AIRLINE MERGER AND MARKET STRUCTURE CHANGE IN JAPAN: A CONDUCT-PARAMETER AND THEORETICAL-PRICE APPROACH[1]

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ABSTRACT

In 2003, the domestic air transportation market in Japan changed from tripoly with All Nippon Airways (NH), Japan Airlines (JL) and Japan Air System (JD) to duopoly with NH and the new Japan Airlines (JJ), the result of the merger of JL and JD. This paper empirically examines the merger effects on the market competition structure using conduct parameter and theoretical price approaches. One might say that the merger changed the market structure because Stackelberg competition with NH as a leader and JL and JD as followers had been developed before the merger, and Cournot competition with NH and JJ developed after the merger.

Keywords: Airline industry; Merger effects; Cournot competition; Stackelberg competition

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1. INTRODUCTION

In November 2001, the planned merger of Japan Airlines and Japan Air System (JJ merger) was announced and a holding company for JL and JD was established in October 2002[2]. JL and JD thoroughly restructured their routes in April 2003 and the merger of route operations was completed. We empirically analyze the effects of the merger on the domestic market structure in Japan with conduct parameter (conjectural variation) and theoretical price approaches.

There are some empirical analyses of the airline market structure with conduct parameter: Brander and Zhang (1990), (1993), and Oum et al. (1993), the routes from O'Hare airport (Chicago), Fischer and Kamerschen (2003), the routes from Hartsfield airport (Atlanta), Fageta (2006), Spain's market and Endo (2004), and Murakami (2010) on Japan's market. Oum et al. (1993) and Endo (2004), for instance, found airlines with a larger share would behave more competitively and those with a smaller share would behave more collusively. These results might reflect the competitive behaviour by large market share airlines as leaders and the collusive behaviour by small market share airlines as followers. But Oum et al. (1993) and Endo (2004) did not infer the airlines' relationship as leaders and followers. The conduct parameter approach can infer that the market would have perfect

[2] This study uses the IATA code for each airline. The IATA code of Japan Airlines, after the merger, is still JL. However, JJ is used for after the merger to differentiate between before and after the merger.

Legacy Carriers			
NH	All Nippon Airways	NH group	All Nippon Airways, Air Nippon, Air Nippon Network and Air Central
JL	Japan Airlines (before the merger)	JL group	Japan Airlines, Japan Transocean Air, JAL Express, J-Air and Ryukyu Air Commuter
JD	Japan Air System	JD group	Japan Air System, Japan Air Commuter and Hokkaido Air System
JJ	Japan Airlines (after the merger)	JJ group	JL group and JD group
Low Cost Carriers (LCC)			
BC	Skymark		
HD	Hokkaido International Airlines (Air Do)		
LQ	Skynet Asia Airways		
7G	Star Flyer		

competition, Cournot competition or cartel, however, this approach cannot infer whether or not the market would have Stackelberg competition. Before the merger, there was a possibility that Stackelberg competition, with NH as a leader and JL and JD as followers, could have developed in the market because NH had maintained a half share. Therefore, in addition to the conduct parameter approach, I adopt the theoretical price approach, which is introduced by Okawa and Ueda (1999), to explicitly infer whether or not there would have been Stackelberg competition.

This paper is organized as follows: section 2 reviews the details of the JJ merger and previous studies on the JJ merger. Section 3 describes air transportation policy in Japan. I analyze the market structure using the conduct parameter approach in section 4 and the theoretical price approach in section 5. Section 6 contains the conclusions.

2. THE MERGER OF JAPAN AIRLINES AND JAPAN AIR SYSTEM

2. 1 Circumstances of the Merger[3]

In November 2001, JL and JD announced that they would merge. They insisted that they could be an equal competitor to NH which had significant market power in the domestic airline market in Japan. NH had about a 50% share of the domestic passenger market due to the fact that the MOT (Ministry of Transportation) had a regulation which mandated that the domestic market should be mainly served by NH. This regulation was in effect from 1972 to 1985. NH was still able to keep a vested right after the abolition of this regulation in 1985[4].

In February 2002, NH objected to this merger. NH was very concerned that competition would decline because the number of competitors would decrease from three to

[3] Arai (2004) explains the merger in detail.
[4] This regulation is seen in detail in section 3.

two. In March 2002, the Fair Trade Commission of Japan (JFTC) focused on the domestic passenger market and reported their fear that the merger might reduce competition. The reasons were: it would be easier to price the fare collusively after the big airlines decreased from three to two, it would be difficult to promote competition with LCCs because the important airports for domestic routes, Haneda airport (Tokyo) and Itami airport (Osaka), were full and had few slots for LCCs' new entries.

In April 2002, to respond to the JFTC's report, JL and JD proposed two plans: Firstly, they would return nine slots at Haneda to the airport administrator, MLIT (Ministry of Land, Infrastructure, Transport and Tourism which was MOT until 2001) to promote new entries by LCCs. Secondly, they would reduce normal fares by 10% for at least three years, and they would set discount fares for all flights on all routes except for single tracking routes before their merger. Additionally, in April 2002, MLIT announced that they would assign the Haneda slots, which would be returned by JL and JD, to LCCs by priority.

JFTC accepted the merger of JL and JD in April 2002. In October 2002, a holding company for JL and JD was established. JL and JD thoroughly restructured their routes in April 2003 and their overlapping routes had vanished. Thus, the JJ merger was recognized in 2003. In October 2006, JL acquired JD and the JJ merger was completed.

