Multimarket contact and price: An analysis of two counteracting effects

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Abstract

In this empirical research the relationship between multimarket contact and price is analyzed. Whereas former empirical work often finds only evidence for a positive effect of multimarket contact, in this work it is argued that this effect is complemented by a negative effect on price. A panel of US domestic airline data from 2003 until 2016 is used for several fixed effects models. Through the inclusion of an interaction term of multimarket contact and carrier size it becomes possible to distinguish between two counteracting effects. And indeed robust evidence for the coexistence of both a positive and a negative effect of multimarket contact on airfares is found. For the average airline the eventual effect is negative, whereas it becomes more positive when the size of the carrier increases.

Introduction

On the one hand, multimarket contact leads to increased interaction between firms. Which then may decide to collectively forgo the opportunity of aggressive price reductions in fear of retaliatory responses in other shared markets (Edwards, 1955). On the other hand, increased interaction may lead to collaborations between firms that enables them to decrease costs and therewith prices (Heide and Miner, 1992). Generally, empirical research has found evidence for a positive effect of multimarket contact on prices, commonly referred to as the mutual forbearance effect (Evans and Kessides 1994; Gimeno and Woo, 1996, 1999). Seemingly contradictory, Van Reeven and Pennings (2015) have empirically shown that multimarket contact may also lead to collaborations such as the sharing of ground resources and the alignment of flight networks. They have found evidence for a resulting positive effect of multimarket contact on product quality. However, the empirical literature has not yet found evidence for a negative effect of multimarket contact on prices due to these collaborations. In this paper, an empirical analysis of the US airline industry reveals that both a positive and a negative effect of multimarket contact on prices coexist and that for the averagely sized airline the negative effect is bigger.

The inclusion of an interaction term of multimarket contact and airline size should help in the discovery of a negative effect on price. Size is a suitable candidate to identify the negative cooperative effect since it mostly depends on the size of a firm whether collaborating is beneficial. Larger firms do often not favor collaborations, since these collaborations often limit their ability to exploit their market position. However collaborations are likely to provide growth opportunities for smaller firms and therefore they tend to welcome them. This is mainly evident in industries with complementary products, which are defined as products of which the value may be enhanced by products of another firm. Namely, when complementarity exists collaboration leads to both an increased demand for a firm's own products and that of other firms, which in turn may increase the demand for the first firm. In the airline industry for example, customers often need a transfer in order to reach their final destination. Flight transfers may require changing carrier and in order to facilitate a smooth transfer, collaborations are necessary.

Everything considered, the main hypothesis for this empirical work will be; In industries with complementary products, multimarket contact has a more positive effect on prices for large firms than for small firms. This hypothesis is tested with the help of a rich panel data set from the US airline industry that stretches from 2003 until 2016. The empirical results show that at first sight only a positive effect is present in the relationship between multimarket contact and price. A closer look however reveals that this effect is complemented by a negative effect in the US airline industry. From the extended model we can conclude that the negative effect is dominant for an averagely sized airline and that the effect becomes more positive when firm size increases.

This research complements the knowledge about the competitive effects of multimarket contact. While a more balanced illustration of the quality effects was yet established by Van Reeven and Pennings (2015), this article will complement the thus far one-sided image of the price effects of multimarket contact. Next to the additional insight for researchers, this empirical analysis shows that regulatory institutions should base policy on the two-sided price effects that result from multimarket contact. This research should motivate policy makers to facilitate multimarket contact in order to increase cooperation between competitors. These collaborations namely facilitate price reductions, which can be considered as desirable for consumers.

In the following section a more in-depth theoretical background is provided. Literature is presented in order to lay a theoretical foundation for the hypotheses that are set in the section thereafter. In the fourth section, the data and methodology of the research are described. The panel dataset of the airline industry is introduced and the fixed effect models will be specified. Subsequently, the results of the regressions and their intuition are presented and checked for robustness. Eventually, the conclusions about the relationship between multimarket contact and prices are discussed.

Literature Review

Multimarket contact is best described as multiple firms that compete in more than one shared market. For multimarket competitors single-market strategies do not necessarily result in the highest profits overall. Namely, aggressive competitive strategies in one shared market may lead to retaliatory responses in another shared market. In fear for these consequences, a firm will most likely refrain from aggressive price reductions in shared markets (Edwards, 1955). Multimarket contact increases the attractiveness of colluding. Namely, the presence of multimarket contact allows firms to be punished in more than one shared market when they would still decide to decrease prices heavily. Colluding with other firms prevents these competitors to execute punishments (Bernheim and Whinston, 1990).

Empirically the mutual forbearance hypothesis has been tested in several industries. For example, Mester (1987) found that prices of Californian savings and loan firms were higher in markets with higher levels of multimarket contact. Furthermore, evidence from regional cement markets showed that the price-cost margin is positively related to the level of multimarket contact (Jans and Rosenbaum, 1997). Moreover, strong empirical evidence was found for the presence of a positive effect of multimarket contact on airfares in the US airline industry (Evans and Kessides, 1994). As it turned out carriers engage less in aggressive price policies in fear of retaliatory responses on shared routes.

