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Strategic Alliance versus Competition:
Airlines' Choices and their Impact on Economic Welfare

Hideki Murakami

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Hideki MURAKAMI
Graduate School of Business Administration
Kobe University
2-1 Rokkodai-cho, Nada-ku, Kobe, 657-8501, JAPAN
Tel : +81-78-803-6941 Fax: +81-78-803-6969
E-mail: hidekim@kobe-u.ac.jp

Abstract

This paper theoretically analyses the duopolistic behavior of two hypothetical airlines operating in a four-point hub-and-spoke route network system, and examines the impact of this behavior on economic welfare. The important character of these two airlines is that they are of different (i.e., asymmetric) cost structures and products. The main findings are that (1) in rare cases, two asymmetric airlines might form a strategic alliance, and (2) Cournot competition is much more likely to generate economic welfare than a strategic alliance. However, in some cases in which the degree of economies of density is sufficiently small, two firms may engage in Cournot competition, despite the fact that strategic alliance generates greater economic welfare. Therefore, the degree of economies of density is the key factor to which governments should attend.

Keywords: Airlines with asymmetric structure, Two-stage duopolistic game, Economies of density, Cost complementality, Economic welfare

1. Introduction

Since the mid-1980s, many countries have experienced a liberalization of international markets by accepting the US open-sky policy. International air markets have been tightly regulated in terms of setting airfares, flight frequency, the designation of airlines, the choice of alliance partners and so on. Since many countries still tightly regulate the use of fifth freedom rights among each other, each airline cannot build their optimal route networks.

In order to overcome these legislative operational restrictions, a domestic airline sometimes lobbies for strategic alliance with a foreign airline. Such alliances are of two types: deep- and shallow-type. The former allows two airlines to agree on setting the same ticket price, the control of departures, the mutual holding of equities, and/or code-sharing. This type of strategic alliance requires antitrust immunity from their countries. The shallow-type alliance, on the other hand, does not require government approval, since the airlines are not regarded as forming a cartel. Rather, the two airlines simply agree on the coordination of operations and/or issue through-tickets on a route-by-route basis.

This paper analyses the economic effects of strategic alliance between airlines by introducing the concept of an “asymmetric firm structure”. We define an asymmetric firm structure as the alliance of two firms that are asymmetric with respect to their cost structure and their products. In other words, one airline is assumed to be a low-cost carrier, while the other is the high-cost network carrier, and they produce differentiated products.

In order to see the effects of an alliance on economic welfare, we usually consider the ticket price level, output level, cost level and efficiency of production. The ticket price level is normally affected by the degree of competition, which in turn is dependent on the strength of barrier to entry. There have been many empirical and theoretical studies on entry behaviors and inter-firm rivalries, including the works of Bresnahan and Reiss (1990), (1991), Berry (1992), Brandar and Zhang (1990), (1993) and Oum et al. (1993). As for airline costs, Caves et al. (1984) introduced the idea of economies of density, and empirically showed that this concept was a significant factor in the economics of airline industries. Brueckner and Spiller (1991), (1992), and Zhang (1996) stress the importance of cost complementarities in airline networks. Due to cost complementarities, the decrease in output due to competition in a hypothetical route (A) may raise the level of marginal cost of route (B) which is adjacent to (A). Oum, Park, and Zhang (1996) and Park (1997) apply the concept of economies of density and cost complementarities in a network to the analysis of strategic alliances between airlines in international markets.

These analyses assume that the firm size is symmetric and airlines produce homogeneous products. However, based on our observations of the operations of Southwest Airlines and Jet Blue in the US and Ryan Air in Europe, low-cost airlines have played important roles in both international and domestic air markets. In marked contrast to the US mega-carriers, these low-cost airlines have not developed huge hub-and-spoke route systems, computer reservation system, or frequent flyer programs. Although many researchers insist that efficient route systems and customer-binding strategies are vital for the survival and continued competitiveness of airlines, these lower-cost airlines have actually survived without these devices. To elucidate the mechanism of this survival, this paper aims to analyze the behaviors of two airlines with asymmetric cost structure and differentiated products.

Schmalensee (1987) and Mason and Nowell (1992) previously analyzed the duopoly competition between firms of asymmetric firm size (i.e., firms of different cost structures). Schmalensee contends that if a firm has sufficient cost advantage over its rival, mutual profits generated by competition might exceed the profit generated by collusion. Mason and Nowell demonstrate that two asymmetric firms tend to conduct non-collusive behaviors and require a longer period of time to reach market equilibrium than would two symmetric firms. This paper will attempt to apply these concepts of the asymmetric firm structure to the analysis of a duopolistic airline model.

Section two explains the route systems assumed in this study, as well as the properties of low- and high-cost airlines. Section three explains the incentives for low- and high-cost airlines to agree or disagree with collusive behavior (i.e., the strategic alliance) using the two-stage game framework, and also analyses how agreement between two asymmetric airlines on strategic alliance or Cournot competition affects price, output, profit and economic welfare.