2. 2 Previous Studies on the Merger of JL and JD

There are not many studies on the merger of JL and JD, however Yanagawa (2002) provides a simple theoretical model analysis with three firms. He assumes that the firms are symmetrical, the output is homogeneous, the marginal costs are constant and the fixed costs are zero. He pointed out that a cartel would not be induced under the Stackelberg case of one leader and two followers because the leader would not have had an incentive for a cartel, while an incentive for a cartel would occur under Cournot duopoly.

Empirically, MLIT (2005) reported that the merger had affected the number of flights and fare levels. It found JJ had decreased flights by 7.4% between October 2001 (before the merger) and October 2004 (after the merger), while NH and LCCs increased flights on most of the routes where JJ decreased flights, and domestic total flights increased by 8.9%. With respect to fare levels, when JJ merged, JJ reduced normal fares by 10% and this should have been maintained for at least three years. But JJ raised fares by 11% in July 2003 because of passenger decreases due to the Iraqi war and SARS (Severe Acute Respiratory Syndrome). Therefore, the fare levels had returned to the levels before the merger but had not increased. MLIT concluded that passenger benefit had not decreased according to the analysis of the number of flights and fare levels. However, they recommended continued observation of the data changes.

Sawano (2006) analyzed the decision factor of fares and pointed out that NH set the discount fares for advance purchase on more routes to compete with JJ's improved domestic network. Hence, he stated that price competition in a duopolistic market was intense despite the decrease in the number of airlines after the merger.

3. AIR TRANSPORTATION POLICY IN JAPAN

The airline industry had been strictly regulated by MOT with entry and fare pricing regulations until 1985 as shown in Table 1. One of the main purposes of the regulation was to create a stable and better air network through avoiding competition among airlines. With reference to entry, MOT assigned an operation market for the three big airlines; domestic trunk lines and local lines for NH, international and domestic trunk lines for JL and domestic local lines for JD[5]. The number of domestic trunk and local routes for each airline in 1985 was respectively: eight and sixty-five for NH, thirteen and zero for JL, and three and sixty-four for JD. Fares had been regulated until 1994, based on the average cost pricing rule.

The airline market in Japan experienced rapid growth in the 1970's and 1980's. The market, based on both international and domestic passenger-km, became the second largest in the world in 1985. Some researchers pointed out that strict regulations were obstacles to the promotion of better services and reduced fares, as seen from the 1978 deregulation act of the airline industry in the USA. Entry regulation in Japan had been gradually relaxed by promoting double and triple tracking since 1986 and by promoting LCC's new entries since 1998. In addition, JL, which had been a national company, was completely privatized in 1987 and the three large airlines stood on an equal footing as private companies. However, demand-supply balancing regulation on each route had remained. In 2000, demand-supply balancing regulation was abolished and airline firms were allowed to decide their network freely, while the slots at the four congested airports in Tokyo (Haneda and Narita) and Osaka (Itami and Kansai) are still assigned by MOT. Thus, there is a lot of room remaining for government intervention because more than 40% of all domestic flights use Haneda airport.

The first deregulation of fare pricing occurred in 1994 when fares could be discounted by up to 50% without government approval. Price cap regulation was implemented in 1996 and airline firms could voluntarily reduce their normal fares by up to 25% of the maximum fare which was set by MOT. Finally, in 2000, pricing regulation changed from approval of fares by MOT to notification of fares to MOT prior to being to set. Airline firms can now freely set their own fares.

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[5] Domestic Trunk Lines are routes of which both endpoints are Tokyo (Haneda or Narita airport), Osaka (Itami or Kansai airport), Fukuoka, Sapporo and Naha. Local Lines are all of the other routes.

Figure 1 shows passenger-km in the domestic market for each airline group. The shares in 1985, just before deregulation, were NH group, 58.1%, JL group, 26.4% and JD group, 17.2%. NH's share accounted for more than half because of the operation market regulation which assigned a large role for NH in the domestic market. The shares in 2002, just before the merger, were NH group, 48.1%, JL group, 27.5%, JD group, 21.6% and LCCs, 2.7%. The deregulation policy had promoted double and triple tracking and new entries of LCC, however, NH still maintained an overwhelming share. In 2007, after the merger, the shares between NH group, 46.3%, and JJ group, 44.5%, are quite similar and LCCs have constantly increased their share, 9.2%.

In Figure 2, we can see the change in slots at Haneda airport which were debated in the JJ merger as we stated in section 2. The transition is almost the same as passenger-km and NH had maintained a large share of the Haneda slots. MOT (MLIT) kept the slot assignment regulation at Haneda after the abolition of demand-supply balancing regulation in 2000, because Haneda is the most congested airport. The share of slots are NH group, 40.3%, JJ group, 42.8% and LCCs, 17.0% in 2007. One can recognize that the slots are assigned favourably to increase the growth of LCCs.

Table 2 shows the number of routes for the number of airlines (single, double, triple and quadruple) from 1975 to 2007 and one can see that there were only 19 multi tracking routes in 1985 (three triple and sixteen double tracking routes). There are sixty-four multi tracking routes in 2007. Table 3 shows the number of cases for each entry pattern after ten years of deregulation. NH is always a leader except for two cases and JL and JD are mostly followers. The routes which had competition between JL and JD were only triple tracking routes and there were no double tracking routes for JL and JD until 1997.

