versus no subsidy at all. Market entry and exit is also considered in the "long run" versions of strategic trade policy models, where new firms enter the market as long as overall profits are positive (cf. Horstmann/Markusen, 1986 and Collie, 1992).

B. Welfare Maximizing Export Subsidies

In this section I derive the welfare maximizing export subsidy strategy, also considering market exit decisions. To simplify the analysis, I assume a situation, where potential market participants - one domestic and one foreign - are producing identical goods for a third market with the same technology. The model involves three steps. First, the domestic government announces the subsidy level. Firms then decide whether to participate or to stay out of the market. When entering the market, they behave as Cournot-maximizers and simultaneously choose their production quantity. As usual, the solution path just takes the opposite direction.

(a) Quantity choice

If there are both firms in the market, we have the situation described by Brander/Spencer (1985).³ π_d and π_d^* then define the profit of the domestic and of the foreign firm. y and y^* denote the home and foreign output. Both firms bear constant marginal costs c and fixed costs F , which only occur, if firms take up production.⁴ The domestic firm receives a subsidy s for every unit of its production quantity. The price on the third market is a function of y and y^* . I assume a linear inverted demand curve of the third country $p \equiv a - b(y + y^*)$.⁵ π_d and π_d^* thus become:

$$\pi_d = (a - b \cdot (y + y^*)) \cdot y + s \cdot y - c \cdot y - F \quad (1)$$

and

³Cf. Brander, Spencer (1985, pp. 85).

⁴ F may be seen as the costs of R&D, marketing and the construction of production plants for the good x . The constant marginal costs correspond to a neoclassical technology.

⁵Global linearity of the demand function results from a quadratic utility function of the consumers. This rather restrictive assumption is made for illustrative reasons: It allows an explicit solution of the model.

$$\pi_a^* = (a - b \cdot (y + y^*)) \cdot y^* - c \cdot y^* - F. \quad (2)$$

The following implicit functions define the profit maximizing quantities y and y^* :

$$\pi_{d_y} = k - 2by - by^* + s = 0 \quad (3)$$

and

$$\pi_{d_{y^*}} = k - 2by^* - by = 0, \quad (4)$$

where $k \equiv a - c > 0$.

The second order conditions are both satisfied because of $\pi_{yy} = \pi_{y^*y^*} = -2b < 0$.

In addition, the conditions for global uniqueness and stability $\text{tr}(H) < 0$ and

$$\det(H) > 0 \text{ with } H = \begin{pmatrix} \pi_{d_{yy}} & \pi_{d_{yy^*}} \\ \pi_{d_{y^*y}} & \pi_{d_{y^*y^*}} \end{pmatrix} = \begin{pmatrix} -2b & -b \\ -b & -2b \end{pmatrix} \quad (5)$$

hold.

From equation (3) and (4) the profit maximizing y and y^* become

$$y_d(s) = \frac{k + 2s}{3b} \quad (6)$$

and

$$y_d^*(s) = \frac{k-s}{3b}.^6 \quad (7)$$

The profit functions are then

$$\pi_d(s) = \frac{(k+2s)^2}{9b} - F \quad (8)$$

and

$$\pi_d^*(s) = \frac{(k-s)^2}{9b} - F.^7 \quad (9)$$

I assume that with no government activity both profits are not negative, that means $k \geq 3d$ with $d = \sqrt{b \cdot F}$.

Now I derive the output and profit-function for the case that only the domestic firm serves the market. Then the profit definition becomes

$$\pi_m = (a - b \cdot y) \cdot y + s \cdot y - c \cdot y - F. \quad (10)$$

This gives the optimizing quantity decision of

⁶An interior solution exists for $s \leq k$. If $s > k$, then $y_d^*(s) = 0$.

