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Murakami, Hideki

Asahi, Ryota

Graduate School of
Business Administration

KOBE UNIVERSITY

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Hideki Murakami Ryota Asahi

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by

Hideki MURAKAMI

Associate Professor

Kobe University, Graduate School of Business

Phone: +81-78-803-6941

FAX: +81-78-803-6977

E-mail: hidekim@panda.kobe-u.ac.jp

and

Ryota ASAHI

Ph.D. student

Kobe University, Graduate School of Business

Phone: +81-78-803-6941

FAX: +81-78-803-6977

E-mail: ryota.net1011@hotmail.co.jp

Abstract

A number of empirical studies have shown that multimarket contacts facilitate collusive behaviors between full-service carriers (FSCs) in the U.S. airline industry. This paper empirically investigates the effects of multimarket contacts on air carriers' pricing behaviors and highlights those of low-cost carriers (LCCs) and FSCs as well as those among LCCs. We estimated the simultaneous demand and price (pseudo-supply) equations to derive these impacts of multimarket contacts by using cross-sectional data of the year 2006 (top 30 U.S. air markets with 4484 sample observations). We found that having multimarket contacts among FSCs leads to collusive setting of high airfares. However, the effect of multimarket contacts is lowered among LCCs, and the degree depends on the number of LCCs in a market. We also found that LCCs' airfares stay at low levels, even though they repeat multimarket contacts among LCCs. These results suggest that LCCs' behaviors are not affected by multimarket contacts, and that these behaviors have strong impacts on lowering airfares.

1. Introduction

"Multimarket contact" describes the situation where there are many inter-carrier rivalries between a limited number of carriers in multiple markets (cross-sectionally and dynamically, and both). Since Edwards first described this situation (1955), it has been said that this setup blunts the edge of the airlines' competition. Many authors have empirically analyzed the effect of multimarket contact and support the notion that multimarket contacts have a collusive effect (for example, Heggestad and Rhoades 1978, Scott 1982, Jan and Rosenbaum 1996, Parker and Roller 1997, Fernandes and Marin 1998, and Fu 2003).

In the field of airline industries, the authors of many studies have also tried to analyze collusive effects due to multimarket contact. Evans and Kessides (1994), Singal (1996), Gimeno and Woo (1996, 1999), Gimeno (2002), and Zou et al. (2011) showed that multimarket contacts statistically increased carriers' airfares. Baum and Korn (1999) found that airline behaviors, such as entry and exit, decreased as multimarket contacts increased.

Although most studies have revealed that multimarket contacts have collusive effects in the airline industry, in all cases the authors used the data of the 1980s and did not consider the presence of low-cost carriers (LCCs). There have been many studies on the economic impact of LCCs. Dresner et al. (1996) and Windle and Dresner (1999) analyzed the effect of LCCs' entries and found that they significantly decreased airfares. Morrison (2001) also showed that entries of LCCs influenced airfares in the LCCs' potential routes. Goolsbee and Syverson (2008) found that incumbents significantly cut airfares when threatened by Southwest's entry. Murakami (2011b) studied whether price-lowering effects due to LCCs entries lasted over time and estimated the change in social welfare in accordance with the change in airfares of full-service carriers (FSCs) and LCCs. However, few previous studies have applied the idea of the competitive effect of multimarket contact to examining airline competitions with LCCs.

In this paper we empirically investigate whether multimarket contacts increase airfare, whether LCCs influence the collusive effect through multimarket contact behaviors, and whether multimarket contact effects exist among LCCs. We estimated the simultaneous demand and price (pseudo-supply) equations to derive these effects of multimarket contacts by using cross-sectional data of the year 2006 for the top 30 U.S. air markets, with 4484 sample observations. We found that multimarket contacts among FSCs lead to collusive setting of high airfares. However, the effect of multimarket contact is decreased by competition with LCC(s), and the degree depends on the number of LCCs in a market. We also found that LCCs' airfares stay at low levels, even though they repeat multimarket contacts among LCCs. These results suggest that LCCs' behaviors are not affected by multimarket contacts.

In Section 2 we model the simultaneous demand and pseudo-supply equation-system to measure the effect of multimarket contacts, highlighting the impact of LCCs presence. In Section 3 we describe the data, and in Section 4 we show the empirical results. In Section 5 we present concluding remarks.

2. Econometric model

In this section we construct a simultaneous demand and pseudo-supply equation system to estimate the effect of multimarket contact. Dresner et al. (1996) and Murakami (2011a, 2011b) applied the simultaneous demand and pseudo supply equation model to the analysis of the competition between FSCs and LCCs, and we follow their methods. In addition, in terms of measuring the effect of multimarket contact, we follow the ideas proposed by Jan and Rosenbaum (1996), who studied the cement industry. Jan and Rosenbaum (1996) also estimated simultaneous equation systems by nonlinear 3SLS (three stage least squares), adding a multimarket contact variable to right-hand side of the pseudo-supply equation.