Table 1. Deregulation Policy at a Glance

	Entry Regulation	**Pricing Regulation**
Before Deregulation	Demand-supply balancing Operation market restriction NH: Domestic trunk line and local line JL: International line and domestic trunk line JD: Domestic local line	Approval by MOT based on average cost pricing
1986	Abolition of the operation market restriction Setting the criteria for double and triple tracking Double: more than 700,000 passengers per year Triple: more than 1,000,000 passengers per year	
1987	(Privatization of JL)	
1992	Reduction of the criteria for double and triple tracking Double: more than 400,000 passengers per year Triple: more than 700,000 passengers per year	
1994		Discount fares by up to 50% can be set without approval by MOT.
1996	Reduction of the criteria for double and triple tracking Double: more than 200,000 passengers per year Triple: more than 350,000 passengers per year	Price cap regulation
1997	Abolition of the criteria for double and triple tracking	
1998	Entry of BC and HD	
2000	Abolition of demand-supply balancing (Slots at the four congested airports in Tokyo and Osaka are still assigned by MOT)	Fares can be set freely. (Notification to MOT prior to setting fares is necessary)
2002	Entry of LQ	
2003	(Merger of JL and JD [JJ merger])	
2006	Entry of 7G	

Table 2. Number of Multi Tracking Routes

	1975	1980	1985	1990	1995	2002	2003	2007
Quadruple Tracking	0	0	0	0	0	4	0	1
Triple Tracking	2	2	3	6	22	22	8	10
Double Tracking	9	18	16	25	35	48	62	53
Single Tracking	122	149	146	142	183	199	203	178

Source: *Annual Statistical Survey of Japanese Aviation* (*Koku Yuso Tokei Nempo*).

Table 3. Number of Cases for Each Entry Pattern from 1986 to 1996

Leader (s)	Follower	Number of Cases
NH･JL	JD	8
NH･JD	JL	7
NH	JL	7
NH	JD	2
JD	NH	2

Source: *Annual Statistical Survey of Japanese Aviation* (*Koku Yuso Tokei Nempo*).

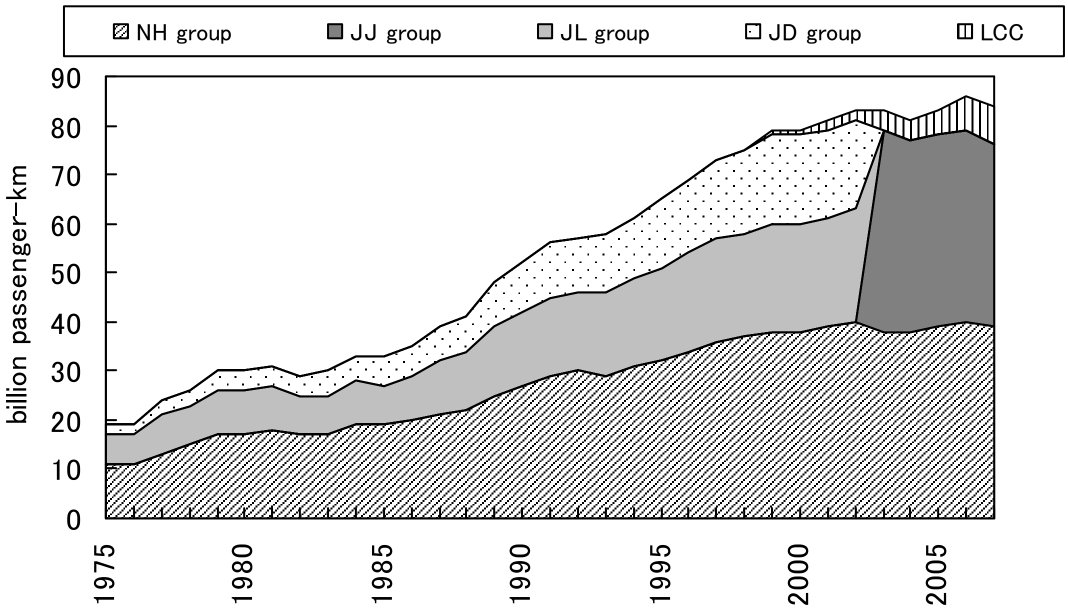

Figure 1. Passenger-km (Domestic)

Source: *Annual Statistical Survey of Japanese Aviation* (*Koku Yuso Tokei Nempo*).