The main findings are that (1) in rare cases, two asymmetric airlines might form a strategic alliance, and (2) Cournot competition is much more likely to generate economic welfare than a strategic alliance. However, in some cases in which the degree of economies of density is sufficiently small, two firms may engage in Cournot competition, despite the fact that strategic alliance generates greater economic welfare. Therefore, the degree of economies of density is the key factor to which governments should attend. Section four summarizes the findings of this paper.

2. Route Systems, Profit Functions, and their Relevant Properties

Figure 1 shows the hypothetical "pre-entry" route system.

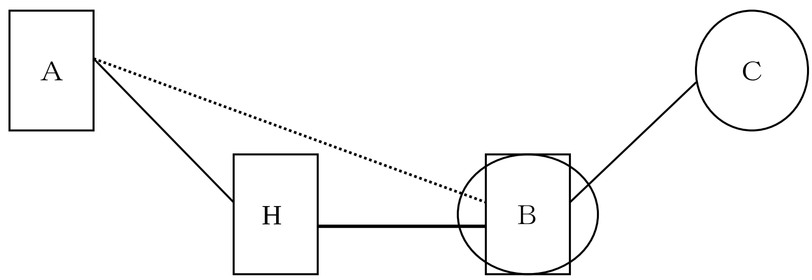

Figure 1. Pre-entry route structure

Firm 1, the high-cost-incumbent network carrier, serves three airports within a rectangular area: airports A, H, and B. There is traffic flow between A-H and H-C, and these two routes are connected by direct flights. There is also traffic flow between A-B, but there are no direct flights. Firm 2, the low-cost airline, serves two airports within a circular region: airports B and C. Firm 2 intends to enter the H-B market, which we assume has more traffic than any other route.

The next assumption concerns the "post-entry" route system. Figure 2 shows the situation in which Firm 1 and Firm 2 form a strategic alliance under which they agree on the share of joint profit, the proximity of their ticket counters, and the coordination of departures and baggage handling. Due to this alliance, new traffic flow is generated between A-C, but there is no direct flight between them. Passengers moving between A-C must change planes at hub H and/or hub B. New traffic flow is also generated between H-C, but since there is no direct flight, passengers must change planes at airport B.

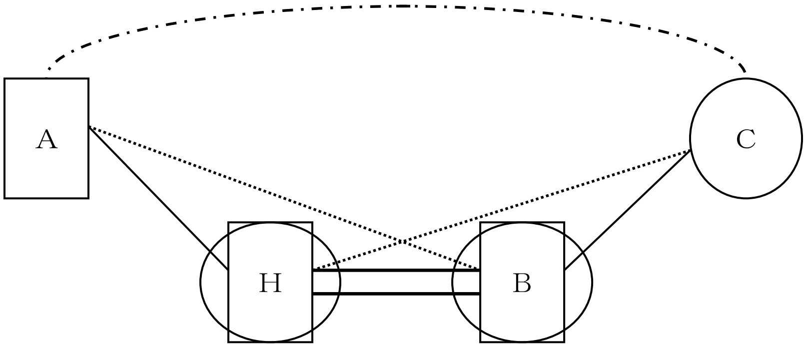

Figure 2. Route structure after the strategic alliance

Figure 3 shows the route system after Firm 2 has entered and the two firms initiate Cournot competition between H-B. This competition inevitably has an impact on the markets of routes A-B and H-C. Passengers traveling routes A-B and H-C can choose either the H-B flight offered by Firm 1 or that offered by Firm 2 depending on the level of air-ticket prices. In this case, neither Firm 1 nor Firm 2 provides seamlessly connected services at either hub H or hub B, so passenger flow between A-C is assumed to be zero.

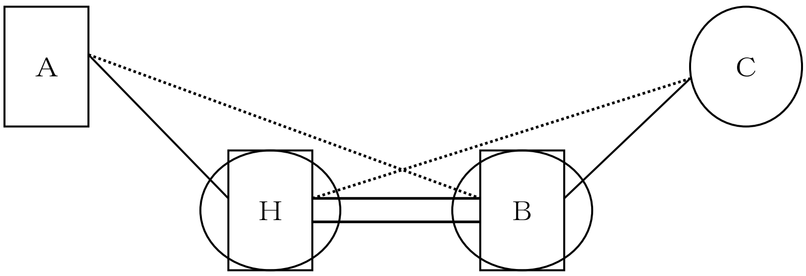

Figure 3. Route structure under duopolistic competition

Under the assumption shown in Figure 3, the profit function of Firm 1 and Firm 2 can be written as follows.

