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Collusive Market Sharing with Spatial Competition

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Collusive Market Sharing with Spatial Competition

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Abstract

This paper develops a spatial model to analyze the stability of a market sharing agreement between two firms. We find that the stability of the cartel depends on the relative market size of each firm. Collusion is not attractive for firms with a small home market, but the incentive for collusion increases when the firm's home market is getting larger relative to the home market of the competitor. The highest stability of a cartel and additionally the highest social welfare is found when regions are symmetric. Further we can show that a monetary transfer can stabilize the market sharing agreement.

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1 Introduction

Market sharing agreements between independent firms are set up to suppress competition. Firms join together to split up a certain territory between them, so that each cartel member serves a part of the whole territory as a monopoly and does not invade the territory of the other firms. This kind of agreement can be observed in many industries. For example the European Commission identified a market sharing agreement in the market of Choline chloride in 2004, where the cartel members

"...allocate markets worldwide among the participating undertakings, including an agreement that the North American producers would withdraw from the european market." (EC decision on Choline cloride, Case COMP/E-2/37.533)

The industrial organization literature on collusive behaviour focuses on agreements on a price or quantities.[1] Approaches to analyze the effects of market sharing agreements are relatively few. Belleflamme and Bloch (2008) study market sharing agreements in a duopoly model where firms face fixed costs of production in a spaceless model. [2]

Gross and Holahan (2003) study collusive market sharing a model with spatially separated markets. Each firm is located in its home market and is faced with transportation costs to serve the other market. They show that increasing transportation costs tend to destabilize the collusive agreement if firms compete in prices. Andree (2012) extends the analysis of Gross and Holahan (2003) to quantity competition and shows that market sharing agreements are more stable with higher transportation costs in this model setting.

However, Gross and Holahan (2003) and Andree (2012) use a spatial model where markets are separated by interregional transportation costs. These models analyse the geographic situation of two separated cities where distance between these cities is significant but transport inside a city is costless. These models do not count for intraregional transportation costs. We develop a spatial model to analyze market sharing agreements if intraregional transportation costs matter. We assume that there are two regions and two firms. In a market sharing agreement each firm serves only its home region. Further, using our model we can analyze the stability of a collusive agreement if regions are spatially asymmetric. This case is relevant, since it is hard to imagine a case where firms can split up a territory in exactly symmetric regions.

Our results indicate that market sharing agreements are credible in a spatial world, because both firms have incentives to stick to the agreement. However, asymmetry of the regions destabilizes the collusive agreement, because the firm located in the smaller region has a higher incentive to deviate from collusion than with symmetric regions. Further, we can show that stable collusion reduces welfare with asymmetric regions. In our model higher intraregional transportation costs stabilize the collusive agreement.

We extend our model to allow for a secret monetary transfer between the firms, leading to stable collusion.

[1] A survey is given by Feuerstein (2005). Collusion in spatial markets has been studied by Chang (1991, 1992), Hackner (1995), Jehiel (1992), Colombo (2012) and Gupta and Venkatu (2001), Arevalo and Chamorro Rivas (2007) among others.

[2] Another interesting study is Belleflamme and Bloch (2004), who show stability of market sharing agreements in collusive networks.

The paper is organized as follows. Section 2 describes the model and the main results. Section 3 presents an extension to allow for a secret monetary transfer and Section 4 concludes the paper.

2 The model

We assume that there are two firms, A and B, which are producing and selling a homogeneous good. Both firms produce with identical constant-returns-to-scale technologies with constant marginal costs of production that are normalized to be zero. For simplicity we assume that there are no fixed costs. Goods are delivered to the consumers by the firms that have to pay transportation costs of t per unit of distance.

The spatial market is a line of length one with consumers uniformly distributed with density one. The left endpoint is denoted with 0 and the right endpoint is 1. Firm A is located at point 0, while firm B has its locations at point 1. Furthermore we do not allow for any relocation of the firms. This can be motivated by prohibitively high relocation costs. Every consumer has an inelastic demand and buys exactely one unit of the good. The reservation price is denoted as r . We assume that r is sufficiently large so that all consumers are served. If prices of both firms are equal to a consumer, we assume that he buys from the nearer firm. Firms set prices and can spatially discriminate, this means that they set the optimal price at each location x on the line between 0 and 1.[3]

The linear market consist of two regions: the northern and the southern region. The northern region is located in the interval [0,n] and the southern region in [n,1]. For simplicity we assume that the northern region is spatially larger than the southern region, so that $n \geqslant 0.5$.

In a stable market sharing agreement both firms can establish a cartel and serve only there respective home region. On its home market every firm can operate as a monopolist.

