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Abstract

This paper deals with the question whether loose competition policy with respect to strategic alliances may be a substitute for strategic trade policy. I use a concept of strategic alliances which allows to focus on the competition effect: In the first stage the firms decide about forming strategic alliances, in the second stage each alliance designs a strategic contract, and in the third stage alliance members and outsiders compete in the product market. Given this, there are two main differences between the two policy options: (i) Only strategic trade policy takes into account the effects on domestic consumers, (ii) Strategic alliances are not restricted to the case where all firms of one country join the same alliance. It will be shown that on balance allowing firms to form strategic alliances is a superior alternative to strategic trade policy.

JEL-classilication: D43, F12, L13, L41

Key words: strategic alliances, strategic trade policy, oligopoly, competition policy

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1 Introduction

Strategic trade policy is a central part of the so called "new trade theory": The behavior of oligopolistic firms in international markets is changed by a subsidy or tax in order to appropriate rents. This kind of policy works in principle but in practice there exist many problems. Among others, policy makers face the following three obstacles: (i) The government may lack relevant information about firms and markets and thus does not know whether to impose a subsidy or a tax. (ii) Because there exist social costs of public funds it is not assured that the net effect of the policy is positive. (iii) Strategic trade policy usually has adverse effects on foreign countries;[1] if foreign governments retaliate, a prisoners' dilemma may result where both countries are worse off relative to the non-intervention position. These and other problems of strategic trade policy have been extensively discussed in the literature (see e.g. *Eaton/Grossman, 1986*). Nevertheless the basic idea of strategic trade policy remains quite popular for many policy makers and they seek for alternative measures which avoid these problems but preserve the possibility of rent shifting.

This paper asks whether loose competition policy with respect to so called "strategic alliances" may constitute such an alternative. Forming strategic alliances has recently become quite popular among firms which compete in international markets. As will be shown in this paper, if the cooperating firms could gain a strategic advantage over their competitors, strategic alliances could lead to similar results as strategic trade policy. Given this, a loose competition policy with respect to strategic alliances may therefore form an alternative to strategic trade policy.[2] The apparent advantages of such a policy are that the government does not need specific information about the cost structure of firms or market conduct, one need not incure the social costs of public funds as in the case of a subsidy and the risk of foreign retaliation may be reduced because competition policy is a less overt action than subsidies.

Some related issues have already been addressed in the literature. *Auquier/Caves (1979)* discuss the conflict between competition policy and trade policy if the degree of competition can not be varied between domestic and foreign markets: In foreign markets home firms should behave like a single monopolist while in the home mar-

[1] See *Anis/Ross (1992)* for counterexamples.

[2] Public policy with respect to such forms of cooperation differs between countries. *Jorde/Teece (1990)* argue that the unfavorable treatment of production joint ventures in the United States relative to the European Community and Japan constitutes a severe disadvantage for American firms in international competition.

ket competitive behavior is optimal.[3] This conflict is also relevant in my paper. However, I focus on the effects of strategic behavior by firms and countries while *Auquier/Caves* remain in the context of the standard optimal tariff argument. *Dixit (1984)* and *Cowan (1989)* analyze the interaction of strategic trade policy and competition policy. However, in contrast to my paper they only consider merger policy (the government is able to influence the number of domestic firms). The impact of alliances on international competition has up to now only been analyzed in the context of research joint ventures in a oligopoly model with R&D spillovers (see *Motta, 1992* and *Steurs, 1995*). These papers concentrate on the effects of cooperation on R&D investment in an oligopoly model with two home firms and two foreign firms. The impact on product market competition and welfare is not a central issue and alternative policy measures (e. g. R&D subsidies) are not considered.

The remainder of the paper is organized as follows: In section 2 I analyze a Cournot oligopoly model with general demand and cost functions. I show that strategic alliances and strategic trade policy lead to the same result as long as there is no domestic consumption and all firms within a country become members of the strategic alliance. Furthermore I analyze how the results change if the product is also consumed domestically. In section 3 I use a linear model to derive some explicit results about the relative performance of the two policy options for different shares of domestic consumption and I determine the endogenous structure of alliances which results when firms are free to cooperate with each other.

2 General Model

In order to compare the impact of strategic trade policy and of strategic alliances on oligopolistic competition in an international oligopoly I use a model based on *Brander/Spencer 1985*. It is assumed that the firms compete in an integrated world market[4] for a homogenous good with two producing nations, home and foreign, and a third country which is solely an importer of the good. Demand is given by $p(X)$, where p is price, X is industry output, and $p'(X) < 0$. Given this, strategic trade policy and strategic alliances are modelled as first stage actions in a two stage game with Cournot–Nash competition between the oligopolists in the second stage. In order to assure stability of the Cournot equilibrium it is assumed that

[3]See also *Roderik (1989)* which analyzes how domestic market structure does affect optimal trade taxes.

[4]See *Dixit (1984)* for the analysis of strategic trade policy and competition policy in an alternative setting with segmented markets. For my analysis the assumption of an integrated market is more realistic because strategic alliances are most common in industries where firms compete in a world market which is almost perfectly integrated.

each firms reaction curve slopes downward [i. e. $p'(X) + x_i p''(X) < 0$] and that each firms residual demand curve intersects its marginal cost curve from above [i. e. $c''(x_i) > p'(X)$]. Throughout this section it will be assumed, that either all or none of one country's firms join in a strategic alliance. Therefore we must only distingish between the output of a home firm x_i^h and a foreign firm x_i^f. The number of firms in each country is given by n_h and n_f, respectively. It will be assumed that all firms are identical. Therefore total output is given by $X = X^h + X^f = n_h x_i^h + n_f x_i^f$.

2.1 Equivalence of Strategic Trade Policy and Strategic Alliances

Strategic trade policy is modelled as an output subsidy (or tax if applicable): The governments pay per unit subsidies s_h and s_f. These subsidies are credibly set in advance of the quantity decisions of the firms. How could the member firms of a strategic alliance achieve a similar commitment? The basic idea is as follows: The firms commit to a certain output level by signing a strategic contract which stipulates payments between the alliance members which are based on the individual output decisions. Budget balance within the alliance is assured by evenly sharing in a resulting surplus or loss. The contract has to be binding and must be observed by the other firms in the industry — a secret agreement would not induce any reaction by outsiders.