$$\pi^{1CO} = Q_{AH}^1 D(Q_{AH}^1) + Q_{BH}^1 D(Q_{BH}^1 + Q_{BH}^2) + Q_{AB}^1 D(Q_{AB}^1) - c(Q_{AH}^1 + Q_{AB}^1) - c(Q_{BH}^1 + Q_{AB}^1) \quad (1)$$

$$\pi^{2CO} = Q_{BH}^2 D(Q_{BH}^1 + Q_{BH}^2) + Q_{BC}^2 D(Q_{BC}^2) + Q_{HC}^2 D(Q_{HC}^2) - C(Q_{BH}^2 + Q_{HC}^2) - C(Q_{BC}^2 + Q_{HC}^2) \quad (2)$$

On the other hand, under the assumption that Firm 1 and Firm 2 form a strategic alliance and agree to share their profits equally, their profit functions can be written as follows.

$$\pi^{1AL} = \pi^{2AL} = \frac{1}{2}[Q_{AH}^1 D(Q_{AH}^1) + (Q_{BH}^1 + Q_{BH}^2)D(Q_{BH}^1 + Q_{BH}^2) + Q_{AB}^1 D(Q_{AB}^1) + Q_{BC}^2 D(Q_{BC}^2)$$
$$+ Q_{HC}^2 D(Q_{HC}^2) + (Q_{AC}^{1+2})D(Q_{AC}^{1+2}) - c(Q_{AH}^1 + Q_{AB}^1 + Q_{AC}^{1+2}) - c(Q_{BH}^1 + Q_{AB}^1 + Q_{AC}^{1+2})$$
$$- C(Q_{BH}^2 + Q_{HC}^2 + Q_{AC}^{1+2}) - C(Q_{BC}^2 + Q_{HC}^2 + Q_{AC}^{1+2})] \quad (3)$$

Economic theory assumes the properties of cost function: they are homogeneous degree one, concave (to be checked by seeing whether the Hessian matrix of each cost function is negative definite) and non-decreasing in input prices. In addition, this paper imposes the following assumptions following previous studies.

(A) $\frac{\partial c}{\partial Q_i^1} > 0 \quad (i = AH, BH, AB)$、$\frac{\partial C}{\partial Q_i^2} > 0 \quad (i = BH, BC, HC)$

(B) $\frac{\partial^2 c}{\partial (Q_i^1)^2} < 0 \quad (i = AH, BH, AB)$、$\frac{\partial^2 C}{\partial (Q_i^2)^2} < 0 \quad (i = BH, BC, HC)$

(C) $\frac{\partial^2 c}{\partial Q_i^1 \partial Q_j^1} < 0 \ (i, j = AH, BH, AB, i \neq j)$、$\frac{\partial^2 C}{\partial Q_i^2 \partial Q_j^2} < 0 \ (i, j = BH, BC, HC, i \neq j)$

(D) $C(Q_i^2) < c(Q_j^1) \quad \forall\, Q_i^2 = Q_j^1 \quad (i = BH, BC, HC \quad j = AH, BH, AB)$

Assumptions (A) and (B) mean that economies of density are effective in an airline industry. These assumptions are also made by Caves, Christensen, and Tretheway (1984) and Gillen, Oum, and Tretheway (1990). Assumptions (A) and (C) mean that the cost complementarities exist. Assumption (Ｄ) means that the total cost of Firm 2 is always lower than that of Firm 1. In addition, this paper follows the assumption by

Brueckner and Spiller (1992), Zhang (1996), and Park (1997) that the marginal cost of an airline is linear and slopes downward:

$$MC^1 = 1 - \theta Q^1 \quad (4)$$

$$MC^2 = \phi - \theta Q^2 \quad (5)$$

where $\theta > 0$ and $0 < \phi < 1$. The positive sign of θ and $0 < \phi < 1$ are the restatement of assumption (A) and (B) (that is, the existence of economies of density), and (D) (asymmetric cost structure).

Next, since this paper assumes that two airlines produce differentiated products, our inverse demand functions are written as follows.

$$P_{BH}^1 = \alpha_1 - \beta_1 Q_{BH}^1 - \gamma Q_{BH}^2 \qquad (6)$$

$$P_{BH}^2 = \alpha_2 - \beta_2 Q_{BH}^2 - \gamma Q_{BH}^1 \qquad (7)$$

where $\alpha_1 > 0, \alpha_2 > 0, \beta_1 > 0, \beta_2 > 0$, and assuming that two airlines are substitutes for passengers, $\gamma > 0$ and normally $\beta_1 > \gamma > 0$ and $\beta_2 > \gamma > 0$. For convenience, let β_1 be unity and let β_2 be denoted as just β and not equal unity. This transformation does not lose the generality of analysis. In addition, since this paper assumes that the market B-H is larger than any other route, it is necessary to parameterize this assumption. Without losing the generality, this paper assumes that route B-H is 50% as large as A-H, B-C, A-C, A-B and H-C, and competition in B-H does not affect either A-H or B-C (that is, the demand functions of A-H and B-C do not shift due to the competition in B-H, while those of A-B and H-C do). Our demand functions can now be rewritten as follows.

