Did the Entry
of Low Cost Companies Foster
the Growth of Strategic Alliances
in the Airline Industry?

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We adopt a vertical differentiation model to study the effect of deregulation in the airline industry. In particular, we show that traditional carriers form international alliances on hub-and-spoke networks to compete against low cost companies, which successfully serve short haul routes at relatively cheap prices. The alliance is profitable if the gain in terms of economies of density is sufficiently high and consumers' utility is not significantly decreased by the indirect connection. Social welfare is also evaluated: we find interval regions where the alliance is welfare enhancing, even if it is not convenient for existing flag carriers. [JEL Classification: L29, L93].

1. - Introduction

1.1 *Stylized Facts*

In this paper we analyse whether flag carriers have incentives to form international strategic alliances as a reaction to the competitive pressure from low cost companies on point-to-point

routes. Also, we draw some conclusions on the private and social desirability of international airline alliances created along hub-and-spoke networks.

The deregulation of the air transport system, which took place in the US at the end of 1970's and in Europe during the 1990's, paved the way for the entrance of new competitors, the so called low cost companies. These companies, using a combination of managerial strategies and entrepreneurial talent, reduced significantly the cost of operating flights and gained growing point-to-point market shares at the expenses of existing carriers (Boguslaski *et* al., 2004; Piga C.A. and Filippi, 2002). Their business model was mainly based on serving short haul routes and selling electronic tickets, thus avoiding travel agents and computer reservation system (CRS) fees. Furthermore, many of them established their core activity in relatively cheap secondary airports, whose traffic load increased significantly.

Immediately after the deregulation traditional flag carriers, whose main focus was on the segment of business travellers, were not affected by the competitive pressure from low cost airlines. They did not consider the newcomers as direct competitors, as they were supposed to attract only leisure travellers. Yet, as the number of business travellers using low cost carriers increased rapidly, traditional carriers reacted. First, they improved the quality of the flight service, given that the use of main and expensive airports and the existing wage structure prevented them from saving on costs. Then, they reinvented their own business model by providing almost the same service level at drastically reduced cost (Franke, 2004). Finally, as both strategies failed, traditional carriers, facing the serious risk of being wiped out of the market, decided to develop synergies and intertwine their services by forming *strategic alliances*.

The first international alliance emerged in 1986: Air Florida and British Island decided to link up partially their networks to feed traffic to each other on the London-Amsterdam route. Since then, many alliances have been formed. Initially, most of them involved European and North American companies. During the 1990's, Asia Pacific and Latin American airlines joined these

alliances. In 1997 United, Lufhtansa, SAS, Air Canada, Varig and Thai International formed the first global alliance, the so-called STAR alliance. In 1999, American Airlines, British Airways, Canadian Airlines, Qantas and Cathay Pacific formed the oneworld Global Alliance. Since then, these two global alliances have expanded as new members joined.

Strategic alliances are attractive because they generate efficiency gains by exploiting economies of scale and scope or density, thereby reducing the cost of producing the flight service:

"Economies of scale can be achieved if, holding network size constant, a partner is able to serve the same amount of traffic at a lower cost. Shared use of airport facilities and ground staff, cooperative advertising and promotional campaigns, joint procurement of fuel and amenities, combined development of computer systems and software, and mutual handling of baggage transfers and passengers check-in are some ways that alliances will result in economies of scale [...]. Economies of scope can, also, be exploited if alliance carriers join their existing networks and by that provide efficient connecting service to new origin-destination markets" (Oum *et* al., 2000, page 13).

A crucial element of the alliance is the use of the *hub-and-spoke* system instead of the previously adopted *fully connected system*. By conveying all passengers into the hub, the hub-and-spoke network generates high traffic densities on the spoke routes, yielding lower cost per passenger (Brueckner *et* al., 1992; Morrison and Winston, 1986 and 1995; Brueckner and Pels, 2005). In this way, traditional carriers succeed in extending their network without operating additional flights; they entered into new markets which were either not profitable to operate on their own or where they lacked the right to do so.

In 1999 the U.S. Department of Transportation started an analysis on the main effects of alliances in the air transport sector and gathered a series of empirical data on four markets: *(i)* Behind-Beyond market: travelling from interior US cities via a US gateway to European interior cities via an European gateway; *(ii)* Behind-

Gate market travelling from interior U.S. cities via a US gateway to an European gateway; *(iii)* Gate-Beyond market: travelling from a U.S. gateway city to European interior cities via an European gateway; and *(iv)* Gate-Gate market travelling from a U.S. gateway to an European gateway city. It emerged that traffic growth rates of alliance carriers in all four of these markets were significantly higher than those of non-alliance carriers. Further, and more interestingly for the purpose of this paper, the market with the highest traffic growth rate was the Behind-Beyond market. This means that several short-haul routes connecting interior points of both Europe and US strongly benefit from the alliances networks, as they are involved in inter-continental connecting traffic. That is to say that several *domestic* routes can be profitable served thanks to alliances linking *inter-continental* markets.

Notwithstanding the convincing evidence of a relation between the entry of low cost firms and the growth of international strategic agreements among traditional airlines, scanty attention has been paid by mainstream literature to this issue. Most of the existing works is primarily concerned with the effects of strategic alliances on ticket pricing, flight frequency and welfare (see Oum and Park, 1997; Pels, 2001; Park *et* al., 2001).[1]

1.2 *Our contribution*

Although there exist many reasons as to why airlines form strategic alliances, in the present paper we focus on a different, and quite surprisingly neglected, explanation: an alliance can be a reaction to competition by low cost carriers. Indeed, by successfully linking airline partners' network, a carrier can feed traffic, increase the load factor and get accessibility to thin routes. Thus, by pooling services, members of alliances can compete with low cost firms on routes which would be otherwise unprofitable.

More precisely, the model that we adopt allows to *(i)* analyse whether the alliance really helps existing flag carriers to compete

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[1] Empirical investigation includes Brueckner J.K. and Whalen W. (1998) and Park J. and Zhang G. (2000), *inter alii*.

with low cost airlines on point-to-point route; *(ii)* evaluate the impact of such alliance on social welfare, taking into account consumers' perception of the hub-and-spoke connection.

We consider as a benchmark case a pre-deregulation scenario where two traditional carriers — the incumbents — act as monopolists on their respective routes in a three-city fully connected environment. Then we introduce deregulation and evaluate the effects of the entry of a low cost company — the entrant — in one domestic market. We highlight the profit loss that one of the incumbent suffers on that particular route, due to the competitive pressure by the entrant, while social welfare obviously increases. Finally, we verify whether traditional carriers have incentives to form a strategic alliance to recoup the profit loss suffered in the domestic market and evaluate social welfare.[2]

The main theoretical feature of the model is the introduction of vertical product differentiation, given that flight services can have different quality depending on aircraft's seat density, provision (or not) of food and beverages during the flight, time schedule, stopping at the hub and so on.[3] We verify that, in absence of competitive pressures, traditional flag carriers provide only one type of service for consumers, thus explaining the relative scarcity of vertical differentiation prior to the deregulation. Further, when the low cost carrier enters the market, it is still optimal for the incumbent to serve travellers with only one quality, thereby excluding a variants proliferation strategy. Traditional companies may react to the competitive pressure of low cost companies by forming alliances, and our model allows to represent such option.

