Antidumping Constraints and Trade Elimination

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1. INTRODUCTION

Consider two examples that this article wants to capture. In 1986, Australian firms accused Brazilian exporters of frozen concentrated orange juice to dump their products in Australia. In 1987, imports in Australia of frozen concentrated orange juice from Brazil stopped completely. Imports resumed only when the Brazilian FOB price rose above the minimum at which the Australian antidumping order was effective (BRAGA and SILBER [1993]). In 1990, the US government imposed a 35% antidumping duty against Avesta-Sandvik Tube, the only Swedish producer of stainless welded tubes. As a result, Avesta-Sandvik Tube stopped delivering its product to the United States (FORS [1993]). In both instances, the foreign firms are imperfectly competitive firms. In the frozen orange juice case, not only is Brazil the world's leading exporter (73% of world trade of frozen concentrated orange juice in 1987), but four firms account for 92% of Brazil's exports in this product line (BRAGA and SILBER [1993]). In the stainless welded tube case, Avesta-Sandvik is the only Swedish firm of welded tubes and it is the largest Western producer (FORS [1993]).[1] In both cases, it seems reasonable to consider that firms chose to stop trade rather than to lower their domestic prices to meet the antidumping constraint. In contrast, lowering domestic prices to meet the constraint is exactly what the consumer electronics firms from South Korea chose to do in response to US, Canada and EC antidumping actions on color television sets, microwave ovens and video cassette recorders (BARK [1993]).

These two examples raise some interesting questions. For instance, in which circumstances do firms stop trading in response to antidumping constraints imposed by governments? When do firms continue to trade? Does the nature of the products matter? To answer these questions, we build a simple model of intra-industry trade with antidumping constraints and we derive the international market equilibrium. We then investigate the conditions under which an equilibrium with and without trade exists.

In this paper, we follow ANDERSON, SCHMITT and THISSE (1995) by modelling antidumping restrictions as constraints on the firms' incentive to absorb part of a trade

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1. Similar behavior by firms has been noted by MALUEG and SCHWARTZ (1994) in response to policies aiming at discouraging parallel imports.

barrier. Such an incentive arises in models of imperfect competition with incomplete international arbitrage (see BRANDER and KRUGMAN [1983]). In effect, firms selling in several markets naturally use international price discrimination when they can segment markets. In a world of identical markets, firms practice dumping since barriers to trade increase the perceived elasticity of foreign demands. An antidumping constraint is then interpreted as a restriction forcing firms to select prices such that they fully reflect international transport costs and tariffs. Viewed in this fashion, an antidumping constraint effectively links the foreign price of a good to the domestic price of the same product. It typically forces a firm to set a low price in its domestic market to meet the antidumping restriction abroad. Some firms may simply prefer to stop exporting rather than to satisfy such a constraint. In doing so, they free their domestic price from the foreign antidumping constraint.

To investigate under what conditions firms stop trading in response to antidumping constraints, we analyze the Bertrand-Nash equilibrium in a two-firm-two-country model of product differentiation. We show that, when both countries impose antidumping constraints, Nash equilibria exist where both firms continue to trade, none of them trades, or only one firm trades. In each case, we identify the ranges of parameters for which each of these equilibria holds. We show that these equilibria critically depend on the initial tariff rate (or transport cost) and the degree of substitution between products.

This paper is organized as follows. In the next section, a model generating reciprocal dumping is spelled out. The different Nash equilibria are derived in Section 3 and concluding comments are given in Section 4.

2. MODEL WITH DUMPING

The basic structure of the model is the same as in ANDERSON, SCHMITT and THISSE (1995). There are two identical countries: domestic, D and foreign, F with respective governments G_D and G_F. There are two firms: firm 1 produces good 1 in D and firm 2 produces good 2 in F. Production costs are constant and equal for both firms. Without loss of generality, we henceforth set them equal to zero.

