The Singapore Economic Review, Vol. 56, No. 4 (2011) 593–600

DOI: 10.1142/S0217590811004444

AN EMPIRICAL ANALYSIS OF THE EFFECT OF MULTIMARKET CONTACTS ON US AIR CARRIERS' PRICING BEHAVIORS

HIDEKI MURAKAMI* and RYOTA ASAHI†

Graduate School of Business, Kobe University, Japan

*hidekim@panda.kobe-u.ac.jp

†ryota.net1011@hotmail.co.jp

A number of empirical studies have shown that multimarket contacts facilitate collusive behaviors between full-service carriers (FSCs) in the US 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. Simultaneous demand and price (pseudo-supply) equations are estimated to derive these impacts of multimarket contacts in the top 30 air markets in the US multimarket contacts among FSCs do lead to collusive setting of high airfares. However, the effect of multimarket contacts is lower among LCCs, and the degree depends on the number of LCCs in a market. The airfares of LCCs remain low, even though there are multimarket contacts among LCCs. These results suggest that the behaviors of LCCs are not affected by multimarket contacts.

Keywords: Multimarket contact; airline industry; LCC.

1. Introduction

Multimarket contact (MMC) describes the situation in which there are many inter-carrier rivalries between a limited number of carriers in multiple markets (cross-sectional and dynamically, and both). This setup blunts the edge of the airlines' competition (Edwards, 1955). Empirical studies suggest that MMCs lead to collusive effect (Heggestad and Rhoades, 1978; Scott, 1982; Jans and Rosenbaum, 1997; Parker and Roller, 1997; Fernandez and Marin, 1998; Fu, 2003).

Evans and Kessides (1994), Singal (1996), Gimeno and Woo (1996, 1999), Gimeno (2002), and Zou *et al.* (2011) show that MMCs statistically increase carriers' airfares. Baum and Korn (1999) find that entry and exit decrease as MMCs increase.

Many studies based on the 1980 data suggest that MMCs result in collusive effects in the airline industry. The analysis does not consider low-cost carriers (LCCs) though there have been many studies on the economic impact of LCCs. Dresner, Lin and Windle (1996) and Windle and Dresner (1999) suggest that the entrance of LCCs significantly decreases airfares. Morrison (2001) also shows that entry of LCCs influences airfares in other LCCs' potential routes. Goolsbee and Syverson (2008) find that incumbents significantly cut airfares threatened by Southwest's entry. Murakami (2011b) researches fare discounting effects due to LCCs entry over time and estimates the change in social welfare as a result of the change in airfares of full-service carriers (FSCs) and LCCs. However, few studies have applied the idea of the competitive effect of MMCs to examining airline competitions with LCCs.

This study investigates whether MMCs increase airfare and explores if LCCs lead to collusive effect through MMC behaviors. The study also looks at the presence of MMC effects among LCCs. We estimated the simultaneous demand and price (pseudo-supply) equations to ascertain the effects of MMCs using 4,484 cross-section observations from the top 30 US air markets in 2006. MMCs among FSCs lead to collusive setting of high airfares. However, the effects of MMCs decrease with competition from LCCs, the degree of competition in turn depends on the number of LCCs in a market. LCCs' airfares remain low with repeat MMCs among LCCs. These results suggest that LCCs' behaviors are not affected by MMCs.

Section 2 presents the simultaneous demand and pseudo-supply equations to measure the effects of MMCs and highlights the impact of LCCs. Section 3 discusses the data, Section 4 analyses the findings and Section 5 concludes.

2. Econometric Model

This study builds upon the work of Dresner, Lin and Windle (1996) and Murakami (2011a, b) on applying the simultaneous demand and pseudo-supply equation model in the analysis of the competition between FSCs and LCCs. The analysis of MMC in this study follows the work of Jans and Rosenbaum (1997) who employed non-linear 3SLS (three-stage least squares) and incorporated a MMC variable to the pseudo-supply equation to analyse the cement industry.