To analyze the stability of the market share agreement, we assume that both firms maximize the present discounted value of their payoffs and interact repeatedly in a game that takes places over an infinite time horizon. Further, firms follow a grim trigger strategy[4]. This strategy works as follows: at the starting point both firms choose the cooperative strategy (collusion). If one firm is cheating the other firm in period τ both firms play in period $\tau + 1$ and in all other later on periods the non-cooperative strategy (competition). Thus for this analysis we have to calculate the profits in three different situations. First is the profit under spatial competition (C). Second is the higher profit under cartel circumstances, where the firms are monopolies in their home markets(M). Third we have to estimate the firm's outcome when one firm cheats the other firm and breaks the cartel agreement(B). In this case the cartel breaking firm can obtain a higher profit in the first period, but the firm will receive in all other periods the competition profit. Based on the infinite time horizon we have to discount the future profit to compare present values of all three options.

2.1 Competition

Under the given assumptions Lederer and Hurter (1985) show that with spatial competition and price discrimination, the best price schedule equals the transport costs of the other firm at that lo-

[3] Thisse and Vives (1988) show that spatial price discrimination is the best strategy under these circumstances.
[4] See, e.g. Friedman (1971).

cation (thick line in figure 1). Every firm serves the the region from its own location to the critical consumer[5]and therefore delivers half of the market.

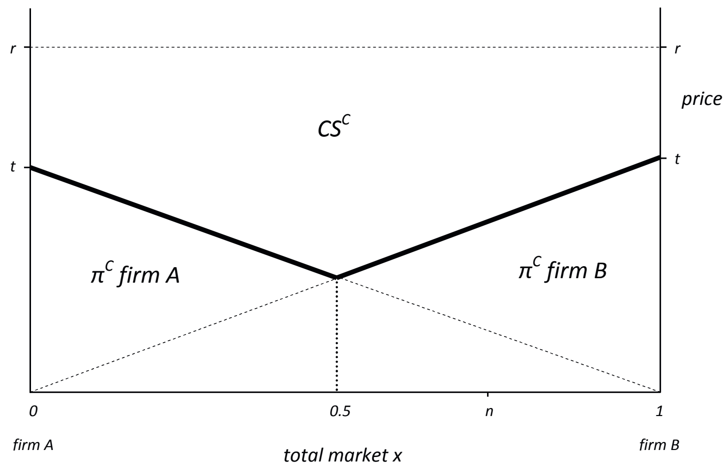

Fig. 1: spatial price lines in the market (broken line: transportation costs; thick line: local price with spatial price discrimination)

Thus firm A serves region [0, 0.5] and firm B [0.5, 1]. This leads to the result, that both firms have the same profit, hence we get for firm A

$$\pi_A^C = \int_0^{0.5} ((1-x)t - tx)\, dx = \frac{1}{4}t \tag{1}$$

and for firm B

$$\pi_B^C = \int_{0.5}^{1} (tx - (1-x)t)\, dx = \frac{1}{4}t. \tag{2}$$

The market results are shown in figure 1. The profits are the areas between the broken and the thick line on its part of the market denoted with $\pi^C\, firm\, A$ and $\pi^C\, firm\, B$. Furthermore we have in the case of spatial competition the area between the local price (thick line) and the horizontal line at r as a consumer surplus (CS^C).

[5] At the place of the critical consumer the transportation costs from both firms are equal (because of symmetry these costs have the same amount at half the distance between the location of the firms and it is represented by the point of intersection of the broken lines at $x = 0.5$).

2.2 Collusion

Under collusion both firms only serve their respective market, which is defined by n. Firm A serves region [0, n] and firm B has region [n, 1] as its home market. In their home region each firm can operate as a regional monopoly and set the price r at each location. Therefore the firms can make the following profits:

$$\pi_A^M = \int_0^n (r - tx)\, dx = rn - \frac{1}{2}tn^2 \tag{3}$$

and

$$\pi_B^M = \int_n^1 (r - (1-x)t) = \frac{1}{2}(1-n)(tn + 2r - t). \tag{4}$$

2.3 Stability of Collusion

To obtain a result for the stability of this market sharing agreement we have to calculate the outcome of firms in the cartel breaking case. By invading the other region a firm earns extra profits if the other firm sticks to the agreement. Undercutting the price of the other firm by a very small amount ϵ leads to a complete invasion of the other region[6]. If firm A breaks the agreement, the profit of A is

$$\pi_A^B = \int_0^n (r - tx)\, dx + \int_n^1 (r - tx)\, dx = r - \frac{1}{2}t. \tag{5}$$

If firm B deviates from the collusive agreement and invades the other region, while A sticks to the agreement, B earn the total market profit

$$\pi_B^B = \int_n^1 (r - (1-x)t)\, dx + \int_0^n (r - (1-x)t)\, dx = r - \frac{1}{2}t. \tag{6}$$

The market sharing agreement is stable if and only if the market discount δ rate is larger than the maximum of both critical discount rates (stability criterion: $\delta > max\left\{\delta_A^*, \delta_B^*\right\})$. The critical discount rate can be estimated by equating all discounted payoffs under the agreement with the all discounted payoffs in the cartel breaking case.