Since firms may not always sell in both markets, the demand structure must be consistent with an endogenous number of firms. Assume therefore that the utility function of a representative consumer is additive such that

$$U(x_1, x_2, z) = -\frac{1}{2}A(x_1^2 + x_2^2) - Cx_1x_2 + D(x_1 + x_2) + z\,, \tag{1}$$

where z is the numéraire product and A, C, D are exogenous parameters. We impose $C > 0$ for the products to be substitutes, and $A > C$ for the subutility in x_1, x_2 to be concave. In addition, $D > 0$ ensures that the marginal utility of each good is positive at $x_i = 0$ ($i = 1, 2$). Maximizing utility subject to the budget constraint ($p_1x_1 + p_2x_2 + z \leq m$)

and the non-negativity constraints ($x \geq 0, y \geq 0, z \geq 0$), it is easy to check that the demand for x_1 is:

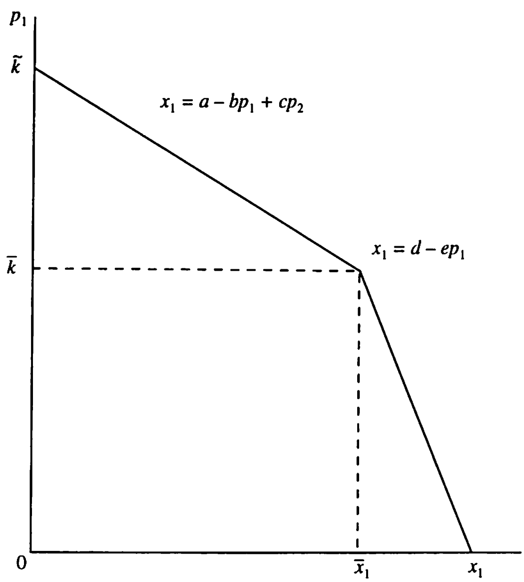
$$x_1 = \begin{cases} d - ep_1 & \text{if } 0 \leq p_1 < \bar{k} \text{ and } p_1 < D, \\ a - bp_1 + cp_2 & \text{if } \bar{k} \leq p_1 \leq \tilde{k} \text{ and } p_1 < D, \\ 0 & \text{if } p_1 \geq \tilde{k} \text{ or } p_1 \geq D \end{cases} \tag{2}$$

where p_1 ($i = 1, 2$) represents consumer prices, $\bar{k} = \frac{1}{c}(bp_2 - a)$ and $\tilde{k} = \frac{1}{b}(a + cp_2)$. The correspondence between (a, b, c, d, e) and (A, C, D) can be found to be

$$a = \frac{D}{A+C}, \quad b = \frac{A}{A^2 - C^2}, \quad c = \frac{C}{A^2 - C^2}, \quad d = \frac{D}{A}, \quad e = \frac{1}{A}. \tag{3}$$

Figure 1 illustrates the demand for good x_1; firm 1 is a monopolist if, given p_2, its price p_1 is below the kink and firm 1 is in a duopoly rivalry if its price is above the kink. Firm 1 faces a steeper (market) demand as a monopolist with respect to its residual demand in a duopoly. A similar demand can be derived for good 2 and since the two countries are assumed to be identical, these demands are also valid for country F (p_1^* and p_2^* respectively). Finally, define q_i (q_i^*) as producer prices in D (F).

Figure 1: Demand for Product 1 in Market D



Markets are separated by an exogenous barrier to trade of size t per unit shipped between them. It is the same size whatever the direction of trade and it can be either a transport cost or a specific tariff.

Consider now the case where countries impose no restriction on firms' behavior and where t is sufficiently low for intra-industry trade to occur. Assume also that there is no international arbitrage so that firms can segment markets by using third degree price discrimination (BRANDER and KRUGMAN [1983]). In this case, firm 1's problem is

$$\max_{p_1, p_1^*} \pi_1 = p_1(a - bp_1 + cp_2) + (p_1^* - t)(a - bp_2^* - cp_2^*), \tag{4}$$

Similarly, firm 2 solves $\pi_2 = p_2^*(a - bp_2^* + cp_1^*) + (p_2 - t)(a - bp_2 + cp_1)$ with respect to p_2 and p_2^*. Since the utility function (1) leads to the same demand structure as in ANDERSON, SCHMITT and THISSE (1995), we note that the solution is

$$p_1 = p_2^* = \frac{a}{2b-c} + \frac{cbt}{(2b-c)(2b+c)}; \quad p_2 = p_1^* = \frac{a}{2b-c} + \frac{2b^2 t}{(2b-c)(2b+c)}. \tag{5}$$