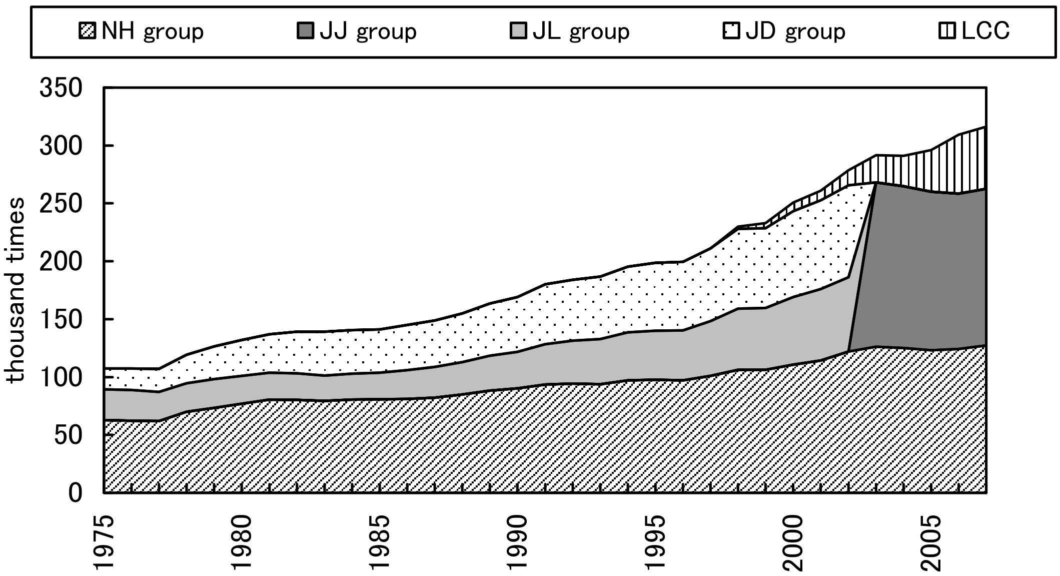

Figure 2. Slots at Haneda Airport

Source: *Annual Statistical Survey of Japanese Aviation* (*Koku Yuso Tokei Nempo*).

4. THE APPROACH TO MARKET STRUCTURE USING CONDUCT PARAMETERS

4.1 Conduct Parameters[6]

In this section, I analyze the market structure of the domestic air transportation market in Japan using conduct parameters (conjectural variations). The conduct parameter is defined as the marginal variation of the market supply which firm i assumes if firm i increases its own supply marginally. This parameter is derived as follows.

One can assume there are n firms which supply a homogeneous product and let the outputs by firm i, q_i, total outputs by n firms, $Q(=\sum_i^n q_i)$ and market price of outputs, P. The inverse demand function and the cost function of firm i are defined as $P = P(Q)$ and $C_i(q_i)$ respectively. The profit function of firm i is denoted as equation (1):

$$\pi_i = P(Q)q_i - C_i(q_i). \tag{1}$$

Taking the first-order-condition, we have:

$$\frac{\partial \pi_i}{\partial q_i} = P(Q) + P'(Q)\frac{dQ}{dq_i}q_i - MC_i = 0. \tag{2}$$

dQ/dq_i is referred to as the conjectural variation. If $dQ/dq_i = 0$, equation (2) is equal to the first-order-condition under perfect competition. Similarly, (2) is equal to the first-order-condition under Cournot competition if $dQ/dq_i = 1$, and the cartel case if $dQ/dq_i = Q/q_i$, which means an inverse of firm i's share and will be equal to the number of firms n, if all of the firms are symmetric. By defining the price elasticity of demand $\varepsilon(= -(dQ/Q)/(dP/P))$ and the market share of firm i, $s_i(= q_i/Q)$, equation (2) can be rewritten as (3) and the

[6] See Iwata (1974) on explanation of conjectural variation in detail. Recently, there are some arguments about model setting for conjectural variation estimation and estimated conjectural variation interpretation (see Fischer and Kamerschen (2003), Corts (1999) and Puller (2009)). Using a conduct parameter (conjectural variation) approach with firm-level data is still valuable for understanding market behavior.

conduct parameter is formularized. From equation (3), we can understand that the conduct parameter of firm i is derived by market price, price elasticity of demand, the marginal cost of firm i and the market share of firm i:

$$\frac{dQ}{dq_i} = \frac{P - MC_i}{P} \frac{\varepsilon}{s_i}. \tag{3}$$

4.2 Estimate of the Total Cost Function

We must estimate the total cost function of the airlines in order to analyze the cost structure. The total cost function is defined as equation (4).

$$TC = TC(Y(Q, CS, MX), W_L, W_F, W_K, W_M, T, D_{NH}, D_{JL}, D_{JD}, D_{BC}, D_{JJ}), \tag{4}$$

where,

TC : total cost

Y : output index

Q : output quantity

CS : average aircraft size

MX : domestic service ratio

W_i : price of input factor ($i = L$ [labor], $i = F$ [fuel], $i = K$ [capital], $i = M$ [material])

T : trend

D_g : airline dummy ($g = NH$ [All Nippon Airways], $g = JL$ [Japan Airlines (before merger)], $g = JD$ [Japan Air System], $g = JJ$ [Japan Airlines (after merger)], $g = BC$ [Skymark])

The dataset is a carrier-specific unbalanced panel of 5 carriers (NH, JL, JD, JJ, BC) over 20 years (1987-2007). The sample size is 68 and the details are: NH, 1987-2007; JL, 1987-2002; JD, 1987-2002; JJ, 2003-2007; BC, 1998-2007. Table 4 defines the variables. The data source is primarily *the Annual Financial Statements* of each airline. Also referenced is *the JAA Annual Civil Aviation Handbook*[7].

The output measure of seat-km is modelled after Fisher and Kamerschen (2003). The total cost consists of passenger and freight service costs, however, only seat-km is used as an output measure for two reasons. Firstly, about 90% of total aviation revenues are passenger service revenues[8]. Secondly, passenger service and freight service can be recognized as almost joint products. Seat-km includes domestic and international seat-km because it is impossible to separate the costs into domestic and international. At the same time, one can expect that the cost structure of domestic service and international service are different. Hence, seat-km is weighted by domestic service ratio to adjust for this difference. Seat-km is also weighted by average aircraft size because Japan's carriers operate many large aircrafts even for domestic routes, due to the airport slot constraints especially at Haneda and Itami airports[9].