⁷Cf. footnote 4.

$$y_m(s) = \frac{k+s}{2b}. \quad (11)$$

The profit function thus is

$$\pi_m(s) = \frac{(k+s)^2}{4b} - F. \quad (12)$$

(b) *Entry choice*

A firm enters the market, if its profit is greater than or equal to zero. A higher subsidy leads to higher domestic and lower foreign profits. Therefore the foreign firm stays out of the market, if

$$s > k - 3d.^8 \quad (13)$$

(c) *Subsidy choice*

Given the possible reaction of the two firms, I assume that the government chooses a subsidy level, that maximizes social welfare given by

$$W(s) = \pi(s) - y(s) \cdot s. \quad (14)$$

There exist two possible strategies: First the government can choose $s_m \equiv k - 3d + \varepsilon$ ($\varepsilon > 0$) to deter foreign entry. (11) and (12) then determine welfare to be 0

$$W(s_m) = \frac{k^2 - s_m^2}{4b} - F. \quad (15)$$

⁸Cf. equation (9).

Because W_{s_m} is negative, the government will choose ε as small as possible - in a more formal expression $\varepsilon \rightarrow 0$ -.

Second, it may allow the foreign firm to enter the market with $s \equiv s_d$ and $s_d \leq k - 3d$. Then it faces a social welfare of

$$W(s_d) = \frac{k^2 + s_d k - 2s_d^2}{9b} - F. \quad (16)$$

Because $W_{s_d} < 0$, the optimizing s_d satisfies

$$W_{s_d} = \frac{k - 4s_d}{9b} = 0. \quad (17)$$

This gives

$$s_d = \frac{k}{4}. \quad (18)$$

Government plays $s = s_d$ if $W(s_d) > W(s_m)$,

$$\Rightarrow \frac{k^2}{8b} - F > \frac{k^2 - (k - 3d + \varepsilon)^2}{4b} - F, \quad (19)$$

$$\Rightarrow k > \frac{3\sqrt{2}}{\sqrt{2}-1} \left(d - \frac{\varepsilon}{3}\right). \quad (20)$$

For $k \geq \frac{3\sqrt{2}}{\sqrt{2}-1} d$, it is therefore not advisable to help the domestic firm into a monopolistic position. The best policy in this case is entry accommodation with

$s_d = \frac{k}{4}$. However, if F or b is big enough, so that $k < \frac{3\sqrt{2}}{\sqrt{2}-1} d$, then government

pursues an entry deterrence strategy with $s_m = k - 3d + \varepsilon$. For comparably high values of d , namely $4d > k$, the entry deterrence subsidy s_m is lower than $\frac{k}{4}$. The foreign firm then leaves the market even before the rent shifting subsidy level is reached. The possible outcomes described above can be summarized as in the following diagram:

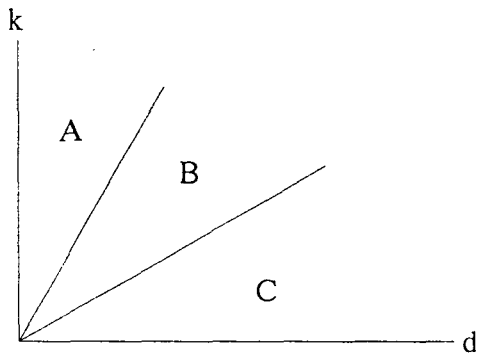


Figure 1 - Subsidy strategies depending on cost and demand structures

Region A contains the demand and cost parametrizations which lead to a rent shifting policy as the best strategy for a welfare-maximizing politician. In Region B and C the domestic government will subsidize in a way that the foreign firm leaves the market. However, in Region C this subsidy is smaller than $k/4$, whereas in Region B it exceeds that level.

Figure 2 illustrates the dependence of the optimizing subsidy on the value of F holding all other variables constant.

Without market exit decisions, s is not dependent of F , whereas in our case the optimal subsidy jumps at $F = \frac{k^2(\sqrt{2}-1)^2}{18b}$ to the entry deterrence value of $s = k - 3d + \varepsilon$, which decreases with a further rise of F .