The model generates *reciprocal dumping* since

$$p_2 - p_2^* = p_1^* - p_1 = \frac{bt}{2b+c} \leq t, \tag{6}$$

or, equivalently, the *dumping margin*

$$dm = p_1 - (p_1^* - t) = p_2^* - (p_2 - t) = \frac{(b+c)\,t}{2b+c} \tag{7}$$

is greater or equal to zero for $t \geq 0$. The equilibrium profit when firms share both markets can be found to be

$$\pi_1^S = \pi_2^S = \left[p_1^2 + (p_1^* - t)^2\right], \tag{8}$$

where subscript S stands for «segmented» markets. Such an equilibrium holds as long as both firms find it profitable to trade and thus as long as $p_1^* - t \geq 0$, or

$$t \leq \hat{t} = a\left(\frac{2b+c}{2b^2 - c^2}\right). \tag{9}$$

For the remainder of this article, we impose $0 \leq t \leq \hat{t}$.

3. ANTIDUMPING

Assume now that each government imposes an antidumping restriction on imports from the other country. Several cases are possible as firms may choose to continue to trade despite this restriction, or they may prefer to stop trading. We investigate each case separately deriving the conditions under which a Bertrand-Nash equilibrium exists.

3.1 Firms Sell in Both Markets

Suppose first that the two firms continue to share both markets. By imposing an antidumping constraint ($dm \leq 0$), each government forces the foreign firm to choose a set of prices such that the cost of trading across borders is fully passed on to consumers. It is easy to show (ANDERSON, SCHMITT and THISSE [1995]) that the constraint will always be binding. Thus, in the symmetric equilibrium with trade, $dm = 0$ or $p_1 = p_1^* - t = q_1$ (similarly $p_2^* = p_2 - t = q_2$). Firm 1's problem in the presence of an antidumping restriction is thus

$$\max_{q_1} \pi_1 = q_1\left[\left(a - bq_1 + c(q_2 + t)\right) + \left(a - b(q_1 + t) + cq_2\right)\right], \tag{10}$$

where q_i ($i = 1, 2$) is the producer price. The equilibrium is characterized by

$$q_1^T = q_2^T = \frac{2a - (b - c)t}{2(2b - c)}, \tag{11}$$

and the firm's equilibrium profit is

$$\pi_i^T = 2bq_i^2, \quad i = 1, 2, \tag{12}$$

where T stands for «tied» markets.

For antidumping restrictions to be consistent with trade, no firm should want to deviate by selling only in its domestic market. Thus (11) and (12) hold only if no firm should find it more profitable to stop trading. Suppose firm 1 did just that. Its profit would then be $\pi_1 = p_1(a - bp_1 + cp_2)$ which, given $p_2 = q_2^T + t$, makes it selects $p_1 = \frac{a}{2b - c} + \frac{tc(3b - c)}{4b(2b - c)}$. Firm 1's profit from deviating and stoping trade would then become $\pi_1^d = \frac{[4ab + ct(3b - c)]^2}{16b(2b - c)^2}$. Comparing π_1^d with π_1^T, firm 1 chooses to share both markets while satisfying the antidumping constraint if

$$t \leq t_1 = \frac{2ab(\sqrt{2}-1)}{\frac{1}{2}(b-c)(2\sqrt{2}b+c)+bc}. \tag{13}$$

We require therefore the symmetric trade equilibrium with antidumping constraints to satisfy (13).

3.2 Firms Sell in One Market

Suppose now that both firms have chosen not to trade in response to antidumping restrictions. In this case, each firm is the only seller in its domestic market. The obvious symmetric equilibrium is the unconstrained monopoly equilibrium. Thus, firm 1 maximizes $\pi_1 = p_1(d - ep_1)$ so that

$$p_1^m = \frac{d}{2e}, \quad \pi_1^m = \frac{d^2}{4e}. \tag{14}$$

Similarly for firm 2 in market F.