For the input factor, labor, fuel, capital and materials are used. Capital costs are a sum of interest payments, depreciation, aircraft lease charges, aircraft maintenance costs and other capital maintenance costs. Capital price W_K is calculated by equation (5) which is based on a perpetual inventory method devised by Jorgenson and Griliches (1967).

$$W_K = PI * (r + \delta), \tag{5}$$

where,

PI : price index for investment goods

r : interest rate (= interest payment / bonds)

δ : depreciation rate (= (depreciation + aircraft lease charges + aircraft maintenance costs + other capital maintenance costs) / (tangible fixed asset + lease aircraft asset))

[7] NH data since 2004 include its subsidiary, Air Nippon, Air Nippon Network and Air Central. BC data in 2004 consists of only five months because the closing date changed. Thus, BC data in 2004 is multiplied 12/5.

[8] Passenger service revenues account for 91% (NH), 85% (JJ), 97% (BC) of total aviation revenues in 2006.

[9] For instance, NH has ten B747-400s with 565 seats and seven B777-300s with 514 seats for domestic routes in 2009. Haneda airport treats 657 million domestic passengers with only 324 thousand traffics (landings and take offs) in 2007.

Equation (4) is specified in a Translog form:

$$\ln TC = \alpha_Y \ln Y + \sum_i \alpha_i \ln W_i + \alpha_T T + \sum_g \alpha_g D_g$$

$$+\frac{1}{2}\beta_{YY}(\ln Y)^2 + \frac{1}{2}\sum_i \sum_j \beta_{ij}(\ln W_i)(\ln W_j) + \sum_i \beta_{Yi}(\ln Y)(\ln W_i). \quad (6)$$

The imbedded hedonic output function is specified as a log-linear form:

$$\ln Y = \ln Q + \gamma_{CS} \ln CS + \gamma_{MX} \ln MX, \quad (7)$$

where α, β, γ are parameters. Restrictions, equation (8), are imposed to keep the total cost homogeneous of degree one in input prices.

$$\sum_i \alpha_i = 1,\ \sum_i \beta_{ij} = \sum_j \beta_{ij} = 0,\ \sum_i \beta_{Yi} = 0. \quad (8)$$

Furthermore, Shepherd's lemma is applied to the total cost function. Then the input share equation is obtained as follows:

$$\frac{\partial \ln TC}{\partial \ln W_i} = S_i = \alpha_i + \sum_j \beta_{ij} \ln W_j + \beta_{Yi} \ln Y, \quad (9)$$

where S_i is a share of input i in total cost $(i = L, F, K, M)$.

The Seemingly Unrelated Regression (SUR) is applied to both the total cost function and the input share equations. Price and cost data are deflated to 2000 prices and all observations of each variable are divided by the sample mean for the estimate. The estimated results are shown in Table 5. One can see from Table 5 that the parameter signs and significance are reasonable. I then look at the output attribute, average aircraft size and domestic service ratio effects to the total cost. The negative value of the average aircraft size parameter (-0.4146) suggests that economies of aircraft size occurs. The positive value of the domestic service ratio parameter (0.1911) implies that the average cost of international routes is cheaper than that of domestic routes and it can be inferred that this positive value is reflected in the longer distances of international routes[10].

Table 4. Definition of Variables

Variable	Definition	Unit	Mean	Standard Deviation	Minimum	Maximum
TC (Total Cost)	= Operating cost + Interest payment	million yen	723,149	498,487	12,912	1,999,668
Q (Output)	Total Seat-km (Domestic + International)	million seat-km	59,524	42,401	1,056	143,698
CS (Average Craft Size)	Seat-km per flight-km	seat	275	46	148	330
MX (Domestic Service Ratio)	Domestic Seat-km / Total Seat-km	-	0.6734	0.3023	0.2064	1.0000
W_L (Wage)	Average annual salary per employee	thousand yen	10,921	2,895	4,322	16,250
W_F (Fuel Price)	Fuel expenditure per flight-km	yen	0.4615	0.0689	0.3343	0.7351
W_K (Capital Price)	Equation (5)	index	30.8057	15.6935	16.0851	96.4310
W_M (Material Price)	= (TC - Labor cost - Fuel cost - Capital cost) / seat-km	yen	5.1898	1.0020	3.1664	7.0848
T (Trend)	Time Trend（1987＝1）	-	11.2206	5.9371	1.0000	21.0000
S_L (Share of Labor)	Share of labor input expenditure	-	0.1894	0.0418	0.1106	0.2787
S_F (Share of Fuel)	Share of fuel input expenditure	-	0.1543	0.0346	0.1154	0.2814
S_K (Share of Capital)	Share of capital input expenditure	-	0.2422	0.0352	0.2025	0.3401
S_M (Share of Material)	Share of material input expenditure	-	0.4141	0.0379	0.2901	0.4669

Source: NH, JL, JD, JJ, BC, *Annual Financial Statements*.
Japan Aeronautic Association, *Annual Civil Aviation Handbook* (*Koku Tokei Yoran*).