Depending on the degree of commitment between member companies, alliances can be distinguished in route-by-route alliances, broad commercial alliances and equity alliances. We consider a broad commercial alliance, which is the most common

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[2] For instance, in the 1990's Quantas and Air Vanuatu formed a code-share alliance on the Australia-Vanuatu route where neither carrier alone was able to provide a profitable service.

[3] One of the more recent contributions using vertical differentiation is that of Barbot C. (2006).

agreement between carriers: partners cooperate through coordination of flight schedule and ground handling, joint use of ground facilities, flight code-sharing, block seat sale, and joint advertising and promotion: in this way, they share the cost of the flight service, taking advantage of economies of scale and scope and higher traffic density. Air Canada-Lufthansa, Air Canada-United, Lufthansa-Thai are examples of broad commercial alliances. Further, alliances can be classified into complementary and parallel alliances. Complementary alliances are formed when carriers link up their networks in order to feed each other traffic; parallel alliances, on the contrary, induce collaboration among carriers that, before the alliance, competed on the same routes. The broad commercial alliance that we represent is a complementary one.

On these grounds, a crucial assumption of our paper is that the alliance, based on a hub-and-spoke system, allows members to exploit economies of scope/density from funnelling passengers through the hub. We show that it is profitable to form the alliance only in presence of relatively strong economies of density and when passengers are not excessively inconvenienced by the indirect connection. It follows that the incumbent may recover the profit loss in the domestic segment affected by the low cost company if it can *(i)* effectively reshape its cost structure and *(ii)* properly manage the connecting flight service on the international routes.

Our results are consistent with the analysis conducted by Oum *et* al. (2000) on complementary and parallel alliances. As far as the complementary alliance is concerned, they write: «Collaboration between partners is likely to improve the quality of their connecting services and to reduce the air fares of their connecting services. [...]. Since the partners funnel more connecting traffic to each other, they can further increase load factors on their origin-destination routes and thus reduce operating costs on those routes. Consequently, they can offer lower air fares to origin-destination passengers. Decreases in partner airlines' air fares in origin-destination markets will not only cause diversion of some existing passengers to the partners, but stimulate new demands for local

travels». (Oum *et* al., 2000, page 73). In the same analysis, using a database consisting of North Atlantic alliance route, empirical tests have been conducted to verify this theoretical rationale, which indeed has been confirmed.

We also evaluate social welfare and find parameter regions where the private and social incentives to form the alliance do not coincide. This happens when the gain for alliance members in terms of economies of scope is not very high. In this case, depending on the degree of inconvenience suffered by passengers using the indirect connection, two alternative situations emerge. As the price charged by the alliance is negatively correlated with the loss of utility, when passengers' utility significantly decrease, the alliance is privately not profitable but society at large would enjoy a higher welfare in presence of the alliance. On the contrary, when passengers are relatively not affected by the hub-and-spoke connection, the alliance is profitable for firms but not for society at large. Hence, depending on the loss of utility, the regulator should either provide incentives to form a welfare enhancing alliance when it is not privately convenient or block the proposed alliance if social welfare would decrease.

The paper is laid out as follows. The next section presents the basic model while Section 3 introduces the benchmark case where traditional flag carriers are monopolists in their respective routes. Section 4 considers the entry of the low cost company in one segment and the expected profit loss for the incumbent carrier. Section 5 analyses the incentive for existing carriers to form a strategic alliance by implementing a hub-and-spoke system and evaluate social welfare. Section 6 concludes the paper.

2. - The General Setup

We consider an airline industry which consists of three gateway cities labelled as *A, B* and *C*. *A* and *B* are located in Europe, while *C* is located in the US. Routes between these gateways are operated by an European carrier and an US carrier, say 1 and 2 respectively. We assume that the European carrier 1

serves the routes *AB* and *AC*, while the US carrier 2 serves the route *BC*.

The network is represented in Graph 1. In each route they serve, these carriers are allowed to provide travellers with two variants of the service — say *high-quality* variant *h* and *low-quality* variant *l*.

GRAPH 1

INITIAL NETWORK STRUCTURE
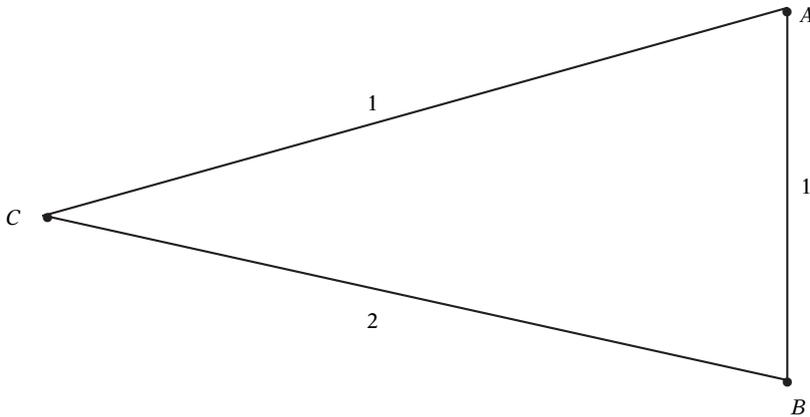
What we mean by difference in quality in the airline sector is the provision of different flight services. It follows that the distinction between economy and business class is not taken into account, as it represents an attempt to price discriminate within the same flight service.

Qualities are set previously to the game, and so they are exogenous variables. The cost of providing the two variants is fixed and denoted by K_h and K_l respectively, with $K_h > K_l$. Barla and Constantatos (2000) and (2005) assume that all airlines face a similar cost structure and that the cost of offering one seat does not depend on the number of seats carried on a route. We follow them and assume then that the cost of offering a flight service is only linked to the quality while it does not depend on the number of seats. Although this assumption is not entirely realistic, it allows

us to focus on strategic considerations and to capture the essential difference between the two types of service available.[4]

The demand model is directly inspired by traditional models of vertical product differentiation (see Mussa and Rosen, 1978; Gabszewicz and Thisse, 1979; Shaked and Sutton, 1982). Travellers are uniformly distributed with density equal to 1 over the interval [0,1]. The utility traveller $\theta, \theta \in [0,1]$ derives from buying at price p_i the variant i, $i \in \{h,l\}$, writes as follows

(1) $U = \theta\beta u_i - p_i$

where u_i and p_i refer to the quality and the price of the service i, respectively.

The additional parameter $\beta, \beta \in [0,1]$ introduces the difference in quality between fully connected and hub-and-spoke services. When $\beta = 1$ passengers are served by a fully connection, while $\beta < 1$ indicates the presence of a hub-and-spoke service which entails a loss of utility for consumers. So, if $\beta < 1$ the attractiveness of flying in terms of travel time lost for reaching the ending-point decreases. Traditionally, it is assumed that the full price paid by travellers consists of the ticket price and the non-ticket cost. The non-ticket cost derives from the difference between the desired time and the actual time of departure, namely the total time of flight including stops at hubs and so on. In our vertically differentiated model, we depart from using the full price and introduce the parameter β. While it does not affect consumers' attitude toward flying in the case of fully connected flights (as for fully connection $\beta = 1$), it has a strong impact on travellers' willingness to pay for flying in case of a hub-and-spoke system. Furthermore, when the hub-and-spoke system requires the combination of different carriers to connect spokes through the hub, it is likely that consumers experience a higher loss of time and suffer from additional inconveniences, such as an increased probability of lost baggage, transfer delay at the connection point, etc.