To be concrete, let us assume that all home firms form a strategic alliance. The alliance contract stipulates output based payments μ_h per unit. The output based payments to an alliance member i will be shared equally by the other $n_h - 1$ member firms: If they are positive, each of the other alliance members will contribute $1/(n_h - 1)$ of the sum; if they are negative, each firm will receive $1/(n_h - 1)$ of the sum. Thus the net transfer to firm i is given by:

$$t_i^h(x_1^h, \ldots, x_{n_h}^h) = \mu_h x_i^h - \mu_h \frac{1}{n_h - 1} \sum_{\substack{l=1 \\ l \neq i}}^{n_h} x_l \quad (1)$$

Now it will be shown that such transfer payments have the same effect on the incentives of firms as a subsidy. Suppose that the home government imposes a per unit subsidy s_h and that all home firms cooperate and the alliance members agree on output based payments μ_h. Assuming that all firms have identical cost functions $c(x_i)$, a domestic firms profit is then given by

$$\pi_i^h(x_1^h, \ldots, x_{n_h}^h, X^f, s_h, \mu_h) = x_i^h p(X) - c(x_i^h) + s_h x_i^h + \mu_h x_i^h - \mu_h \frac{1}{n_h - 1} \sum_{\substack{l=1 \\ l \neq i}}^{n_h} x_l. \quad (2)$$

The following first–order condition for profit maximization which implicitly defines the reaction function results:

$$\frac{\partial \pi_i^h}{\partial x_i^h} = x_i^h p' + p - c' + s_h + \mu_h = 0. \tag{3}$$

With respect to the incentives of the firm the subsidy and the output based payment between alliance members have identical effects, because neither the financing of the subsidy nor the transfer payments to the other alliance members are influenced by the output decision of the firm.

While production subsidies are a widley used policy measure, it is not common that firms forming a strategic alliance sign a contract which stipulates payments based on output decisions (besides, such contracts may be banned by antitrust legislation). However, the same effect will be achieved if the cooperating firms establish a production joint venture for an intermediate product, agree on an appropriate transfer price, and equally share in the resulting profits or losses of the joint venture. As shown in *Morasch (1994, pp. 90–94)* forming a joint venture with an appropriate transfer price is formally equivalent to signing an alliance contract with output based payments. In this paper the strategic contract formulation is used because it allows an analogic treatment of subsidies and strategic alliances.

A main difference between strategic alliances and strategic trade policy stems from the fact that the alliance members try to maximize joint profits while the government is interested in domestic welfare. However, these two objective functions coincide if there is no domestic consumption and if all domestic firms take part in a single alliance.[5] *Brander/Spencer (1985)* have shown for $n_h = n_f = 1$ that in the case of unilateral policy a positive subsidy will raise domestic welfare. When both governments use strategic trade policy, the equilibrium of the two-stage game is given by positive subsidies and lower welfare for both nations than in the situation without policy.

This prisoners' dilemma situation need not result in the case of an oligopoly with more than one firm in each producing country: In this case the standard terms of trade argument for an export tax is also relevant. Which of the two effects — rent shifting or terms of trade — dominates, depends on the number of firms and on the cost and demand structure. The same argument applies to strategic alliances: Whether the alliance members have an incentive to expand or to reduce output depends on the number of member firms and on the cost and demand structure. As shown in *Morasch (1995b)* — see also *Gaudet/Salant (1991)* — the profits of a group of k oligopolists in a market with n firms would rise by committing to

[5]It is assumed that the firms are wholly owned by domestic residents. For an analysis with internationally owned firms see *Welzel (1995)*.

a marginal expansion of output (what would be achieved by positive subsidies or transfer payments) if

$$k < 1 + \lambda(n-k) \quad \text{with} \quad \lambda \equiv -\frac{R'}{1+R'} = -\frac{p' + x_i p''}{c'' - p'}. \tag{4}$$

For symmetric countries with $n_h = n_f$ both governments will use positive subsidies as long as $\lambda > (n-2)/n$ — this holds independent of n for an oligopoly with linear demand and costs because $\lambda = 1$ in this case. Countries or alliances which are "large" relative to the number of firms in the world market will have an incentive to reduce output; the reduction of output would then result in a positive externallity for the other firms. Because an alliance need not comprise all firms of one country, the effects of alliances and subsidies may differ. However, without explicit information about the demand and cost structure it is not possible to say anything specific about the relative impact of the the two policy options. To shed some light on this issue, in section 3 the equilibria of a linear model are explicitly determined as a function of the alliance structure.

2.2 Analysis with Domestic Consumption

The subsidy levels and the output based payments will differ if the good is partly consumed within the two producing countries. If for simplicity it is assumed that the two producing countries are symmetric, the share of own production which is consumed domestically in each country is given by $\gamma = \gamma_h = \gamma_f \in [0, 0.5]$ — with $\gamma = 0$ all output is exported to the third country while $\gamma = 0.5$ indicates that everything is consumed within the two producing countries (because markets are integrated, each country exports half of the production to the other producing country). If $\gamma > 0$ the government will use higher subsidies because this increases consumer surplus as long as price exceeds marginal costs. In contrast the joint profit maximization problem of a strategic alliance will not change. For the case without retaliation (unilateral policy) the resulting output based transfer payments are too low to maximize domestic welfare and thus strategic alliances would be preferred.

Suppose now that both countries use strategic trade policy or allow strategic alliances, respectively. Because the effects on domestic consumption are neglected by the alliances, in equilibrium the output based transfer payments will be lower than the subsidies. What are the effects on welfare? For symmetric countries the following result can be proved:[6]

[6]The same argument applies for countries of different size as long as $\gamma_h/\gamma_f = n_h/n_f$, i. e. the relative size of the industry is identical in both nations.

Proposition 1 *(i) For $\gamma > 0$ the equilibrium subsidies exceed the transfer payments which result in the equilibrium with strategic alliances. (ii) If only a very small part of total production is consumed within the producing countries ($\gamma \to 0$), the subsidy equilibrium leads to subsidy levels which exceed the jointly optimal ones. In this case strategic alliances are preferred. (iii) If the good is only consumed by the two producing countries ($\gamma = 0.5$), there does exist a Nash–equilibrium in the subsidy game where joint welfare, $W^h + W^f$, of the two producing nations is maximized: The equilibrium subsidies induce output levels which lead to $p = c'$ for all firms. In this case strategic trade policy is preferred to strategic alliances.*

Proof: Because all firms within a country are identical it is convenient to argue on the basis of aggregate output X^h and X^f and aggregate profits Π^h.

ad (i) In the subsidy equilibrium for $\gamma = 0$ and in the strategic alliance equilibria irrespective of the value of γ the firms earn positive profits and thus $p > c'$. Given this, $\gamma > 0$ will give an extra incentive for subsidies because domestic consumer surplus will be increased if production rises. Thus for $\gamma > 0$ equilibrium subsidies will be higher than the transfer payments in the equilibrium with strategic alliances.

ad (ii) As long as domestic consumption is relatively low, it would be jointly optimal for the producing countries to reduce production (this is the standard terms of trade argument for an export tax). Because transfer payments are lower than subsidies for $\gamma > 0$, total production in the case of strategic alliances is lower and thus more in line with the jointly optimal production decision.

ad (iii) In the case of $\gamma = 0.5$ total consumer surplus of the producing countries is given by $CS = \int_0^X p(y)\,dy - p(X)X$ and by symmetry of both countries $CS^h = CS/2$. Suppose that both countries initially use subsidies which induce $p = c'$ and that the government of the home country marginally changes s_h^*, which in turn induces a marginal change of the output of home firms, X^h. This would not have a direct effect on W^h, the domestic welfare: $\partial\Pi^h/\partial X^h = p'(X)X^h + p(X) - c'(X) = p'(X)X^h$ because $p(X) - c'(X) = 0$ and $\partial CS/\partial X^h = p(X) - p'(X)X - p(X) = -p'(X)X$; the two effects cancel out because in equilibrium $X^h = X/2$ and $d\,CS^h = 1/2\,d\,CS$. However, the change of the subsidy level by the home government would also induce a reaction by foreign firms. dX^f has the following effects on Π^h and CS: $\partial\Pi^h/\partial X^f = p'(X)X^h$ and $\partial CS/\partial X^f h = -p'(X)X$; again the two effects cancel out.