Table 5. Estimate Results

Parameter	Estimate	t-value	Parameter	Estimate	t-value
α_Y	0.8187	12.56***	β_{YK}	-0.0029	-0.51
α_L	0.1817	30.89***	β_{YM}	0.0146	2.51**
α_F	0.1514	32.89***	β_{LL}	0.1197	4.78***
α_K	0.2472	54.28***	β_{LF}	-0.0501	-3.31***
α_M	0.4197	89.19***	β_{LK}	-0.0139	-1.07
α_T	0.0510	1.53	β_{LM}	-0.0558	-3.26***
α_{NH}	0.0325	1.24	β_{FF}	0.0798	5.06***
α_{JL}	0.2478	3.27***	β_{FK}	-0.0179	-1.78*
α_{JD}	-0.1830	-2.54**	β_{FM}	-0.0118	-0.93
α_{JJ}	0.2154	5.13***	β_{KK}	0.0685	5.88***
α_{BC}	-0.2742	-1.62	β_{KM}	-0.0368	-3.62***
β_{YY}	-0.0924	-5.28***	β_{MM}	0.1044	5.96***
β_{YL}	-0.0188	-2.26**	γ_{CS}	-0.4146	-9.53***
β_{YF}	-0.0012	0.22	γ_{MX}	0.1911	2.23**

Note: R-squared of Total Cost Function is 0.999, Labor Share 0.373, Fuel Share 0.374, and Capital Share 0.557.
***Significant at 1%, **5%, *10%.

[10] However, a significant effect from average route distance, which was done in many previous studies, cannot be inferred here.

4.3 Estimate of the Demand Function

Now I try to estimate a demand function to understand the market structure of the domestic passenger market. The demand function is defined as equation (10) and is specified as a log-linear form.

$$X = X(P, GDP, D_{NH}, D_{JL}, D_{JD}, D_{JJ}), \quad (10)$$

where,

X : passenger-km

P : fare (revenue per passenger-km) (in 2000 prices)

GDP : gross domestic product (in 2000 prices)

D_g : airline dummy ($g = NH$ [All Nippon Airways], $g = JL$ [Japan Airlines (before merger)], $g = JD$ [Japan Air System], $g = JJ$ [Japan Airlines (after merger)])

Since the deregulation of fare pricing occurred in 1994, I use the data from 1994 to 2007 which is extracted from the *Airlines Annual Financial Statements* and the *Annual Report on National Accounts*. This paper focuses mainly on the market behaviour of the total domestic airline market in Japan. I include only NH, JL, JD and JJ and exclude BC because BC has a very small share of the total domestic market (3.9% in 2006). The sample size is 37 and the details are as follows: NH, 1994-2007; JL, 1994-2002; JD, 1994-2002; JJ, 2003-2007. The fare is passenger revenue per passenger-km in 2000 prices. The regression results with OLS are as follows[11]:

$$\ln X = -0.921 \ln P + 2.107 \ln GDP - 7.663 D_{NH} - 8.408 D_{JL} - 8.394 D_{JD} - 7.754 D_{JJ} \quad (11)$$

(-9.67***) (11.77***) (-3.31***) (-3.64***) (-3.63***) (-3.34***)

$$\overline{R^2} = 0.968, \quad SE = 0.039, \quad n = 37$$

[11] The t-values are in parentheses. $\overline{R}^2$ is the adjusted coefficient of determination.

The price elasticity of demand is 0.921. This value is approximately the same as the results of previous research.

4.4 Estimate of Conduct Parameter

As mentioned above, a marginal cost is needed to estimate the conduct parameter. Marginal cost is calculated for each carrier using the estimate results in section 4.2 and equation (12):

$$MC = \frac{TC}{Q}\frac{\partial \ln TC}{\partial \ln Q}. \quad (12)$$

I use the price elasticity of demand, 0.921, which was estimated in section 4.3, and assume that the elasticity is constant during the analyzing period. In Figure 3, one can see the estimated conduct parameters of three airlines (two airlines after the merger) which are calculated by substituting the marginal costs and the price elasticity of demand into equation (3). Seat-km share of three airlines is used as a market share. NH's conduct parameters are mostly plotted near 1.0, while those of JL are nearly 2.0 and JD are nearly 1.5 before the merger. One can recognize that NH has Cournot behaviour and JL and JD have collusive behaviour. Additionally, the collusive behaviour of JL and JD could largely be caused by regulation, because the operating routes among airlines were strictly regulated and JL and JD had few overlapping markets until 1986. Even after deregulation in 1986, the competition between JL and JD was limited, because demand-supply balancing regulations remained until 2000. Actually, as mentioned in the entry pattern after deregulation in Table 3, NH is a leader and JL and JD are followers in most of the cases and the routes which had competition between JL and JD were only triple tracking routes and there were no double tracking routes for JL and JD until 1997. From these conduct parameters, the entry pattern, and the fact that the share of NH was more than 50%, one could guess Stackelberg competition would develop with NH as a leader and JL and JD as followers.

After the merger of JL and JD to JJ in 2003, it was suggested that Cournot competition between NH and JJ developed, because the conduct parameters of NH and JJ are nearly 1.0.