The mutual forbearance effect that is found can be explained by two factors, the increased familiarity and increased punishments due to multimarket contact. First of all, firms often operate in highly complex environments where gathering the necessary information about rivals in order to arrive at the efficient outcome is troublesome. When firms operate in a multimarket environment, more contact with the competition is made which facilitates familiarity. Subsequently, competitors will more easily notice price reductions, which may lead to more cautious behavior with regards to price reductions. Second of all, increased punishments are expected due to multimarket contact, since it results in opportunities in other markets to retaliate firms' aggressive pricing strategies (Miller and Chen, 1994).

As mentioned, multimarket contact facilitates more frequent interaction between rivals, which increases in turn the familiarity with competitors. Although this may aid mutual forbearance, it may also facilitate cooperative behavior (Heide and Miner, 1992). The expectation of future interaction in itself may already facilitate cooperation other than simply forbearing the opportunity to aggressively compete. This so-called relational extendedness increases the chances that firms see possibilities for efficient and trustworthy cooperative actions that may for example increase product quality. Besides, empirical work from Baum and Korn (1996) provides the evidence that increased firm's familiarity with rivals' strategies may enable tacit communication between the two parties. Smoothened communication is the first step towards engaging in a collaborative agreement. The increased familiarity and relational extendedness may thus provide an opening for forms of cooperation that are not only beneficial to the companies but also to their customers.

When multimarket contact and the resulting increased interaction between competitors could have multiple effects, interest is raised concerning the environment in which either effect is dominant. As it turns out, quality-improving collaborations are especially relevant for firms in sectors that produce complementary products. This means that a collaboration is beneficial when two products of different companies are more valuable when used together than if used separately (Economides, 1999). Several industries where this requisite is met are empirically researched. For example, both in the banking sector and in the telecom industry collaboration between several competitors leads to better services. Namely, executing a bank transfer between banks requires cooperation of both firms, similarly making a phone call to somebody with a different telecom provider requires access to both networks. These industries are thus characterized by complementary products. In both industries, a higher level of multimarket contact facilitates these collaborations and has led to advantages for consumers in the form of improved product quality (Heggestad and Rhoades, 1978; Parker and Röller, 1997).

The presented empirical work thus far either finds evidence for an adverse or for a beneficial effect of multimarket contact on consumer surplus. However, the two effects of multimarket contact on quality may coexist. Van Reeven and Pennings (2015) have empirically researched the effect of multimarket contact on product quality in the airline industry. It became apparent that two counteracting effects are indeed present in that industry. In their empirical analysis they argue there is a negative effect of multimarket contact on quality, which can be seen as evidence for the mutual forbearance hypothesis. Simultaneously, there is a positive effect of multimarket contact on service quality. They argue that multimarket contact facilitates cooperation, which is observable in the airline industry as separate airlines that share their ground resources and coordinate their networks. Therefore, this effect is described as the network coordination effect.

The size of the firm is crucial in identifying the dominant effect (Katz and Shapiro, 1985). Large firms or incumbents generally tend to oppose high degrees of interfirm collaboration, since it limits their ability to decide freely upon their own strategies. Because they depend on other companies, large companies are restricted in exploiting their market position. Conversely, smaller firms tend to prefer a higher degree of collaboration. This provides these smaller companies with an opportunity to benefit from the existing demand of products from competitors. Van Reeven and Pennings (2015) empirically confirmed that size is a mediator in the relationship between multimarket contact and product quality. When taking into account that increased contact possibly leads to cooperative behavior and that efficiency gains could evolve from that behavior, a negative effect should be observed in the relationship between multimarket contact and prices. This negative effect of multimarket contact on prices will be called the network coordination effect in the remainder of this article. Again, it is essential that the firms in the industry offer complementary products in order to make these cooperative strategies sufficiently rewarding.

Hypotheses

The literature review serves as a theoretical basis for the hypotheses of this research. The first hypothesis will be revisited in order to facilitate the comparison with other empirical work. Due to the dynamic character of the airline industry, retesting the hypothesis is advisable since Van Reeven and Pennings (2015) already showed that the competitive effects of multimarket contact are different in the period before 9/11 than in the period after the attack. Subsequently, evaluation of the second hypothesis will reveal whether or not there is also a negative effect of multimarket contact on prices.

Hypothesis 1*: Multimarket contact has a positive effect on prices.*

Hypothesis 2*: In industries with complementary products, multimarket contact has a more positive effect on prices for large firms than for small firms.*

In order to test the hypotheses, data from the airline industry will be used. This industry and the role of multimarket contact in the industry have been widely researched before (Yu and Cannella, 2013). The industry is suitable for multimarket contact analysis for several reasons. First of all, routes can be seen as separate markets, which provides us with clear boundaries between markets. Secondly, flights are relatively homogeneous products, which results in a fair comparison between markets. Finally, opportunities for co-operation are present in the industry, such as the possibility to start code-sharing agreements and to share ground resources. As pointed out by van Reeven and Pennings (2015), cooperation has become of even larger strategic importance in recent times. Intensified safety regulations, the emergence of competitive low-cost airlines and the resulting reduced significance of legacy carriers necessitate firms to reorient their strategies. As a result, the share of interlining passengers has grown considerably and therewith the complementarity of flights has increased as well. This trend will most likely lead to more collaboration and therewith higher product quality and lower prices.