Our empirical model to investigate the effect of multimarket contact is as follows:

[Demand equation]

$$\mathrm{logQ_{kj}} = \alpha_0 + \alpha_1 \mathrm{logP_{kj}} + \alpha_2 \mathrm{logDist_j} + \alpha_3 \mathrm{logPOP_{kj}} + \alpha_4 \mathrm{logINC_j} + \sum_{m=3}^{10} \alpha_5^m \mathrm{MKT_j^m} + u_{kj}$$

[Pseudo-supply equation]

$$\mathrm{logP_{kj}} = \beta_0 + \beta_1 \mathrm{logQ_{kj}} + \beta_2 \mathrm{logDist_j} + \beta_3 \mathrm{logHHI_{kj}} + \beta_4 \mathrm{LCC_j} + \beta_5 \mathrm{VSLCC_{kj}}$$
$$+ (\beta_6 + \textstyle\sum_{n=1}^{3} \theta_n \mathrm{INLCCn_j} + \theta_4 \mathrm{INLCCA_j}) \mathrm{logMMC_{kj}} + e_{kj},$$

where $\mathrm{P_{kj}}$ and $\mathrm{Q_{kj}}$ are the average airfare and output of route j of carrier k, respectively. $\mathrm{INC_j}$ is the arithmetic per capita income of route j. $\mathrm{Dist_j}$ is the distance between a city pair of route j. $\mathrm{POP_j}$ is the arithmetic average of the O/D population. $\mathrm{MKT_j^m}$ are binary variables that take 1 for the market where m carriers compete, and the benchmark market of this binary variable is duopoly markets. This $\mathrm{MKT_j^m}$ variable is introduced to control the market size in the demand equation. The parameters of this variable could be positive or negative. In the negative case, for example, if too many carriers enter a market and compete for limited demand, the demand that each carrier faces could be smaller than what each carrier would face in a duopoly market.

$\mathrm{Dist_j}$ in the pseudo-supply equation is used as the proxy variable of marginal cost. This variable will have a positive effect on airfares. $\mathrm{HHI_j}$ is the Herfindahl index, and higher $\mathrm{HHI_j}$ means that the market is more concentrated. Since high concentration may lead to strong market power, the parameter will be positive. $\mathrm{LCC_k}$ is a binary variable that takes 1 if firm k is an LCC. $\mathrm{VSLCC_{kj}}$ is a binary variable that takes 1 if firm k competes with LCC(s) in a market.

To analyze whether LCCs have a collusive effect through multimarket contact behaviors, we set the case "between FSC competition" as the benchmark, and statistically test the three hypotheses that the effect of multimarket contact on airfares is equal between (a) an FSC vs. an LCC, (b) FSCs vs. LCCs, and (c) an LCC vs. an LCC. To test these hypotheses, we use the coefficients of "slope dummy" variables, $\mathrm{INLCCn_j}$ and $\mathrm{INLCCA_j}$. $\mathrm{INLCCn_j}$ are a binary variable that takes 1 for a route if n LCC(s) operate and compete with FSC(s) in route j, and $\mathrm{INLCCA_j}$ takes 1 for the cases where there exist only LCCs in route j. The parameter-signs of these two binary variables will be negative if LCCs' behaviors are not affected by multimarket contact. Especially in the markets where we observe "between-LCCs" competition, the slope-angle could be steep (i.e., the absolute value of θ_4 could be large). $\mathrm{MMC_{kj}}$ is firm k's multimarket contact on route j. The sign of parameter β_6 of $\mathrm{MMC_{kj}}$ will be positive if multimarket contacts have collusive effects. $\mathrm{u_{kj}}$ and $\mathrm{e_{kj}}$ are random error terms of the demand equation and pseudo-supply equation, respectively.

Multimarket contacts have been measured by several methods. Our method is to count the number of overlapping markets in which firms compete with one another. This measurement is defined as follows:

[Multimarket contact (MMC) measurement]

$$\mathrm{MMC_{kj}} = \frac{\sum_{k \neq l} \mathrm{a_{kl} D_{kj} D_{lj}}}{\mathrm{f_j} - 1}$$

$$\mathrm{a_{kl}} = \sum_{\mathrm{j=1}}^{\mathrm{n}} \mathrm{D_{kj} D_{lj}}$$

where D_{kj} is a binary variable that takes 1 if firm k operates in route j. f_j is the number of firms that operate in route j. This measurement has been used in many previous studies.