To sum up: Strategic alliances and strategic trade policy yield the same results if all firms within a country cooperate and the product is not consumed domestically. With domestic consumption strategic trade policy is preferred in the case of unilateral policy, because the government does also consider the effect on consumer surplus. With bilateral policy, strategic alliances lead to higher welfare for the

producing countries if the extent of domestic consumption is relatively low. However, if goods are only consumed within the two producing countries joint welfare is maximized by strategic trade policy.

3 Linear Model

The general formulation does not allow the explicit determination of the equilibria. Therefore two questions which are quite important for the evaluation of strategic alliances in comparision with strategic trade policy could not be answered so far: (i) Given that the good is consumed domestically, under what conditions are strategic alliances superior to strategic trade policy and/or non–intervention? (ii) Given that the firms are free to form strategic alliances, what alliance structure will result and how is welfare affected?

To analyze these questions, a linear model with $p(X) = 1 - X$ and constant variable costs c will be used in the following. When dealing with question (i), the assumption that either all or none of the firms within a country cooperate will be maintained. In addition it will still be assumed that the two producing countries are symmetric — the number of firms and the extent of domestic consumption is identical in both countries. In contrast, the endogenous formation of alliances will be discussed in a setting with asymmetric countries: For $n \leq 10$ all possible combinations of the numbers of home and foreign firms will be considered. In order to keep the analysis tractable, however, the explicit comparisions in terms of welfare are restricted to the setting without domestic consumption.

3.1 Determination of the Equilibria

For a given number of home and foreign firms or a given alliance stucture a two–stage–game must be solved: Subsidies or output based payments are fixed in the first stage, firms compete in Cournot fashion in the second stage. I will first determine the strategic alliance equilibria of this game, which are not affected by the extent of domestic consumption. In a second step the subsidy equilibria with domestic consumption will be considered.

Equilibrium with Strategic Alliances

A strategic alliance aims to maximize the profits of its member firms. In order to achieve this result the transfer payments have to be fixed appropriately. Because it will now be assumed that an alliance does not necessarily comprise all firms of

one country, it is convenient to introduce a somewhat different notation which does not distinguish between home firms and foreign firms. The alliance structure — number and size of strategic alliances — will be expressed by $(n; k_1, \ldots, k_z)$ with z being the number of alliances and $k_j \leq n$ indicating the number of firms which comprise alliance αj (the index j will be used to indicate alliances, while i will be used to indicate firms). The output of a firm i which belongs to an alliance αj will be denoted by $x_i^{\alpha j}$ with $i \in \{\sum_{l=1}^{j-1} k_l + 1, \ldots, \sum_{l=1}^{j} k_l\}$.

For a given alliance structure the following two–stage game must be analyzed: In the first stage the alliance members determine the output based transfer payments μ_j. In the second stage alliance members and outsiders choose their output levels x_i. In a first step the equilibrium output levels must be determined as a function of the μ_j. The μ_j will change the incentives of the cooperating firms in the same way as a change in marginal costs by the same amount would have done. Thus the profit function of firm i which is member of alliance αj is given by:

$$\pi_i^{\alpha j}(\mu_j) = [1 - X - c]x_i^{\alpha j} + \mu_j x_i^{\alpha j} - \mu_j \frac{1}{k_j - 1} \sum_{\substack{l=1 \\ l \neq i}}^{k_j} x_l^{\alpha j} \tag{5}$$

This leads to the following first order condition:

$$1 - X + x_i^{\alpha j} p'(X) - c + \mu_j = 0 \tag{6}$$

The equilibrium outputs in a quantity setting oligopoly with strategic alliances are the same as in an asymmetric Cournot oligopoly with marginal costs $c - \mu_j$ for firms which belong to alliance αj and c for outsiders (which will be indicated by the superscript ω). Solving first–order conditions in the familiar way (including imposing symmetry of all firms comprising one alliance) yields

$$x_i^{\alpha j}(\mu_1, \ldots, \mu_z) = \frac{1 - c + (n+1)\mu_j - \sum_{l=1}^{z} k_l \mu_l}{(n+1)} \tag{7}$$

$$x_i^{\omega}(\mu_1, \ldots, \mu_z) = \frac{1 - c - \sum_{l=1}^{z} k_l \mu_l}{(n+1)}. \tag{8}$$

If the equilibrium outputs are substituted in equation (5), the profits of alliance members are obtained as a function of the alliance structure $(n; k_1, \ldots k_z)$ and the transfer payments μ_j. Based on this, we can solve the game on the second stage and obtain the subgame perfect Nash–equilibrium transfer payments as follows:

$$\mu_j^*(n; k_1, \ldots, k_z) = \frac{(1-c)(n+1-2k_j)}{k_j[(z+1)(n+1) - 2\sum_{l=1}^{z} k_l]} \tag{9}$$

Note that μ_j^* is only positive if $k_j < (n+1)/2$ — larger alliances will use negative transfer payments and thus reduce production relative to the Cournot equilibrium.

Equilibrium Subsidies with Domestic Consumption

If the products are also consumed domestically, a country which wants to impose a output subsidy or tax must also consider the impact on domestic consumer surplus. With linear demand $p(X) = 1 - X$ total consumer surplus is given by $X^2/2$. As in section 2 it will be assumed that the two producing countries are symmetric; thus the share of own production which is consumed domestically will be indicated by $\gamma \in [0, 0.5]$. Given this, the government of the home country aims to maximize the following function:[7]

$$W^h(X^h, X^f) = [1 - c - (X^h + X^f)]X^h + \gamma(X^h + X^f)^2/2 \tag{10}$$

Subsidies affect the total output of all home firms as follows:

$$X^h(s_h, s_f) = \frac{n_h[1 - c + (n+1)s_h - n_h s_h - n_f s_f]}{(n+1)} \tag{11}$$

Based on this, the subsidy in the case of unilateral and bilateral policy may be determined. To facilitate comparisions, I also report the output based transfer payments in the case of strategic alliances which comprise all firms of a country. If only the home country imposes a subsidy or only home firms cooperate the equilibria are given by:

$$s_h^*(s_f = 0) = \frac{(1-c)[(n+1-2n_h) + \gamma n]}{n_h[(2+2n_f) - \gamma)]} \tag{12}$$

$$\mu_h^*(n; n_h) = \frac{(1-c)(n+1-2n_h)}{n_h(2+2n_h)} \tag{13}$$

If both countries are engaged in strategic trade policy or firms in both countries form a strategic alliance, the following subsidy s_h^* and output based payments μ_h^* result:

$$s_h^* = \frac{(1-c)[(n+1-2n_h) + \gamma(3n_h - n_f)]}{n_h[(3+n) - 2\gamma)]} \tag{14}$$

$$\mu_h^*(n; n_h, n_f) = \frac{(1-c)(n+1-2n_h)}{n_h(3+n)} \tag{15}$$

The equilibrium values of s_h and μ are identical if $\gamma = 0$. For symmetric countries, $\partial s_h/\partial\gamma > 0$ — subsidies are thus higher than transfer payments for $\gamma > 0$.[8]

[7] Because countries are symmetric, the same analysis applies to the decision problem of the foreign government — in this case only the indices h and f have to be substituted for each other.

