On The Choice between Strategic Alliance and Merger in the Airline Sector: The Role of Strategic Effects

by

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Abstract: We consider a market with three competitors, two of which need to cooperate in order to be able to enter this market. Firms first choose capacity under demand uncertainty then compete in quantities after the uncertainty has been resolved. We specify strategic alliance (SA) as an agreement where two airlines jointly choose capacity and divide it equally among themselves. Contrary to the full merger case, after demand is revealed the alliance members market their capacity shares independently. Our main result is that the profit of the cooperating firms is greater under SA than under full merger.

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1. Introduction

In recent years, increased cooperation among airlines has been a major trend in the air transport sector. Full mergers, code-sharing agreements and block-seat sales are examples of the variety of cooperation forms that have been used by airlines. The need for cooperation arises mostly from the desire of major airlines a) to offer a global service, b) to increase service quality, c) to exploit size economies, and d) to gain market power.4

In this paper we admit from the outset that, for some of or all the above reasons cooperation is desirable and ask why in many instances it may take the form of strategic alliance (SA) rather than that of full merger. By SA we mean situations of partial cooperation, where firms cooperate on some decisions but act as competitors on others. SA formation is usually attributed to i) regulations preventing foreign airlines for providing domestic services or owning national carriers, and ii) the fact that “the investment required to develop an efficient global service network is perhaps prohibitively large, even for major airlines”.5 While considering the above factors as being very important, we show that strategic reasons may also enhance the desirability of SA.

We consider a market with three competitors, two of which need to cooperate in order to be able to enter this market. Firms first choose capacity then compete in quantities. Capacity being a longer run decision it is taken under uncertainty over the state of demand while the seat sales decision is taken after the demand state has been revealed. We specify SA as an agreement where two airlines jointly choose capacity and divide it among themselves according to some rule.6 Contrary to the full merger case, after demand is revealed the alliance members market their capacity shares independently. Our main result is that the profit of the cooperating firms is greater under SA than under full merger.

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4 According to Oum et al. (2000) cooperation allows i) expansion of seamless service networks (i.e., avoid changing airline); ii) traffic feed between partners; iii) cost efficiency (economies of scale, scope and traffic density); iv) increased service quality; v) marketing advantages (pooling of frequent flyer programs, CRS display)
5 Oum et al. (2000).
6 The alliance described in this paper is closer to block seat sales agreements rather than to code sharing agreements.
As is well known, in a Cournot triopoly a two-firm merger, while it succeeds in increasing the price, it turns out to be detrimental for the profit of the merged firms. By internalizing part of the effect a firm’s quantity decision has on rival profits, the merged entity sets its quantity more prudently (the price goes up). At the same time, this attitude induces a more aggressive reaction from the third firm and results in market share losses for the merged firms.7

When the decision to merge is taken before capacity choices it has two strategic effects on the quantity choices: a) through capacity choices and b) directly. When instead of merger the cooperating firms form a SA then the latter effect disappears, since for given capacity choices they will act as aggressively as the third firm. While this change in attitude is of little importance when the cooperating firms are capacity constrained, it becomes important in low demand states where capacity is not binding. In those states the SA members will market their capacity more aggressively and, as a result, as capacity becomes binding they wish to have more. This in turn implies that in the capacity stage, the SA’s reaction function is located outwardly relative to the reaction function of the merged entity. While the cooperating firms still make less profit than their independent rival, they do much better forming a SA than merging. Obviously, when joining forces implies cost reductions the cooperating partners’ profit may be larger than that of the third firm, despite the aforementioned disadvantageous strategic effect. If SA and merger confer similar cost reductions, the former becomes the first best solution in terms of profit maximization.

The existing literature on airline strategic alliances is not enormous. Park (1997) and Oum, Park and Zhang (2000) analyze the effect of airline alliances on traffic levels, fares, and welfare. The analysis is based on the distinction between complementary and parallel alliances, the former referring to cases where firms link up their existing networks to build a larger one, while the latter referring to collaboration between firms competing on the same routes. They show that complementary alliances are likely to increase welfare while parallel alliances to decrease it.