Firm A's critical discount rate we obtain by solving

$$\left(\frac{1}{1-\delta}\right)\pi_A^M = \pi_A^B + \left(\frac{\delta}{1-\delta}\right)\pi_A^C \tag{7}$$

for δ. We get:

[6] To avoid ϵ-equilibria and because ϵ is an infinite small number it is convenient to use r instead of $r - \epsilon$.

$$\delta_A^* = \frac{2\left(tn^2 + 2r - t - 2rn\right)}{4r - 3t}. \tag{8}$$

By using the expression

$$\left(\frac{1}{1-\delta}\right)\pi_B^M = \pi_B^B + \left(\frac{\delta}{1-\delta}\right)\pi_B^C \tag{9}$$

we can similarly estimate the critical discount rate of firm B, obtaining:

$$\delta_B^* = \frac{2n\left(tn + 2r - 2t\right)}{4r - 3t}. \tag{10}$$

Using the critical discount rates we can analyze the stability of a market sharing agreement. The result is summarized in the following proposition.

Proposition 1: Existence of a set of discount rates that support stability of a market sharing agreement between firm A and B is ensured if $r \geq \frac{t(3-4n+2n^2)}{4(1-n)}$.

Proof: Since $n \geq .5$, we can show that $\delta_B^* - \delta_A^* = \frac{2r(4n-2)+2t(1-2n)}{4r-3t} \geq 0$. Therefore, the relevant discount rate for stability is δ_B^* in that area. Because the highest possible value for a discount rate is one, there always exists a set of discount rates that support collusion if $\delta_B^* \leq 1$. Solving this inequality with respect to r yields the critical value of the reservation price.

Proposition 1 summarizes the general sustainability of a collusive market sharing agreement. It is important to notice that setting up a cartel with market sharing is credible for a wide range of parameters.

One important feature of our model is that we integrated intraregional transportation costs by setting up a spatial model. We consider the effect of a change in transportation costs on the sustainability of collusion. Proposition 2 sums up the outcome of our analysis.

Proposition 2: An increase in transportation costs reduces the stability of a collusive market sharing agreement.

Proof: Taking the derivative of $\delta_B^*$with respect to transportation costs, we get $\frac{\partial \delta_B^*}{\partial t} = \frac{4nr(2n-1)}{(4r-3t)^2} > 0$. Since an increase in transportion costs leads to a higher discount factor, the set of discount rates supporting stability is reduced.

This result indicates that collusion is more likely to be sustained for lower transportation costs. The reason for this is that π_B^C depends positively on t, while π_B^M and π_B^B are negatively affected by higher tranportation costs. With higher transportation costs a market sharing agreement is less attractive, because after deviating from the agreement a firm earns the profit with competition for all following periods. This punishment is getting less harsh with higher tranportstion costs and therefore breaking the collusive agreement is more attractive.

Next, we will derive the effect of asymmetric regions on credibility of collusion. The result is summarized in Proposition 3.

Proposition 3: An increase in the size of the northern region reduces the stability of the market sharing agreement.

Proof: Taking the derivative of $\delta_B^*$with respect to the border gives $\frac{\partial \delta_B^*}{\partial n} = \frac{4(tn+r-t)}{4r-3t} > 0$. The critical discount rate increases with a larger northern region.

The stability of a collusive market sharing agreement is reduced by a larger northern region, because the incentive to deviate for the firm located in the southern region increases. The profit of deviating remains unaffected by a larger *n,* but the profit with competition is larger compared to a lower value of *n*. Breaking the cartel and returning to competition leads to an increse in spatial market size to the southern firm. Therefore the incentive to collude is reduced if regions are more asymmetric in size.

We can now have a look at the welfare effects in this model. The following proposition gives the result of the analysis.

Proposition 4: A market sharing agreement leads always to a welfare loss, if n>.5. More asymmetric markets increase the welfare loss.

Proof: In a spatial linear model with inelastic demand and given reservation price, the maximization of social welfare is equivalent to the minimization of total transport costs. We define T as the function of total transport costs, given by $T = \int_0^n (tx)\, dx + \int_n^1 (t(1-x))dx = t(\frac{1}{2} - n + n^2)$. Calculation of the minimum of this function yields $n = .5$, so that any market sharing agreement with $n > .5$ resuts in a lower social welfare. Since T is increasing in n the loss in social welfare increases with rising asymmetry.