This study employs the following model specification. Demand equation is given by:

$$\begin{aligned}\log Q_{kj} &= \alpha_0 + \alpha_1 \log P_{kj} + \alpha_2 \log \mathrm{Dist}_j + \alpha_3 \log \mathrm{INC}_j \\ &\quad + \alpha_4 \log \mathrm{POP}_j + \sum_{m=3}^{10} \alpha_5^m \mathrm{MKT}_j^m + u_{kj},\end{aligned}$$

pseudo-supply equation is given by:

$$\begin{aligned}\log P_{kj} &= \beta_0 + \beta_1 \log Q_{kj} + \beta_2 \log \mathrm{HHI}_j + \beta_3 \log \mathrm{DIST}_j + \beta_4 \mathrm{LCC}_k + \beta_5 \mathrm{VSLCC}_{kj} \\ &\quad + \left(\beta_6 + \sum_{n=1}^{3} \theta_n \mathrm{INLCCn}_j + \theta_4 \mathrm{INLCCA}_j\right) \log \mathrm{MMC}_{kj} + e_{kj},\end{aligned}$$

where P_{kj} and Q_{kj} are the average airfare and output of route j of carrier k, respectively. INC_j is the arithmetic per capita income of route j. Dist_j is the distance between a city pair of route j. POP_j is the arithmetic average of the O/D population. MKT_j^m is a binary variable that takes 1 for the market where m carriers compete, and the benchmark market of this binary variable is duopoly. This 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.

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

The benchmark is the outcome from collusive effect of MMC behaviors "between FSC competition". Three hypotheses on the effect of MMC on airfares were tested against the benchmark. These are (a) an FSC versus an LCC; (b) FSCs versus LCCs; and (c) an LCC versus an LCC. The coefficients of "slope dummy" variables, INLCCn_j and INLCCA_j are used as indicators, where INLCCn_j is a binary variable that takes 1 for a route if an LCC(s) operates and competes with FSC(s) in route j, and 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 MMC. Especially in the markets where we observe "between-LCCs" competition, the slope-angle is intuitively expected to be steep (i.e., the absolute value of θ_4 could be large). MMC_{kj} is firm k's MMC on route j. The sign of parameter β_6 of MMC_{kj} is expected to be positive if MMCs have collusive effects. u_{kj} and e_{kj} are random error terms of the demand equation and pseudo-supply equation, respectively.

MMCs can be measured in several ways. The measurement adopted here is to count the number of overlapping markets in which firms compete with one another. This measure is defined as:

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

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

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. HHI_j measures the degree of market concentration. Bailey, Graham and Kaplan (1985) suggested that the market concentration is an endogenous variable determined by output, distance, and other exogenous factors. Waldfogel and Wulf (2006) suggested that the MMC variable may be endogenous. Endogeneity tests of these variables are carried out. To test the null hypothesis that $\log\mathrm{HHI}_j$ and $\log\mathrm{MMC}_{kj}$ are not correlated with the error term e_{kj}, Hausman test is performed for each variable. The test result is to reject the null hypotheses for both cases at the 1% level of significance ($\chi_{(1)} = 188.37$ and 11.67, respectively).

3. Descriptive Statistics

Carrier-specific data from scheduled operations in city-pair routes were utilized in this study drawn from 2006 cross-sectional data from DB1A.[1] Per-capita individual income and demographic data were collected from *Regional Accounts Data*, Bureau of Economic Analysis. Monopoly markets were omitted, i.e., 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. The remaining 4484 observations consist of non-connecting flights from the top 30 largest US 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 given in Table 1.

Classification of sampled 19 carriers into FSCs and LCCs was based on the carrier's unit cost from the Air Carrier Financial Reports, *Form 41, Financial Data*, estimated at 95% confidence interval of carriers' unit costs. A number of carriers that operated at very low unit cost level were excluded, together with those operating at very small networks. Carriers that were allied with another airline and carriers that ceased operation in 2006 were omitted. Based on the above criteria, Airtran Airways, Spirit Airlines, Jet Blue Airways, and Southwest Airlines were classified as LCCs. There are 714 markets with at least one LCC operating; 71 markets with at least two LCCs operating, and 5 markets with at least three LCCs operating.