Data and methodology

For the analysis, data will be used from the United States Bureau of Transportation Statistics. More precisely, the Airline Origin and Destination Survey (DB1B) will be used for most variables. This is a 10% sample of airline tickets from reporting foreign and domestic carriers. This dataset contains data of US domestic airline tickets of flights between two American cities. Quarterly data from the first quarter of 2003 until the fourth quarter of 2016 will be included. The use of the most recent data aids to draw conclusions about the current state of the industry, furthermore data earlier than 2003 is excluded in order to make sure the results are not influenced by 9/11 and the following year. This traumatic event has had a large influence on the industry and it is therefore likely that the industry behaved differently in the following year. (Van Reeven and Pennings, 2015) Furthermore, data from the Air Carriers T-100 Segment (all carriers) database is used for the calculation of the available seat miles per airline and the number of seats. Finally, the dataset is complemented with financial data from the United States Bureau of Transportation Statistics. Specifically, schedules B-1 and P-1.2 from the Air Carrier Financial Reports (Form 41 Financial Data) are used. The model will be based on observations that differ on the basis of route, airline and quarter, where the route will be defined as a citypair in line with most empirical work in the airline industry. (Yu and Cannella, 2013) A citypair is a combination of the origin and destination city. Often more than one airport is located in a city, however flights from both airports are regularly used as direct substitutions and are therefore defined as being part of the same market.

The dependent variable in the model will be the average market fare which contains the average one way price on route j for airline i in quarter t. In

Table 1. Summary statistics

	Mean	SD	Min	Max
1. Multimarket contact	538	356	18.7	2104
2. Route Herfindahl	0.67	0.27	0.17	1.00
3. Hub effect	30.71	16.83	1.00	117.50
4. Ln(Route passengers)	7.81	2.00	0.00	12.30
5. Average market share at route airports	0.32	0.20	0.00	1.00
6. Available seat miles	1.88x10^10	9.71x10^9	3.80x10^7	3.84x10^10
7. Number of seats	2.14x10^7	1.29x10^7	48678	4.81x10^7
8. Number of passengers	947932	632875	2620	2573110
9. Number of routes	901	487	100	2104
10. Available cash	0.063	0.086	-0.006	0.479
11. Net income	-0.004	0.031	-0.497	0.155
12. Operating expenses	0.105	0.103	0.000	0.641

order to calculate the average price, only direct one-way tickets are included in the dataset. In line with Evans and Kessides (1994), some extreme observations are excluded. The data namely contains some keypunch errors and data collection errors, which has led to some unusually small or large airfares. Ticket prices more than 50 percent above the 99th percentile or 50 percent below the 1st percentile are dropped. Furthermore, the dataset normally includes some very small airlines that often voluntarily contributed to the data collection process. Since these carriers behave very differently from their larger counterparts and only make up a small part of the total number of flights they were eliminated. In order to do so a similar approach to Evans and Kessides (1994) is chosen, namely observations from airlines that flew on less than 100 routes in a specific quarter were dropped. Finally, in line with most other empirical research, tickets with bulk fares and unknown or unspecified online carriers were excluded.

The main independent variable is a construct for multimarket contact. This variable shows the average number of routes an airline shares with other carriers on route *j*, for airline *i* at quarter *t*. The construct that is used for this analysis is similar to the constructs in most other empirical research concerning multimarket contact. (Evans and Kessides, 1994; Gimeno and Woo, 1996, 1999; Van Reeven and Pennings, 2015 etc.) The measure is based on pairwise comparisons of carrier contact on specific routes. In any quarter there are n routes and m airlines, with on route j at time t only f carriers offering a service. D_{ij} is a dummy variable signifying whether carrier j operates on route i. These dummies are used for the calculation of a symmetric matrix A of the size (m x m). Element a_{kl} measures the number of routes that is shared between carriers k and l.