The effect of a market sharing agreement on social welfare is illustrated in figure 2. Under the market share agreement we have at all location between 0 and 1 the price r and therefore we have no consumer surplus. Firm A makes the profit represented by the area $0ABC$ while the profit obtained by firm B is $1DBE$. The social welfare in the market sharing agreement case is the sum of these two profits. We can see that we get welfare loss by the grey triangle ADF. This loss is brought about by the higher transportation costs of firm A to serve the further away located consumers. If n is getting closer to 0.5, the size of the triangle is decreasing. Hence a n at the midpoint between firm A and firm B will give us no welfare loss in the market sharing agreement compared to the competition case.

If firm A breaks the agreement it will earn in this period the profit indicated by area $0GEC$[7]. In this case we have maximized welfare loss in our model, indicated by the area $01G$.

[7] How shown above if firm B breaks the agreement it can obtain the same profit. Therefore we have in the agreement breaking period the same mirror-inverted results for both firms if one is cheating the other.

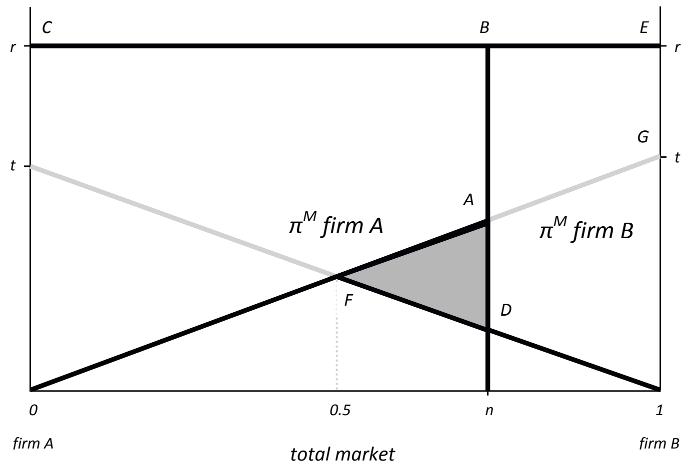

Fig. 2: producer surpluses under the market sharing agreement

3 Extension: Monetary Transfer

The firm with a larger home market under the market share agreement has a higher inducement to stabilize the spatial cartel. In our model firm A benefit more than firm B from the agreement:

$$\pi_A^M \geq \pi_B^M > \pi_i^C \;\; i = A, B \tag{11}$$

Hence we can introduce a monetary transfer μwhich is given from firm A to firm B to hold the agreement stable. The payment is given from A to B in every period B does not deviate from the agreement. This payment (MP) can be inserted in the agreement profits (3) and (4), leading to

$$\pi_A^{MP} = rn - \frac{1}{2}tn^2 - \mu \tag{12}$$

and

$$\pi_B^{MP} = \frac{1}{2}(1-n)(tn + 2r - t) + \mu. \tag{13}$$

With this extended profits under agreement conditions we obtain the following new critical discount rates for both firms:

$$\delta_A^{MP*} = \frac{2\left(tn^2 + 2r - t - 2rn + 2\mu\right)}{4r - 3t} \tag{14}$$

$$\delta_B^{MP*} = \frac{2\left(tn^2 + 2rn - 2tn - 2\mu\right)}{4r - 3t}. \tag{15}$$

We have shown the highest stability of the cartel is guaranteed if the critical discount rates of both firms are equal. To find the optimal value of transfer payment for a maximizing stability we can set

$\delta_A^{MP*} = \delta_B^{MP*}$and solve this equation for μ. We get the critical $\mu^*$for a compensatory payment

$$\mu^* = n\left(r - \frac{1}{2}t\right) - \frac{1}{2}r + \frac{1}{4}t. \tag{16}$$

The firm with larger home market have to give the other firm a higher monetary transfer if the regions are more asymmetric to ensure a more stable cartel. If the market sizes are equal, there are no cartel-stabilizing payments required. If firm A has the larger home market than firm B a payment stabilizes collusion.

Although the agreement is stabilized with the payment, the social welfare will not improve in the case of a monetary transfer. Since there are still higher transportation costs if the markets are asymmetric, the effects on social welfare remain unaffected.

4 Conclusion

We consider a spatial model to investigate the stability of a market sharing agreement. Firms can make a collusion and share a market to earn higher profits (if it is not a delinquency). Our results indicate that the size of the market share is important for the stability of a cartel. The firm with the smaller share of the market has overall stronger incentive to leave the agreement. If two firms divide the market between them into two equal segments the stability of the cartel is maximized.

Additionally if both firms serve half the market (either under competition or market sharing agreement) the social welfare is maximized. A stronger asymmetry in the firm's home markets will lead to higher overall transportation costs and therefore to a welfare loss.

Furthermore we have introduced the option of a monetary transfer between the firms. We have shown that the firm with the larger home market can pay an optimal amount to the other firm to maximize the stability of the agreement. This amount is increasing in the firm's market size.

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