4. Empirical Results

The demand and price (pseudo-supply) equations were estimated simultaneously by an iterative 3SLS to measure the effect of MMCs. Table 2 presents the results. Model 1

Table 1. Descriptive Statistics of Continuous Variable

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

[1] Data from Origin and Destination Data Bank 1A, Bureau of Transportation Statistics, USA. This file contains data as reported by participating air carriers from the continuous 10% sample of airline tickets, where a ticket contains ONLY domestic points/airports. It includes the full itinerary and the dollar amounts paid by each passenger. The data are summarized by routing and fare paid. DOT posts the mileage for each itinerary segment, applies a numeric code identifying each city/airport, and a world area code to indicate the state/country.

Table 2. Results of Empirical Models

Variable	Model 1			Model 2		
	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
LCC	−0.290	0.009	0.000	−0.189	0.020	0.000
VSLCC	−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

provides estimated parameters of the system equation without coefficient binary variables in the price equation, and Model 2 consists of estimated parameters inclusive of binary variables. The signs of the parameters of variables are as expected and statistically significant, except for the Herfindahl index. The reason for the unexpected sign of the Herfindahl index parameter is the presence of LCCs that have a large market share. The more concentrated the market, the lower the level of average airfares in the market.

The results for both models show that the coefficient of MMC is significantly positive. This suggests that MMCs have collusive effects and are consistent with previous studies that indicate MMCs result in collusive establishment and high airfares in the airline industry.

The coefficients, INLCC1, INLCC2, and INLCC3, are negative and significant. The results suggest that the collusive effects decrease with competition from LCC(s). This shows that LCCs are competing aggressively with FSCs, regardless of the MMCs. 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 MMCs 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 $(\text{d.o.f.}) = 1$, p-value $= 0.813$). Boguslaski, Ito and Lee (2004) indicated that the presence of an LCC in a market does not influence other LCCs' entry behavior. This implies that LCCs tend to compete with each other aggressively.

To examine whether each parameter of INLCCn$_j$ is significantly different, we test the following hypotheses, respectively: (1) $H_0 : \theta_1 = \theta_2$, (2) $H_0 : \theta_2 = \theta_3$ and (3) $H_0 : \theta_1 = \theta_3$. We reject hypotheses (1), suggesting that the effect of MMCs on carrier's air-ticket price is statistically different between one-LCC-operating-markets and two-LCCs-operating-markets. The difference between INLCC1 and INLCC2 could be explained that 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 increased due to the increase in the number of LCCs.

Hypothesis (2) is thus rejected while the results confirm hypothesis (3). These two results suggest that competition among carriers is reduced when the number of LCCs increases from two to three. These results also imply that LCCs may choose comparatively collusive behavior given competition with "well-known rivals", to avoid wasteful competition in favor of coexistent and joint maximization of profits.

5. Conclusion

The hypothesis that MMCs blunt the edge of competition was originally suggested by Edwards (1955) and theoretically proved by Bernheim and Whinston (1990). Studies have since shown that MMCs result in a collusive effect in certain industries, including the airline industry.

While there are many studies indicating that airlines set higher fares given MMCs in the airline industry, these studies do not take into account the presence of LCC(s). The distinguishing feature of this study is the presence of LCCs when MMCs occur.

The main conclusions of the study are:

(1) MMCs among FSCs led to high airfares due to collusion among carriers; (2) the existence of LCC(s) leads to collusive impacts, and the degree of impact on airfares depends on the number of LCCs in a market; (3) in the case where there are only LCCs in a market (i.e., LCC versus LCC), MMCs do not lead to lower fares and airfares remain low, even though there are repeated MMCs among LCCs.

The findings of this study are consistent with previous studies. Further, the reliability of the results is based on analysis of a large number of sample observations to avoid data selection bias.

