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European airlines conduct after September 11th*

Marco ALDERIGHI

Bocconi University, Research Centre for Regional Economics, Transports, Tourism,
Via Gobbi, 5, 20136 Milano, Italy. e-mail: marco.alderighi@uni-bocconi.it
Tel. +39 02 5836 5440, Fax. +39 02 5836 5439.

Alessandro CENTO

KLM Royal Dutch Airlines, Revenue Management Department,
Via Modigliani 45, 20090 Segrate, (MI), Italy; e-mail: alessandro.cento@klm.com
Tel +39 02 2189 9229, Fax: +39 02 2695 2254.

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Abstract

This paper analyses the reorganisation that European carriers have implemented after September 11th in the transatlantic flights. We model carriers' conduct as a mixture of short- and long-term goals where the weights depend on firm-specific variables (adjustment costs, financial situation) and subjective expectations on the crisis duration. Data provide some support to our conjectures that high adjustment costs induce low flexibility and a focus on the long-term; and that a bad financial situation shifts the carries attention to short-term. Finally, the analysis of the composition of short- and long-term reaction provides some insights into the carriers' perspectives of the crisis duration.

Keywords: European Airline Industry, Dynamic Oligopoly, Costs of Adjustment, Crisis.

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1 Introduction

The ups and downs of the airline sector reflect fluctuations in the world economy. However, in more than 50 years since the World War II, the European Airline industry has faced only one annual decrease in traffic. This was in 1991, when the Gulf War and the ongoing recession combined to produce a minus 6% in passenger flow.

The September 11th terrorist' attacks to the Twins Towers in New York and to the Pentagon in Washington created a situation, which might be comparable to 1991 but much more dramatic. The industry was already recording zero growth due to the worldwide economy downturn. Between September 11th and November 4th, North Atlantic traffic fell by 26%; there was a decrease of more than 10% in Europe and more than 17% in the Far East. In the next weeks, European and US carriers reduced the capacity offer between European and North Atlantic destinations, on average, by 20% and similar adjustments occurred in other international routes.

Data on transatlantic flights show that the capacity reduction differred among carriers and destinations following a pattern which is not simple to interpret. The aim of this paper is to analyse the reorganisation that European carriers have realised after September 11th in the transatlantic flights. Roughtly speaking, we want to shed light on the carriers' decision of capacity reduction (or expansion) for each route. We divide the after shock period into two parts: the short-term (i.e. the crisis period) and the long-term (the post-crisis period). We suppose carriers to be profit maximisers and we model carries' conduct as a mixture of short- and long-term goals.

We explain the variability of the short- and long-term conduct in terms of firm specific variables (adjustment costs, financial situation) and in terms of carriers' expectations of the crisis duration.

From an empirical point of view, we assume that the short-term tactic is based on the evaluation of the demand fall after the September 11th and that long-term plans are based on the profitability before September 11th. The validity of the latter indicator depends on the fact that carriers' long-term conjectures are usually an extrapolation of past experiences.

Data provide some support to our conjectures that high adjustment costs, corresponding to high market shares, induce low flexibility and a focus on the long-term and that a bad financial situation shifts the carries attention to short-term. Finally, the analysis of the composition of short- and long-term reaction provides some insights into the carriers' perspectives of the crisis duration.

The paper is organised as follows: section 2 reviews some contributions on the airline conduct in different perspectives. In section 3, we present a brief description of the airlines industry focusing on the impact of the terrorist' attacks. In sections 4 and 5 we provide the theoretical model and the empirical analysis, respectively. The final conclusions are presented in section 6.

2 Review of literature

Carriers determine the capacity supply through a process called network planning. This process is usually organised in three levels:

(1) Strategic planning: alliances, buying/selling new aircraft, anticipating new routes, usually every 1-3 years.

(2) Tactical planning: scheduled timing, numbers of frequencies and aircraft size. It takes place every semester.

(3) Operational actions: pricing strategies and small adjustments of the network to improve operations such as reducing connections time at hub, changing aircraft size for some ad hoc day. This process follows the short-term demand fluctuation and competitor moves (day-to-day).