(1) $$A=(a_{kl})$$

where

(2) $$a_{kl} = \sum_{j=1}^{n} D_{kj} D_{lj}$$

and

(3) $$k, l = 1, 2, \dots, m.$$

These definitions enable the calculation of the multimarket contact construct of airline i on route j at time t:

$$\textit{Multimarket contact}_{ijt} = \frac{1}{f_{jt}} \sum_{k=1}^{m} \sum_{l=k+1}^{m} a_{klt} D_{kjt} D_{ljt}$$

Table 2. Correlation matrix

	1	2	3	4	5	6	7	8	9	10	11	12
1. Multimarket contact	1.00											
2. Route Herfindahl	0.38	1.00										
3. Hub effect	0.37	0.01	1.00									
4. Ln(Route passengers)	-0.42	-0.65	0.06	1.00								
5. Average market share at route airports	0.29	0.55	0.18	-0.40	1.00							
6. Available seat miles	0.53	-0.06	0.41	0.02	0.05	1.00						
7. Number of seats	0.55	-0.01	0.31	-0.00	0.18	0.89	1.00					
8. Number of passengers	0.52	-0.04	0.24	0.02	0.18	0.81	0.95	1.00				
9. Number of routes	0.78	-0.01	0.47	-0.06	0.06	0.67	0.67	0.64	1.00			
10. Available cash	-0.23	-0.12	-0.14	0.10	-0.27	-0.43	-0.50	-0.45	-0.26	1.00		
11. Net income	-0.07	0.08	-0.16	-0.03	0.13	-0.08	0.00	0.07	-0.12	-0.04	1.00	
12. Operating expenses	-0.26	0.07	-0.19	-0.03	-0.00	-0.39	-0.29	-0.29	-0.31	0.10	-0.07	1.00

The measure for multimarket contact is best understood with an example. If for example the route New York – Boston is operated by three carriers in the fourth quarter of 2016; Delta airlines, American airlines and Southwest airlines. Imagine that Delta and American share 350 routes, American and Southwest 250 routes and Delta and Southwest 400 routes. Then the multimarket contact for Delta airlines on route New York – Boston would be (350+400)/2 = 375. This measure of multimarket contact allows isolation of the effect of the multimarket contact of the airline in question, since it does not take into account the multimarket contact between the other two carriers on the route.

Additionally, several independent variables are added to the model. First of all, a variable for carrier size is added as a control variable in order to accommodate for the economies of scope. Choosing the correct measure for airline size is important since the variable is also used in the main interaction with multimarket contact. Measuring the size of an airline is done in various manners throughout the empirical literature, however several concerns arise with some of these measures. For example Van Reeven and Pennings (2015) make use of the number of routes of an airline *j* in quarter *t*. However, as seen in Table 2, the correlation coefficient between multimarket contact and the number of routes is 0,78. Therefore the use of this measure raises concerns about the existence of multicollinearity with the multimarket contact variable. Since both variables will be used in an interaction term, multicollinearity would be a severe problem. Evans and Kessides (1994) make use of the number of passengers of an airline *j* in quarter *t*. This measure may be subject to endogeneity due to its direct relationship with market demand. Since demand is a direct determinant of market fares, including the number of passengers into the interaction term will most likely lead to endogeneity issues. Considering these challenges, the available seat miles of an airline j in quarter t will be used. This variable is exogenous to a larger extent since the available seat miles cannot be adapted as quickly to the market demand. Furthermore, the measure includes both the length of its flights and the capacity of its airplanes on those flights and is therefore most complete. However since there are clearly different measures used in previous empirical analyses, robustness will be checked through the use of the discussed measures and the number of seats of an airline j in quarter t as well.

Moreover, in order to correct for the effect of market structure on route i at time t on the relationship the Herfindahl index is included. The index is defined as the sum of squares of the market shares of all carriers on a specific route. Also the number of route passengers is added to the model, this allows controlling for the market demand on route i in quarter t. Since this variable has a non-normal distribution, a logarithmic transformation is executed as is done in most other empirical research. This control variable should not be confused with the considered measure for airline size that makes use of passenger data of an airline j at time t. Furthermore, it is possible that the relationship of interest is disturbed by the market power of a carrier at an airport. This is measured as the average market share at the origin and destination airports of a particular observation. Namely, higher levels of market power could be used by an airline to increase their margins. Moreover, a similar effect could arise from one of the end points being a hub airport for the airline. This hub effect is measured by the average number of routes that airline i serves from the origin and destination cities at time t.

In order to aid interpretation, the measures for multimarket contact, airline size and their interaction terms are normalized to their smallest values in the sample. Most empirical authors that research the multimarket contact-price relationship do not include firm characteristics. However, this may lead to omitted variable bias since a large part of the variation in prices is caused by firm characteristics. The available cash and net income are used to measure the financial health of the company. Also the operating expenses are included in order to control for cost-driven price fluctuations. All these three variables are divided by the firm's total assets in order to enable comparison of the financial health and cost efficiency between airlines.

The sample includes data from all quarters of 2003 up until 2016 and consists of 134.269 observations. The minimum number of airlines in the sample is 9 and the maximum number of airlines is 14. Only 5 airlines are present in the sample over the course of the entire period. Further summary statistics are included in table 1. As can be observed, both the Herfindahl index and the market shares at the endpoints are indices on a range from +/- 0 to 1.