One limitation of the study is the need to update the dataset in creating panel data. Previous studies on the effect of MMCs are based on panel data. Second, we may have to investigate whether the behaviors of airlines under MMCs lead to mergers or alliances. Knowledge of this would guide entry and exit policy.

References

Bailey, EE, DR Graham and DP Kaplan (1985). *Deregulating the Airlines*. Cambridge, MA: MIT Press.

Baum, JAC and HJ Korn (1999). Dynamics of dyadic competitive interaction. *Strategic Management Journal*, 20(3), 251–278.

Bernheim, BD and MD Whinston (1990). Multimarket contact and collusive behavior. *The RAND Journal of Economics*, 21(1), 1–26.

Boguslaski, C, H Ito and D Lee (2004). Entry patterns in the Southwest airlines route system. *Review of Industrial Organization*, 25(3), 317–350.

Dresner, M, JSC Lin and R Windle (1996). The impact of low-cost carriers on airport and route competition. *Journal of Transport Economics and Policy*, 30(3), 309–328.

Edwards, CD (1955). Conglomerate bigness as a source of power. *Business Concentration and Price Policy*, pp. 331–352.

Evans, WN and IN Kessides (1994). Living by the 'Golden Rule': Multimarket contact in the US airline industry. *The Quarterly Journal of Economics*, 109(2), 341–366.

Fernandez, N and PL Marin (1998). Market power and multimarket contact: Some evidence from the Spanish hotel industry. *The Journal of Industrial Economics*, 46(3), 301–315.

Fu, WW (2003). Multimarket contact of US newspaper chains: Circulation competition and market coordination. *Information Economics and Policy*, 15(4), 501–519.

Gimeno, J (2002). The performance effects of unintended and purposive multimarket contact. *Managerial and Decision Economics*, 23(4–5), 209–224.

Gimeno, J and CY Woo (1996). Hypercompetition in a multimarket environment: The role of strategic similarity and multimarket contact in competitive de-escalation. *Organization Science*, 322–341.

Gimeno, J and CY Woo (1999). Multimarket contact, economics of scope, and firm performance. *The Academy of Management Journal*, 42(3), 239–259.

Goolsbee, A and C Syverson (2008). How do incumbents respond to the threat of entry? Evidence from the major airlines. *Quarterly Journal of Economics*, 123(4), 1611–1633.

Heggestad, AA and SA Rhoades (1978). Multi-market interdependence and local market competition in banking. *The Review of Economics and Statistics*, 60(4), 523–532.

Jans, I and DI Rosenbaum (1997). Multimarket contact and pricing: Evidence from the US cement industry. *International Journal of Industrial Organization*, 15(3), 391–412.

Morrison, SA (2001). Actual, adjacent, and potential competition estimating the full effect of Southwest Airlines. *Journal of Transport Economics and Policy*, 35(2), 239–256.

Murakami, H (2011a). An empirical analysis of inter-firm rivalry between Japanese full-service and low-cost carriers. *Pacific Economic Review*, 16(1), 103–119.

Murakami, H (2011b). Time effect of low-cost carrier entry and social welfare in US large air markets. *Transportation Research*, Part E, 47, 306–314.

Parker, PM and LH Roller (1997). Collusive conduct in duopolies: Multimarket contact and cross-ownership in the mobile telephone industry. *The RAND Journal of Economics*, 28(2), 304–322.

Scott, JT (1982). Multimarket contact and economic performance. *The Review of Economics and Statistics*, 64(3), 368–375.

Singal, V (1996). Airline mergers and multimarket contact. *Managerial and Decision Economics*, 17(6), 559–574.

Waldfogel, J and J Wulf (2006). Measuring the effect of multimarket contact on competition: Evidence from mergers following radio broadcast ownership deregulation. *Contributions to Economic Analysis & Policy*, 5(1).

Windle, R and M Dresner (1999). Competitive responses to low cost carrier entry. *Transportation Research*, Part E, 35(1), 59–75.

Zou, L, M Dresner and RJ Windle (2011). Many fields of battle: How cost structure affects competition across multiple markets. *Journal of Transport Economics and Policy*, 45(1), 21–40.