As noted above, HHI_j measures the degree of market concentration. Bailey et al. (1985) suggested that the market concentration is an endogenous variable determined by output, distance, and other exogenous factors. In addition, Waldfogel and Wulf (2006) suggest that the variable of multimarket contact may be endogenous. Thus we must check the endogeneity of these variables. To test the null hypothesis that $\log HHI_j$ and $\log MMC_{kj}$ are not correlated with the error term e_{kj}, we carried out the Hausman test for each variable. The test result was that we rejected the null hypotheses for both cases at the 1% level of significance ($\chi_{(1)} = 188.37$ and 11.67, respectively).

3. The Data

We used the carrier-specific data of the scheduled operations in city-pair routes. They are cross-sectional data of the year 2006 collected from DB1A, which files a 10% random choice of samples from all the U.S. domestic flight operations. Per-capita individual income and demographic data were collected from *Regional Accounts Data*, Bureau of Economic Analysis. We omitted monopoly markets, carriers that did not have 10% market share in duopoly markets, and carriers that did not have 5% share in triopoly or greater markets. Carriers reported as carrier XX (carriers that are not filed in IATA codes) in DB1A were also omitted. There are 4484 observations. These data consist of non-connecting flights from the top 30 largest U.S. airports and their regions and include 487 duopoly markets, 460 tripoly markets, 195 four-carrier operating markets, 101 five-carrier operating markets, 87 six-carrier operating markets, 41 seven-carrier operating markets, 2 eight-carrier operating markets, and 2 ten-carrier operating markets. The descriptive statistics of continuous variables are shown in Table 1.

To classify the sampled nineteen carriers into FSCs and LCCs, we calculated the carrier's unit cost with the cost data from the Air Carrier Financial Reports, *Form 41, Financial Data*, and estimated the 95% confidence interval of carriers' unit costs. We found a number of carriers that operated at very low unit cost level, and then excluded carriers with very small networks, carriers that were allied with another airline, and carriers that went bankrupt around 2006. As a result, we defined Airtran Airways, Spirit Airlines, Jet Blue Airways, and Southwest Airlines as LCCs.

There are 714 one-LCC-operating-markets, 71 two-operating-markets, and 5 three-operating-markets in this sample.

4. Empirical results

We estimated demand and price (pseudo-supply) equations simultaneously by an iterative 3SLS method to measure the effect of multimarket contact. Table 2 presents the results. Model 1 provides estimated parameters of the system equation without coefficient binary variables of price equation, and Model 2 provides estimated parameters of the system equation with those variables. The results indicate that the parameters of variables meet the expected signs and are statistically significant except for the case of the Herfindahl index. The reason for the unexpected sign of the Herfindahl index parameter is that there are lots of markets where LCCs have a large market share. In such a case, the more concentrated a markets is, the lower the level of average airfares in the market.

The results for both cases show that the coefficient of multimarket contact is significantly positive. These results suggest that multimarket contacts have collusive effects and are consistent with previous studies that indicate multimarket contacts have led to collusive establishment of high airfares in the airline industry.

The coefficients of INLCC1, INLCC2, and INLCC3 are significantly negative. These results show that the collusive effects are decreased by competition with LCC(s), indicating that LCCs compete aggressively with FSCs, regardless of the multimarket contacts. The parameter of INLCCA is significantly negative, and the absolute value of θ_4.is almost the same as β_6. This result implies that multimarket contacts among LCCs do not influence LCC ticket prices (we cannot reject the hypothesis that $\beta_6 + \theta_4 = 0$ by the Wald test, and $\chi^2 = 0.056$ with degree of freedom (d.o.f.)=1, P-value¬=0.813). Boguslaski et al. (2004) indicated that the presence of an LCC in a market did not influence other LCC's entry behavior and this implies that LCCs tend to compete with each other aggressively. Therefore, it is inferred that our finding is consistent with their study.

An interesting finding in our study is that the degree of completion is not strengthened in "slope-up" way. To examine whether each parameter of $\mathrm{INLCCn_j}$ is significantly different, we test following hypotheses respectively: (1) $\mathrm{H_0}: \theta_1 = \theta_2$, (2) $\mathrm{H_0}: \theta_2 = \theta_3$ and (3) $\mathrm{H_0}: \theta_1 = \theta_3$. We reject hypotheses (1), suggesting that the effect of multimarket contacts on carrier's air-ticket price is statically different between one-LCC-operating-markets and two-LCCs-operating-markets. The difference between

INLCC1 and INLCC2 could be explained in the following ways. In one-LCC-operating-markets, FSCs could induce an LCC to work in collusion, especially when the LCC with a small market share is deficit-ridden. However, in two-LCCs-operating-markets, competition between FSCs and two LCCs is accelerated due to the increase in the number of LCCs.