For the eventual hypotheses testing of this panel dataset fixed effects estimators will be used. More precisely, carrier-route fixed effects will be included in order to control for characteristics such as flight distance and the degree of luxury services of the carrier on that route. Furthermore, time fixed effects will be added in order to control for the time-related shocks. In the airline industry this includes for example fluctuating kerosene prices and economic growth. For the analysis used to answer the first hypothesis a fixed effects model will be used that includes all named control variables and fixed effects next to prices and multimarket contact. This regression will serve as a benchmark in order to be able to judge whether the data behaves similarly as previously researched datasets. Subsequently, an interaction between size and multimarket contact will be added. The interaction will provide the opportunity to investigate whether or not the relationship between price and multimarket contact is influenced by carrier size. This will enable answering the second hypothesis.

Results

The hypotheses are tested in three stages. First of all, a base regression is estimated in order to facilitate comparison with earlier research investigating overall price effects of multimarket contact. Secondly, an interaction term is added in order to assess whether there are indeed two counteracting effects present in the relationship. The interaction between multimarket contact and the size of the airline should reveal whether there is an empirical foundation for a network coordination effect. Finally, the robustness of the results is tested through revisiting the measure for size and redefining routes as airport pairs instead of city pairs. Also, an exploration of the effects of multimarket contact on different levels of the price distribution is given in order to complement the illustration of average price behavior. Table 3 provides the main estimation results for the base regression and the regression that includes the interaction term.

The baseline regression is found in the first column of table 3. The effect of multimarket contact on price is positive and significant at the 1% level. This finding is in line with most empirical research in which often a positive effect

Table 3. Effect of multimarket contact on average market fare in dollars

Model	(1)	(2)
Dependent variable	Ln(Average market fare)	Ln(Average market fare)
Multimarket contact	0.094***	-0.307***
	(0.009)	(0.024)
Multimarket contact × Available seat miles		0.474***
		(0.026)
Route Herfindahl	0.078***	0.078***
	(0.006)	(0.006)
Hub effect	0.003***	0.003***
	(0.000)	(0.000)
Ln(Route passengers)	0.007***	0.009***
	(0.001)	(0.001)
Available seat miles	0.331***	0.127***
	(0.010)	(0.015)
Average market share at route airports	0.203***	0.221***
	(0.014)	(0.014)
Cash available	-0.157***	-0.162***
	(0.014)	(0.014)
Net income	0.117***	0.137***
	(0.027)	(0.027)
Operating expenses	0.114***	0.110***
	(0.010)	(0.010)
Constant	4.943***	4.851***
	(0.015)	(0.014)
Carrier-Route Fixed Effects	Yes	Yes
Quarter Fixed Effects	Yes	Yes
N	134,269	134,269
R-squared	0.208	0.206

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

of multimarket contact on prices due to mutual forbearance is identified (Yu and Cannella, 2013). The coefficient for the standardized measure of multimarket contact in the base model is 0,094; meaning that changing the level of multimarket contact from its minimum level to its maximum level leads to an approximate average price increase of 9,4%, ceteris paribus.

As has been explained in the theoretical background, multimarket contact can facilitate cooperation in industries with complementary products. Especially smaller firms tend to favor this cooperation over mutual forbearance. In order to assess whether there are also empirical grounds for the negative effect of multimarket contact on prices an interaction between size and multimarket contact is added.

The coefficient of the interaction term between available seat miles and multimarket contact in model 2 is positive and significant at the 1% level. This means that the effect of multimarket contact on prices indeed becomes more positive when the airline size increases. These results are in line with hypothesis 2 and hint at the presence of a network coordination effect. Furthermore, the

Table 4a. Effect of multimarket contact on different percentiles of the fare distribution in dollars

Model	(3)	(4)	(5)	(6)	(7)	(8)
Dependent variable	Ln(Fare 10th percentile)	Ln(Fare 10th percentile)	Ln(Fare 25th percentile)	Ln(Fare 25th percentile)	Ln(Fare 50th percentile)	Ln(Fare 50th percentile)
Multimarket contact	0.005	-0.433***	0.055***	-0.558***	0.064***	-0.404***
	(0.025)	(0.067)	(0.014)	(0.037)	(0.010)	(0.027)
Multimarket contact × Airline size		0.518***		0.724***		0.554***
		(0.074)		(0.041)		(0.029)
Route Herfindahl	0.069***	0.069***	0.123***	0.123***	0.100***	0.100***
	(0.018)	(0.018)	(0.010)	(0.010)	(0.007)	(0.007)
Hub effect	-0.003***	-0.003***	0.000	0.000*	0.002***	0.002***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Ln(Route passengers)	0.079***	0.081***	0.041***	0.043***	-0.002	-0.000
	(0.004)	(0.004)	(0.002)	(0.002)	(0.001)	(0.001)
Airline size	0.633***	0.410***	0.327***	0.015	0.307***	0.068***
	(0.029)	(0.043)	(0.016)	(0.024)	(0.012)	(0.017)
Average market share at route airports	0.460***	0.479***	0.175***	0.203***	0.145***	0.166***
	(0.039)	(0.039)	(0.021)	(0.021)	(0.016)	(0.016)
Cash available	-0.161***	-0.166***	-0.043**	-0.050**	-0.104***	-0.109***
	(0.039)	(0.039)	(0.021)	(0.021)	(0.015)	(0.015)
Net income	0.668***	0.689***	0.339***	0.369***	0.290***	0.312***
	(0.075)	(0.075)	(0.041)	(0.041)	(0.030)	(0.030)
Operating expenses	0.202***	0.198***	0.152***	0.148***	0.187***	0.184***
	(0.027)	(0.027)	(0.015)	(0.015)	(0.011)	(0.011)
Constant	3.419***	3.520***	4.174***	4.315***	4.852***	4.960***
	(0.039)	(0.041)	(0.021)	(0.023)	(0.015)	(0.016)
Carrier-Route Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Quarter Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
N	133,578	133,578	134,158	134,158	134,262	134,262
R-squared	0.070	0.070	0.102	0.104	0.168	0.171