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[4] One can alternatively think of $K_h = \bar{k} + k_h$ and $K_l = \bar{k} + k_l$, where the total cost includes a fixed cost of operating the flight, $\bar{k}$, plus an additional component representing the additional services which are provided, with $k_h > k_l$.

3. - The Air Transport Market Before the Deregulation

We start by analysing the air transport market before the deregulation process. This will serve as a benchmark case. Consider the two flag carriers which act as monopolists in their respective routes. They provide only fully connected services, as they are not allowed to establish inter-continental service networks.

We assume that passengers travelling in the route AC (BC) always choose the direct connection offered by carrier 1 *(2)*. Accordingly, the profit accrued by carrier 1 is the sum of the monopoly profits in AB and AC, while the profit accrued by carrier 2 consists only of the monopoly profit in BC.

In every route the carrier has to decide whether to provide only a single variant or both the high quality and the low quality service. As we consider here only fully connected flights, we normalize β to 1. We analyse generic carrier 1 but the corresponding analysis for carrier 2 can be easily derived by symmetry. The options available for the monopolist are: *(a)* to supply the market with both flight services h and l; *(b)* to supply the market with the high quality h; *(c)* to supply the market with the low quality l.

When only a variant i is marketed, marginal consumer is identified by $\theta_i = p_i/u_i$. Therefore, the demand function is:

$$(2) \qquad\qquad D_i(p_i) = (1 - \frac{p_i}{u_i})$$

The profit $\pi_i (p_i)$ accrued by the monopolist supplying this flight service is given by:

$$(3) \qquad\qquad \pi_i(p_i) = (1 - \frac{p_i}{u_i})p_i - K_i$$

Maximising with respect to p_i we get the optimal monopoly price, $p_i^M = u_i/2$. By substitution, one can easily verify that the demand for variety i is always positive. The optimal profit is

(4)
$$\pi_i^M = \frac{1}{4}u_i - K_i$$

Non-negativity of the above profit implies $K_i \leq u_i/4$. For future reference, $\bar{K}_i = u_i/4$ denotes the threshold value above which the carrier does not provide the service of quality i.

When both variants h and l are available for consumption at some instant, marginal consumers are identified by $\theta_h = (p_h - p_l)/(u_h - u_l)$ and $\theta_l = p_l/u_l$); demand functions write:

(5)
$$D_h(p_h, p_l) = (1 - \frac{p_h - p_l}{u_h - u_l}), \ D_l(p_h, p_l) = (\frac{p_h - p_l}{u_h - u_l} - \frac{p_l}{u_l})$$

where p_h and p_l are the market prices for variant h and variant l respectively, on the route that we consider.

Profit function $\pi_{h,l}(p_h, p_l)$ is then given by:

(6)
$$\pi_{h,l}(p_h, p_l) = (1 - \frac{p_h - p_l}{u_h - u_l})p_h + (\frac{p_h - p_l}{u_h - u_l} - \frac{p_l}{u_l})p_l - (K_h + K_l)$$

From the joint maximisation of *(6)* with respect to p_h and p_l we obtain the equilibrium prices $p_i^M = u_h/2$ and $p_l^M = u_l/2$. Replacing these prices in expression *(5)* we find that the demand for variety h is always positive, while the one for variety l is equal to zero. This anticipates the result of the comparison, indicating that the firm will provide only one type of service. In fact, substituting p_h^M and p_l^M in *(6)* yields the optimal profit:

(7)
$$\pi_{h,l}^M = \frac{1}{4}u_h - (K_h + K_l)$$

which is non-negative iff $(K_h + K_l) \leq u_h/4$.

We compare π_i^M and $\pi_{h,l}^M$ to prove that:

PROPOSITION 1: It is never profitable for the monopolist to provide both the high and the low quality flight service. In particular, when

$$\frac{1}{4}(u_h - u_l) \geq K_h - K_l$$

the optimal strategy for the monopolist is to supply the high quality variant, and *vice versa.*

PROOF. *See APPENDIX*

Two main indications derive from the above result. Firstly, in each route, *AB*, *BC* and *AC*, a carrier acting as a monopolist prefers to supply only one type of service. This provides a rationale for the relative scarcity of vertical segmentation prior to the deregulation of the sector. Secondly, the carrier opts for the high quality variant if the quality difference $(u_h - u_l)/4$ is large enough to cover the cost gap $(K_h - K_l)$. This happens when travellers enjoy such a high utility that the monopolist is able to charge a price that overcompensates the additional cost required to operate the high quality flight.

We compute social welfare, defined as the sum of profits and consumer surplus. In each segment, as we have demonstrated that the incumbent provides only one quality variant, profit is π_i^M as in *(4)*, while consumer surplus is given by:

$$(8) \qquad CS_i^M = \int_{\theta_i}^{1} (\theta u_i - p_i^M) d\theta = \frac{1}{8} u_i$$

Social welfare in segment *i* amounts therefore to:

$$(9) \qquad SW_i^M = \pi_i^M + CS_i^M = \frac{3}{8} u_i - k_i$$

For future reference, we write the overall profit functions for carrier 1 and 2 and the aggregate social welfare of the airline industry:

$$(10) \qquad \Pi_1^M = \pi_{1_{AC}}^M + \pi_{1_{AB}}^M = \frac{1}{4}(u_{AC} + u_{AB}) - (K_{AC} + K_{AB})$$

(11)
$$\Pi_2^M = \pi_{2_{BC}}^M = \frac{1}{4}u_{BC} - K_{BC}$$

(12) $SW^M = SW_{1_{AC}}^M + SW_{1_{AB}}^M + SW_{2_{BC}}^M = \frac{3}{8}(u_{AC} + u_{AB} + u_{BC}) - (K_{AC} + K_{AB} + K_{BC})$

One can notice that we indicate the utility of each segment without specifying if it is of high or low quality. As we will explain in the next section, the quality of both services offered by the incumbent is by assumption always higher than the one offered by the low-cost carrier. It follows that it is immaterial to the aim of our analysis which variety incumbents provide in their respective route.

4. - The Entry of the Low Cost Company

As we introduced before, deregulation induced the entry of low-cost companies on short-haul markets. These new entrants reshaped the airline industry by providing essential services at relatively cheap prices. On the basis of these stylized facts, we assume that a low cost company enters into the short segment AB and starts competing against carrier 1, the incumbent. Graph 2 represents the airline network after the entry of the low-cost company.

