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Discussion paper

Disadvantageous semicollusion: Price competition in the Norwegian airline industry

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Abstract:

Motivated by observations in the Norwegian airline industry in the late 90s, we develop a semicollusive model with collusion on gross prices and competition on contracts for large customers (corporate contracts). The theoretical predictions are tested on detailed data on gross prices, large customer prices and quantities in the Norwegian airline industry in the period 1998-2001. We control for cost and demand factors as well as route specific heterogeneity, and find results in line with what our theory model predicts. An increase in the share of large customers and their rebates increase business- and leisure prices for passengers not travelling on these contracts, leading to a perverse price structure with an excessive high price for those consumers that are expected to be the most price sensitive ones. The effect is most pronounced in the business class. The effect is found to differ according to the quality (number of flights) the airline companies can offer.

[1] We are indebted to the Norwegian Research Council for financial support through the project 'Improving Competition Policy' at SNF.

1. Introduction

Price competition is typically regarded as beneficial for consumers and for society. The reason is that prices then will approach costs, and thereby lead to a reduction in the dead weight loss. If price fixing initially, it is a large dead weight loss and apparently a large scope for welfare improving price reductions. Any movement towards price competition in an industry with price fixing initially should in that respect benefit society. In this article we show that this intuition will not always be correct. Motivated by the Norwegian airline industry, we consider a market with price fixing except for discounts for some large corporate customers. It turns out that the discounts may lead to a perverse price structure, where the remaining customers will face a higher price than in a situation with price fixing and no discounts to large customers.

In 1998 Gardermoen airport outside Oslo was opened, and the number of slots increased substantially. The two active airlines on domestic Norwegian routes – SAS and Braathens – could then expand capacities on domestic routes where they until then had a limited number of flights. This made it possible for both of them to offer attractive contracts to large corporate customers, customers that had employees travelling on several of the domestic routes. Both airlines offered discounts to large customers, and the discount was deducted from the gross price that all passengers had to pay. Features in this industry promoted collusion on gross prices, and the two airlines were allowed to consult each other when they set future gross prices. We therefore simultaneously observed legal collusion on gross prices, and harsh competition for large corporate customers.

We present a theoretical model that captures the main elements described above concerning the competitive situation in the Norwegian airline industry in that period. Firms are allowed to collude on gross prices. We investigate how competition on large corporate customers, given that the discount is subtracted from the gross price, will affect prices. It is shown that both an increase in the number of large corporate customers with such contracts and an increase in the discount in these contracts will have an upward pricing pressure on the gross price. The intuition is that when firms collude on gross prices they take into account the existing contracts with large corporate customers, both the number of contracts and the discounts given. They do their best in compensating for the discount by increasing the gross price and thereby increase the net prices paid by the discounted customers. The unintended effect of such a pricing strategy is that the remaining non-discounted consumers have to pay the higher gross price that now is even higher than the monopoly price. We also show that the size of the discount will depend on the quality differences between the two airlines. The airline with the highest quality can earn a margin on these contracts that is equal to the quality difference.

Our simple theoretical model provides testable hypotheses on how large customer contracts affect both net and gross prices. This allows us to formulate price models, which we apply to a very detailed data set on large customer prices and quantities for five Norwegian city-pair routes for the period 1998-2001. To test the theoretical predictions from our model we control for cost and demand factors as well as route specific heterogeneity. Our results are in line with what our theory model predicts. An increase in the share of large corporate customers and their rebates increase business- and leisure prices for passengers not travelling on these contracts. In line with the travelling pattern were large corporate customers predominantly travel on business fares, the price effect is most pronounced in the business segment.

We find that the toughness of competition for large customers depends on the quality of the product – here measured through flight frequency – which also is in line with our theoretical predictions. Accounting for the effect of quality enhances the large customer effects on gross prices.

It is also found that if SAS increases their number of flights relative to their competitor Braathens, prices in business class increase. The effect is significant but relatively modest though. We find not surprisingly no significant effect on pricing in the leisure segment, suggesting that flight frequency is an issue for business travelers, not leisure travelers.

Our model is an example of semicollusion, where firms collude along one dimension and compete along other dimensions. The phenomenon seems to be present in many industries.[2] The explanation for such behavior could be that firms can change one choice variable very quickly and thereby are able to collude on that choice variable, while it is not possible to collude on another choice variable that are changed more seldom. In this particular case the gross price can be changed very quickly while the contract with large corporate customer lasts for several years, and this explains why they collude on gross price and compete on contracts for large customers. In the theoretical literature it has been shown that semicollusion may lead to tough competition along the dimension they compete on.[3] For example, it has been shown that collusion on prices might lead to overinvestment in capacities. This is also confirmed in empirical studies.[4] As far as we know, though, there are neither theoretical nor empirical studies that investigate the semicollusive nature of the price setting we are focusing on.

The article is organized as follows. In the next section we describe the market structure in the Norwegian airline industry in the period in question. In Section 3 we formulate a theoretical model to derive some testable hypotheses. Data is described and some descriptive statistics are provided in Section 4. In Section 5 we present an econometric model and our empirical results. Some concluding remarks are offered in Section 6, where we also discuss some policy implications of our findings.

[2] Se for example Scherer (1970) at p. 407 and Scherer and Ross (1990) at pp. 295 and 674 for anecdotal evidence. Note that the notion semicollusion was not used at that time, but the phenomenon was later on given such a name.

[3] There are several examples of theoretical studies on price collusion followed by competition. For examples on competition on capacity, see; Fershtman and Gandal, (1994), Osborn and Pitchik, (1987) and Benoit and Krishna, (1991), for examples on competition on R & D, see; Fershtman and Gandal (1994), Brod and Shivakumar (1999) and Mukherjee (2002), for competition on location, see; Friedmann and Thisse (1993), Jehiel (1992) and Eaton and Lipsey (1975), and finally for competition on advertising, see Wang *et. al.* (2007). For a survey of the theoretical and the empirical literature on semicollusion, see Steen and Sørgard (2009).

[4] How price collusion influences investments in capacities are tested empirically in Dick (1992), Ma (2008), Røller and Steen (2006), Salvanes et al. (2003) and Steen and Sørgard (1999). The relationship between price collusion and location is tested in Stavins (1995), Borenstein and Netz (1994) and Salvanes et al. (2005), and between price collusion and advertising is tested in Symeonides (2000a, 2000b) and Wang *et al.* (2007). For a survey, see Steen and Sørgard (2009).

2. The Norwegian airline industry

Historically, Scandinavian Airlines (SAS) and Braathens (BU) divided the Norwegian airline market between themselves. They had each legal monopoly on different routes, except for the largest ones where the second carrier was allowed to have a limited number of flights after 1988. In 1994 Norwegian airlines were free to enter all routes, while in 1997 also foreign airlines were allowed to enter. The airport Gardermoen outside the capitol Oslo opened in 1998, resulting in more flexibility for airlines to expand on domestic routes. It was predicted that deregulation would trigger competition on prices. It did not, at least not in the business segment. Business fares remained high, and even increased considerably in the period from 1998 and until 2001 when Braathens became a failing firm and we returned to monopoly. To illustrate, if we look at 11 routes out of Oslo the average price increase was close to 4 % annually over the five-year period 1993 to 1998, whereas over the two and a half-year period from 1998 and until the return to monopoly in 2001 the annual price increase was as high as 11 % across the same 11 routes.[5]