To be an equilibrium, no firm must have an incentive to sell abroad while satisfying the antidumping constraint when the rival firm sets its unconstrained monopoly price. To identify under which condition one firm would deviate in this fashion, consider firm 1's incentive. Its problem is

$$\max_{q_1, q_1^*} \pi_1 = (d - eq_1)q_1 + q_1^*\left(a - b(q_1^* + t) + cp_2^*\right) \quad s.t. \quad q_1^* \geq q_1 \tag{15}$$

Like in the previous case, the antidumping constraint is binding so that $q_1 = q_1^*$. Given $p_2^* = \frac{d}{2e}$, firm 1 sets $q_1^d = \frac{1}{4e(e+b)}[2e(a+d-2bt)+cd]$, earning $\pi_1^d = \frac{1}{16e^2(e+b)}[2e(a+d-bt)+cd]^2$. Firm 1's profit from deviating by trading is inferior to the unconstrained monopoly profit whenever

$$t \geq t_2 = \frac{a + d + \frac{cd}{2e} - d\left(\frac{b}{e}+1\right)^{1/2}}{b}. \tag{16}$$

It is convenient to express the critical tariff rates t_1 and t_2 in terms of $\alpha = \frac{C}{A}$ and D. The parameter D can be interpreted as the maximum price of the product (see [2]) and α

measures the degree of substitution between products. Using the correspondence between (a, b, c, d, e) and (A, C, D) (see [3]), the critical tariff rates t_1 and t_2 become

$$\frac{t_1}{D} = \frac{4(\sqrt{2} - 1)(1 - \alpha)}{(1 - \alpha)(2\sqrt{2} + \alpha) + 2\alpha}, \tag{17}$$

and

$$\frac{t_2}{D} = (1 - \alpha)\left[2 + \alpha + \frac{\alpha}{2(1 - \alpha)} - \left(\frac{2 - \alpha^2}{1 - \alpha^2}\right)^{1/2} (1 + \alpha)\right]. \tag{18}$$

Proposition 1:

(i) *There exists a symmetric Bertrand-Nash equilibrium where both firms share both markets provided* $t \leq t_1$.

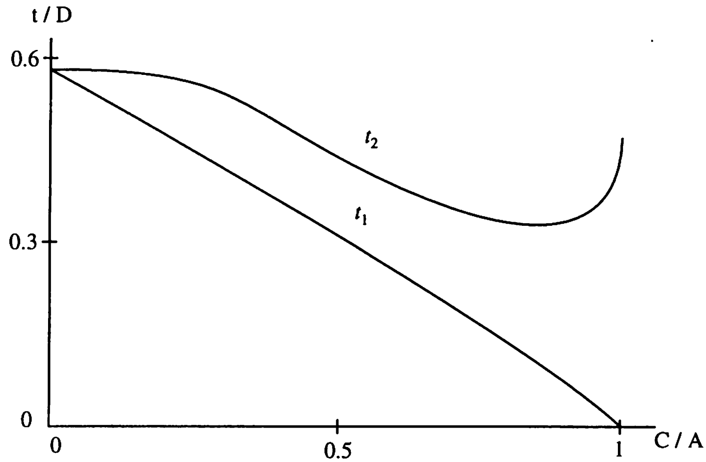
(ii) *There exists a symmetric Bertrand-Nash equilibrium where both firms sell only at home provided* $t \geq t_2$.

(iii) $t_2 \geq t_1$ *with equality if* $C = 0$ *and no Bertrand-Nash equilibrium in pure price strategy exists in* $t_1 < t < t_2$.

Proof: The proof of (i) and (ii) follows from our previous discussion and the proof of (iii) follows from the comparison of t_1 and t_2 as expressed in (17) and (18) for $\alpha \in [0, 1]$.

Figure 2 illustrates Proposition 1. It indicates clearly that the nature of the products matters in the outcome. In effect, the ratio $\frac{C}{A}$ (equal to the ratio $\frac{c}{b}$) depends on the degree of substitution between products. When $c = C = 0$, the demands are independent, and as c (or C) rises, the products become closer substitutes. For $c = b$ $(C = A)$, the total market demand (for both products) is independent of the price levels and each firm's demand depends only upon price differences as in HOTELLING (1929)'s spatial model. Figure 2 indicates therefore that, when the products become better substitutes, firms have a greater incentive to stop trading in response to antidumping constraints. Closer substitution between products also increases the range of parameters where there is no equilibrium in pure strategy. This is not a surprising result as there cannot be, for instance, any pure strategy equilibrium involving international trade with homogeneous products and positive barriers to trade. Hence, Figure 2 shows a standard trade off between product heterogeneity and the scope for pure strategy equilibria with international trade. We note, however, that, given the nature of the problem, there exists a mixed strategy equilibrium in $t_1 < t < t_2$.