In terms of our model, the main advantage for the newcomer

GRAPH 2

THE NETWORK STRUCTURE WITH THE LOW COST COMPANY
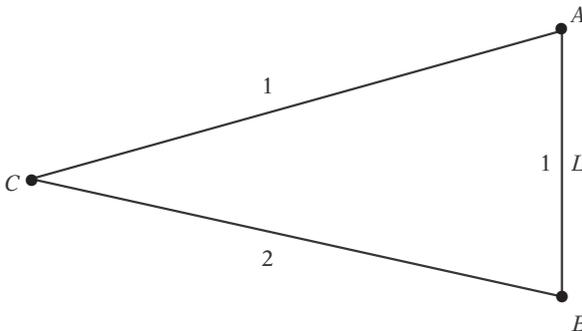
is represented by a very low cost of operating the flight. The new scenario entails for competition in *AB* between carrier 1 and the low-cost company, indicated by *L*. Recall that carrier 1 can provide either a high quality or a low quality service, or both simultaneously. However, we make the following assumption:

ASSUMPTION 1 $u_i > u_L$, where $i = h,l$.

This implies that both services offered by the incumbent are of higher quality than the one provided by the low-cost company. Alternatively, one can think of the entrant's choice to position its flight service at the bottom of the quality ladder. Even if this assumption may represent a limitation of our model, it allows to study the impact of entry of aggressive rivals within a relatively simple theoretical model. Our aim is indeed to find a suitable framework to describe the sequence of events which characterised the air transport sector. Moreover, this assumption seems to be quite realistic, as "no frills" low-cost companies usually offer less comforts to passengers, thereby reducing the quality of the flight service.[5]

We begin by considering how many varieties a generic incumbent offers after the entry of a low cost company.0 The entrance of an aggressive rival providing a very cheap variant could induce the incumbent to sell both a high and low quality service to attract low income passengers.

On the one hand, when it provides only one type of service, marginal consumers are indicated by $\theta_i = (p_i - p_L)/(u_i - u_L)$ and $\theta_L = p_L/u_L$: the incumbent provides the medium/high quality, denoted by i, while the low cost company provides the low quality, denoted by *L*. Demand functions are:

$$(13) \qquad D_i(p_i, p_L) = (1 - \frac{p_i - p_L}{u_i - u_L}), D_L(p_i, p_L) = (\frac{p_i - p_L}{u_i - u_L} - \frac{p_L}{u_L})$$

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[5] Furthermore, as it will be shown later, the incumbent can compete with the entrant only if it offers a higher quality than that offered by the low cost. Indeed, if the service it offers was of lower quality, the incumbent would be prevented from competing successfully with the rival due to the cost difference between the two carriers. Then, assuming $u_i > u_L$ is crucial for the flag carrier to react and for the alliance to take place.

The profit functions for the incumbent and for the low cost company are:

$$(14) \qquad \pi_i(p_i, p_L) = (1 - \frac{p_i - p_L}{u_i - u_L}) p_i - K_i$$

$$(15) \qquad \pi_L(p_1, p_L) = (\frac{p_i - p_L}{u_i - u_L} - \frac{p_L}{u_L}) p_L - K_L$$

From first-order conditions with respect to p_i and p_L we obtain optimal prices:

$$(16) \qquad p_i^D = \frac{2u_i(u_i - u_L)}{4u_i - u_L}, p_L^D = \frac{u_L(u_i - u_L)}{4u_i - u_L}$$

which are always positive.[6]

Demand functions are positive as well, and, by substituting p_i^* and p_L^* in profit functions *(14)* and *(15)*, we get:

$$(17) \qquad \pi_i^D = \frac{4u_i^2(u_i - u_L)}{(4u_i - u_L)^2} - K_i$$

$$(18) \qquad \pi_L^D = \frac{u_i u_L(u_i - u_L)}{(4u_i - u_L)^2} - K_L$$

On the other hand, if the incumbent provides two variants of flight service, indicated by h and l, marginal consumers are identified by $\theta_h = (p_h - p_L)/(u_h - u_l)$, $\theta_l = (p_l - p_L)/(u_l - u_L)$ and $\theta_L = p_L/u_L$. Demand functions are:

$$(19) \qquad D_h(p_h, p_l, p_L) = (1 - \frac{p_h - p_l}{u_h - u_l})$$

$$(20) \qquad D_l(p_h, p_l, p_L) = (\frac{p_h - p_l}{u_h - u_l} - \frac{p_l - p_L}{u_l - u_L})$$

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[6] Second-order conditions are always verified in this and in the following case.

(21)
$$D_L(p_h, p_l, p_L) = (\frac{p_l - p_L}{u_l - u_L} - \frac{p_L}{u_L})$$

Profit functions for the carrier and the low cost company write as follows:

(22) $\pi_{h,l}(p_h, p_l, p_L) = (1 - \frac{p_h - p_l}{u_h - u_l})p_h + (\frac{p_h - p_l}{u_h - u_l} - \frac{p_l - p_L}{u_l - u_L})p_l - (K_h + K_l)$

(23)
$$\pi_L(p_h, p_l, p_L) = (\frac{p_l - p_L}{u_l - u_L} - \frac{p_L}{u_L})p_L - K_L$$

Optimal prices are obtained through first-order conditions:

(24) $p_h^D = \frac{1}{2}(u_h - \frac{3u_l u_L}{4u_l - u_L}), p_l^D = 2u_l(1 - \frac{3u_l}{4u_l - u_L}), p_L^{D'} = \frac{(u_l - u_L)u_L}{4u_l - u_L}$

they are always positive, being $u_h > u_l > u_L$. Moreover, the demands for the three qualities are positive as well, leaving room for the possibility that carrier 1 expands her quality range with respect to the monopoly case.

Optimal profits are easily computed by substituting optimal prices *(24)* into profit functions *(22)* and *(23)*:

(25)
$$\pi_{h,l}^D = \frac{1}{4}\left[u_h - \frac{u_l u_L(8u_l + u_L)}{(4u_l - u_L)^2} \right] - (K_h + K_l)$$

(26)
$$\pi_L^D = \frac{u_l u_L(u_l - u_L)}{(4u_l - u_L)^2} - K_L$$

As in the previous section, we compare π_i^D and $\pi_{h,l}^D$ and find that:

PROPOSITION 2: After the entry of the low cost company, the incumbent continues to provide only one variant of the flight service. In particular, when

$$4\left[\frac{u_h^2(u_h-u_L)}{(4u_h-u_L)^2}-\frac{u_l^2(u_l-u_L)}{(4u_l-u_L)^2}\right]\geq K_h-K_l$$

it opts for the high-quality variant, and *vice versa*.

PROOF. *See APPENDIX* ∎

Proposition 2 tell us that the presence of a strong rival does not alter the choice of carrier 1 to offer only one variant of flight service. This is consistent with the evidence coming from the air transport sector: many traditional carriers tried to fight low cost companies by offering relatively cheap flights, but their attempt mostly failed.[7]

We are now in the position to evaluate the effects of the entry of low cost company, both for firms and for social welfare. For sake of simplicity, we continue to use the generic segment notation, even if we are referring to segment *AB*.