7 See Salant et al. (1983) and Tirole (1989). While the merger succeeds to increase price, the market share losses of the participating firms are sufficiently large to counterweight any such benefits. In strategic terms, the merged firms adopt a soft attitude (“fat cat”) while competition takes place in strategic complements.
Brueckner (2001) analyzes the same issues distinguishing two types of markets, the *inter-hub* and the *interline* markets, where a passenger needs to use two companies in order to complete his trip, even in the pre-alliance situation. It shows that an alliance tends to reduce fares in the interline markets while at the same time tends to increase them in the inter-hub market, due to reduced competition. It also suggests that the positive effects of alliances may outweigh any negative impacts.

Flores-Fillol and Moner-Collonques (2004), examines whether airlines that employ the same hub have an incentive to create an alliance. It concludes that complementary alliances are profitable only for a sufficient degree of product differentiation. Competing alliances may, however, be formed as prisoner’s dilemma outcome even when product differentiation is not enough.

In all the papers presented above, alliance is treated as equivalent to merger, hence the question of why alliance and not merger is completely evacuated. Considering alliance as a joint venture for an intermediate product, Morash (2001) shows how contractual terms about transfer prices and profit sharing may serve as an appropriate commitment device yielding the alliance Stackelberg-like leadership advantages over the outside firms. Chen and Ross (2003) studies input joint ventures as well and shows that they can replicate the effects of a full-scale merger. In this paper strategic effects towards outsiders are not considered.

Section 2 presents the model, section 3 and 4 present the main results and section 5 concludes.

2. The Model

Let us have two cities A and B. The air-transport market between them (market AB) is currently served by a single carrier, airline 3. Airlines 1 and 2 connect a third city H to cities A and B, respectively, according to the map presented in figure 1. Airlines 1 and 2 contemplate entry into the AB market which can be obtained either independently, or through collaboration. We assume here that regulation prevent each of these airlines from putting capacity on the segment is currently not serving. Hence, collaboration is for them the only way to enter the AB market, and this can be done in two ways. First, airlines 1 and 2 merge and the emerging company, airline $M$, competes against airline 3.
Second, airlines 1 and 2 create an SA: each carrier continues flying only on its segment and buys capacity from its partner in order for its passengers to complete their flight between A and B. SA differs from merger in that the partners join forces only in deciding the choice of total capacity and its allocation between them. Once individual capacities are decided, the two partners become rivals in selling AB tickets.

The three carriers are players in a three-stage game. At stage 1, firms 1 and 2 decide on the nature of their relationship: merger or SA. At stage 2, firms make their capacity choice. Whether merger or SA, firms 1 and 2 make their capacity decisions jointly. Stages 1 and 2 are played under demand uncertainty. At stage 3 the demand state is revealed and firms compete in quantities, with potentially binding capacity constraints.

To keep the analysis tractable a) we assume the demand on AB to be \( P = \alpha - Q \), where \( P \) is price, \( Q \) is total quantity and the parameter \( \alpha \) follows a uniform distribution on the support \([0,1]\); b) local traffic, AH and BH, is ignored; c) we rule out any product differentiation among airlines.\(^8\)

On the cost side, we assume that the capacity costs supported in stage 2 are the only cost element. Hence, the marginal cost associated with serving an extra passenger in stage 3 is zero up to capacity. This is consistent with the observation that, in the airline industry, most of the operating costs are associated with offering a seat rather than serving a passenger.\(^9\)

Concerning the capacity cost, we introduce a very simple structure that allows us to focus on demand and strategic considerations. We assume that: i) all airlines face similar cost; ii) the per unit capacity cost (i.e. the cost of offering one seat) is independent of the number of seats carried on a route and equal to \( c \), \( 0 < c \leq \frac{1}{2} \), on the AB link.\(^{10}\) The first assumption is rather standard, the second rules out economies of traffic density and imposes the same cost for carrying a passenger from A to B directly or through H.

