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Collusive Market Sharing with Spatial Competition

Kai Andree
University of Potsdam

Mike Schwan
University of Potsdam

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.

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Contact: Kai Andree - kai.andree@uni-potsdam.de, Mike Schwan - mischwan@uni-potsdam.de.
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1 Introduction

Market sharing agreements between independent firms are set up to suppress spatial 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. 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. Another important study is Belleflamme and Bloch (2004), who show stability of market sharing agreements in collusive networks.

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.

However, Gross and Holahan (2003) and Andree (2012) use a spatial model where markets are separated by interregional transportation costs. These models analyze 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. 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.

Our results indicate that market sharing agreements are credible in a spatial world. 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. Additionaly, we can show that stable collusion reduces welfare with asymmetric regions. In our model higher intraregional transportation costs stabilize the collusive agreement.

The paper is organized as follows. Section 2 describes the model and the main results. Section 3 concludes the paper and gives a discussion of the robustness of the results.

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 constant marginal costs normalized to be zero and no fixed costs. Firms have to pay linear 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 with 1. Firm A is located at point 0 and firm B at point 1. 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.[1]
The linear market consist of two regions: the northern that is located in the interval *[0,n]* and the southern region in *[n,1]*. We assume that the northern region is spatially larger than the southern region, so that $n \geqslant 0.5$.[2]
In a stable market sharing agreement both firms can establish a cartel and serve only there respective home region. 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. Thus we have to calculate profits in three different situations: spatial competition (C), market sharing agreement (M) and the profit with deviating from the cartel (B).

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 location. Every firm serves the the region from its own location to the critical consumer[3]and therefore delivers half of the market.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

[1]Thisse and Vives (1988) show that spatial price discrimination is the best strategy under these circumstances.

[2]A model with this spatial setup is used, as well, by Tharakan and Thisse (2002).

[3]It is easy to see that the critical consumer is located at $x = 0.5$.

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

and for firm B

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

2.2 Collusion

Under collusion both firms only serve their respective market. 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 realize 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 a 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[4]. If firm A breaks the agreement, the profit of A is

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

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

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 the market discount δ rate is larger than the maximum of both critical discount rates (stability criterion: $\delta > max\left\{\delta_A^*, \delta_B^*\right\}$) . We obtain Firm A's critical discount rate 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:

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

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 calculate 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. 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. 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.

3 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.

It remains the question how the models assumptions affect the results of the analysis. We made the assumption of spatial discrimination, it is easy to see that a model with mill-pricing would still lead to a stable market sharing agreement. Suppose a linear model with inelastic demand, asymmetric regions and quadratic transportation costs, where firms set mill prices. [5] The natural market area is at the half of the market, but the incentive of a regional monopoly still exists, because the firms can establish higher prices in their respective area. If regions are very asymmetric this incentive is reduced for the firm located in the smaller region, as in our model. However, in this setup a market sharing agreement would be more stable, because the incentive to deviate is lower. In that case choosing a lower price does not lead to full invasion of the other region, so that only a part of the region can be taken.

Another assumption that influences the basic outcome of the analysis is the spatial position of the exogenous border n. If we would let the firms negotiate on an endogeneous split, we would end up with equally sized regions. The market sharing agreement would still be stable in that case, but Proposition 4 does no longer hold. The assumption of asymmetric regions is empirically the relevant case, because real-life firms would split up the market, so that each firm serves its respective home market. It is hard to think about the case that each home region, say e.g. a country, would have exactely the same size.

[5] As in Tharakan and Thisse (2002).

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