Regarding profits, non-negativity of π_i^D and π_L^D respectively requires:

(27)
$$K_i<\frac{4u_i^2(u_i-u_L)}{(4u_h-u_L)^2}=\hat{K}_i$$
$$K_L<\frac{u_iu_L(u_i-u_L)}{(4u_h-u_L)^2}=\hat{K}_L$$

On the basis of the a forementioned discussion about the cheap cost structure characterising low cost companies, we assume that:

ASSUMPTION 2 $K_L<\hat{K}_L$.

This implies that the low cost company always enjoys positive profits. As for the incumbent, the entry of a very aggressive rival

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[7] Some traditional companies created their own low cost subsidiary: British Airways created Go, SAS did the same with Snowflawes, KLM with Basiq Air and Lufthansa with Germanwings. Other companies imitated low cost's example and reorganised their production process, but encountered many difficulties and became a sort of "hybrid", like Meridiana in Italy and Air Lib Express in France (see JARACH D., 2004).

determines a profit reduction equal to the difference between its pre-entry monopoly profit *(4)* and its post-entry duopoly profit *(17)*:

$$(28) \qquad \Delta\pi_i = \pi_i^M - \pi_i^D = \frac{u_i u_L (8u_i + u_L)}{4(u_L - 4u_i)^2}$$

Moreover, as one can easily verify, $\hat{K}_i < \bar{K}_i$: the cost interval where the incumbent gains a positive profit shrinks. Two possibilities arise, depending on the value of K_i:

1. $K_i < \hat{K}_i < \bar{K}_i$: the incumbent still operates in the market while incurring in the profit loss $\Delta\pi_i$.

2. $\hat{K}_i < K_i < \bar{K}_i$: the incumbent incurs in negative profits and therefore drops out of the market.

We focus on the first interval, given that we are interested in the simultaneous presence of both the traditional carrier and the low cost company along the same route. This will permit a comparison between the present scenario and the following one, where incumbents form the strategic alliance. Hence, consumer surplus is calculated as follows:

$$(29) \quad CS_i^D = \int_{\theta_i}^{1} (\theta u_i - p_i^D) d\theta + \int_{\theta_L}^{\theta_i} (\theta u_L - p_L^D) d\theta = \frac{4u_i^2 (u_i + u_L) + u_L^2 (2u_i - u_L)}{2(4u_l - u_L)^2}$$

Social welfare is given by:

$$(30) \qquad SW_i^D = \pi_i^D + \pi_L^D + CS_i^D = \frac{12u_i^3 - 2u_i^2 u_L - u_L^3}{2(4u_l - u_L)^2} - K_i - K_L$$

In the Appendix we demonstrate that $SW_i^D > SW_i^M$; as the other routes are unaffected, this is sufficient to demonstrate that also the aggregate social welfare increases after the entry of the low cost company, thus confirming that a duopoly is better than a monopoly in terms of welfare. The same result obtains by comparing *(12)* with the aggregate social welfare of the airline industry after entry of the low cost on *AB*, given by:

$$SW^D = SW^M_{1_{AC}} + SW^D_{1,L_{AB}} + SW^M_{2_{BC}} =$$

(31)

$$= \frac{12u^3_{AB} - 2u^2_{AB}u_L - u^3_L}{2(4u_{AB} - u_L)^2} + \frac{3}{8}(u_{AC} + u_{BC}) - (K_{AC} + K_{AB} + K_{BC} + K_L)$$

Finally, we write the overall equilibrium profit of carrier 1 after the entry of the low cost company:

(32) $$\Pi^{M,D}_1 = \pi^M_{1_{AC}} + \pi^D_{1_{AB}} = \frac{u_{AC}}{4} + \frac{4u^2_{AB}(u_{AB} - u_L)}{(4u_{AB} - u_L)^2} - (K_{AC} + K_{AB})$$

this holds as we consider $K_{AB} < \hat{K}_{AB}$, otherwise carrier 1 would drop out of segment AB. Equilibrium profit of the low cost company operating on *AB* is:

(33) $$\pi^D_{L_{AB}} = \frac{u_{AB}u_L(u_{AB} - u_L)}{(4u_{AB} - u_L)^2} - K_L$$

while the overall profit for carrier 2 remains unchanged and is given by *(11)*.

5. - The Strategic Alliance

In this section we ask the following question: *Is it profitable for carriers 1 and 2 to form a strategic alliance and offer a hub-and-spoke service on the route AC through the point B?*

As only carrier 1 is directly affected by low cost competitor, it is reasonably the one proposing the alliance. Let us first analyse how the alliance may be implemented: carrier 2 conveys passengers from point C to the hub B while operating the route *BC*, and carrier 1 itself carries those same passengers from B to A while operating the route *AB*. Thus, in this new scenario, represented in Graph 3, carrier 1 and 2, while still providing the full connection on their respective routes *AB* and *BC*, form an alliance to connect A and C through the hub located in B. The hub-and-spoke network is represented by the dashed line, where *AL* indicates that it is implemented by the alliance.

GRAPH 3

THE NETWORK STRUCTURE WITH THE ALLIANCE
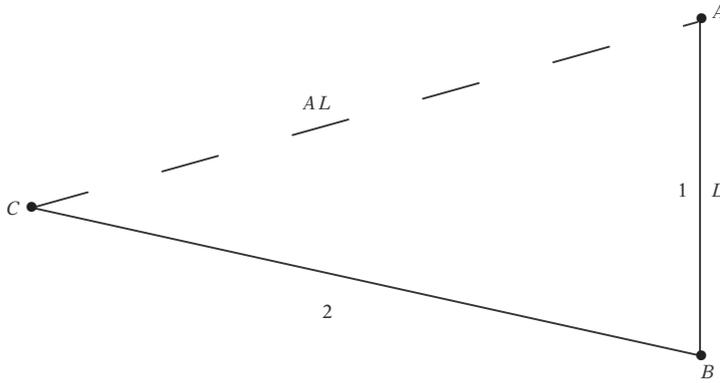
Following the convincing evidence that strategic alliances bring about efficiency gains by exploiting economies of scale and scope or density, we make the following assumption:

ASSUMPTION 3 $K_{ABC} \equiv K_{AB} + K_{BC} - \delta$

Members of the alliance benefit from a reduction in the overall cost of providing the hub-and-spoke connection. So, when carriers 1 and 2 jointly serve the route AC through B, the whole cost is reduced by $\delta > 0$.

Passengers routing via the hub suffer a loss of utility measured by parameter $\beta < 1$, as we know from (utility). The marginal consumer is indicated by $\theta_{AC} = p_{ABC}/\beta u_{AC}$.

The profit deriving from the hub-and-spoke *ABC* is:

$$(34) \qquad \pi_{ABC} = (1 - \frac{p_{ABC}}{\beta u_{AC}})p_{ABC} - (K_{AB} + K_{BC} - \delta)$$

It can be easily proved that, maximising with respect to p_{ABC}, optimal price equals $p_{ABC} = \beta u_{AC}/2$, yielding optimal profit:[8]

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[8] From Propositions 1 and 2 we know that each carrier never provides two quality variants on the same route. It is straightforward to show that full connection and hub-and-spoke connection are perceived by passengers as high and low quality variant, their difference being represented only by parameter β. This is the reason why we disregard the possibility that the alliance offers both the direct and the indirect connection between A and C.