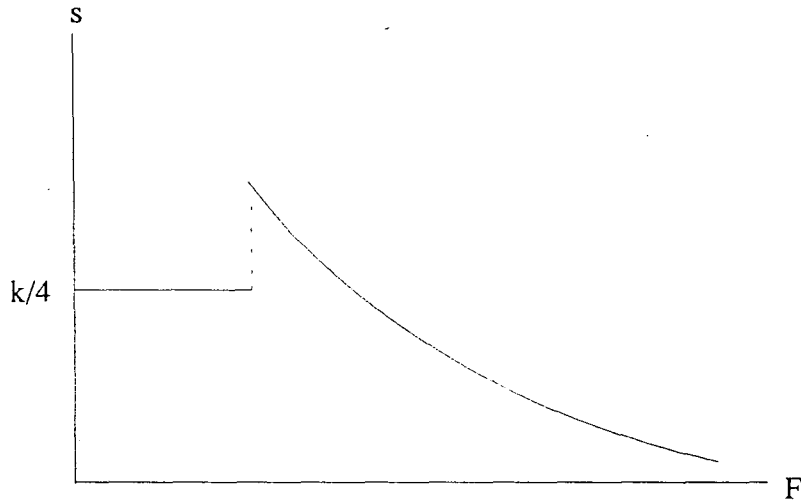


Figure 2 - Export subsidy depending on the fixed costs

C. Welfare Implications

The introduction of possible entry deterrence also changes the judgement of strategic trade policy with respect to the world's welfare. Consider the two exporting countries: In the duopoly case, the sum of domestic and foreign welfare is, using

(16) and a foreign welfare function of $W_d^* = \frac{(k - s_d)^2}{9b} - F$,

$$W_d^E = \frac{2k^2 - s_d k - s_d^2}{9b} - 2F. \quad (23)$$

With $s = \frac{k}{4}$ this becomes

$$W_d^E = \frac{3k^2}{16b} - 2F. \quad (24)$$

If one country has the monopoly power, then it is of course better off whereas the foreign country loses the whole amount of its producer rents. The aggregate welfare is identical to the home country's welfare which is given for $s_m = k - 3d + \varepsilon$ by

$$W_m^E = \frac{6dk - 9d^2 - 2(k - 3d) \cdot \varepsilon}{4b} - F. \quad (25)$$

With free trade, welfare is

$$W_F^E = \frac{2k^2}{9b} - 2F. \quad (26)$$

Without allowing for market exit, unilateral export subsidization is always a negative sum game for the production sector as a whole. This is shown by equations (23) and (26). But in our case of an endogenous market structure, strategic trade policy may also have a positive allocation effect. This is the case for comparatively high values of d when the rationalization effect of reducing the average production costs outweighs the distortion effect of the subsidy. If for instance $d = \frac{k}{3}$, then the difference of (25) and (26) is positive, indicating that the welfare gain of the home country is greater than the welfare loss of the foreign exporters.

This result, however, cannot be generalized. For small values of d , the picture changes and welfare of (25) may be even less than that with an oligopolistic market structure pictured in equation (24).

The distribution effects of a noncooperative trade policy are of course larger with the possibility of entry deterrence, because then the whole producer rent accumulates in the subsidizing country.

The importing countries - the "third market" in our model - are only interested in a high aggregate output of the two exporting countries. In the duopoly case, aggregate output is

$$Y_d \equiv y_d + y_d^* = \frac{3k}{4b}. \quad (27)$$

This is greater than monopoly output

$$y_m = \frac{2k - 3d + \varepsilon}{2b} \quad (28)$$

for $k < 6d$. This works as a counterforce to the results above. The higher d , the greater is the rationalization effect of entry deterrence, but the higher is also the threat of losing consumer rent via monopolized output.

D. Nash-Equilibria when Two Governments are Subsidizing

I now allow for the possibility that the foreign government also subsidizes its production sector. Without accounting for market exit, there exists a unique, symmetric Nash-equilibrium with positive export subsidies by both governments. However, with an endogenous market structure, a symmetric Nash-equilibrium exists only under some specific cost and demand structures. There may also exist non-symmetric equilibria, where one government is able to procure its industry a monopoly advantage.

This section derives these results in the same fashion as part B of this paper. Thus in (a) and (b) it identifies possible market structures as functions of the home and foreign subsidy policy. Then, in (c), it evaluates the conditions under which the symmetric Nash-equilibrium occurs and finally presents one non-symmetric Nash equilibrium.