There were several reasons for why we did not observe price competition in the business segment the first eight years after deregulation. First, there was a potential for collusive behavior in this particular industry. There were only two active firms, and until April 1997 foreign firms were not permitted to serve domestic routes in Norway. Price changes were either to be announced in the press or through the Amadeus computer booking system, which in both cases quickly was observed by the rival, allowing both firms to quickly respond to the rival's price changes. Second, for those routes where both firms did have flights, there existed a system for coordinating prices – so-called interlining. The firms were permitted to consult each other concerning price setting. To allow for late changes of flight schedules for normal (no discount) tickets, from one airline to another, the airlines had «transferable» prices. To implement such a policy, the firms were permitted to meet regularly to inform each other

[5] Compared to the development in the general CPI or other transport forms such as car, boat or train the annual price increase for these groups have been in the order of 2.9-7.6% for the period 1998 to 2001. http://statbank.ssb.no/statistikkbanken/Default_FR.asp?PXSid=0&nvl=true&PLanguage=0&tilside=selecttable/hovedtabellHjem.asp&KortnavnWeb=kpi

concerning future prices. Third, the two firms had initially almost equal market shares in the domestic market. Then it was natural to continue with the initial market sharing in the deregulated system. In fact, there were only rather minor changes in the market shares on each route as well as in the total market shares after deregulation. Fourth, the firms signaled aggressive responses to any move by their rival. In particular, each firm matched the rival's offers. For example, prior to deregulation Braathens introduced a discount ticket named *Billy* to match SAS' discount ticket *Jackpot* and set a price NOK five below the *Jackpot* price. SAS responded immediately by reducing its *Jackpot* price by NOK five.[6] Such an apparently aggressive behavior is analogous to the introduction of a meet-competition clause.[7]

To the extent that we observed competition, this took place along other dimensions like capacity and clustering of flights. During the period 1994 to 2002 we did not experience increased flexibility in departure times, but rather a clustering of flights (Salvanes, Steen and Sørgard, 2005). Capacity increased considerably, and planes were half empty (Salvanes, Steen and Sørgard 2003). We did get a new entrant, Color Air, starting its operation in the summer of 1998. Even though Color Air was a low-cost concept, Braathens and SAS did not primarily meet the new competition with lower prices. Instead they continued to increase their capacity. Hence, the competitive picture did not change, only escalate. We got more capacity, more empty seats and somewhat more price competition in the leisure segment. In total, ten new airplanes entered the Norwegian market after the Gardermoen opening; only three of them were operated by Color Air.[8] October 1st 1999 Color Air exited from the market, after 13 months of operation.

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[6] A statement by a representative for Braathens suggests that this was a deliberate policy for the firms in question: '*We will match any offer by SAS within an hour, and we cannot accept that SAS has cheaper discount tickets than what we have' [our translation] (C. Fougli to Dagens Næringsliv, 20.01.1994).*

[7] An explanation of this principle, that also may serve as an illustration of the companies' strategy, was provided by Audun Tjomsland, the public relations manager for Braathens: *'The two Norwegian firms on Norwegian routes, Braathens and SAS, are of equal size and can follow each other during a price war. The firm that starts a price war will quickly be followed by the rival firm, so that the firm that starts a war will have an advantage only for a day or two. Accordingly, the firms are reluctant to trigger a price war.' [our translation] (Bergens Tidende, 31.07.1995).*

[8] One airplane can be used for a maximum of 16 hours a day in the Norwegian network. Hence, ten new airplanes into the market were a considerable increase of capacity. In particular, since we already had excess capacity on several routes. Statements from SAS can indicate that this capacity increase was part of an aggressive strategy. The managing director of SAS, Jan Stenberg, said in May 1999: '*SAS has no intention to reduce the excess capacity in*

In May 2001, SAS announced that it wanted to buy its rival Braathens. During the next six months of the merger process Braathens became a failing firm and SAS was allowed by the Norwegian Competition Authority to acquire Braathens. Deregulation had led to a monopolized Norwegian airline market. SAS kept their monopoly until the fall of 2002 when Norwegian entered the market.

The present paper will focus on the period 1998 and up to the acquisition. During this period we observed another important feature of the competitive situation emerging, this was the effect of an increasing number of large corporate customer contracts. A large corporate customer contract is a contract between a large corporate customer and one of the carriers, where all employees from this firm will travel with this carrier at a contracted price. The contract will specify a percentage reduction in the business fare. The typical contract will last for 1-2 years, and the contract terms will be a combination of discounts on different routes and a discount according to the customer's total travel volume in the domestic network. The latter implies that the company only has a contract with one of the two carriers. Each firm will not have any detailed knowledge about the terms in the rivals' contracts.

These contracts were available already in 1994, but first in 1998 did they gain importance, both in terms of number of contracts, and in terms of discount size. There are several explanations for this gradual increase. The slot capacity at the old airport Fornebu was exhausted. When Gardermoen opened in 1998, both companies had the possibility to increase their capacity on all routes, also the smaller ones, and both could thereby offer a full domestic network. This led to more competition on large corporate customer contracts since all large customers were now potential large customers for both carriers. Due to the slot restrictions the companies had less of a problem with excess capacity in the first deregulation period, and were therefore less tempted to act aggressively in this market. However, and as shown in Steen and Sørgard (2003), after the opening of Gardermoen the capacity competition increased even more – partly because Color Air entered the market – and this tempted the airline companies to engage in

the domestic market. The plan is to aim for more aggressive price advertising campaigns in the Norwegian market. … I think it is a question about only a few months before Color Air will exit the market [our translation] (NTB-press release May 7. 1999).'

even more aggressive large corporate customer competition. In 2000, the carriers had around 300 contracts, more than a doubling from 1998, and the discounts had become substantial.[9] This escalation of discounts was the outcome of intense rivalry between Braathens and SAS.[10]

3. A theoretical model

Let us consider an industry with two firms, firm 1 and 2, selling a homogenous product and having no capacity constraints. There are two types of consumers, type *A* and *B*, and they may differ concerning the willingness to pay. We will later on interpret consumers of type A business travelers and consumers of type B leisure travelers. Initially we consider traditional price fixing, where firm 1 and 2 jointly set a uniform price that is offered to both consumer groups. Let $C_i(p)$ denote the demand from type *i* consumers, where $i = A, B$. We assume the following:

A1: $\left|\frac{\partial C_A}{\partial P}\frac{P}{C_A}\right| < \left|\frac{\partial C_B}{\partial P}\frac{P}{C_B}\right|$

this implies that the price elasticity of demand is more inelastic for group *A* than for group *B*. If they could discriminate between those two consumer groups, they would set $P_A^M > P_B^M$, where P_i^M denotes the monopoly price to consumer group *i*, where $i = A, B$.

Alternatively, they must set an identical price to both groups of consumers. Let *S* denote group A's fraction of total consumption, *i.e*., $S = C_A/(C_A + C_B)$, and let $|\varepsilon_i|$ denote the absolute value of the price elasticity of demand for group *i*. From the first order condition, we can derive the optimal price-cost margin given that they set an identical price to group *A* and *B*:

$$\frac{P-MC}{P} = \frac{1}{|\varepsilon_A|}\cdot S + \frac{1}{|\varepsilon_B|}\cdot(1-S) \tag{1}$$

[9] *'According to information obtained by the Norwegian pink newspaper, Dagens Næringsliv, some of the large customer discounts are in the order of 50% on certain routes. Normally the discounts are in the range of 5-50% relative to C-price. [our translation] (Dagens Næringsliv 12.09.2001).*

[10] The SAS' large customer contracts' responsible, Stein Bemer, stated: *' We hope to reduce the discount level.... it is evident that a possible merger [with Braathens] would make it possible to achieve this goal, … When the competitive picture changes some of our large customers will not have the same bargaining power to obtain as large discounts as they used to have.' . [our translation] (Dagens Næringsliv 12.09.2001).*

It is then obvious that if they fix one price that is offered to both consumer groups, it will be in between those two monopoly prices; $P_A^M > P^M > P_B^M$.