(35)
$$\pi_{ABC} = \frac{\beta u_{AC}}{4} - (K_{AB} + K_{BC} - \delta)$$

Notice that both optimal price and profit are positively correlated with β, as passengers tend to pay more if their utility is not significantly reduced by the indirect connection.

If a flight service can costlessly accommodate additional passengers, then carrier 1 operates both its own full connection on *AB* and part of the hub-and-spoke connection at the cost K_{AB}. Similarly, carrier 2 bears K_{BC} and provides both its own full connection on *BC* and the remaining part of the hub-and-spoke transport. More realistically, due to the alliance, the frequency of flights on routes *BC* and *AC* increases; larger and more comfortable aircraft may be employed to accommodate additional passengers, thus rising the cost. However, synergies and cost reduction may well compensate these additional costs (Barla and Constantatos, 2006), and members of the alliance can enjoy an overall cost reduction which is split between according to a fraction $\alpha \in (0,1)$.

The expressions for the overall profits accrued by carrier 1 and 2 when they form the alliance are as follows:

(36)
$$\Pi_1^{AL} = \pi_{1_{ABC}}^{AL} + \pi_{1_{AB}}^{D} = \frac{\beta u_{AC}}{4} + \frac{4u_{AB}^2(u_{AB} - u_L)}{\left(4u_{AB} - u_L\right)^2} - (K_{AB} - \alpha\delta)$$

(37)
$$\Pi_2^{AL} = \pi_2^{AL} = \frac{u_{BC}}{4} - [K_{BC} - (1-\alpha)\delta]$$

Take into account the incentives for carrier 1 to propose the alliance. The comparison between *(32)* and *(36)* reveals that:

(38)
$$\Pi_1^{AL} > \Pi_1^{M,D} \text{ if } \delta > \delta_1$$

where:

(39)
$$\delta_1 = \frac{1}{4\alpha}[u_{AC}(1-\beta) - 4K_{AC}]$$

Then, we can state the following:

PROPOSITION 3: Carrier 1 proposes an alliance to carrier 2 consisting on a hub-and-spoke network when its gain in terms of economies of scope is sufficiently high. In particular, this happens when $\delta > \delta_1$.

As a consequence, there exist a threshold value for the potential gain represented by the economies of density δ above which carrier 1 involves carrier 2 in a hub-and-spoke service on the route *AC* through the hub *B*. Moreover, this is more likely to happen the lower the loss of utility incurred by passengers using the indirect connection, measured by $(1-\beta)u_{AC}$. In fact, it is easy to prove that $\partial \delta_1 / \partial \beta < 0$. This implies that, *ceteris paribus*, the region where it is profitable for carrier 1 to propose the alliance tend to enlarge when passengers' satisfaction deriving from the hub-and-spoke service is not too distant from the one determined by the fully connected service, *i.e.* when β is relatively high.

We can now consider the incentives for carrier 2 to become member of this alliance. Carrier 2 still serves passengers which fly only between B and C. Yet, it also serves passengers stopping at B as a hub point. As we assumed that it uses the same aircraft when providing the two services and that the overall cost K_{BC} remains unchanged, carrier 2 is willing to accept the alliance as it gains a positive fraction $(1-\alpha)$ of the cost reduction δ. This can be easily verified by comparing the pre-alliance profit *(11)* with the post-alliance profit *(37)*. Moreover, the agreement between carrier 1 and carrier 2 is stable as it holds for every $\alpha \in (0,1)$.

Thus, if we consider a joint use of the same aircraft by member partners without additional costs of carrying more passengers, then the alliance turns out to be profitable in presence of sufficiently strong economies of density and when consumers' utility is not significantly reduced by the additional connecting route required by the hub-and-spoke system.

5.1 *Welfare Analysis*

Lastly, we evaluate social welfare. Profits of carriers 1 and 2

are given by *(36)* and *(37)*, while the profit of the low cost company is still *(33)*. Consumer surpluses in BC and AB do not vary with the alliance; using respectively *(8)* and *(29)*, one obtains:

$$(40) \qquad CS_{BC} = \frac{1}{8} u_{BC}$$

$$(41) \qquad CS_{AB} = \frac{4u_{AB}^2 \left(u_{AB} + u_L\right) + u_L^2 (2u_{AB} - u_L)}{2\left(4u_{AB} - u_L\right)^2}$$

We need to compute only consumer surplus in the route *AC*, where the alliance operates through the hub-and-spoke network:

$$(42) \qquad CS_{AC} = \int_{\theta_i}^{1} (\theta \beta u_{AC} - p_{ABC}) d\theta = \frac{1}{8} \beta u_{AC}$$

Now we can write the aggregate social welfare:

$$(43) \qquad \begin{aligned} SW^{AL} &= \Pi_1^{AL} + \Pi_2^{AL} + \pi_{L_{AB}}^D + CS_{BC} + CS_{AB} + CS_{AC} = \\ &= \frac{12u_{AB}^3 - 2u_{AB}^2 u_L - u_L^3}{2\left(4u_{AB} - u_L\right)^2} + \frac{3}{8}(u_{AC} + \beta u_{BC}) - (K_{AB} + K_{BC} + K_L) + \delta \end{aligned}$$

From a social welfare's standpoint, the alliance is preferred when:

$$(44) \qquad SW^{AL} > SW^D \quad \text{if } \delta > \delta_2$$

where:

$$(45) \qquad \delta_2 = \frac{3}{8} u_{AC}(1 - \beta) - K_{AC}$$

We can state the following:

PROPOSITION 4: The alliance between carrier 1 and carrier 2 is socially optimal if it produces a sufficiently high efficiency gain: this happens when $\delta > \delta_2$.

Similarly to the evaluation of private incentives to build the

alliance, social welfare analysis confirms the existence of a
threshold value for parameter δ above which the alliance generates
a higher social welfare than the case where carrier 1 and 2 do not
link their services through the hub-and-spoke connection on the
route AC. Moreover, $\partial \delta_2 / \partial \beta < 0$: the region where the alliance is
welfare improving increases when the negative impact of the
indirect connection on passengers' utility is moderate.

As for the coincidence between private and social incentive to
form the alliance, by comparing δ_1 with δ_2 we find:[9]

LEMMA 1: *(i)* When $\alpha \geq 2/3$, then $\delta_1 < \delta_2$ always; *(ii)* when $\alpha < 2/3$, then $\delta_1 \geq \delta_2$ ($\delta_1 < \delta_2$) if $\beta < \hat{\beta}$ ($\beta > \hat{\beta}$), where

$$\hat{\beta} = \frac{8 K_{AC}(1-\alpha) + u_{AC}(3\alpha - 2)}{u_{AC}(3\alpha - 2)}$$

As a consequence, depending on the interplay between
parameters α and β, we need to examine two different cases:

1. When $\delta_1 < \delta_2$, in the three subintervals of interest the
alliance is:

$$\begin{cases} 0 < \delta_1 < \delta_2 \Rightarrow \text{privately and socially not profitable;} \\ \delta_1 < \delta < \delta_2 \Rightarrow \text{privately profitable but socially not profitable;} \\ \delta_1 < \delta_2 < \delta \Rightarrow \text{privately and socially profitable.} \end{cases}$$

2. When $\delta_1 \geq \delta_2$, in the three subintervals of interest the
alliance is:

$$\begin{cases} 0 < \delta_2 < \delta_1 \Rightarrow \text{privately and socially not profitable;} \\ \delta_2 < \delta < \delta_1 \Rightarrow \text{privately not profitable but socially profitable;} \\ \delta_2 < \delta_1 < \delta \Rightarrow \text{privately and socially profitable.} \end{cases}$$

Notice that in both cases there exist an intermediate
parameter region of δ where the private incentive to form the
alliance differs from the social one. However, they present opposite
outcomes.