(a) Quantity choice

With two governments the outcomes of the quantity stage of the game are altered slightly. Profit is in the duopoly case now given by

$$\pi_d = (a - b \cdot (y + y^*)) \cdot y^* + s \cdot y - c \cdot y - F \quad (29)$$

and

$$\pi_d^* = (a - b \cdot (y + y^*)) y^* + s^* \cdot y^* - c \cdot y^* - F. \quad (30)$$

Equilibrium quantities and profits are then a function of both domestic and foreign subsidies

$$y_d(s, s^*) = \frac{k + 2s - s^*}{3b}, \quad y_d^*(s, s^*) = \frac{k + 2s^* - s}{3b}, \quad (31), (32)$$

$$\pi_d(s, s^*) = \frac{(k + 2s - s^*)^2}{9b} - F, \quad \pi_d^*(s, s^*) = \frac{(k + 2s^* - s)^2}{9b} - F. \quad (33), (34)$$

Monopoly output and profits are the same as those derived in part B:

$$y_m(s) = \frac{k + s}{2b} \quad \text{and} \quad \pi_m(s) = \frac{(k + s)^2}{4b} - F. \quad (11), (12)$$

Because of the symmetry in our model, the foreign monopoly has quantities and profits of

$$y_m^*(s^*) = \frac{k + s^*}{2b} \quad \text{and} \quad \pi_m^*(s^*) = \frac{(k + s^*)^2}{4b} - F. \quad (35), (36)$$

(b) Entry choice

The possible payoffs of the entry versus non-entry decision can be represented as follows:

	Foreign firm	
	entry	non-entry
domestic firm	entry	non-entry
	$\left(\frac{(k+2s-s^*)^2}{9b} - F; \frac{(k+2s^*-s)^2}{9b} - F \right)$	$\left(\frac{(k+s)^2}{4b} - F; 0 \right)$
	non-entry	
	$\left(0; \frac{(k+s^*)^2}{4b} - F \right)$	$(0; 0)$

The first (second) term in brackets denotes the domestic (foreign) firm's profit.

Depending on the values of s and s^* , there are Nash-equilibria where both firms enter, where both stay out and where just one firm goes into the market. Figure 3 illustrates the possible outcomes for $k=1$ and $d=\frac{1}{3}$. In Region A, both firms decide to enter the market. For all values of s and s^* which satisfy $\frac{3d-k+s^*}{2} \leq s \leq k-3d+2s^*$, the equilibrium market structure thus is an oligopoly. If s is greater than $k-3d+2s^*$ then a duopolistic market is no longer attractive for the foreign firm. For $s^* < 2d-k$ it moreover has no incentive to produce as a monopolist. Non-entry is here the dominant strategy for the foreign firm. On the other hand, if $s^* \geq 2d-k$ the foreign firm may try to become a monopolist. It will not succeed, if $s \geq \frac{3}{2}d - \frac{k}{2} + \frac{s^*}{2}$ because here the domestic firm enters regardless of what the foreign firm does. Thus in Region B and D the foreign firm certainly stays out of the market.⁹

⁹ That part of Region D, where an oligopolistic situation would yield positive profits for the foreign firm, also does not contain an entry strategy for it, because there the domestic firm will exit anyway and an oligopoly therefore would not be reached.

The domestic firm will make use of its chance to become a monopolist, if $s \geq 2d - k$. The ss^* -combinations in Region B thus lead to a domestic monopoly, whereas in Region D no firm enters the market.

Region C contains the ss^* -combinations which may lead to a domestic or to a foreign monopoly. Finally, Region E is just the mirror image of Region B with the foreign firm as the only producer.