In this section we present a brief review of the literature on carriers conduct organising the main contributions into three corresponding streams of research according to the attention they posed on strategical, tactical and operational decisions.

The first stream (strategic choices) investigates the relation between liberalization, alliance and performance of the airlines. Chang and Williams (2002) study how the European carriers have responded to the liberalized policy. Despite nationality clauses being removed, relatively few airlines have made full use of the liberalisation. The market liberalization explains the strategy for the creation of effective alliances. Janic (1997) shows that the liberalization had a significant impact on the market structure. Airlines can grow by entering various types of mergers and alliances and the overall quality of the service has improved due to increased flight frequency. The investment issue, even if concerning the strategic planning is analysed in the next paragraph.

The second stream (tactical choices) focuses on profitability and investment decision. For example, Chin and Tay (2001) study the implications of profitability and the investment decision on survivability of Asian airlines. Investment decisions and profitability are related to air traffic forecasting, cycle of orders and deliveries, profit cycle, airlines growth and survivability. The study indicates that airline's growth and profitability are positively related. The likelihood of survival increases with asset size and profit. Profitability and survivability are evaluated by Smith (1997) in the framework of the European market liberalization. They identify some critical factors for the airlines survival: financial factor, cost structure, domestic market, size of operations, internationalization and political support. Through an empirical application on European airlines they find that only a limited number of airlines have a fair chance to survive. Based on the critical success factors, the largest Northern carriers enjoy stronger positions. Among the Southern airlines, those with a large domestic market and strong political support have a high likelihood of survival, providing they are able to adjust their cost structure in time. Bruning and Hu (1988) identified empirical evidences that profitability of American carriers depends on firm size, operating efficiency, and flexibility.

The third stream of research deals with operational choices, i.e. pricing equilibrium and market contestability. Borenstein (1989) looks at the role of the hub-and-spoke operational system in airline pricing policies. He concluded that while hubs are efficient operating devices for airlines in terms of the number of different markets the airline can serve, they are detrimental for consumers because the airlines become isolated from competition when they have a monopoly at their hubs. This phenomenon has been termed the strength of hub. Borenstein made three important observations in his study of the links between high fares and hub-and-spoke networks. First, a high (route) price charged by a company is not automatically mimicked by other carriers serving the same route, because the latter has gained control of the market through frequency of fights offered, advantageous departure and arrival times. Second, the source of power can be directly connected to the airlines operations at the end of the route. Third, Borenstein found that the larger the share a carrier has of a route the more attractive the airline to passengers.

Windle and Dresner (1995) focus on the role of the low fare carriers entrance into markets. Questions, that they were concerned with, were the effects of low fare carriers entrance into specific markets and whether the effects were long lasting. The researchers found that market concentration was not a significant contributing factor to pricing on domestic markets. This seems to counter what Borenstein (1989) had concluded, although the authors find that when a low fares carrier enters a market its impact on prices is more significant than market concentration. They produce an example of a high concentrated route served by Southwest having lower fares than a low concentrated route served by two or more high cost carriers. When the low/high fare dummy was removed from their model they found the same results as Borenstein, that market concentration has a statistically significant effect.

Recent literature has proposed significant research on the field of the airline crisis. In particular, Hatty and Hollmeier (2003) present a view of the airline crisis after the September 11th. Crisis management at Lufthansa German Airlines is discussed in depth. In this study it is showed that the reduction of air traffic demand was matched by industry capacity reduction. When demand declines, capacity can not be immediately adjusted due to the insufficient flexibility. Authors conclude that managing the crisis does not only aim at restoring the pre-crisis state but rather at forming a more healthy business environmental. Gillen and Lall (2003) examine shock transmission in the airline industry after September 11th. Their research attempts to identify three main propagation channels: trade effect, alliance effect and wake-up call effects. As espected they noticed that US airlines were the worst hit, Asian carriers were effected the least and recovered much earlier than their European and North American counterparts. Low cost carriers and specialist carriers like Gandalf that cater to business travellers were not effected as much and their market recovered within the first four weeks of the events.