[8] Note, however, that for asymmetric countries with $n_i > 3n_j$ ($i, j \in \{h, f\}$) the subsidies may be lower in the case of bilateral policy.

3.2 Linear Cournot Oligopoly with Domestic Consumption

Based on the equilibrium values of subsidies and transfer payments the welfare effects of strategic trade policy and strategic alliances in a linear Cournot oligopoly with domestic consumption may be analyzed in detail. For the case of unilateral policy it has already been shown that strategic trade policy is preferable if $\gamma > 0$. I will now compare the two policy options in the case of bilateral policy with the alternatives of subsidies which would maximize the joint welfare of the two producing countries and a commitment to non-intervention by both countries. The tax/subsidy level $s_h^{max} = s_f^{max}$ which would maximize the joint welfare of the both producing contries is given by

$$s^{max} = s_h^{max} = s_f^{max} = \frac{(1-c)(n-1-2\gamma n)}{2\gamma n - 2n}. \tag{16}$$

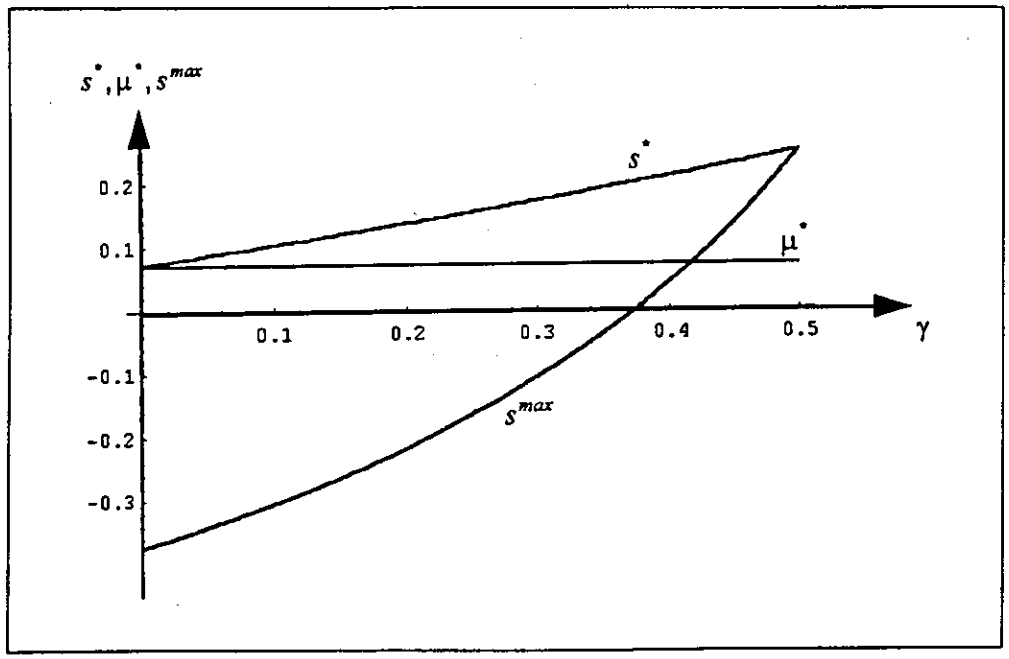

Figure 1: s^*, μ^* and s^{max} as function of γ for $n = 4$

Figure 1 shows s^{max} and the equilibrium values $\mu^* = \mu_h^* = \mu_f^*$ and $s^* = s_h^* = s_f^*$ as a function of γ for $n = 4$. Note that the firms should be taxed if γ is smaller than $(n-1)/2n$ — here the terms of trade effect of lower production dominates the higher consumer surplus which would result by expanding production. As can be

seen by inspection of equation (15), in the symmetric setting the equilibrium with strategic alliances always leads to positive transfer payments; thus for $\gamma < (n-1)/2n$ strategic alliances are worse than non-intervention but better than strategic trade policy. What happens if $\gamma > (n-1)/2n$? For $\gamma = 0.5$ the subsidies equal $(1-c)/n$ and conincide with the equilibrium subsidies in the case of bilateral strategic trade policy [see equations (14) and (16)] — as has been shown in section 2 this result does also hold in a more general setting. For $\gamma \in](n-1)/2n, 0.5[$ either non-intervention, strategic alliances or strategic trade policy may be the second best solution. Figure 2 shows for $n_h \in [2, \ldots, 10]$ the limit values for $W^h(\mu_h^*) > W^h(s_h = 0)$ and $W^h(s_h^*) > W^h(\mu_h^*)$.