Standard errors in parentheses. *** p<0.01, **p<0.05, * p<0.1

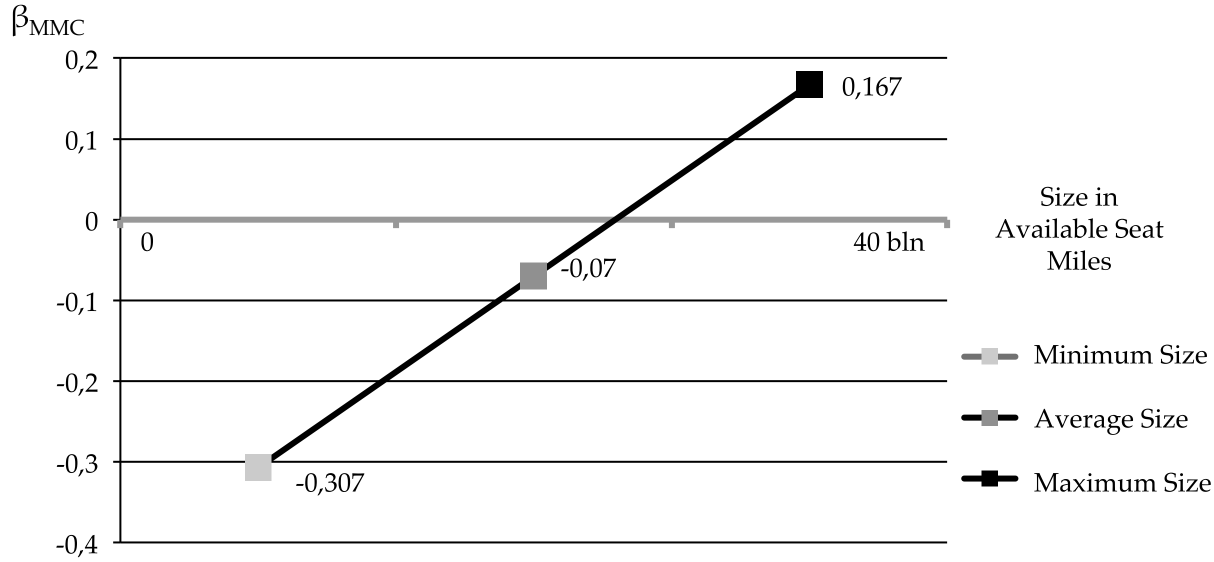
Table 4b. Effect of multimarket contact on different percentiles of the fare distribution in dollars

Model	(9)	(10)	(11)	(12)
Dependent variable	Ln(Fare 75th percentile)	Ln(Fare 75th percentile)	Ln(Fare 90th percentile)	Ln(Fare 90th percentile)
Multimarket contact	0.084***	-0.273***	0.131***	-0.156***
	(0.010)	(0.027)	(0.011)	(0.028)
Multimarket contact × Airline size		0.422***		0.340***
		(0.030)		(0.031)
Route Herfindahl	0.081***	0.081***	0.056***	0.057***
	(0.007)	(0.007)	(0.008)	(0.008)
Hub effect	0.003***	0.003***	0.005***	0.005***
	(0.000)	(0.000)	(0.000)	(0.000)
Ln(Route passengers)	0.003*	0.004**	0.023***	0.024***
	(0.001)	(0.001)	(0.002)	(0.002)
Airline size	0.308***	0.126***	0.367***	0.220***
	(0.012)	(0.017)	(0.012)	(0.018)
Average market share at route airports	0.261***	0.277***	0.310***	0.323***
	(0.016)	(0.016)	(0.017)	(0.017)
Cash available	-0.169***	-0.173***	-0.220***	-0.224***
	(0.016)	(0.016)	(0.016)	(0.016)
Net income	0.106***	0.123***	-0.095***	-0.081**
	(0.030)	(0.030)	(0.032)	(0.032)
Operating expenses	0.131***	0.128***	0.036***	0.034***
	(0.011)	(0.011)	(0.012)	(0.012)
Constant	5.097***	5.179***	5.139***	5.205***
	(0.016)	(0.017)	(0.016)	(0.017)
Carrier-Route Fixed Effects	Yes	Yes	Yes	Yes
Quarter Fixed Effects	Yes	Yes	Yes	Yes
N	134,269	134,269	134,269	134,269
R-squared	0.173	0.174	0.171	0.172