$$P_{BH}^1 = 3\alpha_1 - Q_{BH}^1 - \gamma Q_{BH}^2 \qquad (8)$$

$$P_{BH}^{2} = 3\alpha_2 - \beta Q_{BH}^{2} - \gamma Q_{BH}^{1} \qquad (9)$$

The demand functions of other routes are:

$$P_i^1 = 2 - Q_i^1 \qquad (i = AH,\ AC)$$

$$P_{BC}^{2} = \frac{1}{\beta}\left(2 - Q_{BC}^{2}\right)$$

$$P_{AB}^{1} = 2\alpha_1 - Q_{AB}^{1}$$

$$P_{HC}^{2} = \frac{1}{\beta}\left(2\alpha_2 - Q_{HC}^{2}\right)$$

If Firm 1 and Firm 2 form a strategic alliance, the demand function of route B-H is derived by horizontally adding up each demand function. In this case, δ is zero and $\alpha = \alpha_1 = \alpha_2$.

$$P_{BH}^{1+2} = 3\alpha - Q_{BH}^{1} - \beta Q_{BH}^{2}$$

Now we have a total of six parameters in each profit function: they are, $\alpha_1, \alpha_2, \beta, \gamma, \phi, and\ \theta$. In order to avoid complexity, it is convenient to define these parameters using real numbers. Since this paper is interested in the competition between firms with asymmetric cost structure, We choose real numbers for parameters $\beta, \gamma,\ and\ \phi$ such that two firms are (1) almost symmetric and (2) very asymmetric.

① $\beta = 1.1, \gamma = 0.9, \phi = 0.6$ (almost symmetric)

② $\beta = 1.5, \gamma = 0.5, \phi = 0.5$ (very asymmetric)

In addition, we must impose restrictions on the demand and cost functions of B-H, and should also consider the non-negative conditions of price and output. Considering all these properties and restrictions, we finally obtain the following binding conditions for θ. From ①, we have the conditions that $0.2730 < \theta < 0.2923$ and from ②, $0.2689 < \theta < 0.3138$.

3. Economic Analysis of the Behaviors of Asymmetric Firms

This paper considers the following two stage game: at the first stage Firm 2 invests for entry and advertises itself to shift the demand upward, and at the second stage both firms either engage in Cournot competition or choose a strategic alliance. If the equally shared profit from alliance is greater than the profit from competition, each firm is assumed to choose to agree on the strategic alliance and vise-versa. This paper also refers to the status of the competition by deriving the strategic effect and the effect on the rival's profit following the framework of Tirole (1988). The strategic effect refers to the manner in which the advertising investment of Firm 2 upon entry affects its own profit via the effect on the output of its rival. The effect on the profit of its rival is straightforward: i.e., the manner in which the advertising investment of Firm 2 affects the profit of Firm 1. If the advertising investment of Firm 2 has negative effects on its own profit and on the profit of its rival (a situation referred to as a "puppy dog strategy"), Firm 2 would refrain from choosing large investment, and both firms would initiate negotiations toward a strategic alliance. However, if the advertising investment of Firm 2 has a positive strategic effect on its own profit and a negative effect on the profit of its rival (a situation referred to as a "top dog strategy"), Firm 2 would continue to compete in order to increase its profit. Table 1 relates Tirole's framework with the stability of alliance.

Table 1 states that if both the strategic effect on the profit of Firm 2 and the strategic effect on the profit of its rival are positive (a "fat cat strategy"), both firms will continue the competition. If the strategic effect on its own profit is negative and the strategic effect on the profit of its rival is positive, Firm 1 will continue to compete while Firm 2 will seek to cease competition.

Strategic effect on its own profit	Effect on rival's profit	Status of competition
+	-	Unstable
+	+	Continued
-	+	Unstable
-	-	Would be ceased

Table 1. Tirole (1988)'s framework and the status of competition

We can obtain the solution of this two-stage game by solving the subgame perfect Nash equilibrium at the second stage; then, by using the solutions at the second stage, we can solve the optimization problem at the first stage. At the first stage, Firm 2 must invest in advertising, but when it agrees on alliance, it can advertise jointly with Firm 1, while if it chooses to compete it must pay all the advertising costs. Therefore, it is natural to assume that Firm 2 will invest more on advertising when it competes than when it agrees on alliance. For convenience, we will consider the investment when Firm 2 agrees on alliance to be $K^{AL} = 0.25$, and that when it denies strategic alliance to be $K^{c} = 0.75$.

The important relationship between the investments in advertising and the demand function is that the advertising investment of Firm 2 always shifts the demand function upward. However, it is important to consider whether the advertising investment of Firm 2 at the first stage increases the whole market demand or only its own demand. Depending on whether we set the condition $\alpha_1 \neq \alpha_2$ or $\alpha^* = \alpha_1 = \alpha_2$, we might obtain different results in regard to the strategic effect on the profit of Firm 2 and the effect on its rival (i.e., Firm

1).