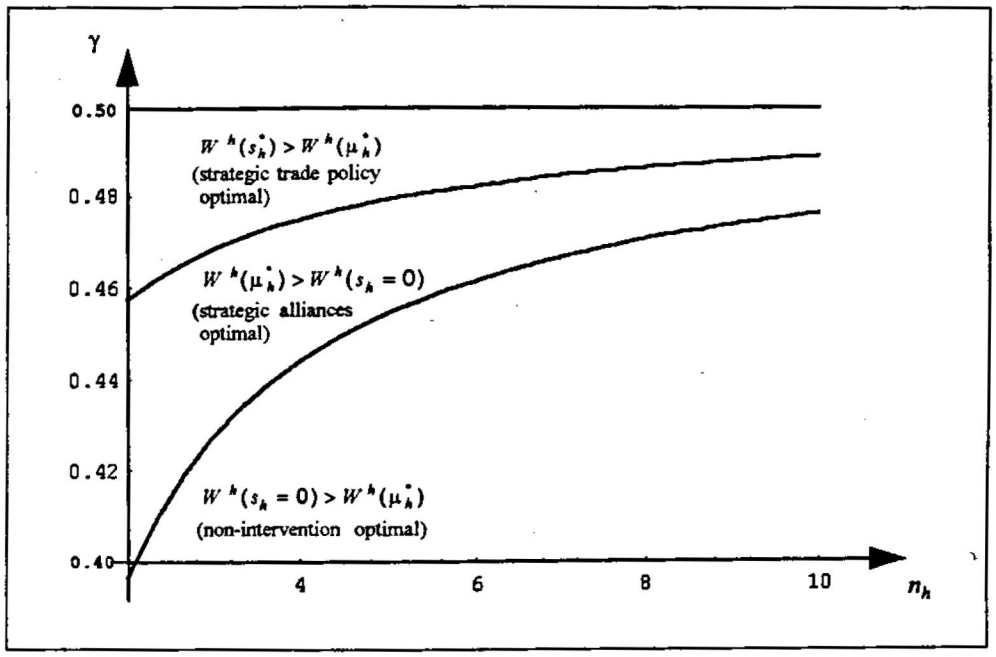

Figure 2: Second best policy options as a function of n_h and γ

While strategic alliances lead to higher welfare than strategic trade policy as long as at least 10% of world production is exported to the third country, non-intervention of both countries would be even better in most cases. Figure 3 shows for $n = 4$ how the welfare with strategic alliances and strategic trade policy differs from the welfare without policy intervention (the welfare in the case of non-intervention is normalized to 1).

To sum up: For $\gamma > (n-1)/2n$ there exists a range of γ where the alliance solution dominates strategic trade policy and non-intervention; however, the welfare

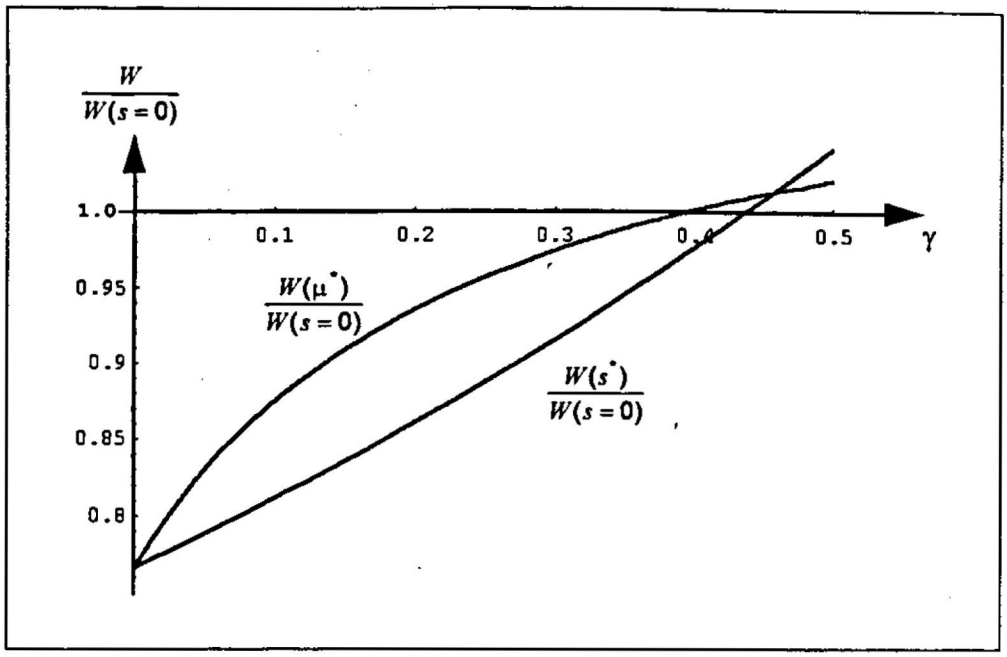

Figure 3: Welfare with alliances, subsidies and non-intervention

differences are not very substantial. Compared with non-intervention, both strategic alliances and strategic trade policy lead to much lower welfare levels for small γ. For $\gamma > 0.2$, however, the welfare difference between strategic alliances and strategic trade policy is larger than the difference beween non-intervention and strategic alliances — if commitment to non-intervention is not achievable, the alliance solution does much less harm than strategic trade policy.

3.3 Endogenous Structure of Strategic Alliances

Until now it has been assumed that the alliance structure is exogenously given: All home firms became members of one alliance and, in the case of bilateral policy, all foreign firms joined in another alliance. In reality, however, it is quite common that only a part of the firms within a country cooperate with each other and that firms form international alliances (alliances which comprise firms of different countries). In this section I will analyze the endogenous determination of the alliance structure based on the incentives of the oligopolists, on the institutional setting (the formation of strategic alliances may be banned in one of the countries) and on "cultural"

constraints (the firms may refrain from cross–country alliances because of cultural differences which render such alliances difficult).

The analysis of alliance formation is based on the concept of "stable alliance structures" and a non–cooperative game of alliance formation, both developed in *Morasch (1995a)*. In section 3.1 the equilibrium transfer payments for a given alliance structure have been derived. Based on this, the equilibrium profits of a firm which is a member of alliance αj and of an outsider are given by:[9]

$$\pi_i^{\alpha j} = \frac{n+1-k_j}{k_j} \frac{(1-c)^2}{[(z+1)(n+1)-2\sum_{l=1}^{z} k_l]^2} \tag{17}$$

$$\pi_i^{\omega} = \frac{(1-c)^2}{[(z+1)(n+1)-2\sum_{l=1}^{z} k_l]^2} \tag{18}$$

Note that the profits of an outsider are higher than the profits of an alliance member if $k_j > (n+1)/2$; thus members of alliances which are large relative to the number of firms within the industry may have an incentive to leave the alliance and become an outsider.

The equilibrium profits of the two–stage game for a given alliance structure determine the payoffs of the alliance formation game — the alliance formation process is then modelled as the first stage of a three–stage game. Following the analysis of coalition formation by *Hart/Kurz (1983)* I will require that an equilibrium alliance structure has to be stable with respect to both single firm and group deviation. Thus an alliance structure is said to be "stable" if the following four conditions are met: (1) Each member firm of a strategic alliance could not earn higher profits if it leaves his alliance and becomes an outsider. (2) None of the outsiders has an incentive to join an alliance which does not block entry.[10] (3) No subset of alliance members of a given alliance could earn higher profits by leaving this alliance and forming a smaller one. (4) No subset of alliances and/or outsiders could form one larger alliance that is stable with respect to single firm deviation and leads to higher profits for each member firm.

When analyzing possible deviations from a given alliance structure, different assumptions are made with respect to single firm deviation (conditions 1 and 2) and group deviation (3 and 4): It is assumed that a single firm would leave the alliance, if as an outsider it could earn higher profits given that all other firms do not change their decisions ("Nash deviation"). In contrast, another alliance will only be formed if the member firms could expect higher profits even after all other firms have

[9] To make it easier for the reader to check my results, the profits for all alliance structures with $n \leq 10$ are reported in the appendix (for $p(X) = 100 - X$ and $c = 0$).