In what follows we will denote this scenario as *pure price fixing*, since there are by assumption no discounts given to any consumers.

Case (i): Discounted price to group A, monopoly price to group B

Let us now introduce discounts for one group of consumers. Motivated by what we observe in the Norwegian airline industry, we assume that firm 1 and 2 compete on discounts to each consumer of type *A*. To simplify, we assume that there is only one consumer of type *A*.[11] The interpretation could be that the consumer of type *A* is a large corporation, and both firms offer discounts separately to this large corporation. At the same time they continue to fix prices to consumer group *B*. If homogenous products and no capacity constraints, then competition on discounts to the large consumer leads to Bertrand-like competition towards the type *A* consumer with price equal to marginal costs in equilibrium.

From the first order condition, it can easily be seen that the optimal price-cost margin on the price to type *B* consumers is as follows:

$$\frac{P_B^0 - MC}{P_B^0} = \frac{1}{|\varepsilon_B|} \qquad (2)$$

Comparing eq. (1) and (2), it follows that as long as consumer *A* is more price inelastic than group *B* consumers, the optimal price for group *B* consumers will be lower than the price we derived for the case of pure price fixing. The reason is that this price should no longer be a compromise between the optimal price to consumer of type *A* and the optimal price for consumers of type *B*.

Let superscript *0* denote the situation with competition for consumers of type *A*, *MC* marginal costs, and *R* the absolute discount to the consumers of type *A*. The prices in case (i) are then:

[11] This assumption is made to simplify the exposition. Note that we later on relax on this assumption.

- Prices for consumers of type *A*: $P_A^0 = P^M - R^0 = MC < P^M$
- Prices for consumers of type *B*: $P_B^0 = P_B^M < P^M$

Obviously, in case (i) the price for the consumers of type *B* is higher than the price for the consumer of type *A*.

Case (ii): Discount on gross price to consumer type A and gross price to consumer type B

Let us now change the price setting rules. In line with what we observed in the Norwegian airline industry, we let the firms set one price that is valid for both consumer groups, which we will denote the *gross price*. In addition they compete for capturing the consumer of type *A*, and the discount is deducted from the gross price set for both consumer groups. Let P^I denote the gross price set to both groups of consumers, and correspondingly R^I the discount given to the consumer of type *A*. When they agree on the gross price, they know that there is a contract with the consumer of type *A* concerning the discount. It implies that discounts are exogenous when they decide to fix the gross price. Put differently, contracts with consumers for discounts are more long term decisions than the decisions on gross price. It is well known from theory of collusion that it is more difficult to collude on a choice parameter that is changed very seldom than a choice variable they can change very quickly (and thereby react very quickly to a deviation by the rival). In line with that, we assume the following rules of the game:

- Stage 1: Firm 1 and 2 set discount *R* to the consumer of type *A*
- Stage 2: Firm 1 and 2 set the gross price *P* to maximize joint profit

Let us solve the game by backward induction. At stage 2, Firm 1 and 2 maximize joint profits by setting *P* – the gross price both group of consumers are facing. The net price paid by the type *A* consumer can be defined as $P_A = P - R$, while the net price paid by group *B* consumers is equal to $P_B = P$. Given that they maximize joint profits, they have the following maximization problem

$$\underset{P}{Max}\, \pi = (P - R - MC)C_A(P - R) + (P - MC)C_B(P) \qquad (3)$$

Let us now compare the optimal pricing in this case with the one we found with pure price fixing. If no discounts (*R* = 0), the situation is identical to the one with pure price fixing with $P_A = P_B = P$. Then it is obvious that the price with pure price fixing, $P = P^M$, is optimal also in this case. If *R* > 0, this cannot longer be true. The net price paid by the type *A* consumer is lowered, and the first order condition concerning the gross price *P* is no longer met as long as $P = P^M$. This can be seen from eq. (4), the first order condition given that *R* > 0:

$$C_A + C_B + \frac{\partial C_A}{\partial P}\left[P - R - MC\right] + \frac{\partial C_B}{\partial P}\left[P - MC\right] = 0 \tag{4}$$

If *R* = 0, then eq. (4) is met if $P = P^M$. If *R* > 0, it is obvious that eq. (4) can only be met if $P > P^M$. The intuition is straight forward. When the firms have offered discounts on the gross price, they can partly offset the price reduction later on by increasing the gross price. By doing so they increase the net price paid by the type *A* consumer. On the other hand, such a price increase will be detrimental to the revenues earned on group *B* consumers since the price will be further increased compared to the optimal one for that type of consumers.

Let us now consider stage 1 of the game. Firm 1 and 2 set the discount to the type *A* consumer simultaneously. There is by assumption no coordination. If $R > P - MC$, each of them will find it profitable to undercut the rival by setting a marginal higher discount. By doing so it wins the contract, and there are no effect on the outcome of stage 2 since the discount is (almost) identical to the one with no undercutting. This implies that undercutting will take place unless $R = P - MC$. The prices we observe are then the following:

- Price for the consumer of type *A*: $P_A^I \equiv P_A^0 = P^M - R^0 = MC < P^M$
- Price for consumers of type *B*: $P_B^I > P^M > P_B^0$

Until now we have assumed that there are two distinct groups of consumers, and that one of the groups consists of only one consumer and this consumer receives a discount. In reality, there are numerous consumers that can receive a discount. Let us check how the price set at stage 2 will be affected both by how large fraction of the consumers that are given discounts and how large discounts they have been given. To illustrate this, let us assume that consumers receiving a discount is a fraction *S* of the total number of consumers, while the discount is still equal to *R*. Furthermore, we now assume that all consumers are identical. At stage 2 the joint profit is as follows:

$$\pi = (P - R - MC) \cdot C(P, R) \cdot S + (P - MC) \cdot C(P) \cdot [1 - S] \qquad (5)$$

Given that firm 1 and 2 maximizes joint profit at stage 2, we can from the first order condition find the condition for the optimal gross price:

$$\frac{P - MC}{P} = \frac{1}{|\varepsilon|} + \frac{S \cdot R}{P} \qquad (6)$$

As marginal cost is fixed the price-cost margin is increasing in both the fraction of consumers that receives a discount and in the size of the discount. Both higher discounts and an increase in the number of consumers with discounts lead to an increased need for correcting the net price to those with discounts. This can be done by raising the gross price.

A comparison

We are now able to contrast our predictions in case (i) and (ii) concerning how the existence of discounts to some consumers will affect the gross price.

Table 1: The size of the discount- and the share of large corporate consumers' effect on gross price

	Case (i)	*Case (ii)*
$\partial P / \partial S$:	**< 0**	**> 0**
$\partial P / \partial R$:	**= 0**	**> 0**

We see from Table 1 that the size of the discount is expected to have no effect on the gross price in case (i). The reason is that the gross price is set to maximize revenues from only the consumers not receiving discounts, and then the discount given to the other group of consumers should not have any effect on that price. In contrast, in case (ii) the gross price is increasing in the discount that is given to one group of the consumers. The reason is that an increase in the gross price (that also the non-contracted consumers faces) is used to partly compensate for the large discounts given to the contracted consumers.

We also see from Table 1 that in case (ii) the gross price is increasing in the fraction of the consumers that are given a discount. This is quite obvious, since a large share of consumers with discounts means that the firms should pay larger attention to how gross price can be used to increase the net price paid by those consumers with discounts. In case (i) we see from Table 1 that the gross price is decreasing in the fraction of consumers with discounts, the opposite of what we predict for case (ii). In case (i) the gross price will be set for a group of consumers that are more price elastic than the average ones. It is then optimal for the firms to set a lower gross price than what they would have done if this gross price should be paid by all consumers.