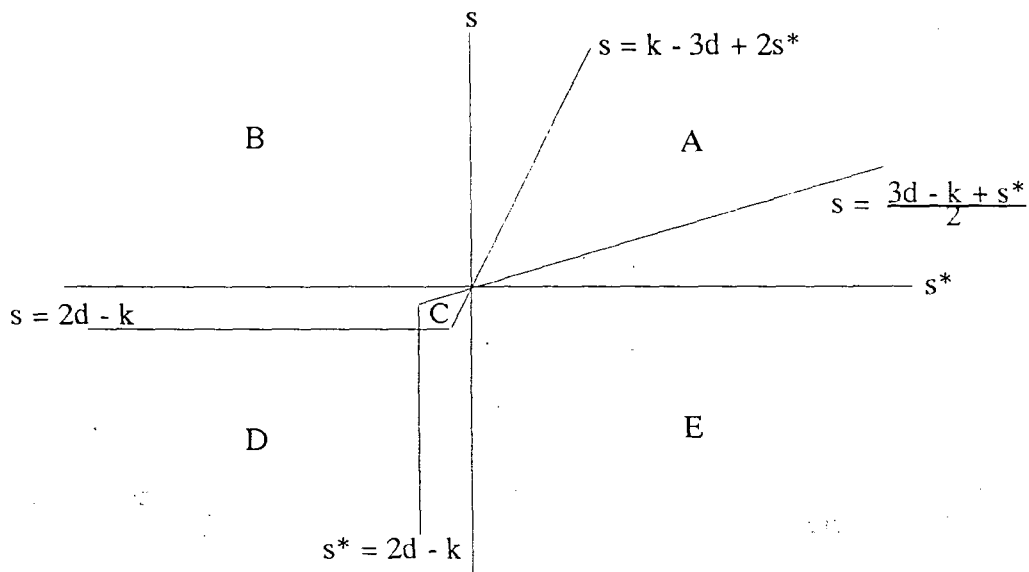


Figure 3 - Market structures depending on s and s^*

(c) *Subsidy Choice*

Given the expected reaction of the two firms, both governments have to commit themselves to their optimizing subsidy level. They obey the following welfare functions for the different market structures:

Foreign firm

entry

non-entry

$$\text{entry} \left(\frac{(k+2s-s^*)(k-s-s^*)}{9b} - F; \frac{(k+2s^*-s)(k-s-s^*)}{9b} - F \right) \left(\frac{k^2-s^2}{4b} - F; 0 \right)$$

domestic firm

$$\text{non-entry} \left(0; \frac{k^2-s^{*2}}{4b} - F \right) \quad (0; 0).$$

The first (second) term in brackets denotes the domestic (foreign) welfare as defined in section B.

First of all, with $s^* \leq 3d - k$ the home country has the opportunity to move into the monopoly situation with a subsidy level of $s=0$ and domestic welfare

$W = \frac{k}{4b} - F > 0$. Therefore, no Nash-equilibrium will be found in Region C or D,

because there for every foreign subsidy level, the domestic government can procure a monopoly for its firm without doing anything which is of course dominant to an equilibrium with no market entry or to the mixed strategy equilibrium.

Brander/Spencer locate the symmetric Nash-equilibrium at $s = \frac{k}{5}$ and $s^* = \frac{k}{5}$.¹⁰

This is also the duopoly equilibrium in our case of endogenous market structure. But with the opportunity to deter foreign entry, it may be possible that there exists

¹⁰ Cf. Brander/Spencer, 1985, p. 95, prop. 4. Combining their results with the special assumptions of this paper will yield the values of s and s^* above.

no such equilibrium at all. This situation will occur when for a given $s^* = \frac{k}{5}$ the strategy of $s = \frac{k}{5}$ is dominated by $s_m = \frac{7k}{5} - 3d + \varepsilon$, $\varepsilon \rightarrow 0$. Monopoly welfare will then be $W_m\left(s_m, \frac{k}{5}\right) = \frac{k^2 - s_m^2}{4b} - F$ which is higher than the duopoly welfare $W\left(\frac{k}{5}; \frac{k}{5}\right) = \frac{2k^2}{25b} - F$ if $d > \frac{7 - \sqrt{17}}{15} k$. Therefore, only under the special assumption of $F \leq \left(\frac{7 - \sqrt{17}}{15}\right)^2 \frac{(a-c)^2}{b}$, the results derived by Brander/Spencer are still valid in a world, where market exit is allowed.

But there also exist Nash equilibria in Region B or E, where one country produces and the other firm stays out. To illustrate this, consider the case of $k=1$ and $d = \frac{1}{3}$ as depicted in figure 2. A domestic subsidy of $s = \frac{\sqrt{5}}{6}$ and a foreign subsidy $s^* = \frac{\sqrt{5}}{12} - \varepsilon$ with $\varepsilon \rightarrow 0$ lead to such an equilibrium. If the domestic subsidy is $s = \frac{\sqrt{5}}{6}$, then a duopoly is not attractive for the foreign country. To get in the duopoly region, the foreign country would have to choose s^* to satisfy $\frac{\sqrt{5}}{12} \leq s^* \leq \frac{\sqrt{5}}{3}$. In this region $\frac{\partial W^*}{\partial s^*} < 0$. The optimizing s^* therefore would be $s^* = \frac{\sqrt{5}}{12}$. But with $s = \frac{\sqrt{5}}{6}$ and $s^* = \frac{\sqrt{5}}{12}$, W^* would be negative. The oligopolistic market is not attractive for the foreign government. The foreign country may also try to get into Region E. Then the foreign subsidy would have to be greater than $\frac{\sqrt{5}}{3}$, which also would result in a negative welfare. It thus has no incentive