Standard errors in parentheses. *** p<0.01, **p<0.05, * p<0.1

coefficient of the normalized measure of multimarket contact is negative and significant. In combination with the positive and significant coefficient for the interaction term, an interesting observation can be made. For small airlines, the cumulative effect of multimarket contact on prices is negative. Simultaneously, for larger airlines the eventual effect is positive. These observations imply that the dominant effect for the industry must be determined by the size distribution. But since the network coordination effect involves a strategic decision at the firm level, multimarket contact is not likely to have an identical dominant effect for all firms in an industry. Additionally to the statistical significance, the economic significance of the results increases substantially when adding the interaction term. Furthermore, it seems to be the case that the positive multimarket contact effect in model 1 is partly offset since the coefficients in the second model are larger which complies with the expectation that two effects are coexisting.

Figure 1. The multimarket contact coefficient for different airline sizes



These findings are best illustrated in a graph and therefore the coefficients of multimarket contact for different levels of size are found in figure 1. As can be seen by the upward sloping curve, the multimarket contact coefficient becomes more positive when size increases. Furthermore, the coefficients for three different sizes are displayed. For an airline of the minimum size in the sample, an increase from the minimum level of multimarket contact to the maximum level of multimarket contact leads to a price decrease of 30,7%. For an airline of the maximum size on the other hand, such an increase leads to an increase of 16,7%. For the averagely sized airline, the effect for this change in the level of multimarket contact is - 7,0%.

With these estimation results in hand, it becomes clear that the effect of multimarket contact differs over firm size. The most logical explanation would be that dealing with multimarket contact is a strategic decision on the firm level. For a large airline, the benefits of interfirm cooperation do not seem large enough since they can depend upon their own large network. These firms are benefitting more from setting artificially higher prices. Cooperation does however seem to become more and more relevant. Whereas the share of interlining transfers was only 4% in 1995, it has been around 15% in recent years. Over the course of the same period the total share of transfers has been stable. Therefore it seems that small airlines are increasingly dependent upon collaborations in order to survive in the competitive industry. The small airlines seem to seek opportunities to share ground resources and coordinate their network in order to stay competitive.

While city pairs are often utilized as the main definition for a market in the airline industry, one could also argue that a market consists of a pair of airports (Evans and Kessides, 1994). Revisited results for this definition are presented in table 5 in Appendix A1. The results for airport pairs are similar to the main results.

Furthermore, although the measure for airline size is carefully chosen as can be read in the methodology section, several other measures for airline size are present in the literature (Van Reeven and Pennings, 2015; Evans and Kessides, 1994). For the sake of comparison, several robustness checks are performed. Table 6 in Appendix A2 shows the results with airline size measured as the number of seats, the number of passengers and the number of routes. All estimations show more or less similar results for both the base models as well as the extended models. The conclusion for hypothesis 2 seems to be robust, since the coefficient for the interaction term is positive and significant at the 1% level for all three cases. However, the multimarket contact and interaction term coefficients for the three different definitions of airline size are larger. This confirms on the one hand the endogeneity concerns for the numbers of passengers and the multicollinearity concerns for the number of routes since the coefficients are clearly biased. Therefore, these measures would lead to an overestimation of the effects. Also the coefficients for the number of seats are larger, this shows that adding the flight distance as an element of airline size is crucial. The explanation for this difference is likely to origin from the fact that airlines with a higher number of seats on average also perform longer flights. In order to correct for the incorrectly equally distributed number of seats, the effect for this measure of size is overestimated.

As a final extension, different points on the price distribution are used as the dependent variable as replacements for the average price. In order to do so, the effects of multimarket contact on the 10th, 25th, 50th, 75th and 90th percentile of the price distribution are presented in tables 4a and 4b. In general the effect of multimarket contact on prices is more positive for higher levels of the price distribution. But what is particularly interesting is that when airline size increases, the extent to which higher levels of the price distribution are affected more positively by an increase in multimarket contact decreases. This is best understood when looking at some of the effects of multimarket contact on different levels of the price distribution for both a minimum sized carrier as well as a maximum sized carrier. For a minimum sized airline the coefficient of multimarket contact is -0,558 on the 10th percentile price level and -0,156 on the 90th percentile price level. For a maximum sized airline the coefficients are 0,085 and 0,184 respectively.

This observation means that multimarket contact increases price dispersion less for larger carriers than for smaller carriers. These findings comply with the results presented earlier. Namely, when a company chooses to execute the mutual forbearance strategy, price dispersion on a route is not favorable since it would mean breaking the agreements with other companies. After all, mutual forbearance requires by definition stable prices. Therefore, the results in tables 4a and 4b are in line with the expectation that multimarket contact increases the price dispersion less for larger airlines.