Note, however, that our A1 assumption is crucial for our prediction that $\partial P / \partial S < 0$ in case (i). We assumed that group *A* consumers are more price inelastic than group *B* consumers. If the opposite is true, the firms have incentives to set a higher gross price towards group *B* consumers since they are more price inelastic than the average consumer. Our prediction concerning $\partial P / \partial R$ are not affected by the assumption A1, though.

Finally, let us consider more in detail the discounts that are set at stage 1 in case (ii). Until now we have assumed symmetry, and this results in prices that are equal to marginal cost. Let us now introduce asymmetry concerning each consumer's willingness to pay. We assume that firm *A*'s product is more valuable for one consumer than firm *B*'s product, and vice versa for another consumer. To illustrate, let us assume that one particular consumer has a willingness to pay equal to Θ_i for product *i* and Θ_j for product *j*, where *i,j* = 1,2. If $\Theta_i > \Theta_j$, then it follows straight forward that Bertrand competition for winning this consumer will lead to the following discounts being offered:

$$R_i = (\Theta_i - \Theta_j) + (P - MC)$$

$$R_j = (P - MC)$$

We see that the firm with the product with the highest quality offered to this particular consumer can set a price that leads to a positive margin. It can extract the value of the additional quality it can offer this consumer compared with the quality that the other firm could offer to this particular consumer.

4. Data and descriptive statistics

We have access to route-specific data from SAS for five Norwegian city pairs for the period 1998 to May 2001 on prices, number of passengers for different customer segments (leisure (M) and business (C) segment), route specific cost components as wage, taxes and number of flights. In addition, we have access to the competing carriers (Braathen's) number of flights on the route and we have collected data on potential demand drivers as the public expenses and tax income in the municipals belonging to the city-pair areas we are analyzing. Finally, we have SAS data on the number of large customers in each customer segment (C and M), and what prices they were charged in the C-segment. The city-pairs' average departures and passengers are shown in Table 2.

Table 2 The analyzed routes: Average daily departures and passengers

City-pair	n	Departures SAS	Departures Braathens	Passengers SAS	Business (C-class) Passengers	Large Customer Share in C-class
Oslo-Bergen (OSLBGO)	24	27.5	21.0	2245	1140	0.54
Oslo-Stavanger (OSLSVG)	41	19.4	23.4	1262	634	0.59
Oslo-Trondheim (OSLTRD)	41	21.8	26.0	1641	784	0.59
Oslo-Bodø (OSLBOO)	41	10.9	6.0	830	251	0.43
Oslo-Kristiansand (OSLKRS)	30	7.1	14.7	337	136	0.50
All routes	177	17.0	18.2	1226	564	0.53

NOTE: monthly data for the period 1998:01-2001:05, except for OSLBGO (1998:01-1999:12) and OSLKRS (1998:12-2001:05). The daily averages are computed as the monthly averages divided by 30.

The five routes are all departing from Oslo, the capital, but represents different demand conditions and size. The largest routes Oslo-Bergen, Oslo-Stavanger and Oslo-Trondheim had annual averages between 1.04 and 1.25 mill passengers, with an average of 43 to 49 daily departures.[12] The smaller routes had between 435 000 and 477 000 annual passengers and 17 to 22 daily departures. On average SAS had 50.3% market share, but this varies across routes. They dominate the routes to Bergen and Bodø with 65 and 69% markets shares respectively, whereas SAS only had 25% of the market on the Kristiansand route. The two last large routes were more evenly shared by the two airline companies; on the Trondheim route Braathens had 52% of the market, whereas on the Stavanger route Braathens had 56% of the market. Also SAS C-class share differs across the routes, highest on the three largest routes (47.8-50.8%), considerably lower on the smaller routes (30.3-40.5%). Finally the large customer share in the business segment differs both across route size and within small and large routes. Thus, the five routes provide us with differences across both competitive situation and demand structure, allowing us to identify the effects of the large customer competition.

To obtain a picture of how the market and the large customer competition evolved we have compared the last five months in our sample (January-May) 'late' to the corresponding earliest year we have observations for the January-May period, 'early' .[13] Clearly the number of large customers increased substantially over the period with an average across routes of 15% as compared to total PAX that only increased by 3%. During the same period the overall large-customer share in C-class increased from 0.50 to 0.58. The corresponding changes also at the route level are presented in Table 3.

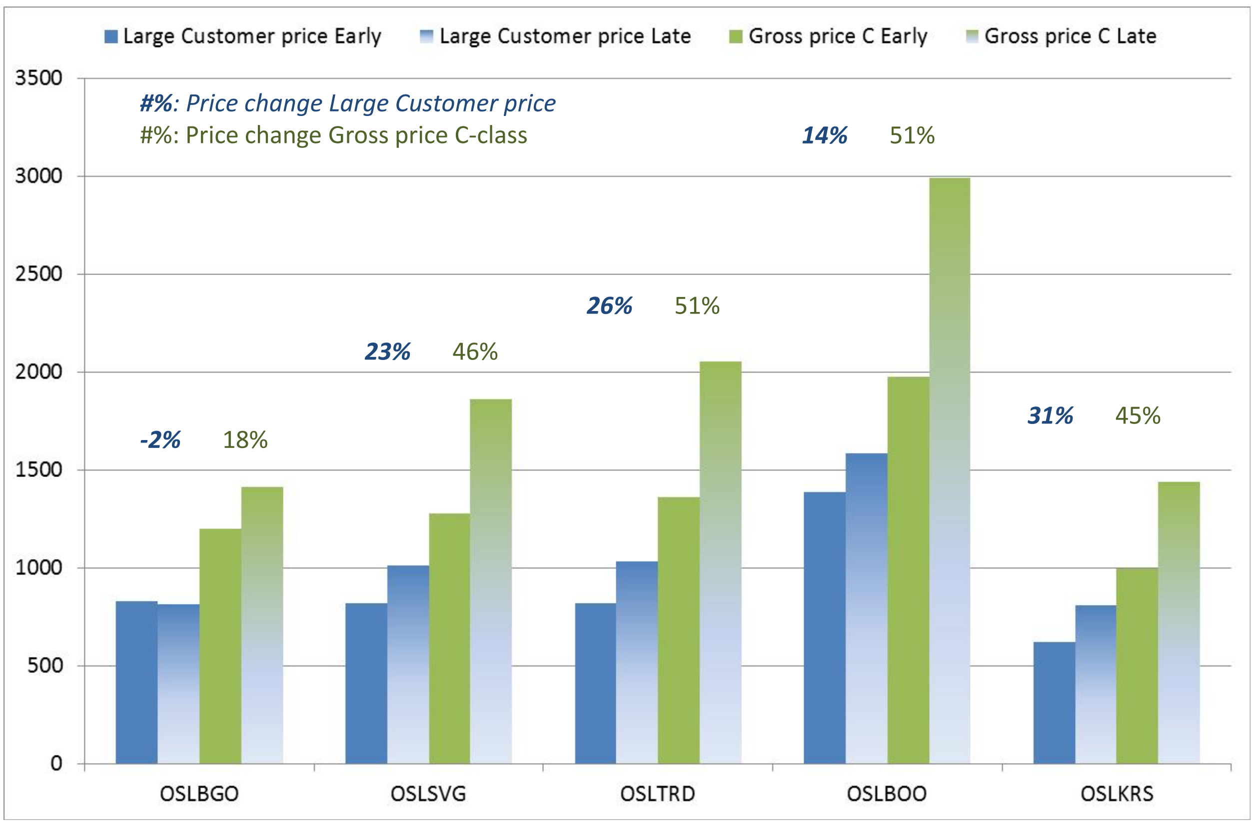
Table 3 Changes in PAX from the 'early' period to the 'late' period across city-pairs.