to leave Region B; it sets $s^* < \frac{\sqrt{5}}{12}$. Suppose $s^* = \frac{\sqrt{5}}{12} - \varepsilon$ with $\varepsilon \rightarrow 0$. In equilibrium $s = \frac{\sqrt{5}}{6}$ must be the best strategy for the home country. If the domestic country, instead of choosing $s = \frac{\sqrt{5}}{6}$, would follow the oligopoly strategy

$\frac{s^*}{2} \leq s \leq 2s^*$, the domestic welfare would be negative.¹¹ Thus for $s^* = \frac{\sqrt{5}}{12} - \varepsilon$, the home country has no incentive to deviate from the entry deterrence strategy.

One Nash equilibrium with entry deterrence thus is $s = \frac{\sqrt{5}}{6}$ and $s^* = \frac{\sqrt{5}}{12} - \varepsilon$,

$\varepsilon \rightarrow 0$ for $k=1$ and $d = \frac{1}{3}$.¹²

¹¹ The optimizing s given $s^* = \frac{\sqrt{5}}{12} - \varepsilon$, and $\varepsilon \rightarrow 0$, is $s = \frac{12 - \sqrt{5}}{48}$. These s, s^* values lead to a negative welfare W .

¹² Because d is then smaller than $\frac{7 - \sqrt{17}}{15} k$, the strategy set $s = \frac{k}{5}$, $s^* = \frac{k}{5}$ is also an equilibrium, so that we have three Nash-equilibria, each resulting in a different market structure: One with both firm producing, one with a domestic monopoly and - because of the symmetry - one with entry deterrence by the foreign government and a foreign monopoly.

E. Summary and Conclusions

The introduction of market entry and exit decisions into the strategic trade policy framework endows one country's government with a new policy strategy, namely the use of export subsidies in order to force foreign competitors out of the market. Thus, the policy of inducing the domestic firm to a Stackelberg-leader position may under certain demand and cost characteristics be dominated by an entry deterrence policy. I have shown, that the higher the fixed or variable cost and the steeper the demand curve and/or the lower the price where no unit of the good is bought, the more tempting is a monopoly position for the home country.

Strategic export policy was typically blamed to lead to a prisoner's dilemma situation for the involved countries. The normative conclusion was then the call for an institutional arrangement to prevent its members from playing negative sum games.¹³ However, I have shown that with an endogenous market structure the positive rationalization effect of an entry deterrence policy may create welfare gains for the subsidizing country that are greater than the losses of its counterpart. In a two government world, the symmetric noncooperative Nash subsidy equilibrium found by Brander/Spencer is only one special case of a variety of outcomes that may occur depending on cost and demand characteristics.

This paper assumed linearity of the cost and demand functions. For this reason, it should be seen only as an illustration of the influences of an endogenous market structure on "optimal" trade policy. However, what it has demonstrated, is that with the introduction of entry and exit decisions, the information which is necessary to choose the welfare maximizing policy also has to include the relative amount of the fixed cost of production. Thus, strategic trade policy becomes even more complicated than in the "traditional" framework of an exogenous market structure. This argument is strengthened by the fact that with the introduction of discontinuities in the welfare functions, which automatically occur in this

¹³Cf. Walz (1992), pp. 92-93.

framework, marginal deviations of the data and choice variables may result in large effects on social welfare.¹⁴

Thus, in my opinion, this paper does not contain any normative case in favour of an interventionistic trade policy. What it may give is an illustration of how certain subsidy levels can be explained not only with the rent shifting argument, but with a trade policy that tries to influence the market structure.

¹⁴ Cf. Horstmann/Markusen, 1992, p. 128.

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