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[9] Recall that the alliance is privately (socially) profitable when $\delta > \delta_1 (\delta_2)$.

In the first case, when $\delta_1 < \delta < \delta_2$, even if the efficiency gain is moderate, carrier 1 proposes the alliance because it can extract a sufficiently high fraction ($\alpha \geq 2/3$) of cost reduction. On the contrary, the social welfare function, taking into account the whole efficiency gain, is not at its highest. It is interesting to remark that, for lower values of α ($\alpha < 2/3$), the same discrepancy of interests appears when $\beta < \hat{\beta}$. This may seem counterintuitive, as high values of β indicate that consumers are not excessively inconvenienced by the indirect connection; this, in turn, would exert a positive effect on consumer surplus. Nonetheless, as the price charged by the alliance on AC is proportional to parameter β itself, as we noticed before, consumer surplus tends to shrink, while the profit of alliance members increase. The balance between the two effects drives the above result.

In the second case, consider the region $\delta_2 < \delta < \delta_1$. Economies of scope still generate an intermediate value of efficiency gain, but this time carrier 1 does not propose the alliance: it would enjoy in fact a small fraction of such gain ($\alpha < 2/3$) and the "compensation" in terms of price (and profit) would not be adequate, given that $\beta \leq \hat{\beta}$. For the same reasons, *mutatis mutandis*, the gain would be sufficient for social welfare to increase, generating the conflict between private and social interest to form the alliance.

The following proposition summarizes the above considerations:

PROPOSITION 5: When the alliance generates intermediate values of efficiency gain for its members, the private and the social incentives to form the alliance do not coincide.

This has important policy implications. In the first case, even if passengers do not suffer from the indirect connection, the regulator should block the proposed strategic alliances as it will increase prices without generating the proper efficiency gain. On the contrary, even if passengers are negatively affected by the indirect connection, the regulator should provide incentives to convince traditional carriers to form the alliance. In this second case, potential member carriers are reluctant to form the alliance. Carrier 1, which in our model acts as the proponent, neither

receives a significant percentage of the cost reduction, nor the alliance guarantees a sufficient high revenue from hub-and-spoke service, but society at large would indeed benefit by the whole reduction in the cost of operating the service.

6. - Conclusions

Our paper portrays the evolution of the air transport sector after the deregulation and provides a rationale for the growth of strategic alliances. We have argued that traditional carriers linked their services and provided hub-and-spoke connections to defend themselves from the fierce competitors as low cost companies. We have used a simple model of vertical differentiation to study a three gateway points' network where initially only two firms operate as monopolists in different routes. In this first case, which serves as a benchmark to represent the situation before the deregulation, we have shown that firms provide only one quality service in each route.

Then, we have considered the entry of a low cost company in one segment and analysed the impact for the incumbent firm, whose market share shrunk. We have examined possible remedies taken by the incumbents. First, we have verified that they cannot react by expanding the product range, as this would eventually induce a cannibalisation effect. Second, we have introduced the possibility for the incumbents to form strategic alliances based on a hub-and-spoke system, thus exploiting economies of scope/density and recover at least part of the profit lost. We have proven that the alliance represents a profitable strategic reaction to low cost carriers when *(i)* members enjoy a sufficient degree of economics of scope/density and when *(ii)* consumers are not sensitive to the additional inconvenience deriving from a hub-and-spoke connection.

Finally, we have extended the analysis of strategic alliances to social welfare evaluation. In particular, we have shown that private and social incentives to form the alliance do not always coincide. Depending on the combination between the efficiency gain and

the loss of utility experienced by passengers using the indirect connection, two opposite cases have emerged. On the one hand, the alliance is privately not profitable but socially desirable when passengers' utility decreases from the hub-and-spoke. On the other hand, the alliance is profitable for firms but not desirable for society when passengers are relatively not affected by the hub-and-spoke connection. This calls for a proper policy intervention by the regulator as to make private and social incentives compatible.

This work can be extended in several directions, for instance by considering the degree of cost saving induced by the alliance as a function of members' effort and/or commitment. Alternatively, we may assume that travellers' attitude towards the hub-and-spoke flight depends on the investment undertaken by traditional carriers as to improve connecting services. Yet, endogenising these elements goes far beyond the purpose of the present paper.

APPENDIX

PROOF of PROPOSITION 1

When the carrier provides both qualities it obtains *(7)*. When it decides to offer only the high quality service its profit amount to:

$$(A1) \qquad \pi_h^M = \frac{u_h}{4} - K_h$$

while in case of provision of the low service alone the profit is:

$$(A2) \qquad \pi_l^M = \frac{u_l}{4} - K_l$$

Let $\Delta u = u_h$. From easy computations, we obtain:

$$\pi_h^M > \pi_{h,l}^M \text{ always}$$
$$\pi_l^M \geq \pi_{h,l}^M \text{ when } \Delta u \leq 4K_h$$
$$\pi_h^M \geq \pi_l^M \text{ when } \Delta u \geq 4(K_h - K_l)$$

As a consequence, the following ranking for profits applies:

$$(A3) \qquad \begin{cases} 0 < \Delta u \leq 4(K_h - K_l) \Rightarrow \pi_l^M \geq \pi_h^M > \pi_{h,l}^M \\ 4(K_h - K_l) < \Delta u \leq 4K_h \Rightarrow \pi_h^M > \pi_l^M \geq \pi_{h,l}^M \\ 4K_h < \Delta u \Rightarrow \pi_h^M > \pi_{h,l}^M > \pi_l^M \end{cases}$$

Then, it is never profitable to supply both services. Moreover, the high quality service is more profitable than the low quality service when $\Delta u > 4 (K_h - K_l)$.

Q.E.D.