Our analysis attempt to proposes an integrated model considering operational, tactical and strategic decisions in a crisis momentum. Specifically, we present a dynamic game-theoretical framework organised into three stages which are a time-continuous sequence of periods. In each period carriers take operational actions (i.e. they choose a price); in each stage they choose their tactics (corresponding to a capacity offer) and in the entire game they follow a strategic planning (that is the choice of a strategy solving the overall game). The empirical model do not consider operational decisions but focuses on tactical and strategic planning that are driven by a short- and long-term indicators, respectively.

A second aspect that characterises our work is the particular use of data on a crisis period. Since this, we can clearly identify the carriers reaction to an exogenous demand shock. The presence of a delay between the passenger fall and the capacity reduction excludes the identification problem.

3 The airlines sector during the crisis

The consequences of the terrorist attacks in United States had a major impact throughout the airlines sector.

> "The losses incurred due to the closure of US and Canadian airspace, flight diversions, cancellations and drop in demand have made it necessary for companies to revise their profit forecast and capacity supply. The forecasting was dependent on an economy upswing in the last quarter of the year which was no longer anticipated in the wake of the 11th September event. The aviation industry has been hit badly by the consequences of the terrorist attacks. It will require immense efforts on the part of Lufthansa staff if we are to avoid an operating loss this year": Lufthansa Chief Executive Officer Jurgen Weber, September 19th, 2001.

The words of Mr. Weber find some confirmations in the descriptive statistics presented below.

<<INSERT TABLE 1>

Before the terrorist attacks the traffic between Europe and US showed a zero growth; afterwards the growth became negative. Table 1 presents the bookings index[1] Europe-US for the period June 01 - May 02. The demand fall started in September (-13% of booking) and reached the lowest peak in October and November (both -26%). The impact was more significant for business (-31% in September) than for leisure travellers (-11%). Business traffic fell until October (-42%) while the leisure recorded the lowest peak in November (-24%).

In Table 2 we restrict our attention to the transatlantic traffic generated by the European carriers. More specifically, we focus on two important indicators concerning the revenue and the capacity offer respectively: the revenue

[1] The bookings index is computed dividing the number of bookings in one period by the number of bookings in the corresponding period of the previous year.

passengers kilometres[2] (RPK) and available seats kilometres[3] (ASK).

<<INSERT TABLE 2>>

Despite the revenue decreased of 3% in September and 4% in October, European carriers did not reduce their capacity supply until November 01, afterwards there was a decrease in the next months.

In general, carriers reduce their capacity offer through reducing the frequencies, the aircraft size or closing the routes. For example, KLM adjusted its flights to USA by reducing weekly frequency to New York (from 13 to 11 frequencies), to San Francisco (from 7 to 6 frequencies), to Miami (from 7 to 5 frequencies) and to Detroit (from 4 to 3 frequencies). It also closed the Amsterdam-Atlanta route and reduced the aircraft size to Canada (Montreal from Boeing 747 to Boeing 767, Toronto from Boeing 747 to McDouglas 11).

<<INSERT TABLE 3>>

Table 3 shows the implanted capacity and the planned capacity, as it was in May 02, for the top 10 destinations. Data before May 02 do not provide any information on the planned capacity since before that date carriers do not present credible plans. In order to correctly interpret the table, it is worth noting that data are computed dividing the implanted or planned capacity in the quarter by the implanted capacity in the corresponding quarter of the previous year. Therefore, the index referred to the quarters (Q3-02 to Q2-03) are compared to the pre-crisis period whilst the index referred to Q4-03 is compared to the crisis period. This explains why the index in the first five columns is lower than 100 and in the last column is equal to or higher than 100.

For example, European carriers reduced their capacity offer to New York by 29% in Q1-02 but the planned capacity has been increased by 20% in the Q4-02. Since that the capacity reduction is larger than the planned increase, the values previous the shock are not completely recovered. Other routes, as Atlanta or Los Angeles presented different patterns. The latter recorded a strong capacity reduction just before the crisis period, whilst the former presents a small variation. In any case, it does not seem that there the planned capacity identifies a full recovery of the demand.