(a) **The profit of Firm 1 and Firm 2 when two firms are of almost symmetric structure** $\{\beta = 1.1, \gamma = 0.9, \phi = 0.6\}$

Solving the two-stage game, we have obtained the following relationship between the profit from alliance (denoted as π^{iAL} $(i = 1,2)$), the profit from Cournot competition (π^{iCr} $(i = 1,2)$) and α (see Figure 4). In this case, we assume that the advertising investment of Firm 2 at the first stage increases the whole demand in the markets B-H, A-B, and H-C $\left(d\alpha^* / dK > 0, \alpha^* = \alpha_1 = \alpha_2\right)$.

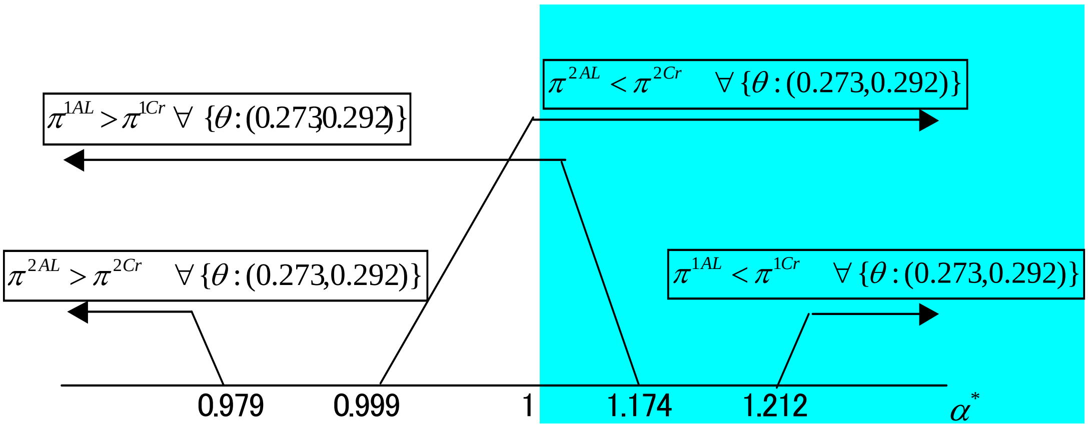

Figure 4. The relationship between π^{iAL}, π^{iCr}, and α^*
when two firms are of almost symmetric structure

We assume that the initial value of α^* is unity and $d\alpha^* / dK > 0$. Therefore, we are interested in only the shaded area. In this area, the profit of Firm 2 from Cournot competition always exeeds the profit from the strategic alliance. However, the relationship between π^{1AL} and π^{1Cr} is quite dependent on the value of θ (i.e., the degree of economies of density) when $1.174 < \alpha^* < 1.212$, and when α^* is larger than 1.212, the profit of Firm 1 from Cournot competition is always larger than its profit from the strategic alliance. On the other hand, when α^* is smaller than 1.174, the profit of Firm 1 from Cournot competition is always smaller than its profit from the strategic alliance. Therefore, in this situation the behavior of Firm 1 is dependent on the degree of upward shift and the degree of economies of density, while the choice of Firm 2 is quite straightforward: it always prefers Cournot competition.

(b) The profit of Firm 1 and Firm 2 when two firms are of very asymmetric structure $\{\beta = 1.5, \gamma = 0.5, \phi = 0.5\}$

On the other hand, when two firms are of very symmetric structure, the results are in marked contrast to the case of almost symmetric structure: the profit of Firm 1 from Cournot competition is always larger than its profit from strategic alliance when $\alpha^* > 1$ (Figure 5).

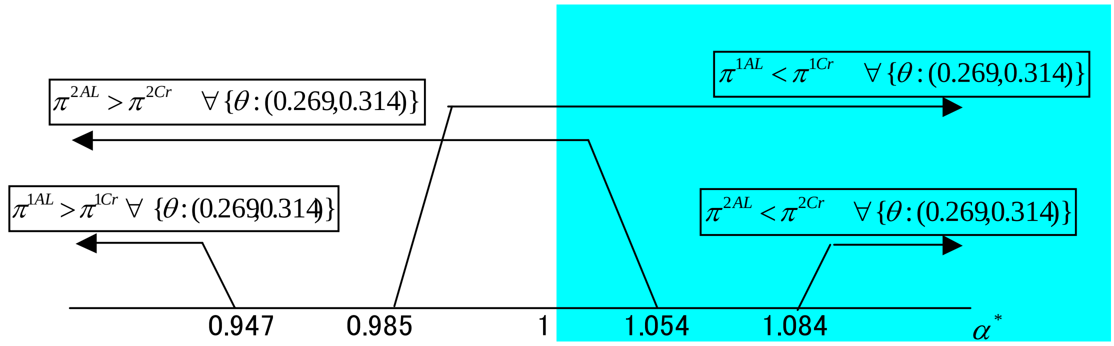

Figure 5. The relationship between π^{iAL}, π^{iCr}, *and* α^*
when two firms are of asymmetric structure.