PROOF of PROPOSITION 2

The profit accruing to carrier 1 when it decides to provide

both qualities is given by *(25)*. One the contrary, when it offers only the high quality variant the profit is:

$$(B1) \qquad \pi_h^D = \frac{4u_h^2(u_h - u_L)}{\left(4u_h - u_L\right)^2} - K_h$$

while in case of provision of the low service alone it gains:

$$(B2) \qquad \pi_l^D = \frac{4u_l^2(u_l - u_L)}{\left(4u_l - u_L\right)^2} - K_l$$

Firstly, $\pi_h^D \geq \pi_l^D$ when:

$$(B3) \qquad 4\left[\frac{u_h^2(u_h - u_L)}{(4u_h - u_L)^2} - \frac{u_l^2(u_l - u_L)}{(4u_l - u_L)^2}\right] \geq K_h - K_l$$

or, alternatively, $\pi_h^D \geq \pi_l^D$ when $K_h \leq \tilde{K}_h$, where

$$(B4) \qquad \tilde{K}_h \equiv K_l + 4\left[\frac{u_h^2(u_h - u_L)}{(4u_h - u_L)^2} - \frac{u_l^2(u_l - u_L)}{(4u_l - u_L)^2}\right]$$

Secondly,

$$(B5) \qquad \pi_h^D - \pi_{h,l}^D = K_l + \frac{(u_h - u_L)u_L^2\left[80u_h u_l - u_L(8u_h + 8u_l + u_L)\right]}{4\left(4u_h - u_L\right)^2\left(4u_l - u_L\right)^2} > 0$$

given that $80\, u_h u_l > u_L\, (8u_h + 8u_l + u_L)$ as $u_h > u_l > u_L$ by definition. It follows that $\pi_h^D > \pi_{h,l}^D$ for every admissible value of parameters at stake. Finally, $\pi_h^D > \pi_{h,l}^D$ when $K_h > (u_h - u_L)/4$. To sum up:

$$\pi_h^D > \pi_{h,l}^D \text{ always}$$
$$\pi_l^D \geq \pi_{h,l}^D \text{ when } K_h \geq (u_h - u_l)/4$$
$$\pi_h^D \geq \pi_l^D \text{ when } K_h \leq \tilde{K}_h$$

We compare $\tilde{K}_h$ with $(u_h - u_L)/4$:

$$(B6) \quad \tilde{K}_h - (u_h - u_L)/4 = K_l + \frac{(u_h - u_L)u_L^2\left[80u_hu_l - u_L(8u_h + 8u_l + u_L)\right]}{4(4u_h - u_L)^2(4u_l - u_L)^2} > 0$$

As a consequence, the following profit ranking holds:

$$(B7) \quad \begin{cases} 0 < K_h \leq (u_h - u_L)/4 \Rightarrow \pi_h^D > \pi_{h,l}^D \geq \pi_l^D \\ (u_h - u_L)/4 < K_h \leq \widetilde{K_h} \Rightarrow \pi_h^D \geq \pi_l^D > \pi_{h,l}^D \\ \widetilde{K_h} < K_h \Rightarrow \pi_l^D > \pi_h^D > \pi_{h,l}^D \end{cases}$$

Then, it is never profitable to supply both flight services. Moreover, the high quality service is more profitable than the low quality service when $K_h < \tilde{K}_h$, and viceversa.

Q.E.D.

Social Welfare after Entry of the Low Cost Company

We prove that the entry of a low cost company in a route previously served by a single carrier is welfare improving. It is sufficient to evaluate SW_i^D vs SW_i^M. We obtain that

$$(C1) \qquad SW_i^D > SW_i^M \text{ if } K_L < \tilde{K}_L$$

where

$$(C2) \qquad \tilde{K}_L = \frac{u_L(16u_i^2 - 3u_iu_L - 4u_L^2)}{8(4u_i - u_L)^2}$$

However, it is immediate to demonstrate that $\tilde{K}_L > \hat{K}_L$; given that under ASSUMPTION 2 $K_L < \hat{K}_L$, then $K_L < \tilde{K}_L$ always holds. It follows that $SW_i^D > SW_i^M$.

Q.E.D.

BIBLIOGRAPHY

Barbot C., «Low-Cost Airlines, Secondary Airports, and State Aid: An Economic Assessment of the Ryanair-Charleroi Airport Agreement», *Journal of Air Transport Management*, vol. 12, 2006, pages 197-203.

Barla P. - Constantatos C., «Strategic Interactions and Airline Network Morphology under Demand Uncertainty», *European Economic Review*, vol. 49, 2005, pages 703-716.

— — - — —, « On the Choice between Strategic Alliance and Merger in the Airline Sector: The Role of Strategic Effects», *Journal of Transport Economics and Policy*, vol. 40, no. 3, 2006, pages 409-424.

— — - — —, «Airline Network Structure under Demand Uncertainty», *Transportation Research E*, vol. 36, 2000, pages 173-180.

Boguslaski C. - Ito H. - Lee D., «Entry Patterns in the Southwest Airlines Route System», *Review of Industrial Organization*, vol. 25, 2004, pages 317-350.

Brueckner J.K., «The Benefits of Codesharing and Antitrust Immunity for International Passengers, with an Application to the Star Alliance», *Journal of Air Transport Management*, vol. 9, 2003, pages 83-89.

Brueckner J.K. - Dyer N.J. - Stiller P., «Fare Determination in Airline Hub-and-Spoke Networks», *RAND, Journal of Economics*, vol. 23, 1992, pages 309-333.

Brueckner J.K. - Pels E., «European Airline Mergers, Alliance Consolidation, and Consumer Welfare», *Journal of Air Transport Management*, vol. 11, 2005, pages 27-41.

Brueckner J.K. - Whalen W., «The Price Effects of International Airline Alliances», *Journal of Law and Economics*, vol. 43, 2000, pages 503-545.

Franke S., «Competition between Network Carriers and Low Cost Carriers - Retreat Battle or Breakthrough to a New Level of Efficiency?», *Journal of Air Transport Management*, vol. 10, 2004, pages 15-21.

Gabszewicz J.J. - Thisse J.F., «Price Competition, Quality and Income Disparities», *Journal of Economic Theory*, vol. 2, 1979, pages 240-259.

Jarach D., «Future Scenarios for the European Airline Industry: A Marketing-Based Perspective», *Journal of Air Transportation*, vol. 9 (2), 2004, pages 23-40.

Morrison S.A. - Winston C., *The Economic Effects of Airline Deregulation*, Brookings Institution, Washington (DC), 1986.

— — - — —, *The Evolution of the Airline Industry*, Brookings Institution, Washington DC, 1995.

Mussa M. - Rosen S., «Monopoly and Product Quality», *Journal of Economic Theory*, vol. 18, 1978, pages 301-317.

Oum T.H. - Park J., «Airline Alliances: Current Status, Policy Issues and Future Directions», *Journal of Air Transport Management*, vol. 3, 1997, pages 133-144.

Oum T.H. - Park J. - Zhang A., *Globalization and Strategic Alliances: The Case of the Airline Industry*, Pergamon Press, Oxford, 2000.

Park J. - Zhang A., «An Empirical Analysis of Global Airline Alliances: Cases in North Atlantic Markets», *Review of Industrial Organization*, vol. 16, 2000, pages 367-384.

Park J. - Zhang A. - Zhang Y., «Analytical Models of International Alliances in the Airline Industry», *Transportation Research B*, vol. 35, 2001, pages 865-886.

PELS E., «Economic Analysis of Airline Alliances», *Journal of Air Transport Management*, vol. 7, 2001, pages 3-7.

PIGA C.A. - FILIPPI N., «Booking and Flying with Low-Cost Airlines», *International Journal of Tourism Research*, vol. 4, 2002, pages 237-249.

SHAKED A. - SUTTON J., «Relaxing Price Competition through Product Differentiation», *Review of Economic Studies*, vol. 49, 1982, pages 3-13.