Table 4 shows the implanted capacity and the planned capacity, as it was in May 02, of European carriers flying on intercontinental routes. As previously, we observe different patterns in data. All carriers (except Iberia) reduced their offer in Q4-01 but there is a strong variability in their choices. Alitalia, that before the crisis (Q3-01) was expanding its offer, after the crisis drastically reduced it (-24%), whilst Lufthansa, which has registered a similar path in Q3-01, reduced less (-8%).

[2] The revenue passengers kilometres is the number of passengers who generated revenue (free travellers are excluded) normalised by the length of the journey in kilometres.

[3] The available seats kilometres is the number of seats offered by the carriers on a given group of lines times the route length (in kilometres).

<<INSERT TABLE 4>>

The main concern of the airline strategy is the duration of the crisis. KLM President & CEO Leo van Wijk released a press statement regarding the Dutch company:

> "...many passengers are cancelling their reservations and we can expect diminishing load factors as result. Demand is diminishing on various intercontinental routes and I do not expect this to change in the near future..."

Analogously, Lufthansa CEO Jurgen Weber claimed that there is uncertainty about the length and effect of the crisis and the future developments in the aviation industry.

3.1 An important element of the carriers' conduct: the adjustment costs

At the end of section 2, we have characterised carriers behaviour as the sum of operational actions, tactics and strategies. In this sub-section, we provide a link between the actual conduct of the carriers and the main assumption of our theoretical model. More specifically, we want to explain why carriers are recalcitrant to change their capacity offers in the day-to-day activity and how carriers decisions of reducing the capacity offer after September 11th are a part of a strategic planning concerning both the crisis and the post-crisis tactics.

Any modification of the flight supply involves costs. For instance, the carrier that decides to enter a new route needs to have new rights at airport (slot), to organise new staff, promote and advertise the new route, launch price actions, check and re-adapt feeding strategies and so on. Moreover, in the short-term, the aircraft for the new route should be moved from a route to the new one and the logistic activity should be adjusted to the new aircraft rotations. Also reducing frequencies or closing a route is a costly decision seeing that a carrier needs to change the aircraft rotations or definitely to ground a plane. We call **adjustment costs** the costs that a carrier incurs when it modifies its flight supply. It is worth noting that adjustment costs are first of all set-up costs and hence are higher when carriers want to enter or expand a route than when they want to exit or reduce it.

Adjustment costs usually are high for large carriers (carriers with higher market shares) since they employ local ground staff whilst are low for small carriers that usually outsource ground activities. In addition, closing and opening an intercontinental route imply a re-optimisation of the network and a re-adjusting of the feeding strategies which is more complex and costly for larger carriers.

Other factors as specific network characteristics (configuration hub and spoke, point to point) and flexibility of the fleet, i.e. the number of aircraft that can operate both on short and long haul route can impact on the importance of the adjustment costs[4].

>From a theoretical prospective adjustment costs represent a barrier to enter or exit the market and support the argument that the airline industry is not a contestable market but a multi-market oligopoly (Berry, 1992). The theory of contestable markets states that a market can be perfectly competitive with only a small number of firms operating in the market. This is true if the costs of entering and exiting the market are relatively low and if the incumbent reaction is delayed. If the carrier on the market (incumbent) rises the price above the competitive price then a new carrier (entrant) can enter the market with a lower fare, make profits, and exit before the reaction. A quick price reaction of the incumbent as well as adjustment costs inhibit the potential entrant to apply this "hit and run" strategy.

The existence of adjustment costs motivates the decision of changing the capacity offer only few times a year and in the meantime to compete in prices. Moreover, adjustment costs induce path-dependency since previous capacity offer impacts on the following choices. Therefore, closing or reducing routes during the crisis period implies direct adjustment costs but also indirect adjustment costs, and the latter comes when the carrier needs to re-expand.

4 Theoretical model

We consider an oligopolistic market[5] consisting of two firms, namely A and B. They produce a homogeneous good and compete in Bertrand-like price with limited capacity. More specifically, we assume that firms revise their capacity offer rarely since modifying their flight supply, they incur into adjustment costs.