We also rejected hypothesis (2) and did not reject hypothesis (3). These two results mean that competition among carriers is softened when the number of LCCs increases from two to three. These results imply that even LCCs may tend to choose comparatively collusive behavior when they face competition with “well-known rivals,” to avoid too fierce a competition and to try to coexistent and co-prosper.

5. Conclusion

The hypothesis that multimarket contact blunts the edge of competition was suggested by Edwards (1955) and has been theoretically supported by Bernheim and Whinston (1990). Based on the idea of multimarket contact, many researchers have empirically showed that multimarket contact has a collusive effect in certain industries, including the airline industry.

While there are many studies indicating that airlines set higher fares when there is multimarket contact in the airline industry, these studies do not take into account the presence of LCC(s). The distinguishing feature of this paper is that we investigated whether the collusive effects of multimarket contact were observed when LCC(s) existed in a market.

By using cross-sectional data of the year 2006 with 4484 sample observations, we found that : (1) multimarket contacts among FSCs led to high airfares due to collusion among carriers; (2) in the case where LCC(s) exist(s) in a market, multimarket contacts have less collusive impacts, and the degree of impacts on airfares depends on the number of LCCs in a market; (3) in the case where there are only LCCs in a market (the LCC vs. LCC case), multimarket contacts have no price-lowering effects and airfares stay at low levels, even though there are repeated multimarket contacts among LCCs.

Our finding (1) is consistent with those of previous literatures. In addition, our contributions are that we found facts (2) and (3) by using rigid econometric models and large number of sample observations in an attempt to avoid data selection bias.

Of course, this study has some limitations. First, although we used abundant sample observations, we may need to update the dataset to panel data. A lot of previous studies use panel data to measure the effect of multimarket contact. Second, we may have to investigate whether the behaviors of airlines under multimarket contact lead to more collusive behavior such as mergers or alliances. Knowing this would be important for determining entry and exit policy. Using panel data and investigating whether multimarket contact leads to mergers or alliances will be done in our future research.

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Table 1

The descriptive statistics of continuous variables.

Name	Mean	SE	Minimum	Maximum
Airfare	167.1	55.5	55.5	563.4
Passengers	4113.9	5598.2	157.0	45144.0
Population	3778600.0	2511000.0	556430.0	17161000.0
Per-capita income	40426.0	4098.8	27000.0	55101.0
Herfindahl index	386.6	146.7	108.1	813.4
Distance	1452.6	819.0	177.0	5095.0
Multimarket contact	156.1	91.2	1.5	416.0

Table 2 Estimated results

	Model 1			Model 2		
Variable	Parameter	Standard Error	p-Value	Parameter	Standard Error	p-Value
Demand equation						
Airfare	-0.497	0.074	0.000	-0.523	0.074	0.000
Distance	0.142	0.043	0.001	0.163	0.043	0.000
Per-capita income	0.284	0.092	0.002	0.290	0.093	0.002
Average population	0.158	0.021	0.000	0.164	0.021	0.000
Tripoly market	-0.511	0.025	0.000	-0.519	0.026	0.000
4-firm market	-1.095	0.036	0.000	-1.115	0.036	0.000
5-firm market	-1.589	0.044	0.000	-1.613	0.044	0.000
6-firm market	-2.388	0.049	0.000	-2.425	0.049	0.000
7-firm market	-2.834	0.060	0.000	-2.877	0.060	0.000
8-firm market	-3.404	0.146	0.000	-3.482	0.148	0.000
10-firm market	-4.041	0.138	0.000	-4.095	0.140	0.000
Constant	4.684	0.939	0.000	4.537	0.948	0.000
Pseudo-supply equation						
Output	0.587	0.021	0.000	0.244	0.011	0.000
Herfindahl index	-1.791	0.017	0.000	-0.741	0.017	0.000
Distance	0.224	0.026	0.000	0.278	0.013	0.000
LCCI	-0.290	0.009	0.000	-0.189	0.020	0.000
VSLCCI	-0.151	0.007	0.000	-0.038	0.022	0.082
MMC (β_6)	0.059	0.005	0.000	0.072	0.005	0.000
INLCC1 (θ_1)				-0.021	0.005	0.000
INLCC2 (θ_2)				-0.048	0.007	0.000
INLCC3 (θ_3)				-0.023	0.011	0.031
INLCCA (θ_4)				-0.076	0.016	0.000
Constant	9.427	0.316	0.000	5.392	0.166	0.000
System R-square	0.966			0.966		
Test of the overall significance	$\chi_{21} = 15175.000$		0.000	$\chi_{24} = 15206.000$		0.000
$H_0: \theta_1 = \theta_2$				0.027		0.000
$H_0: \theta_2 = \theta_3$				-0.025		0.004
$H_0: \theta_1 = \theta_3$				0.002		0.820

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