	OSLGBO	OSLSTV	OSLTRD	OSLBOO	OSLKRS	All five routes
Increase in total monthly PAX SAS	-14.9 %	4.8 %	38.0 %	-7.7 %	7.6 %	3.2 %
Increase in total monthly PAX SAS' large customers	4.3 %	1.8 %	46.8 %	-3.7 %	35.1 %	14.9 %
Increase in Large-customers share in C-class	26.0 %	4.2 %	13.6 %	17.9 %	14.6 %	16.9 %

[12] These three are among the top five of the Norwegian routes. The largest Norwegian city-pair routes are among the largest city pair routes in Europe.
[13] For three of the routes this provides a time span of three years, i.e., 1998 vs 2001, for the Bergen and the Kristiansand routes the time span will be shorter, 1 and 2 years, respectively.

The focus in our model is how the large customer competition has influenced on the price development, in particular on the gross prices in the business segment. Clearly the large customers increase in numbers relative to other customers across all routes. According to our model this suggests that the gross price might increase accordingly to compensate for the revenue loss. Before we turn to the econometric analysis we will therefore take a closer look at the price development on these five routes. Using the same 'early' and 'late' periods we have displayed the gross price- and large customer price development in Figure 1.

Figure 1 Price development from the 'early' period to the 'late' period across five city-pairs



If we focus on the three routes with longest time span in the data we see that in three years the large customer price has increased with 14-26%, whereas the gross price has doubled (46-51%). This implies that the large customer rebates have escalated significantly over the time period.

Furthermore a price increase in the order of 50% over three years is difficult to attribute to changes in cost and local demand.

These routes represent quite different demand pattern and size. For instance, the Stavanger and Trondheim routes are both large commuting city-pairs, whereas the North-South route between Bodø and Oslo is both smaller and has less business travelers. Hence, the data suggests that the large customer competition might have led to very high prices for the business travelers with no corporate contracts.

However, comparing prices like here disregard other factors as changes in costs and demand, as well as the competitive situation on the route (relative number of flights, alternative transport alternatives etc.). In the next section we will formulate an econometric price model that accounts for these effects and more formally test the predictions from our theory model.

5. An econometric price model

Apparently the gross prices in C-class have been significantly affected by the large customer competition. This is also what we predict from our theory model. In this section we will formulate an econometric price model to test further the implications from our model using the city-pair data presented above.

We need an econometric model that is able to mimic the development in the economic variables we are interested in. The simplest and most robust alternative is to use an autoregressive model. In an autoregressive model the variable in question (here price p_t) is explained by its lagged observation (p_{t-1}). This simple framework also accounts for the very common problem of serial correlation in prices over time, *i.e.*, high values this month are likely followed by high values next month etc.

Since we have a panel of prices we have to account for unobserved heterogeneity across city-pairs that is not controlled for through other variables. We use a fixed effect model. The fixed effect model accounts for unobserved heterogeneity across routes by allowing for indicator variables across routes that capture unobserved heterogeneity in each city-pair ($CityPair_i$). We also introduce other observable control variables to capture differences across routes. First we include route specific cost variables. In particular, we include a wage variable (*WAGE*) that measures all wage expenditures from cabin attendants and pilots per seat kilometer on the route, and a variable measuring all costs due to charges and fees on the route, also measured per seat kilometer (*TAX*). Second, we include variables expected to be highly correlated with demand for airline services for each route. The included variables are tax income to the region corresponding to each route (*INCTAX*) and the expenditures of the municipalities in the regions (*EXP*). (See the Appendix A for data sources and details on the construction of these variables). To control for general price increases we also include the Norwegian consumer price index (*CPI*).

We include controls for the opening of the new main airport Gardermoen in Oslo (*GAR*) and the potential competitive effect of Color Air on the routes they entered and competed with SAS and BU (*COL*).[14] Finally we include monthly dummy variables to account for seasonality in prices.

Using these variables we can construct a generic price model for the development of both leisure (M) prices and business prices (C):

$$\begin{aligned} P_{i,t}^{j} &= \gamma P_{i,t-1}^{j} + \beta_1 WAGE_{i,t} + \beta_2 TAX_{i,t} + \beta_3 EXP_{i,t} + \beta_4 INCTAX_{i,t} + \beta_5 CPI_t \\ &+ \beta_6 GAR_t + \beta_7 COL_{i,t} + cons + \sum_{s=2}^{12} \lambda_s M_t^s + \sum_{i=1}^{4} \phi_i CityPair_i + \varepsilon_{i,t}^{j} \end{aligned} \qquad (7)$$

Where $p_{i,t}^{j}$ is SAS' average price in *j*-class, (*j*=C,M), at route *i*, (*i*=1-5) in period *t*. The parameters $\gamma, \beta_1 - \beta_7, \lambda_s$ and ϕ_i are parameters to be estimated and $\varepsilon_{i,t}^{j}$ is the error term capturing random noise and assumed to have the standard properties.

Our theory model predicts that prices are affected by the large customer competition in two ways. First, an increase in the large customer rebate (*R*) suggests that the gross price in particular in the business segment – C-class should increase. Second, we anticipate a similar

[14] The Gardermoen dummy is equal to one from October 1998. Color Air entered on two of the analyzed routes, OSLBGO and OSLTRD in August 1998 and went bankrupt and stopped flying in October 1999. Thus the COL-dummy is set to one from August 1998 until October 1999 for these two routes.

effect from an increase in the share of large customers (*S*). Furthermore, we saw that the effect on prices might differ to the extent that the competing products differ in quality. In our case a major quality component will be the frequency of flights. We have therefore calculated an index measuring the relative number of flights between the two main competitors SAS and BU (*RFL*).[15] Since we are concerned with how quality interact with the effects of both the share and the size of the large customer rebate we interact *S* and *R* with *RFL*. Now we extend the price model in (7) accordingly:

$$\begin{aligned} P_{i,t}^{j} &= \gamma P_{i,t-1}^{j} + \beta_1 WAGE_{i,t} + \beta_2 TAX_{i,t} + \beta_3 EXP_{i,t} + \beta_4 INCTAX_{i,t} + \beta_5 CPI_t \\ &+ \beta_6 GAR_t + \beta_6 COL_{i,t} + cons + \sum_{s=2}^{12} \lambda_s M_t^s + \sum_{i=1}^{4} \phi_i CityPair_i \\ &+ \theta_{RFL} RFL_{i,t} + \theta_S S_{i,t} + \theta_R R_{i,t} + \theta_{SxRFL} S_{i,t} \cdot RFL_{i,t} + \theta_{RxRFL} R_{i,t} \cdot RFL_{i,t} + \varepsilon_{i,t}^{j} \end{aligned} \tag{8}$$

The parameters θ_{RFL} measures the effect of SAS competitive situation with regards to BU with regards to number of flights, θ_S the price effect from an increase in the large customer share and θ_R the price effect from an increase in the large customer rebate.[16] Note that the interaction terms, θ_{SxRFL} and θ_{RxRFL} have to be considered when we calculate marginal effects for all of these.[17] Since this is an autoregressive model we can both measure how short run changes in the variables affects price and also how prices are affected in the long run.[18] Finally, since prices in the two customer segments are set simultaneously, we estimate the two price equations simultaneously using the SURE estimator.

The estimated price equations are presented in Table 4.[19] The explanation power is high, and most of the variables are significant. SAS cost variables are positive and significant in 3 out of

[15] The relative number of flights is calculated as *RFL*= Departures SAS/Departures BU

[16] We are able to calculate large customer shares for each segment (M and C). However, we do not have access to the large customer prices in the M-segment and have therefore used the large customer rebate from the C-segment as the R variable in both price equations.