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\(^{8}\) This is done in order to isolate the effects under study from those due to product differentiation. Notice that the assumption of airline 3 flying AB directly (which could be an important advantage in quality, as any traveler only knows too well) is only made in order to simplify notation. One could equally assume that airline 3 flies through another city, or even through H, since local traffic is ignored.

\(^{9}\) In other words, once a seat has been added to capacity, its cost is the same whether a passenger flies on it or not. The analysis could easily be extended to include a positive marginal cost in stage 3.

\(^{10}\) This implies that the cost of offering a seat on the AH or BH segments is \( c/2 \).
Finally, we restrict $c$ to values below $\frac{1}{2}$ to rule out the trivial case where the market AB is never served in equilibrium.\footnote{Obviously, if $c>\frac{1}{2}$ capacity costs in the AB exceed the maximum expected revenue from that market.}

3. The Case of Merger

Airlines 1 and 2 form a single entity $M$, that chooses total capacity as well as quantity. The game examined in this section is a two-stage duopoly between symmetric airlines, $M$ and 3.

Lemma 1: When airlines 1 and 2 merge, $K_M^M = K_3^M = \left(1 - 2\sqrt{c}\right)/3$, while

$$\Pi_M^M = \Pi_3^M = \left(1/27\right)(1 - 6c + 4\sqrt{2} \cdot c^{3/2}).$$

Proof: Let us assume that both players have already chosen capacities with $K_i \leq K_j$, $i, j = M, 3$ $i \neq j$. Define $\alpha_{1M} = 3K_i$, $\alpha_{2M} = K_i + 2K_j$. There are three possibilities according to the realization of $\alpha$. First, when $\alpha \in \left(0, \alpha_{1M}\right]$ (the demand is very low) none of the firms is constrained. The Cournot solution is $q_i = q_j = a/3$, $p = \alpha/3$. Second, when $\alpha \in \left(\alpha_{1M}, \alpha_{2M}\right]$ (intermediate demand states) firm $i$ is constrained while its rival is not. The Cournot solution is $q_i = K_j$, $q_j = (\alpha - K_j)/2$, and $P = (\alpha - K_j)/2$. Third, when $\alpha \in \left(\alpha_{2M}, 1\right]$ (high demand states) both firms are constrained with $q_i = K_i$, $q_j = K_j$, and $P = a - K_i - K_j$. Hence, at the first stage firm $i$ maximizes

$$E\left(\Pi_i\right) = \int_0^{\alpha_{1M}} \frac{\alpha^2}{9} d\alpha + \int_{\alpha_{1M}}^{\alpha_{2M}} \left(\frac{\alpha - K_i}{2}\right) K_j d\alpha + \int_{\alpha_{2M}} \left(\alpha - K_i - K_j\right) K_i d\alpha - cK_i$$

while its rival maximizes:

$$E\left(\Pi_j\right) = \int_0^{\alpha_{1M}} \frac{\alpha^2}{9} d\alpha + \int_{\alpha_{1M}}^{\alpha_{2M}} \left(\frac{\alpha - K_i}{2}\right)^2 d\alpha + \int_{\alpha_{2M}} \left(\alpha - K_i - K_j\right) K_j d\alpha - cK_j.$$ 

It is straightforward to show (proof available by the authors) that the only equilibrium involves the symmetric capacity choices and profits described in the lemma, QED.
There is no much to comment on the merger case. Each of the merged firms 1,2, collects half the duopoly profit. Since the two firms act in a fully coordinated manner, the way they split capacity, hence profits, is irrelevant for the market outcome.

4. The Case of Strategic Alliance

In this section firms 1 and 2 form a strategic alliance defined as an agreement where partners a) jointly choose capacity in order to maximize total expected profit, b) share this capacity equally among themselves,\(^{12}\) c) market their capacity share independently. This implies that market structure in the third stage is triopoly, potentially asymmetric. It also implies that the way the chosen capacity is distributed between cooperating airlines affects market outcome. We start by assuming an equal distribution of the alliance capacity among the alliance members.