Firm 2 will prefer to offer strategic alliance when its advertising at the first stage does not increase the market demand very significantly ($1 < \alpha^* < 1.054$), but when the intercept of market demand curve increase more than 8.4%, the two firms will initiate Cournot competition. When $1.054 < \alpha^* < 1.084$, Firm 2 will prefer either strategic alliance or competition depending on the degree of economies of density. In this range, because]the density works more strongly, Firm 2 will prefer competition. Generally speaking, competition might occur more easily when the two firms are of very symmetric structure than when the two firms are of almost symmetric structure.

(c) The Characteristics of Competition between Two Firms of Asymmetric Structure

According to the results in 3(a) and 3(b), it is very unlikely that two firms that have asymmetric structure will agree on the strategic alliance regardless of the degree of asymmetry. Even when the demand curve shifts upward just slightly, either of the firms would deny the strategic alliance. Our next question, then, would concern the type of Cournot competition to be conducted, and whether or not this competition would be likely to continue.

The effects of the advertising investment of Firm 2 on its own profit via the outputs of its rival (strategic effect) and the effects of the advertising investment of Firm 2 on the profits of its rival are shown in Table 2.

When $\alpha^* = \alpha_1 = \alpha_2$	Almost symmetric case	Asymmetric case
Strategic effect on its own profit	$-\frac{9}{10} Q^2_{BH} \frac{\partial Q^1_{BH}}{\partial \alpha^*} \frac{d\alpha^*}{dK} < 0$	$-\frac{1}{2} Q^2_{BH} \frac{\partial Q^1_{BH}}{\partial \alpha^*} \frac{d\alpha^*}{dK} < 0$
Effect on rival's profit	$-\frac{9}{10} Q^1_{BH} \frac{\partial Q^2_{BH}}{\partial \alpha^*} \frac{d\alpha^*}{dK} < 0$	$-\frac{1}{2} Q^1_{BH} \frac{\partial Q^2_{BH}}{\partial \alpha^*} \frac{d\alpha^*}{dK} < 0$
When $\alpha_1 \neq \alpha_2$	**Almost symmetric case**	**Asymmetric case**
Strategic effect on its own profit	$-\frac{9}{10} Q^2_{BH} \frac{\partial Q^1_{BH}}{\partial \alpha_2} \frac{d\alpha_2}{dK} > 0$	$-\frac{1}{2} Q^2_{BH} \frac{\partial Q^1_{BH}}{\partial \alpha_2} \frac{d\alpha_2}{dK} > 0$
Effect on rival's profit	$-\frac{9}{10} Q^1_{BH} \frac{\partial Q^2_{BH}}{\partial \alpha_2} \frac{d\alpha_2}{dK} > 0$	$-\frac{1}{2} Q^1_{BH} \frac{\partial Q^2_{BH}}{\partial \alpha_2} \frac{d\alpha_2}{dK} > 0$

Table 2. Results of the strategic effects on the profit of Firm 2 and the effects on the profits of its rival

When $\alpha^* = \alpha_1 = \alpha_2$, the advertising investment of Firm 2 would decrease its own profit, and thus Firm 2 is unwilling to make a large investment at the first stage. If Firm 2 refrains from large investment, this is good news for Firm 1, because the effect of investment on the profit of the rival is negative. Therefore, the advertising investment of Firm 2 increases the whole market demand, Firm 2 will refrain from large investment, and will not compete aggressively regardless of the degree of asymmetry. It might also be said that when Firm 2 expects that demand will increase only slightly, it will not enter a B-H market when two firms are of asymmetric structure.

However, when $\alpha_1 \neq \alpha_2$ (in other words, when Firm 2 succeeds in increasing its own demand by investment in advertising), Firm 2 will take a "top dog" strategy: it will try to drive its rival out of the market by aggressive investment in advertising, which might be an important business strategy for Firm 2 to bind its own customers. In this case, we expect that very fierce competition would be conducted in route B-H.

(d) Prices, Outputs, and Economic Welfare

Finally, we will investigate how the prices, outputs, and economic welfare would be affected by Cournot competition. Table 3 shows the price and output in each market. The price-output sets when two firms form strategic alliance are also shown. The degree of economies of density is set at 0.28 (medium value).

In the almost symmetric case, the total traffic volume (the vertical sum of outputs) as a result of Cournot competition is 4.87 when the intercept of the market demand curve increases by

10%. When the two firms form a strategic alliance, the total traffic volume is 4.86, so the traffic volumes for both the two cases are almost the same. The weighted average of the price is 1.21 as a result of Cournot competition, while it is 1.34 as a result of the strategic alliance. The reason why the monopolistic traffic volume does not differ substantially from the volume of the competitive case is that the new market A-C is created in the monopolistic case. However, it is apparent that competition would reduce the average price level, and thus that consumer surplus would increase.