[17] For instance, consider the marginal effect of an increase in S: $\partial p_{i,t}^{j} / \partial R = \theta_R + \theta_{RxRFL} RFL$.

[18] The long run effect is a combination of the autoregressive parameter (γ) and the indicator parameter, e.g., the long run effect of an increase in S is thus : $\left(\partial p_{i,t}^{j} / \partial R\right)^{LR} = \theta_R / (1-\gamma) + \left(\theta_{RxRFL} / (1-\gamma)\right) RFL$.

[19] Note that we are able to calculate the actual gross price offered to customers without corporate large customer contracts, and thus use this gross price in our C-price equation estimation. In lack of information on the corresponding gross price in the M-class in we use the average M-price in our M-price equation estimation.

Table 4 SURE estimates of the price models in (8)

	C-price		M-price	
$P^C_{i,t-1}$	0.117**	(0.027)		
$P^M_{i,t-1}$			0.405**	(0.065)
RFL	-112.908**	(38.138)	-38.511**	(17.014)
RFL*R	0.001	(0.029)	0.054**	(0.018)
RFL*S	333.31**	(97.189)	238.65*	(123.83)
R	0.839**	(0.047)	-0.022	(0.028)
S	-38.689	(123.865)	75.068	(133.614)
TAX	661.83**	(186.091)	-40.270	(128.067)
WAGE	1928.31**	(750.631)	1817.17**	(499.91)
EXP	0.0001*	(0.00007)	-0.00002	(0.00005)
INCTAX	0.001**	(0.0001)	0.0002**	(0.00008)
CPI	-0.803	(6.004)	-10.746**	(3.907)
GAR	-40.177**	(12.176)	-10.314	(8.516)
COL	24.285**	(9.334)	-5.935	(6.099)
$CityPair_1$ (OSLSVG)	130.12**	(42.268)	4.038	(27.484)
$CityPair_2$ (OSLTRD)	184.14**	(54.158)	29.339	(35.358)
$CityPair_3$ (OSLBOO)	924.77**	(135.976)	283.15**	(91.994)
$CityPair_4$ (OSLKRS)	120.42	(92.457)	1.600	(61.760)
M^2	17.945	(11.288)	6.276	(7.346)
M^3	-1.550	(11.850)	35.494**	(7.685)
M^4	30.988**	(12.870)	46.650**	(8.701)
M^5	39.804**	(12.920)	54.528**	(8.635)
M^6	43.135**	(14.354)	42.645**	(9.738)
M^7	-2.222	(15.771)	-44.076**	(11.653)
M^8	48.360**	(13.790)	43.365**	(12.657)
M^9	44.426**	(15.904)	66.960**	(10.548)
M^{10}	66.967**	(15.355)	54.763**	(10.430)
M^{11}	61.442**	(16.701)	37.755**	(11.178)
M^{12}	47.942**	(16.818)	55.013**	(11.562)
Cons	-2307.77**	(510.815)	530.18	(354.82)
N	172		172	
R^2	0.996		0.991	

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$

four cases, prices increase with cost increases. The demand drivers show a similar pattern, being positive and significant in three out of four cases, suggesting that as economic activity increases in the relevant municipals prices increase. The two insignificant cost- and demand parameters we find in the M-equation. CPI is negative and only significant in M, but this is very likely due to the high positive correlation with *WAGE* and *INCTAX* (0.78-0.79). The new airport seems to have reduced C-prices somewhat, whereas Color air if anything increased prices in C. Interestingly enough, we find no significant effects in the leisure segment M from the entry of Color Air and the new main airport. The city-pair dummies pick up price level differences across routes and prices are clearly seasonal, lowest during the summer. 18 out of the 22 monthly dummy variables are significant.

Turning now to the marginal effects of large customer shares, the large customer rebates and the quality variable *RFL,* six of the ten θ-parameters are significant. However to be able to sign the marginal effects we have to calculate the marginal effects based on also the interaction terms. To get a relative measure on the impact of these effects we present the results as elasticities measured for the average value of the variables. Short and long run elasticities are displayed in Tables 5 and 6.

Table 5 Short- and long-run elasticities C-class

	S	*R*	*RFL*
Short Run	0.102**	0.364**	0.041**
	(0.026)	(0.013)	(0.020)
Long Run	0.115**	0.412**	0.047**
	(0.029)	(0.016)	(0.022)
N	172	172	172

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$

Table 6 Short- and long-run elasticities M-class

	S	*R*	*RFL*
Short Run	0.069**	0.051**	0.053
	(0.019)	(0.023)	(0.037)
Long Run	0.115**	0.086**	0.089
	(0.039)	(0.038)	(0.064)
N	172	172	172

Standard errors in parentheses
* $p < 0.10$, ** $p < 0.05$

The results are in line with what our theory model *Case (ii)* predicts. Both an increase in the share of large customers (*S*) and the rebate they are given (*R*) increase prices in C- and M-class. The effect is most pronounced in the business class. What we see is that in the long run an increase in the large customer share with 10% increases the prices by just about 1% in both price categories. An increase in the rebate has a much larger effect in the C-segment where a 10% increase in the rebate increase C-price by more than 4%, M-price only by 0.86%.[20] It is also interesting to note that three out of four interaction terms are significant, suggesting that the large customer competition differs with the quality of the product – here measured through flight frequency.

Focusing on the quality index we see that an increase in RFL – that is SAS increases their number of flights relative to their competitor BU, increases prices in the business segment. The effect is significant but relatively modest though, suggesting that an increase in the index with 10% only allows SAS to increase C-price by 0.4-0.5%. We find not surprisingly no significant effect on pricing in the leisure segment, suggesting that flight frequency is an issue for business travelers, not leisure travelers.

We have also estimated the price models in (8) where we exclude the interaction terms between quality (*RFL*) and the large customer variables (*R* and *S*), to see how important the relationship between quality and the large corporate customer competition is. Typically the elasticities for the share of the large customers (*S*) are reduced whereas the rebate effect (*R*) stays the same in C-class when we exclude the interaction terms. However, the elasticities in M-class are now all insignificant and the quality (*RFL*) effect disappears. This suggests that the interaction between quality and the large customer competition is important. Neglecting this effect (i.e., the interaction terms) make us underestimate both the large customer- and the quality effects.[21]

Summing up, we find support for semi collusion taking place. Both increases in the share of large customers and the rebate given to the large customers have a significant positive effect on prices. The effect is also found to differ according to the quality (number of flights) the airline companies can offer. The effect is found to be most substantial for the most relevant

[20] Note however that we probably underestimate the M-price effect here since we use the real C-gross price in our estimations, whereas we use the average M-price in our estimations (refer the previous footnote).
[21] The results can be obtained on request to the authors.

price category – flexible business tickets. This also mirrors what we saw in the descriptive section.

6. Some concluding remarks

In this paper we have shown that very tough competition for large corporate customers can lead to a semi collusive outcome with very high prices for non-contracted consumers. Actually, the gross price faced by the consumers without such large customer contracts are excessive in the sense that these prices are set above monopoly prices to regain lost revenue from the tough competition for large corporate customers.

This kind of competition has been observed in several markets where large corporate customers use their bargaining power. We take the model to data on large customer contracts in the Norwegian airline market where we have access to unique data on prices for the different consumer groups on the route level. We estimate price models where we control for cost and demand factors as well as route specific heterogeneity. Our results are in line with what our theory model predicts. An increase in the share of large customers and their rebates increase business- and leisure prices. In line with the travelling pattern for large corporate customers where business class mostly is the preferred alternative, the effect is most pronounced in the business class.