[10] Entry of another firm will be blocked if it reduces the profits of the firms which are already members of the alliance.

reoptimated their decisions.[11] How could these assumptions be justified? I do not explicitly consider time consuming contracting and reorganization processes in my model. However, single firm deviation and group deviation differ precisely in this respect: When a firm wants to leave a given alliance this may be achieved relatively easily while forming a new alliance is a much more complex and time consuming task. To give this idea an explicit time structure: Suppose the firms decide about alliance formation in period $t = 1$, in $t = 2$ the necessary contracting and reorganization processes take place, and in $t = 3$ the firms compete in the product market. If in $t = 2$ some firms left a given alliance and decided to form another one, these firms would not be able to carry out the contracting and reorganization processes in the same period and thus could not influence the product market competition in $t = 3$; therefore a deviation from the proposed alliance structure is only feasible in $t = 1$ and in this case the other firms would be able to react accordingly. However, for a single firm it may be possible to leave a given alliance in $t = 2$ and to compete as a Cournot oligopolist in $t = 3$; at this time the other firms could do nothing more than adjust their production decisions — forming new alliances is no longer feasible.

In order to explicitly determine the stable alliance structures in the linear model a non–cooperative game, based on *Bloch (1995)*, will be analyzed.[12] For the case of international alliances the game can be described as follows: The n symmetric players are ordered and the first player names an integer a_1, either 1 (if the firm does not want to cooperate) or the number of firms which are supposed to be part of alliance $\alpha 1$; accordingly player $a_1 + 1$ names an integer a_2 and this process will continue until $\sum a_i = n$. The action space of a firm i which has to make a choice is thus given by $a_i \in \{1, \ldots, n - i + 1\}$. An outcome of the game is a partition of the set of firms into disjoint alliances (remaining outsiders being a special case of an alliance). An outcome of the alliance formation game directly determines an alliance structure $(n; k_1, \ldots, k_z)$ and a corresponding payoff vector $(\pi_i^{\alpha 1}, \ldots, \pi_i^{\alpha z}, \pi_i^{\omega})$.[13] Based on these payoff vectors the equilibrium alliance structure may be determined by backward induction. Because this alliance formation game is a finite game with perfect information the existence of a subgame–perfect Nash equilibrium is assured (see *Fudenberg/Tirole, 1991, p. 91* for a proof).

The same procedure will be applied if strategic alliances are only permitted in one country: In this case, however, only the firms of this country are players in the alliance formation game. If alliances are permitted in both countries but international

[11] For a similar approach see the concept of far–sighted strong equilibrium of *Li (1992)*.

[12] *Bloch (forthcoming)* shows that for symmetric firms the equilibrium alliance structure generated by this game coincides with the Markov–perfect equilibrium structures of an alternating offer bargaining game based on *Selten (1981)* which closely reflects real procedures of alliance formation.

[13] Because all firms are symmetric, only the number but not the identity of the outsiders is relevant.

alliances are not feasible because of huge cultural differences, the analysis becomes somewhat more complicated. In this case the equilibrium alliance structure in each country has to be derived for every possible alliance structure in the other country. Given this, a Nash–equilibrium of a simultaneous move game where the firms in both countries choose an stable alliance structure has to be determined.

Given the assumptions about stable alliance structures and the game of alliance formation, I have analyzed the alliance formation process for all three scenarios: Alliances only in one country, "national" alliances in both countries and international alliances. The stable alliance structures and the results of the alliance formation game have been explicitly derived for $n \leq 10$. To obtain the results, the equilibrium profits for all possible alliance structures have been computed for $p(X) = 100 - X$ and $c = 0$ (see the tables in the appendix). Based on this information the extensive form (the "game tree") of the game of alliance formation has been constructed. Then this game has been solved by applying subgame perfection in connection with the refinement that an alliance has to be stable with respect to single firm deviation (in alliances which comprise more than $(n+3)/2$ members, a firm is better off if it leaves the alliance and becomes an outsider — see equations (17) and (18)). If this refinement is applied, the alliance formation game always results in a stable alliance structure.[14]

As an example I will show how the equilibrium has been determined in the case of international alliances for $n = 5$. The same reasoning applies in all other cases. Table 1 gives an description of the extensive form of the game.[15]

As already mentioned, the game will be solved by backward induction. Firm 4 always prefers $a_4 = 2$ when a subgame is reached where it has to choose. Given this firm 3 will play $a_3 = 2$ whenever it has to decide. Based on this the optimal strategy for firm 2 is given by $a_2 = 4$ and the first firm earns the highest profits if it refrains from cooperating ($a_1 = 1$).[16] Thus the equilibrium alliance structure is given by $(5; 4)$.

[14] In the case of national alliances in both countries I derived the stable alliance structures in each country for all possible alliance structures in the other country. Then I determined the Nash equilibrium of the resulting simultaneous move game between the two countries.

[15] The profits in bold face are the decision relevant profits; the boxes show which strategy is optimal on the relevant stage. Because the last firm could not choose between different strategies, only the strategies of $n-1$ firms are reported.

[16] Note that a five firm alliance would not be stable with respect to single firm deviation.

n	a_1	a_2	a_3	a_4	π_1	π_2	π_3	π_4	π_5
5	1	1	1	1	2.78	2.78	2.78	**2.78**	2.78
				2	1.56	1.56	**1.56**	**3.13**	3.13
			2		1.56	**1.56**	**3.13**	3.13	1.56
			3		2.78	2.78	**2.78**	2.78	2.78
		2		1	1.56	3.13	3.13	**1.56**	1.56
				2	1.00	**2.00**	2.00	**2.00**	2.00
		3			2.78	**2.78**	2.78	2.78	2.78
		4			**6.25**	**3.13**	3.13	3.13	3.13
	2		1	1	3.13	3.13	1.56	**1.56**	1.56
				2	2.00	2.00	**1.00**	**2.00**	2.00
			2		**2.00**	2.00	**2.00**	2.00	1.00
			3		3.13	3.13	**1.56**	1.56	1.56
	3			1	2.78	2.78	2.78	**2.78**	2.78
				2	**1.56**	1.56	1.56	**3.13**	3.13
	4				**3.13**	3.13	3.13	3.13	6.25
	5				**5.00**	5.00	5.00	5.00	5.00

Table 1: Alliance formation game for $n = 5$

Now I am able to answer the central questions:

- Which alliance structure will result in equilibrium?
- How is welfare affected relative to non–intervention and to strategic alliances?[17]

The results for $n \leq 10$ are presented in tables 2 and 3. I distinguish between four cases: National alliances in the home country, national alliances in the foreign country, national alliances in both countries and international alliances. The numbers indicate how many firms are members of alliance $\alpha 1$, $\alpha 2$ and $\alpha 3$ — for example $2, 2|2$ represent two two–firm alliances in the home country and one two–firm alliance in the foreign country. In the line below I show how welfare is affected by the given alliance structure. The signs have the following meaning: The first two signs refer to the change of welfare relative to non–intervention, sign $[W^h(\mu^*) - W^h(s = 0)]$, and the strategic alliance equilibrium, sign $[W^h(\mu^*) - W^h(s^*)]$. The next two signs give the same information with respect to foreign welfare — sign $[W^f(\mu^*) - W^f(s = 0)]$