	Almost Symmetric Case ($\theta = 0.28$)			Asymmetric Case ($\theta = 0.28$)		
Price, Output	Alliance	Cournot ($\alpha = 1$)	Cournot($\alpha = 1.1$)	Alliance	Cournot ($\alpha = 1$)	Cournot ($\alpha = 1.1$)
P^1_{AH}, Q^1_{AH}	1.25, 0.75	1.38, 0.62	1.35, 0.65	1.34, 0.66	1.37, 0.63	1.34, 0.66
P^1_{AB}, Q^1_{AB}	1.42, 0.58	1.75, 0.25	1.78, 0.42	1.69, 0.31	1.69, 0.31	1.71, 0.49
P^2_{BC}, Q^2_{BC}	0.99, 0.92	1.07, 0.85	1.24, 0.87	1.06, 0.63	1.08, 0.61	1.07, 0.62
P^2_{HC}, Q^2_{HC}	1.10, 0.82	1.10, 0.82	1.14, 0.96	1.15, 0.57	1.14, 0.57	1.20, 0.66
$P^{1+2}_{AC}, Q^{1+2}_{AC}$	1.53, 0.47			1.83, 0.17		
P^1_{BH}, Q^1_{BH}		1.40 0.65	1.15, 0.79		1.62, 0.98	1.70, 1.16
P^2_{BH}, Q^2_{BH}		1.25, 1.07	1.00, 1.18		1.31, 0.80	1.39, 0.88
P^{1+2}_{BH}, Q^1_{BH}	1.67, 1.26			1.74, 0.61		
P^{1+2}_{BH}, Q^2_{BH}	1.67, 0.06			1.74, 0.43		

Table 3. Price and output in each market as a result of competition and alliance

In the asymmetric case, the total traffic volume as a result of Cournot competition when demand shifts upward by 10% is 4.47, and even if we assume that the market demand curve does not shift upward, the traffic volume is 3.90. On the other hand, the total traffic volume as a result of the strategic alliance is only 3.38,despite the fact that a new market A-C is created. The weighted average price is 1.42 as a result of Cournot competition with a 10% increase of the intercept of the demand curve, while it is 1.44 as a result of alliance. The average price level of the Cournot case is slightly lower than that of the alliance case, but if the output increases significantly, the consumer surplus would apparently increase through competition.

What then, would be the status of the total economic welfare? In order to examine this, this section derives the total economic welfare (W^j) using the following formula:

$$W^j = \pi^{1j} + \pi^{2j} + \sum_{i=1}^{6} CS_i^j \quad \left(i = AH,\ AB,\ BH,\ HC,\ BC,\ AC \quad j = AL,\ Cr \right)$$

where CS_i^j is the consumer surplus of each market. This is easily computed, since this paper assumes a linear demand function.

In both the asymmetric and almost symmetric cases, the total economic welfare from Cournot competition (W^{Cr}) is always greater than that from strategic alliance (W^{AL}) regardless of the degree of economies of density, as long as the intercept of the market demand curve shifts upward by more than 10.8%. If the demand curve shifts upward by less than 10.8%, whether or not W^{Cr} is greater than W^{AL} is dependent on the degree of economies of density. The more effective the operation of the economies of density, the more likely it is that $W^{Cr} > W^{AL}$. In this case, it might happen that two firms engage in Cournot competition even though strategic alliance generates greater economic welfare. Such a case might occur when the economies of density is small (around 0.275-0.285). In this case, it might be better for the government to recommend that the two firms agree on a strategic alliance, although this case might happen less frequently than that in which

$\pi^{1Cr} > \pi^{1AL}$, $\pi^{2Cr} > \pi^{2AL}$ and $W^{Cr} > W^{AL}$ occur simultaneously.

4. Summary of Findings

The present theoretical analyses have revealed the following.

(1) When two firms are of almost symmetric structure, the low-cost airline (Firm 2) will consistently prefer Cournot competition, while the high-cost airline (Firm 1) might not do so, unless the market demand curve shifts upward very significantly that is, by more than 21%.

(2) When two firms are of asymmetric structure, the high-cost airline (Firm 1) will consistently prefer Cournot competition, while the low cost airline (Firm 2) might be reluctant to do so. However, if the market demand curve shifts upward by 8.4% due to advertisement by the low-cost carrier, the low-cost airline will also prefer to compete. Therefore, Cournot competition will be more likely to occur when the two firms are of asymmetric structure than when they are of almost symmetric structure. This result is consistent with the discussions by Schmalensee (1987) and Mason and Nowell (1992).

(3) In both cases, the low-cost airline would invest in advertising very aggressively to defeat its rival only when it can bind its own customers. If it fails to bind them, the low- cost airline would not invest on advertising very aggressively because the investment would decrease its profit.