It is also interesting to note that the large customer competition differs with the quality of the product – here measured through flight frequency. Frequency matters also to prices. We find that if SAS increases their number of flights relative to their competitor BU, prices in business class increase. The effect is significant but relatively modest though. We find not surprisingly no significant effect on pricing in the leisure segment, suggesting that flight frequency is an issue for business travelers, not leisure travelers.

When we disregard the interaction between quality and the large corporate customers' variables we find both lower effects from the large corporate customer competition and that the quality effects disappear. This suggests that the interaction between quality and the large customer competition was important in this market. Neglecting this effect (i.e., the interaction terms) make us underestimate both the large customer- and the quality effects.

A similar example was seen in Sweden in the fall of 1999, where harsh competition on large customers was the reason for why the Swedish gasoline companies chose to cooperate illegally to nullify the large discounts to their corporate customers. They were able to coordinate high public gasoline prices legally, but were unable to discipline the competition on the large customer discounts without explicit cooperating. The cartel was later exposed and the cartel members had to pay large fines due to their collusive actions.

We see that compared to a situation of pure price fixing (price fixing on all prices), the semicollusive outcome is detrimental to welfare. It leads to distortions in the price setting, and in particular to prices above the monopoly prices for the non-contracted customers. Although this is true, it seems misguided to design the competition rules such that full collusion is attainable. In this particular case it is likely that it would be more welfare enhancing to restrict the devices that allows price fixing. This is expected to lead to tougher price competition for all consumers, including those without any corporate contract.

References

Benoit, J.-P. and V. Krishna (1991): 'Entry deterrence and dynamic competition: The role of capacity reconsidered', *International Journal of Industrial Organization*, 9, 477-495.

Borenstein, S. and J. Netz (1999): 'Why do all flights leave at 8 am?: Competition and departure-time differentiation in airline markets', *International Journal of Industrial Organization*, 17, 611-640.

Brod, A. and R. Shivakumar (1999): 'Advantageous semicollusion', *Journal of Industrial Economics*, 47, 221-230.

Dick, A.R, (1992): 'The competitive consequences of Japan's export cartel associations' *Journal of the Japanese and International Economics,* 6, 275-298

Eaton, B. C. and R. C. Lipsey (1975): 'The Principle of Minimum Differentiation Reconsidered: Some New Developments in the Theory of Spatial Competition', *Review of Economic Studies*, 42, 27-49.

Fershtman, C. and N. Gandal (1994): 'Disadvantageous Semicollusion'*, International Journal of Industrial Organization*, 12, 141-154.

Friedman, J. M. and J.-F. Thisse (1993): 'Partial Collusion Fosters Minimum Product Differentiation', *Rand Journal of Economics*, 24, 631-645.

Jèhiel, P. (1992): 'Product differentiation and price collusion'. *International Journal of Industrial Organization*, 10, 633-641.

Ma, T-C., (2008): 'Disadvantageous collusion and government regulation', *International Journal of Industrial Organization*, 26, 168-185.

Mukherjee, A. (2002): 'Advantageous and disadvantageous semicollusion', KERP 2002/10, Keele University.

Osborne, M.J. and C. Pitchik (1987): "Cartels, Profits and Excess Capacity", *International Economic Review*, 28(2), 313-28.

Röller, L.-H. and F. Steen (2006): 'On the Workings of a Cartel: Evidence from the Norwegian Cement Industry', *American Economic Review*, 96, 321-338.

Salvanes, K.G., F. Steen and L. Sørgard (2005): "Hotelling in the air? Flight departures in Norway", *Regional Science & Urban Economics* 35, Issue 2, March 2005, 193-213,

Salvanes, K.G., F. Steen and L. Sørgard (2003): "Compete, Collude or Both - Deregulation in the Norwegian airline industry", *Journal of Transport Economics and Policy,* 2003, vol. 37, iss. 3, pp. 383-416(34).

Scherer, F. M. (1970): *Industrial Market Structure and Economic Performance*, Rand McNally & Company, Chicago.

Scherer, F.M. and D. Ross (1990): *Industrial Market Structure and Economic Performance*, Houghton Mifflin Company.

Stavins, J. (1995): 'Model entry and exit in a differentiated-product industry: The personal computer market', *The Review of Economics and Statistics*, (4), 571-584.

Steen, F. and L. Sørgard (2003): "From a regulated duopoly to a private monopoly: The deregulation of the Norwegian airline Industry", *Swedish Economic Policy Review*, Vol. 9, 2003, 191-221.

Steen, F. and L. Sørgard (2009): "Semicollusion", *Foundations and Trends® in Microeconomics*: Vol. 5: No 3, pp 153-228

Symeonidis, G. (2000a): 'Price competition, Non-price competition and market structure: Theory and evidence from the UK ', *Economica*, 67, 437-456

Symeonidis, G. (2000b): 'Price and non-price competition with endogenous market structure', *Journal of Economics & Management Strategy*, 9, 53-83

Wang, S.-S., T. P. Dahr and K. W. Stiegert (2007): 'Semi-collusive market outcomes: Theory and evidence', mimeo, University of Wisconsin-Madison.

Appendix A - Data definitions and data sources

All airline data on the city-pair level has been provided by Scandinavian Airlines and Braathens SAFE. The consumer price index (CPI) is collected from Statistics Norway. The variables representing local demand are collected from "The Norwegian Social Science Data Service, "The Municipal Database" and are as follows:

- EXP: Gross Expenditures in total, collected from municipal accounts at the municipal level. Chapter 1, item 000-599 until 1991, and chapter 1 item 01-59 from 1991.
- INCTAX: Taxes, collected from the municipal accounts; chapter 1.900 until 1991, and chapter 1.800, from 1991.

In order to be able to use the figures in the analysis, the numbers are aggregated to regions corresponding to the city-pairs. The basis for the aggregation is the classification of municipals explained below, where closeness in terms of commuting area around each airport are used as the aggregation criterion. The figures from each municipal that is located in the airport region are aggregated. Using these airport region figures we then aggregate into 5 city-pair regions.

Classification of Municipals

The classification of municipals is based on "*The Norwegian Official Statistics, Standard for Municipal Classification - 1994*", and "*Regional classification in the general equilibrium model, MISMOD*", WP 63/1990, Centre for Applied Research, by Frode Steen. Municipals are categorised and given a centrality code which indicates the commuting possibilities (closeness) between the airport area and the municipal. Dependent on the size of the nearby cities, the municipals are given centrality codes. For the largest cities; Oslo, Bergen, Trondheim, Stavanger and Kristiansand, centrality code "3" indicates good commuting possibilities and short distance in time to the airport (which always are located within, or very close to its city municipal). For the airports located in Bodø, a smaller city the centrality code "2" indicates good commuting possibilities. Hence, the classification used here is based on these codes, where all relevant (close) municipals are attributed to one of the 6 airports included in our 5 city-pairs. Then these 5 regions are aggregated into city-pair variables. Table A1 summarises the municipals, and their airport region codes.