[17]Note that the welfare analysis is restricted to the case without domestic consumption.

and sign $[W^f(\mu^*) - W^f(s = 0)]$. The last two signs indicate how joint welfare of the two producing countries is changed relative to the non-intervention solution, sign $[W^{h+f}(\mu^*) - W^{h+f}(s = 0)]$, and how world welfare is affected, sign $[W^{\Sigma}(\mu^*) - W^{\Sigma}(s = 0)]$.

n	n_h	n_f	national, h only α_1,α_2 / ΔW	national, f only α_3 / ΔW	national, both $\alpha_1,\alpha_2\|\alpha_3$ / ΔW	international $\alpha_1,\alpha_2,\alpha_3$ / ΔW
2	1	1	-	-	-	2 ++|++|+−
3	2	1	2 OO|OO|OO	-	-	3 ++|++|+−
4	2	2	2 +O|−O|−+	2 −O|+O|−+	2|2 −O|−O|−+	4 ++|++|+−
	3	1	3 +O|+O|+−	-	-	+O|+−|+−
5	3	2	2 +−|−−|−+	2 −O|+O|−+	2|2 −+|−−|−+	4 ++|++|+−
	4	1	4 +O|+O|+−	-	-	+?|+?|+−
6	3	3	2 +−|−−|−+	2 −−|+−|−+	2|2 −−|−−|−+	3,2 −?|−?|−+
	4	2	3 +−|−−|−+	2 −O|+O|−+	3|2 −+|+−|−+	−+|−−|−+
	5	1	4 +−|+−|+−	-	-	−−|−−|−+
7	4	3	3 +−|−−|−+	2 −−|++|−+	3|2 −−|−−|−+	3,3 −+|−−|−+
	5	2	4 O−|O−|OO	2 −O|+O|−+	2,2|2 −−|−−|−+	−+|−−|−+
	6	1	5 +−|+−|+−	-	-	−−|−−|−+

Table 2: Alliance structure and welfare comparisions for $n \leq 7$

In lieu of discussing each of the many cases, I will point out the general tendencies.

- If in the case of national alliances the industry of a country comprises only two firms, these firms will cooperate. With at least three firms within a country

n	n_h	n_f	national, h only α_1,α_2 / ΔW	national, f only α_3 / ΔW	national, both $\alpha_1,\alpha_2 \mid \alpha_3$ / ΔW	international $\alpha_1,\alpha_2,\alpha_3$ / ΔW
8	4	4	3 +−|−|−+	3 −|+−|−+	3|3 −|−|−+	4,3 −?|−?|−+
	5	3	4 +−|−|−+	2 −|+−|−+	2,2|2 −|−|−+	−+|−|−+
	6	2	5 +−|+−|+−	2 −O|+O|−+	5|2 −+|+−|−+	−+|−|−+
	7	1	3,3 −|−|−+	-	-	−|−|−+
9	5	4	4 +−|−|−+	3 −|+−|−+	4|3 −|−|−+	4,4 −+|−|−+
	6	3	5 O−|O−|OO	2 −|+−|−+	5|2 −|+−|−+	−+|−|−+
	7	2	6 +−|+−|+−	2 −O|+O|−+	3,3|2 −+|−|−+	−+|−|−+
	8	1	4,3 −−|−|−+	-	-	
10	5	5	4 +−|−|−+	4 −|+−|−+	4|4 −|−|−+	4,3,2 −|−|−+
	6	4	3,2 −|−|−+	3 −|+−|−+	3,2|3 −|−|−+	−|−|−+
	7	3	6 +−|−|−+	2 −|+−|−+	3,3|2 −|−|−+	−?|−|−+
	8	2	5,2 −|−|−+	2 −O|+O|−+	4,3|2 −+|−|−+	−+|−|−+
	9	1	4,4 −|−|−+	-	-	−|−|−+

Table 3: Alliance structure and welfare comparisions for $n = 8, 9, 10$

usually one firm will remain an outsider[18] and the other firms will form one or two alliances.

In the case of unilateral policy the welfare of the country with alliances will shrink relative to non-intervention if two alliances form (otherwise $W^h(\mu^*) \geq$

[18]All firms cooperate for $n_h = 3$ and $n_h = 4$ if $n_f = 1$.

$W^h(s = 0)$). Strategic trade policy will always lead to higher welfare than strategic alliances if the alliance does not comprise all firms of the country; however, the welfare difference is usually not quite large.

In the case of bilateral policy usually both countries are worse off relative to non–intervention. However, in some cases with asymmetric countries the smaller country is better off, because the alliance in the large country reduces output. The alliance solution could only dominate the strategic trade policy equilibrium for a large country which would impose a tax.

- In the case of international alliances for $n \leq 5$ a single alliance will be formed which comprises all firms or all but one firm (for $n = 5$). The producing countries will thus be better off than in the case of national alliances in both countries (however, worldwide welfare will be reduced).

  If $n \geq 6$ at least two alliances will form and the welfare of each producing nations will be reduced relative to the non–intervention equilibrium. Given this, for producing countries with less than $n/2$ firms the strategic trade policy equilibrium leads to higher welfare than the equilibrium with international alliances; otherwise the result depends on the exact alliance structure (the partition of domestic and foreign firms into different alliances).

4 Conclusion

In this paper it has been shown that allowing strategic alliances may lead to the same result as strategic trade policy. However, the differences of the two policy instruments have also been discussed: (i) If goods are consumed domestically the positive effects of this consumption on domestic welfare will not be considered by the cooperating firms. (ii) It is not assured that all firms within a country will become members of the strategic alliance: Entry may be blocked by other alliance members and, if possible, international alliances may be formed.

In the case of domestic consumption unilateral strategic trade policy leads to higher welfare than the alliance solution. However, the analysis of bilateral policy in the linear model showed that alliances of all firms within a country are preferred as long as at least 10% of total production is exported to the third country. If the endogenous formation of strategic alliances is restricted to national alliances because of cultural barriers, the relative performance of the two policy options crucially depends on the relative size of the industries in the two countries. Without domestic consumption the trade policy solution is usually somewhat better. In the case of international alliances a single alliance will be formed if $n \leq 5$ which is the optimal solution from

the point of view of the producing countries. However, if the industry comprises more than six firms, at least two alliances will form.

To sum up: Strategic alliances usually lead to somewhat lower welfare than strategic alliances in the case of unilateral policy. In the case of bilateral policy the relative performance depends on the circumstances. In most cases it would be best if the government could assure that all firms within a country join in a single alliance. On balance I would argue that the possible disadvantages of the alliance solution relative to strategic trade policy will be more than compensated by the advantages mentioned in the introduction. However, it should be noted that a welfare improvement relative to non–intervention is only assured under special circumstances.