**Lemma 2:** When airlines 1 and 2 form a strategic alliance, unless \(c\) is too small (i.e., \(\forall c > 0.0006\)),

\[
K^A_A = \frac{1}{4} \left( 2 - 2c^{1/4} \cdot \sqrt{2} + 2.5\sqrt{c} + \sqrt{2c} \right),
\]

\[
K^A_3 = \frac{1}{8} \left( 2 + 2c^{1/4} \cdot \sqrt{2} + 2.5\sqrt{c} - 5\sqrt{2c} \right),
\]

while

\[
\Pi^A_A = \frac{1}{24} \left[ 1 - 3c + \sqrt{2} \cdot c^{3/2} + \left( \sqrt{2c} - 1 \right) \sqrt{2} + 5\sqrt{c} \cdot c^{3/4} \right],
\]

and

\[
\Pi^A_3 = \frac{1}{48} \left[ 1 - 3c + 22\sqrt{2} \cdot c^{3/2} - \left( 3\sqrt{2c} + 1 \right) \sqrt{2} + 5\sqrt{c} \cdot c^{3/4} + 3\sqrt{2c} \right].
\]

Proof: Since we have assumed a 50% capacity-sharing rule among alliance members, \(K_1 = K_2 = K_A/2\). We need to examine two cases according to whether \(K_A \leq 2K_3\) or \(K_A \geq 2K_3\). We only present the former since it turns out to be the only equilibrium. Therefore, as \(\alpha\) increases, each alliance partner becomes capacity constrained before the outside firm. Define \(\alpha_{1,A} = 2K_A\), \(\alpha_{2,A} = K_A + 2K_3\), which divide the realizations of \(\alpha\) into three zones analogous to those in the merger case. At the first stage, the alliance chooses its capacity maximizing

\(^{12}\) We currently work on the role of sharing rules. Preliminary results show that the equal sharing rule yields the highest profit.
\[ E(\Pi_3) = \int_0^{\alpha_{2,4}} \int_0^{\alpha_{2,4}} \left( \frac{\alpha - K_A}{2} \right) K_A d\alpha + \int_0^{\alpha_{2,4}} \left( \frac{\alpha - K_A - K_3}{2} \right) K_3 d\alpha - cK_A \]  

while the outside firm maximizes

\[ E(\Pi_3) = \int_0^{\alpha_{2,4}} \int_0^{\alpha_{2,4}} \left( \frac{\alpha - K_A}{2} \right)^2 d\alpha + \int_0^{\alpha_{2,4}} \left( \frac{\alpha - K_A - K_3}{2} \right) K_3 d\alpha - cK_3 \]  

Solving the system of first order conditions yields the expression in the lemma. Notice that \( \forall c \leq 0.0006 \) the second order conditions for the maximization of (5) are not met, which creates a discontinuity in the reaction function of firm 3. We simply ignore this case since it has no special interest, QED.

With the two lemmata at hand, we proceed to show

**Proposition 1:** A strategic alliance is preferable to merger as a means for the participating firms to enter the AB market, while the outside firm prefers that its competitors merge; i.e., \( \forall c \in (0.0006, 0.5] \), \( \Pi_A^d \geq \Pi_M^M \) and \( \Pi_3^d \leq \Pi_3^M \).

**Proof:** First we compute the \( \Pi_A^d - \Pi_M^M \) difference for all the admissible values of \( c \). The results are reported in figure 2, which shows that \( \forall c \in (0.0006, 0.5] \), \( \Pi_A^d \geq \Pi_M^M \).

Similarly, figure 3 reports the \( \Pi_3^d - \Pi_3^M \) difference, which is positive \( \forall c \in (0.0006, 0.5] \), QED.