Table A1: The municipals' airport-region codes

Air-port Code	Mun-icipal No	Municipal Name	Air-port Code	Mun-icipal No	Municipal Name	Air-port Code	Mun-icipal No	Municipal Name	Air-port Code	Mun-icipal No	Municipal Name
1	104	Moss	1	237	Eidsvoll	2	1001	Kristian-sand	4	1243	Os
1	123	Spydeberg	1	238	Nannestad	2	1002	Mandal	4	1245	Sund
1	124	Askim	1	239	Hurdal	2	1014	Vennesla	4	1246	Fjell
1	135	Råde	1	301	Oslo	2	1017	Songdalen	4	1247	Askøy
1	136	Rygge	1	419	Sør-Odal	2	1018	Søgne	4	1251	Vaksdal
1	137	Våler	1	532	Jevnaker	2	1021	Marnardal	4	1253	Osterøy
1	138	Hobøl	1	533	Lunner	2	1027	Audnedal	4	1256	Meland
1	211	Vestby	1	534	Gran	2	1029	Lindesnes	4	1259	Øygarden
1	213	Ski	1	602	Drammen				4	1260	Radøy
1	214	Ås	1	604	Kongsberg	3	1102	Sandnes	4	1263	Lindås
1	215	Frogn	1	605	Ringerike	3	1103	Stavanger	5	1601	Trondheim
1	216	Nesodden	1	612	Hole	3	1114	Bjerkreim	5	1624	Rissa
1	217	Oppegård	1	623	Modum	3	1119	Hå	5	1638	Orkdal
1	219	Bærum	1	624	Øvre Eiker	3	1120	Klepp	5	1648	Midtre Gauldal
1	220	Asker	1	625	Nedre Eiker	3	1121	Time	5	1653	Melhus
1	221	Aurskog-Høland	1	626	Lier	3	1122	Gjesdal	5	1657	Skaun
1	226	Sørum	1	627	Røyken	3	1124	Sola	5	1662	Klæbu
1	227	Fet	1	628	Hurum	3	1127	Randaberg	5	1663	Malvik
1	228	Rælingen	1	702	Holme-strand	3	1129	Forsand	5	1664	Selbu
1	229	Enebakk	1	711	Svelvik	3	1130	Strand	5	1714	Stjørdal
1	230	Lørenskog	1	713	Sande	3	1141	Finnøy	5	1719	Levanger
1	231	Skedsmo	1	714	Hof	3	1142	Rennesøy	6	1804	Bodø
1	233	Nittedal	2	904	Grimstad	3	1145	Bokn	6	1840	Saltdal
1	234	Gjerdrum	2	926	Lillesand	4	1201	Bergen	6	1841	Fauske
1	235	Ullensaker	2	935	Iveland	4	1241	Fusa			
1	236	Nes	2	937	Evje og Hornnes	4	1242	Samnanger			

Notes: Airport region codes used in the table translate to airports as follows: 1 - Oslo, 2 - Kristiansand, 3 – Stavanger, 4 – Bergen, 5 – Trondheim, 6 - Bodø

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17/11 **Gregory Corcos**, Massimo Del Gatto, Giordano Mion, and Gianmarco I.P. Ottaviano, "Productivity and Firm Selection: Quantifying the "New" Gains from Trade".

18/11 **Grant R. McDermott** and **Øivind Anti Nilsen**, "Electricity Prices, River Temperatures and Cooling Water Scarcity".

19/11 Pau Olivella and **Fred Schroyen**, "Multidimensional screening in a monopolistic insurance market".

20/11 **Liam Brunt**, "Property rights and economic growth: evidence from a natural experiment".

21/11 Pau Olivella and **Fred Schroyen**, "Multidimensional screening in a monopolistic insurance market: proofs".

22/11 **Roger Bivand**, "After "Raising the Bar": applied maximum likelihood estimation of families of models in spatial econometrics".

23/11 **Roger Bivand**, "Geocomputation and open source software:components and software stacks".

24/11 Simon P.Anderson, Øystein Foros, **Hans Jarle Kind** and Martin Peitz, "Media market concentration, advertising levels, and ad prices".

25/11 **Liam Brunt**, Johs Lerner, and Tom Nicholas, "Inducement Prizes and Innovation".

26/11 **Øivind Anti Nilsen** and **Katrine Holm Reiso**, "Scarring effects of unemployment".

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01/12 February, **Ola Honningdal Grytten**, "The Protestant Ethic and the Spirit of Capitalism the Haugian Way".

02/12 February**, Alexander W. Cappelen**, Rune Jansen Hagen, **Erik Ø. Sørensen**, and **Bertil Tungodden**, «Do non-enforceable contracts matter? Evidence from an international lab experiment".

03/12 February, **Alexander W. Cappelen** and **Bertil Tungodden**, "Tax policy and fair inequality".

04/12 March, Mette Ejrnæs and **Astrid Kunze**, «Work and Wage Dynamics around Childbirth".

05/12 March, **Lars Mathiesen**, "Price patterns resulting from different producer behavior in spatial equilibrium".

06/12 March, **Kurt R. Brekke**, Luigi Siciliani, and Odd Rune Straume, "Hospital competition with soft budgets".

07/12 March, **Alexander W. Cappelen** and **Bertil Tungodden**, "Heterogeneity in fairness views - a challenge to the mutualistic approach?"

08/12 March, Tore Ellingsen and **Eirik Gaard Kristiansen**, "Paying for Staying: Managerial Contracts and the Retention Motive".

09/12 March, **Kurt R. Brekke**, Luigi Siciliani, and Odd Rune Straume, "Can competition reduce quality?"

10/12 April, Espen Bratberg, **Øivind Anti Nilsen**, and Kjell Vaage, "Is Recipiency of Disability Pension Hereditary?"

11/12 May, **Lars Mathiesen**, **Øivind Anti Nilsen**, and **Lars Sørgard**, "A Note on Upward Pricing Pressure: The possibility of false positives".

12/12 May, **Bjørn L. Basberg**, "Amateur or professional? A new look at 19th century patentees in Norway".

13/12 May, Sandra E. Black, Paul J. Devereux, Katrine V. Løken, and **Kjell G. Salvanes**, "Care or Cash? The Effect of Child Care Subsidies on Student Performance".

14/12 July, **Alexander W. Cappelen**, Ulrik H. Nielsen, **Erik Ø. Sørensen**, **Bertil Tungodden**, and Jean-Robert Tyran, " Give and Take in Dictator Games".

15/12 August, **Kai Liu**, “Explaining the Gender Wage Gap: Estimates from a Dynamic Model of Job Changes and Hours Changes”.

16/12 August, **Kai Liu**, **Kjell G. Salvanes**, and **Erik Ø. Sørensen**, «Good Skills in Bad Times: Cyclical Skill Mismatch and the Long-term Effects of Graduating in a Recession”.

17/12 August, **Alexander W. Cappelen**, **Erik Ø. Sørensen**, and **Bertil Tungodden**, «When do we lie?».

18/12 September, **Kjetil Bjorvatn** and Tina Søreide, «Corruption and competition for resources”.

19/12 September, **Alexander W. Cappelen** and Runa Urheim, “Pension Funds, Sovereign-wealth Funds and Intergenerational Justice”

20/12 October, **Ingvild Almås** and **Erik Ø. Sørensen**, “Global Income Inequality and Cost-of-Living Adjustment: The Geary–Allen World Accounts”.

21/12 November, **Ingvild Almås** and Åshild Auglænd Johnsen, “The cost of living in China: Implications for inequality and poverty”.

22/12 December, **Alexander W. Cappelen, Tom Eichele, Kenneth Hugdahl, Karsten Specht, Erik Ø. Sørensen**, and **Bertil Tungodden**, “Fair inequality: a neureconomic study”.

23/12 December, **Ingvild Almås, Alexander W. Cappelen, Kjell G. Salvanes, Erik Ø. Sørensen,** and **Bertil Tungodden**, «Willingness to compete: family matters».

24/12 December, **Ingvild Almås, Alexander W. Cappelen, Kjell G. Salvanes, Erik Ø. Sørensen**, and **Bertil Tungodden**, «Willingness to compete in a gender equal society».

25/12 December, Ari Hyytinen, **Frode Steen**, and Otto Toivanen, “Anatomy of Cartel Contracts”.

26/12 December, **Sandra E. Black**, Paul J. Devereux, and **Kjell G. Salvanes**, “Losing Heart? The Effect of Job Displacement on Health”.

27/12 December, **Frode Steen** and **Lars Sørgard**, “Disadvantageous Semicollusion: Price competition in the Norwegian airline industry”.

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