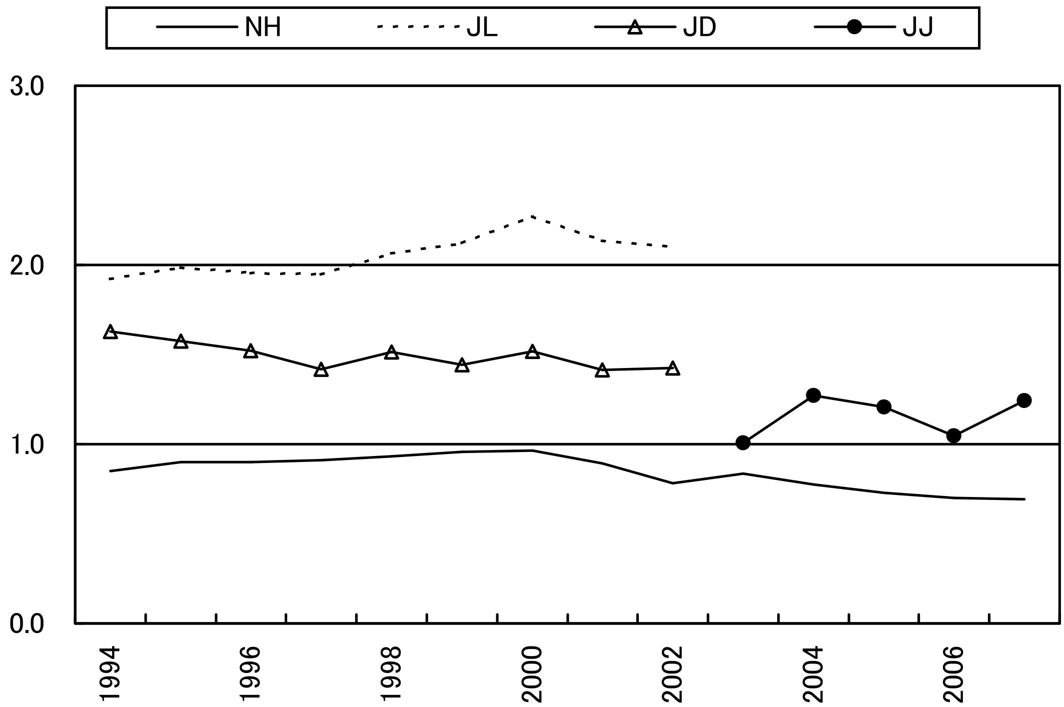

Figure 3. Conduct Parameter

5. THE APPROACH TO MARKET STRUCTURE USING THEORETICAL PRICE

5.1 Method for Deriving Theoretical Price[12]

The above conduct parameter analysis suggests that there could have been Stackelberg competition which includes NH as a leader and JL and JD as followers before the merger, and

[12] See Okawa and Ueda (1999).

Cournot competition between NH and JJ after the merger. In this section, I apply another approach which focuses on NH, JL, JD and JJ to evaluate market structure.

Firstly, I derive the theoretical price in each market structure by solving the optimization problem with the specified demand function and cost function. Secondly, I infer the market structure from a comparison of the actual price and the theoretical price.

Here, the inverse demand function is specified as $P = AQ^{-\frac{1}{\varepsilon}}$. ε is the price elasticity of demand. The profit of firm i will be identical to equation (1), if each airline shows Cournot behavior. By first-order-condition, the theoretical price with Cournot competition is derived as equation (13):

$$\frac{\partial \pi_i}{\partial q_i} = P(Q) + P'(Q)\frac{dQ}{dq_i} q_i - MC_i = 0,$$

$$P\left(1 - \frac{s_i}{\varepsilon}\right) = MC_i,$$

where $s_i (= q_i / Q)$ is the market share of firm i. The first-order-condition for n firms is:

$$P = \frac{\sum_{i=1}^{n} MC_i}{n - \frac{1}{\varepsilon}}. \qquad (13)$$

Next, let us think about the Stackelberg competition case which includes the first firm as a leader and the others as followers. q_l is defined as the output of the leader and q_i^F as the output of follower i $(i = 2, \cdots, n)$. Additionally, $Q^F = \sum_{i=2}^{n} q_j^F$ and $Q = q_l + Q^F$ are satisfied. The profit of follower i is expressed as:

$$\pi_i^F = P q_i^F - C_i(q_i^F).$$

I arrive at (14) by first-order-condition and followers' conduct parameters, $dQ^F / dq_i^F = 1$, which are derived under Cournot competition assumption among followers:

$$P\left(1-\frac{s_i^F}{\varepsilon}\right)=MC_i \tag{14}$$

where $s_i^F (=q_i^F/Q)$ is the market share of follower i. Equation (14) for $n-1$ firms is:

$$P\left[1-\frac{s^F}{\varepsilon}\right]=\frac{\sum_{i=2}^{n} MC_i}{n-1}, \tag{15}$$

where $s^F (=Q^F/\{(n-1)Q\})$ is the average share of the followers. From (15), the slope of the reaction function of the followers, dQ^F/dq_l, is derived as equation (16) if one assumes MC_i is constant.

$$\frac{dQ^F}{dq_l}=-\frac{(n-1)\left(1-\frac{1+\varepsilon}{\varepsilon}s^F\right)}{1+(n-1)\left(1-\frac{1+\varepsilon}{\varepsilon}s^F\right)}. \tag{16}$$

The profit of the leader is:

$$\pi_l = P(Q)q_l - C_l(q_l).$$

By first-order-condition:

$$P\left[1-\frac{s^L}{\varepsilon}\left(\frac{dQ^F}{dq_l}+1\right)\right]=MC_l, \tag{17}$$

where s^L is the market share of the leader. The following equation is obtained by substituting (17) for (15) and considering $s^L+(n-1)s^F=1$:

$$\varepsilon - s^L\frac{dQ^F}{dq_l}-s^L-ha-hs^L=0,$$

where $h=MC_l/\sum_{i=2}^{n} MC_i$ and $a=\varepsilon(n-1)-1$. Substituting (16) for the above equation:

$$h(\varepsilon+1)(s^L)^2+\{(\varepsilon+2)ha-\varepsilon^2\}s^L+a(ha-\varepsilon)=0. \tag{18}$$