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Appendix

n	k_1	k_2	k_3	π_i^{ω}	$\pi_i^{\alpha 1}$	$\pi_i^{\alpha 2}$	$\pi_i^{\alpha 3}$
2				11.11			
2	2				12.50		
3				6.25			
3	2			6.25	6.25		
3	3				8.33		
4				4.00			
4	2			2.78	4.17		
4	3			6.25	4.17		
4	4				6.25		
4	2	2			3.06	3.06	
5				2.78			
5	2			1.56	3.13		
5	3			2.78	2.78		
5	4			6.25	3.13		
5	5				5.00		
5	2	2		1.00	2.00	2.00	
5	3	2			1.56	3.13	
6				2.04			
6	2			1.00	2.50		
6	3			1.56	2.08		
6	4			2.78	2.08		
6	5			6.25	2.50		
6	6				4.17		
6	2	2		0.59	1.48	1.48	
6	3	2		0.83	1.10	2.07	
6	3	3			1.65	1.65	
6	4	2			0.93	3.09	
6	2	2	2		0.98	0.98	0.98

Table 1: Profits as a function of the alliance structure for $n = 2, 3, 4, 5, 6$

n	k_1	k_2	k_3	k_4	π_i^{ω}	$\pi_i^{\alpha 1}$	$\pi_i^{\alpha 2}$	$\pi_i^{\alpha 3}$	$\pi_i^{\alpha 4}$
7					1.56				
7	2				0.69	2.08			
7	3				1.00	1.67			
7	4				1.56	1.56			
7	5				2.78	1.67			
7	6				6.25	2.08			
7	7					3.57			
7	2	2			0.39	1.17	1.17		
7	3	2			0.51	0.85	1.53		
7	3	3			0.69	1.16	1.16		
7	4	2			0.69	0.69	2.08		
7	4	3				1.00	1.67		
7	5	2				0.60	3.00		
7	2	2	2		0.25	0.75	0.75	0.75	
7	3	2	2			0.51	0.93	0.93	
8					1.24				
8	2				0.51	1.79			
8	3				0.69	1.39			
8	4				1.00	1.25			
8	5				1.56	1.25			
8	6				2.78	1.39			
8	7				6.25	1.79			
8	8					3.13			
8	2	2			0.28	0.97	0.97		
8	3	2			0.35	0.69	1.21		
8	3	3			0.44	0.89	0.89		
8	4	2			0.44	0.56	1.56		
8	4	3			0.59	0.74	1.18		
8	4	4				1.03	1.03		
8	5	2			0.59	0.47	2.07		
8	5	3				0.66	1.65		
8	6	2				0.41	2.89		
8	2	2	2		0.17	0.61	0.61	0.61	
8	3	2	2		0.21	0.41	0.72	0.72	
8	3	3	2			0.50	0.50	0.86	
8	4	2	2			0.31	0.88	0.88	
8	2	2	2	2		0.42	0.42	0.42	0.42

Table 2: Profits as a function of the alliance structure for $n = 7$ and $n = 8$

n	k_1	k_2	k_3	k_4	π_i^{ω}	$\pi_i^{\alpha 1}$	$\pi_i^{\alpha 2}$	$\pi_i^{\alpha 3}$	$\pi_i^{\alpha 4}$
9					1.00				
9	2				0.39	1.56			
9	3				0.51	1.19			
9	4				0.69	1.04			
9	5				1.00	1.00			
9	6				1.56	1.04			
9	7				2.78	1.19			
9	8				6.25	1.56			
9	9					2.78			
9	2	2			0.21	0.83	0.83		
9	3	2			0.25	0.58	1.00		
9	3	3			0.31	0.71	0.72		
9	4	2			0.31	0.46	1.24		
9	4	3			0.39	0.59	0.91		
9	4	4			0.51	0.77	0.77		
9	5	2			0.31	0.46	1.24		
9	5	3			0.51	0.51	1.19		
9	5	4				0.69	1.04		
9	6	2			0.51	0.34	2.04		
9	6	3				0.46	1.62		
9	7	2				0.30	2.78		
9	2	2	2		0.13	0.51	0.51	0.51	
9	3	2	2		0.15	0.35	0.59	0.59	
9	3	3	2		0.17	0.41	0.41	0.69	
9	3	3	3			0.48	0.48	0.48	
9	4	2	2		0.17	0.26	0.69	0.69	
9	4	3	2			0.31	0.48	0.83	
9	5	2	2			0.21	0.83	0.83	
9	2	2	2	2	0.09	0.35	0.35	0.35	0.35
9	3	2	2	2		0.23	0.39	0.39	0.39

Table 3: Profits as a function of the alliance structure for $n = 9$

n	k_1	k_2	k_3	k_4	k_5	π_i^{ω}	$\pi_i^{\alpha 1}$	$\pi_i^{\alpha 2}$	$\pi_i^{\alpha 3}$	$\pi_i^{\alpha 4}$	$\pi_i^{\alpha 5}$
10						0.83					
10	2					0.31	1.39				
10	3					0.39	1.04				
10	4					0.51	0.89				
10	5					0.69	0.83				
10	6					1.00	0.83				
10	7					1.56	0.89				
10	8					2.78	1.04				
10	9					6.25	1.39				
10	10						2.50				
10	2	2				0.16	0.72	0.72			
10	3	2				0.19	0.50	0.85			
10	3	3				0.23	0.61	0.61			
10	4	2				0.23	0.40	1.00			
10	4	3				0.28	0.49	0.74			
10	4	4				0.35	0.61	0.61			
10	5	2				0.28	0.33	1.25			
10	5	3				0.35	0.42	0.92			
10	5	4				0.44	0.53	0.78			
10	5	5					0.71	0.71			
10	6	2				0.35	0.29	1.56			
10	6	3				0.44	0.37	1.19			
10	6	4					0.49	1.04			
10	7	2				0.44	0.25	2.00			
10	7	3					0.34	1.58			
10	8	2					0.22	2.66			
10	2	2	2			0.10	0.44	0.44	0.44		
10	3	2	2			0.11	0.30	0.50	0.50		
10	3	3	2			0.13	0.34	0.34	0.57		
10	3	3	3			0.15	0.39	0.39	0.39		
10	4	2	2			0.13	0.22	0.57	0.57		
10	4	3	2			0.15	0.26	0.39	0.67		
10	4	3	3				0.30	0.46	0.46		
10	4	4	2				0.30	0.30	0.78		
10	5	2	2			0.15	0.18	0.67	0.67		
10	5	3	2				0.21	0.46	0.78		
10	6	2	2				0.15	0.78	0.78		
10	2	2	2	2		0.07	0.30	0.30	0.30	0.30	
10	3	2	2	2		0.07	0.20	0.33	0.33	0.33	
10	3	3	2	2			0.22	0.22	0.37	0.37	
10	4	2	2	2			0.14	0.37	0.37	0.37	
10	2	2	2	2	2		0.21	0.21	0.21	0.21	0.21

Table 4: Profits as a function of the alliance structure for $n = 10$

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