Figure 2: Symmetric Nash Equilibria



3.3 Asymmetric Equilibrium

We now investigate whether, in response to antidumping constraints by both countries, there exists a Bertrand-Nash equilibrium in which one firm trades while the other firm sells only at home. To analyze this case, we assume that firm 1 is the exporting firm.

Firm 1's optimal pricing decision is given by:

$$\max_{q_1, q_1^*} \pi_1 = (d - eq_1)\, q_1 + \left[a - b(q_1^* + t) + cp_2^*\right] q_1^* \qquad s.t. \quad q_1^* \geq q_1 \tag{19}$$

Since the constraint is binding, firm 1 maximizes

$$\max_{q_1} \pi_1 = q_1 \left[a + d - q_1(e + b) - bt + cp_2^*\right]. \tag{20}$$

Firm 1's profit, as a function of its rival's price, can be found to be

$$\pi_1 = \frac{(a + d - bt + cp_2^*)^2}{4(b + e)}. \tag{21}$$

By assumption, firm 2 sells only in its domestic market. Since it shares its domestic market with firm 1, it maximizes:

$$\max_{p_2^*} \pi_2^* = \left[a - bp_2^* + c\,(q_1 + t)\right] p_2^*. \tag{22}$$

Solving (20) and (22), the optimal prices are

$$q_1 = \frac{2b\,(a+d) + ca - (2b^2 - c^2)\,t}{4b\,(b+e) - c^2}, \quad p_2^* = \frac{2a\,(b+e) + c\,(a+d) + c\,(b+2e)\,t}{4b\,(b+e) - c^2}, \tag{23}$$

and firm 2's profit is $\pi_2 = b(p_2^*)^2$. We now derive the ranges of tariff rates for which this asymmetric outcome is an equilibrium.

Firm 1 can deviate by not trading in which case it is a monopolist at home where it earns $\pi_1^d = \frac{d^2}{4e}$. Firm 1 does not deviate if $\pi_1 \geq \pi_1^d$, where π_1 is given by (21). Firm 1 prefers to trade whenever

$$t \leq t_4 = \frac{1}{2b^2 - c^2}\left[2b(a+d) + ca - \frac{d[4b(b+e) - c^2]}{2\sqrt{e(b+e)}}\right]. \tag{24}$$

Taking into account the correspondence between (a, b, c, d, e) and (A, C, D) and defining $\alpha = \frac{C}{A}$, the critical rate t_4 can be found to be

$$\frac{t_4}{D} = \left(\frac{1-\alpha}{2-\alpha^2}\right)\left[4 + 3\alpha - \frac{(8 - 5\alpha^2)\,(1+\alpha)}{2\sqrt{(1-\alpha^2)\,(2-\alpha^2)}}\right]. \tag{25}$$

Consider now firm 2. It must not find it profitable to export while satisfying the antidumping constraint. Suppose it does export; firm 2's equilibrium profit is then the same as in the tied market equilibrium that is $\pi_2^d = 2b\,(q_2^d)^2$ where its profit-maximizing price is

$$q_2^d = \frac{2a + (c-b)t + 2cq_1}{4b}. \tag{26}$$

Comparing π_2 and π_2^d, firm 2 does not trade whenever

$$t \geq t_3 = \frac{4(\sqrt{2} - 1)\,b\,[2a(b+e) + c(a+d)]}{\sqrt{2}(b+c)\,[4b(b+e) - c^2] - 4(\sqrt{2} - 1)\,bc\,(b+2e)}. \tag{27}$$

Expressing t_3 in terms of A, C, D, and using $\alpha = \dfrac{C}{A}$, the critical rate is

$$\frac{t_3}{D} = \left[\frac{2(\sqrt{2}-1)(1-\alpha^2)}{\frac{1}{4}\sqrt{2}(1+\alpha)(8-5\alpha^2)-(\sqrt{2}-1)\,\alpha\,(3-2\alpha^2)} \right]. \tag{28}$$