(4) The situation in which $\pi^{1Cr} > \pi^{1AL}$, $\pi^{2Cr} > \pi^{2AL}$ and $W^{Cr} > W^{AL}$ is likely to occur as long as the advertising investment of the low-cost airline pushes the market demand curve upward by more than

10.8%. However, when the degree of economies of density is sufficiently small, it might happen that two firms engage in Cournot competition even though a strategic alliance would generate greater economic welfare. Therefore, the degree of economies of density is the key factor to which the government should attend.

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References

Berry, S. T., 1992, “Estimation of a Model of Entry in the Airline Industry,” *Econometrica* Vol.60 No.4, 889-917.

Brander, J. A., and A. Zhang, 1990, “Market Conduct in the Airline Industry: An Empirical Investigation,” *RAND Journal of Economics* Vol.21 No.4, 567-83.

Brander, J. A., and A. Zhang, 1993, “Dynamic Oligopoly Behaviour in the Airline Industry,” *International Journal of Industrial Organization* 11, 407-35.

Bresnahan, T. F. and P. C. Reiss, 1990, “Entry in Monopoly Markets,” *Review of Economic Studies* 57, 531-53.

Bresnahan, T. F. and P. C. Reiss, 1990, “Entry and Competition in Concentrated Markets,” *Journal of Political Economy* Vol.99 No.5, 977-1009.

Brueckner, J. K. and P. T. Spiller, 1991, “Competition and Mergers in Airline Networks,” *International Journal of Industrial Organization* Vol.9, 323-42.

Brueckner, J. K., N. J. Dyer and P. T. Spiller, 1992, ”Fare Determination in Airline Hub-and Spoke Networks”, *RAND Journal of Economics* Vol. 37, 309-33.

Caves, D. W., L. R. Chistensen, and M. W. Tretheway, 1984, “Economies of Density versus Economies of Scale: Why Trunk and Local Service Airline Costs Differ,” *RAND Journal of Economics* Vol.15 No.4, 471-89.

Dresner, M., J.S.C. Lin, and R. Windle, 1996, "The Impact of Low Cost Carriers on Airport and Route Competition,” *Journal of Transport Economics and Policy*, Vol. 30, No.3, 309-27.

Gillen D. W., T. H. Oum and M. W. Tretheway, 1990, “Airline Cost Structure and Policy Implications: A Multi-Product Approach for Canadian Airlines,” *Journal of Transport Economics and Policy* Vol.24 No.1, 9-33.

Hendricks, K., and G. Tan, 1997, “Entry and Exit in Hub and Spoke Networks,” *RAND Journal of Economics* Vol.28 No.2, 291-303.

Khanna, T., R. Gulati, and N. Nohria 1998, "The Dynamics of Learning Alliance: Competition, Cooperation, and Relative Scope," *Strategic Management Journal*, Vol.19, 193-210.

General Accounting Office (US).1995, *International Aviation: Airline Alliances Produce Benefits, but Effect on Competition is Uncertain*.

Mason, C.F., O.R. Phillips, C. Nowell, 1992, "Duopoly Behavior in Asymmetric Markets: An Experimental Evaluation," *The Review of Economics and Statistics*, Vol.LXXIV, 662-70.

Morrison, S. A. and C. Winston, 1987, “Empirical Implications and Tests of the Contestability Hypothesis,” *Journal of Law and Economics* Vol.30, 53-66.

Morrison, S. A. and C. Winston, 1996, Causes and Consequences of Airline Fare Wars”, *Brookings Papers* (Microeconomics), 84-123.

Morrison, S. A. and C. Winston, 1995, *Evolution of Airline Industry*, Brookings Institution, Chapter 4.

Oum, T.H., and J.H. Park, 1997, “Airline Alliance: Current Status, Policy Issues, and Future Directions,” *Journal of Air Transport Management*, V.3, NO. 3, 133-144.

Oum, T.H. J.H. Park, and A. Zhang, 2000, *Globalization and Strategic Alliance: The Case of the Airline Industry*, Pergamon, 7-118.

Park, J. H., 1997, The Effect of Airline Alliance on Markets and Economic Welfare,” *Transportation Research* Part E, Vol.33, No.3, 181-95.

Park, J. H. and A. Zhang ,1998, “Airline Alliances and Partner Firms' Outputs,” *Transportation Research* Part E, Vol.34 No.4, 245-55.

Schmalensee, R. ,1987, "Competitive Advantage and Collusive Optima," *International Journal of Industrial Organization* 5, 351-67.

Singh, N. and X. Vives, 1984, “Price and Quantity Competition in a Differentiated Duopoly,” *RAND Journal of Economics* Vol. 15 No.4, 547-54.

Tirole, J.,1988, *The Theory of Industrial Organization*, MIT Press, Chapter 8.

Windle, R. and M. Dresner ,1999, “Competitive Responses to Low Cost Carrier Entry,” *Transportation Research* Part E Vol.35 No.1, pp.59-75.

Zhang, A. 1996, “An Analysis of Fortress Hubs in Airline Networks,” *Journal of Transport Economics and Policy* Vol. 30 No.3, 293-307.