Discussion and Conclusion

As it has turned out, multimarket contact increases the interaction between competitors, which can lead to both a positive and a negative effect on prices. In industries with complementary products, multimarket contact has a negative effect on price for smaller companies whereas multimarket contact has a positive effect on price for larger companies. Therefore the overall dominant effect in the industry is decided by its size distribution.

In this empirical work the relationship between multimarket contact and price has been revisited. A fixed effects model with a size interaction term has been used to analyze the competitive effects of airlines that compete in more than one shared market. All in all, it has become evident that in the airline industry both a mutual forbearance effect as well as a network coordination effect are present. It comes down to the size distribution and resulting strategic decisions of the carriers to determine the dominant effect. Besides the effect on average airfares, an exploration of the effects on the price distribution confirmed these findings. Therefore the main hypothesis is confirmed meaning that in industries with complementary products, multimarket contact has a more positive effect on prices for large firms than for small firms.

Although the knowledge concerning the competitive effects of multimarket contact has been extended, several limitations about this research exist. For example, explicit forms of cooperation are not included into the model. Investigating whether for instance code sharing agreements and route adaptations actually arise from multimarket contact would enable confirming the exact mechanism through which the negative effect of multimarket contact on prices works. Furthermore, although the results about the airline industry are conclusively confirming that multimarket contact decreases prices for the average carrier, such strong conclusions cannot directly be drawn for other industries. Multi industry empirical research could be used to investigate how the size distribution of an industry exactly affects the relationship between multimarket contact and price.

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Appendix A1

Table 5. Effect of multimarket contact on average market fare in dollars (Airline pairs)

Model	(13)	(14)
Dependent variable	Ln(average market fare)	Ln(average market fare)
Multimarket contact	0.104***	-0.212***
	(0.007)	(0.018)
Multimarket contact × Available seat miles		0.401***
		(0.022)
Route Herfindahl	0.075***	0.076***
	(0.006)	(0.006)
Hub effect	0.003***	0.003***
	(0.000)	(0.000)
Ln(Route passengers)	0.019***	0.019***
	(0.001)	(0.001)
Available seat miles	0.292***	0.119***
	(0.010)	(0.014)
Average market share at route airports	0.164***	0.173***
	(0.012)	(0.012)
Cash available	-0.181***	-0.187***
	(0.013)	(0.013)
Net income	0.113***	0.127***
	(0.018)	(0.018)
Operating assets	0.098***	0.099***
	(0.009)	(0.009)
Constant	4.768***	4.851***
	(0.012)	(0.013)
Carrier-Route Fixed Effects	Yes	Yes
Quarter Fixed Effects	Yes	Yes
N	147,539	147,539
R-squared	0.215	0.217

Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Appendix A2

Table 6. Effect of multimarket contact on average market fare in dollars, robustness check for different measures of airline size

Model	(15)	(16)	(17)	(18)	(19)	(20)
Dependent variable	Ln(Average market fare)	Ln(Average market fare)	Ln(Average market fare)	Ln(Average market fare)	Ln(Average market fare)	Ln(Average market fare)
Multimarket contact	0.128***	-0.354***	0.186***	-0.274***	0.103***	-0.315***
	(0.009)	(0.020)	(0.012)	(0.026)	(0.009)	(0.017)
Multimarket contact × Airline size		0.635***		0.621***		0.658***
		(0.024)		(0.031)		(0.022)
Route Herfindahl	0.074***	0.069***	0.064***	0.078***	0.078***	0.069***
	(0.006)	(0.006)	(0.007)	(0.007)	(0.006)	(0.006)
Hub effect	0.003***	0.003***	0.003***	0.004***	0.003***	0.003***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Ln(Route passengers)	0.007***	0.009***	0.006***	0.006***	0.007***	0.010***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Airline size	0.354***	0.060***	-0.048***	-0.196***	0.420***	0.058***
	(0.013)	(0.017)	(0.009)	(0.012)	(0.015)	(0.019)
Average market share at route airports	0.205***	0.227***	0.296***	0.298***	0.197***	0.239***
	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)
Cash available	-0.132***	-0.122***	-0.167***	-0.162***	-0.176***	-0.155***
	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)
Net income	0.116***	0.181***	0.135***	0.121***	0.108***	0.186***
	(0.027)	(0.027)	(0.027)	(0.027)	(0.027)	(0.027)
Operating expenses	0.117***	0.124***	0.153***	0.143***	0.128***	0.133***
	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)
Constant	4.844***	4.958***	4.968***	5.029***	4.778***	4.893***
	(0.014)	(0.015)	(0.013)	(0.014)	(0.015)	(0.015)
Carrier-Route Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Quarter Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
N	134,269	134,269	134,269	134,269	134,269	134,269
Rsquared	0.204	0.209	0.200	0.202	0.205	0.210

The models differ with regard to the measure for airline size; model 15&16 include the number of seats of an airline, model 17&18 include the number of routes of an airline and model 19&20 include the number of passengers of an airline. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1