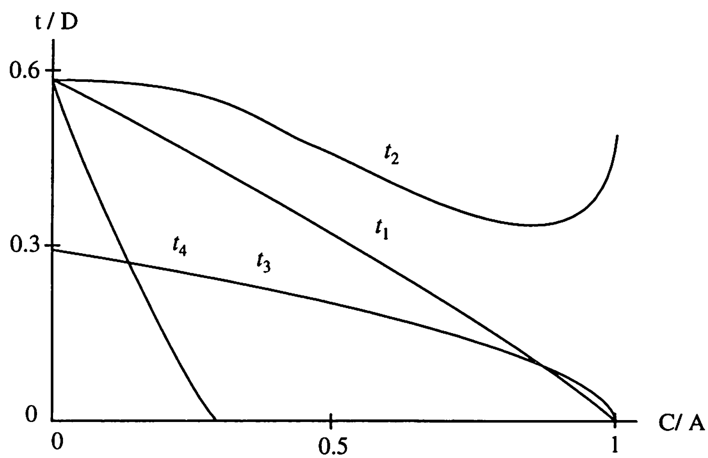
Proposition 2:

An asymmetric Bertrand-Nash equilibrium exists provided $t_3 \leq t \leq t_4$. It requires a high rate of protection and a low degree of substitution between products.

Proof: The proof of Proposition 2 follows from the comparison of t_3 and t_4 as expressed in (25) and (28) for $\alpha \in [0, 1]$. It can be found in particular that there exists $(\frac{t}{D}, \frac{C}{A})$ for which $t_3 \leq t \leq t_4$.

Figure 3 illustrates the asymmetric case. As it is apparent, an asymmetric Nash equilibrium requires both a relatively high barrier to trade and a relatively low degree of substitution between products. Moreover, the asymmetric Nash equilibrium exists only jointly with the symmetric Nash equilibrium with international trade.

Figure 3: Symmetric and Asymmetric Equilibria



4. CONCLUSION

We have shown that, in the presence of antidumping restrictions, the international duopoly equilibrium is consistent with both firms trading, both firms not trading or just one firm trading. These different equilibria depend both on the extent of protection and on the degree of substitution between products. A symmetric international trade equilibrium requires a low degree of substitution in demand associated with a low degree of protection (or low international barrier to transport), while firms not trading in response to antidumping constraints require some protection and a high degree of substitution. Finally, an asymmetric equilibrium in which only one firm trades requires both high barriers to international trade and a low degree of substitution between products. One advantage of our formulation is that it leads to unambiguous predictions. In effect, with more than one industry, our model predicts that antidumping restrictions have relatively more effect on the volume of international trade whenever the initial cost of transportation and/or the tariff rate is high relative to the value of the product, and when the degree of substitution between products is high. This may have some testable implications.

In this article, we have considered only the market equilibrium given antidumping constraints. A natural theoretical extension is to ask whether governments should impose an antidumping constraint in the first place. This issue can be investigated by adding an initial stage to the game in which governments choose whether to impose an antidumping constraint. Such an initial stage captures the idea that governments have a strong influence on the environment in which firms operate and make choices. ANDERSON, SCHMITT and THISSE (1995) analyzes such a game but could not generate antidumping as an equilibrium outcome when firms always trade. Allowing firms to stop trading in response to antidumping actions may alter this outcome. This, however, is beyond the scope of the present article.

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SUMMARY

This article investigates the international duopoly equilibrium when two countries impose antidumping constraints. It shows that, depending on the parameters of the model, three Nash equilibria exist: one in which both firms trade, one in which no firm trades and one in which a single firm trades.

RESUME

Cet article analyse l'équilibre de duopole lorsque deux pays imposent des contraintes antidumping. Il montre que, suivant la valeur des paramètres du modèle, trois équlibres de Nash existent: un équilibre dans lequel les deux entreprises partagent les deux marchés, un équilibre dans lequel chaque entreprise ne vend que dans son marché domestique, et un équilibre dans lequel une entreprise vend dans les deux marchés alors que l'autre ne vend que dans son marché domestique.

ZUSAMMENFASSUNG

In diesem Artikel wird das Gleichgewicht eines internationalen Duopols untersucht, bei dem zwei Länder Antidumping-Massnahmen ergreifen. Es wird gezeigt, dass in Abhängigkeit der Parameter des Modells drei Nash-Gleichgewichte existieren: ein Gleichgewicht, in dem beide Firmen Güter international austauschen, ein anderes, in dem keine Firma internationalen Handel betreibt, und ein drittes, in dem nur eine Firma Güter exportiert.