By solving equation (18), the leader's optimal share s^{L*}, then, the followers' share s^{F*} will be derived. By substituting s^{F*} for (15), the theoretical price with Stackelberg competition is given as equation (19):

$$P = \frac{\frac{\sum_{i=2}^{n} MC_i}{n-1}}{1-\frac{s^{F*}}{\varepsilon}}. \qquad (19)$$

5.2 Estimate Results for Theoretical Price

Theoretical prices are estimated using equation (13) under Cournot competition and (19) under Stackelberg competition. The average actual prices of three airlines (two airlines after the merger) and the theoretical prices for Cournot and Stackelberg can be seen in Figure 4. The actual prices are plotted in approximation to the theoretical prices with Stackelberg rather than those with Cournot from 1994 to 2002. After the merger, one could say that NH and JJ behaved as Cournot competitors.

Finally, I estimate the equation below to test the hypothesis that the merger changed the market structure from Stackelberg competition to Cournot competition.

$$P_T = A + BP_A$$

where,

P_T : Theoretical Price (under Stackelberg from 1994 to 2002 and Cournot from 2003 to 2007)

P_A : Actual Price

A, B : Parameters

The null hypothesis is defined as the case in which the theoretical price would be equal to the actual price, that is $A = 0$ and $B = 1$. The estimated result is as follows;

$$P_T = -4.602 + 1.346 P_A. \qquad (20)$$

(-1.05) (1.45) $\overline{R^2} = 0.705$

The t-values are in parentheses. The t-values are not significant and the null hypothesis is not rejected. Therefore, there is the possibility that the market exhibited Stackelberg competition before the merger and Cournot competition after the merger[13].

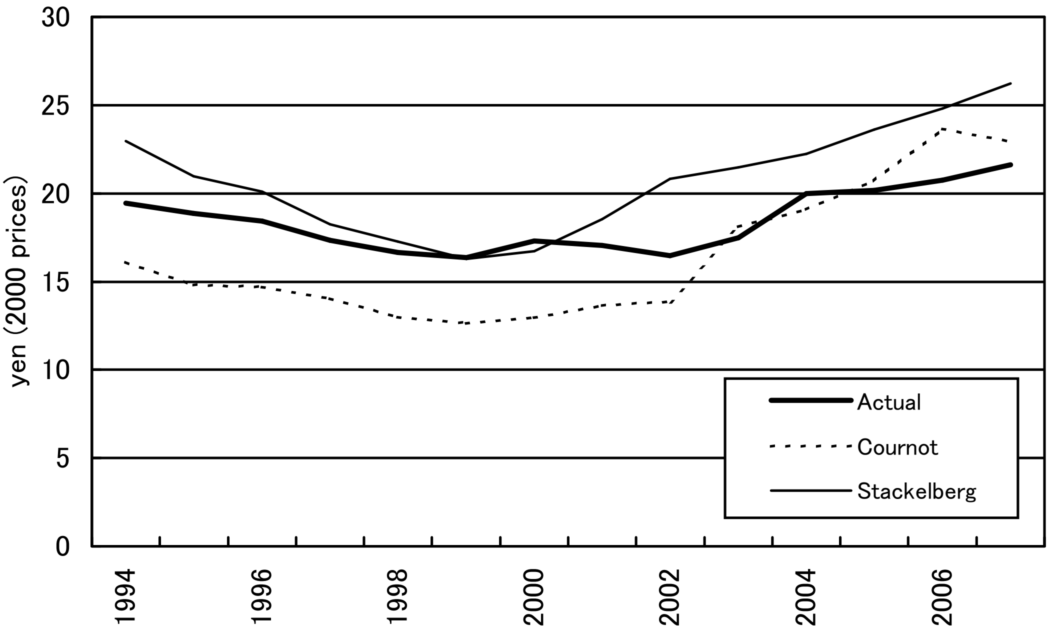

Figure 4. Actual and Theoretical Price

[13] I also test other two theoretical price cases, Cournot competition from 1994 to 2007 and Stackelberg competition from 1994 to 2007. The null hypothesis that the theoretical price would be equal to the actual price is rejected in both cases.

Cournot competition from 1994 to 2007 $P_T = -22.424 + 1.147 P_A$ $\overline{R^2} = 0.750$
(-3.57***) (3.38***)

Stackelberg competition from 1994 to 2007 $P_T = -8.512 + 0.588 P_A$ $\overline{R^2} = 0.779$
(-1.98*) (2.53**)

6. CONCLUSION

I examined the JL and JD merger effects for the market competition structure with conduct parameter and theoretical price approaches. It is inferred that Stackelberg competition with NH as a leader and JL and JD as followers had developed before the merger, and Cournot competition with NH and JJ developed after the merger. Thus, one might say that the merger changed the market structure and JJ had become NH's equal rival.

However, with Cournot competition, there is an incentive for two firms to behave collusively as Yanagawa (2002) stated and fares have actually had an upward trend since the merger as seen in Figure 6. Therefore, continued observation of the conduct parameters is necessary. It is recognized that this study focuses only on the total market. It will be useful in future research to analyze each route separately because some routes have another major competitor, the high speed train (Shinkansen).

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