The intuition behind the results in proposition 1 is straightforward. Cooperation allows entry into the AB market, but at the same time makes the last stage reaction of the joining partners softer, thus yielding market shares to the outside firm. To see this clearly let first \( K_A = K_M = K_{12} \), so \( \alpha_{1,M} = \alpha_{1,A} = \alpha_1 \), and compare profits in demand states where neither the alliance nor the merged firm are capacity constrained. From the first integrals in (2) and (4) it is obvious that the alliance performs better in terms of partner’s profits. This happens since \( \forall \alpha \in [0, \alpha_1] \) capacity choices are irrelevant and the allied partners behave like unconstrained Cournot triopolists. We find, therefore, the well know result of Salant, *et al.* (1893): when firms compete in strategic substitutes a merger reduces the total profit of the participating firms. Hence, preferring alliance to merger
has a first strategic effect related to third stage outcome and stemming from low demand states.

Now assume also that whether merger or alliance the outsider’s capacity is fixed at \( K_3 = \bar{K}_3 \). It is easy to see that

\[
\frac{\partial E(\Pi_s)}{\partial (K_s)}\bigg|_{K_1, K_3} = \frac{2\alpha^i}{8} > \frac{2\alpha^i}{9} = \frac{\partial E(\Pi_u)}{\partial (K_u)}\bigg|_{K_1, K_3}.
\]

In other words, preferring alliance to merger increases the cooperating firms’ marginal profit due to capacity and pushes their second stage reaction function outwards. This implies that \( K^A_M > K^M_M \) and \( K^A_3 < K^M_3 \). Figure 4 reports the \( K^A_A - K^M_M \) difference and shows that it is positive for all the admissible values of \( c \). This means that the alliance’s total capacity exceeds that of the merged firm, therefore, whenever constrained, the alliance partners have in total a larger market share than their merger counterpart. This holds true independently of whether the outside firm is capacity constrained.

5. Conclusion

Using a simple model we have shown that, in the presence of demand uncertainty airline alliance dominates merger in terms of profits as a form of cooperation. Strategic alliance is therefore not necessarily a second best solution justified by regulation limiting airline mergers. Also the effect underlines in this paper could explain the recent strategy by Air France and KLM in trying to maintain some independence despite their recent “merger”.13 Obviously, it remains to be verified if a strategic alliance allows the same type of cost synergies than a full merger.14

Two useful extensions of our analysis are currently under investigation. The first investigates whether some unequal division of capacity among alliance members yields higher total profits. Preliminary results show this not to be the case and the 50% rule adopted in the previous analysis to be the joint profit maximizing agreement. The second

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13 This strategy has been coined “one group, two airlines”.

14 Note that it is not clear that the merger necessarily performs better in that respect than the SA. Indeed, suppose that economies of aircraft size are the main source of cost saving associated with cooperation between airlines (i.e. the per-unit capacity cost is decreasing with the level of capacity). In this case, the strategic advantage of the SA could very well be reinforced since the alliance chooses more capacity than the merged entity and most importantly it creates an asymmetry with the rival. Also, consider, for instance, that the three airlines are somewhat differentiated, and the uncertainty that they face contains an idiosyncratic component. If airline 1’s idiosyncratic uncertainty is not perfectly correlated with that of firm 2, forming a strategic alliance allows the two airlines to reduce the cost of holding excess capacity, like in Barla and Constantinatos (2000).
allows for \( n > 3 \) airlines and investigates whether the results of this paper hold for all \( m \)-firm cooperation case with \( 2 \leq m \leq n \).\(^{15}\)

\(^{15}\) We are also examining the impact of explicitly including local traffic (AH and BH).
References


**Figures**

Airline 1 | Airline 2
---|---
A | H | B
Airline 3

**Figure 1:** The network configuration

**Figure 2:** The $\Pi_A^A - \Pi_M^M$ difference for all admissible values of $c$. 
**Figure 3:** The $\Pi^A_3 - \Pi^M_3$ difference for all admissible values of $c$.

**Figure 4:** Total industry profit difference $(\Pi^A_A + \Pi^A_3 - 2\Pi^M_M)$ for all admissible values of $c$.

**Figure 5:** The second order condition at the admissible root
**Figure 6:** The alliance maximum profit for all the admissible values of $c$. (The upward sloping part corresponds to the problematic region of very small $c$’s in Figure 4).