The model is set in a continuous time framework and firms are profit maximisers. To keep things simple, we assume that at date 0 there is an unpredicted negative shock (that is described as a temporary reduction of the demand) and that firms modify their capacity offer only twice, one when the shock has occurred and another when it ends. In what follows we present a basic version where we assume that the duration of the crisis is known just after the shock is occurred. At the end of the section, we informally present some extensions which do not substantially change the main results of the model. Therefore, we start assuming no uncertainty on the duration of the crisis, no financial constraints and no differences in the adjustment costs. The timing of the game is as follows:

- (Stage 0) Before time 0, the market is on a long-term equilibrium, that means the capacity that firms A and B have chosen is the solution of a

[4] For instance the Boeing 767 can operate both short route within Europe and long haul between Europe and US whilst the Boeing 747-400 can not economically operate routes under 4000 km.

[5] In this model, we focus on a single market that corresponds to a single intercontinental route.

capacity-price game[6]. The outcome of this stage-game is J_0, K_0 and p_0, where J_0 and K_0 are respectively the capacity choice of firm A and B at stage 0 and p_0 is the equilibrium price at stage 0.

- (Stage 1) At time 0, there is an unpredicted (negative) shock in the demand with certain duration $\theta > 0$. Firms change their capacity[7] and afterwards, they enter a price-game. The outcome is summarised by J_1, K_1, p_1.
- (Stage 2) At time θ, the negative shock ends. Firms modify their capacities with a cost that is increasing in the capacity change[8]. Afterwards, firms play a price-game. In this case, the outcome is J_2, K_2, p_2.

We solve the model backwards starting from stage 2, then we move to stage 1.

We will only focus on the behaviour of firm A, since analogous solution is for firm B. The overall profit of firm A can be described as a sum of the discounted instantaneous profits. We call π_1^A and π_2^A the instantaneous profit of firm A at the stage 1 and 2 respectively[9]. The overall profit for firm A, namely Π^A, is:

$$\Pi^A = \int_0^\theta e^{-rt}\pi_1^A dt + \int_\theta^\infty e^{-rt}\pi_2^A dt = r^{-1}\left(1 - e^{-r\theta}\right)\pi_1^A + r^{-1}e^{-r\theta}\pi_2^A \qquad (1)$$

where r is the interest rate and e^{-rt} is the discount factor.

The second stage equilibrium is computed assuming that firms have already chosen their capacity in the first stage.

The inverse demand in the second stage is $p_2 = a - Q_2$ where Q_2 is the quantity supplied by both firms. During the crisis period $(0, \theta)$ the demand was $p_1 = b - Q_1$ with $0 < b < a$. At time $t \in [\theta, \infty)$, firms A and B maximise their profit given J_1 and K_1, where J_1 and K_1 are respectively the capacity choice of firm A and B in period 1. At time $t = \theta$, they choose the capacity J_2 and K_2, afterwards they compete in a Bertrand-like price competition[10].

In the second stage, per period profit of firm A is:

$$\pi_2^A = (b - c - J_2 - K_2)\, J_2 - D\,(J_1, J_2, \delta) \qquad (2)$$

[6] Because no costs of adjustment are assumed in stage 1, the equilibrium levels before time 0 do not impact on the choices in stage 1 and 2 but we maintain this assumption because it is necessary to consistently compute the capacity change.

[7] For simplicity, in the first stage, the capacity adjustment is costless.

[8] See for example Gould (1968).

[9] Because firms can not change their capacity offer during the stage, their per period profit is constant.

[10] We assume that firms can not collude so that the equilibrium is given by the solution of the static capacity-price game as in Kreps and Scheinkman (1983). For a critical analysis of the outcome of the capacity-price game see Davidson and Deneckere (1990).

where c is the unit-cost for the capacity setting and $D(J_1, J_2, \delta) = \delta(J_2 - J_1)^2$ are the (per-period) adjustment costs[11]. We define $J_2^* = J_2^*(J_1, K_1)$ the optimal capacity level in the second stage as function of J_1 and K_1. Hence, after some computations, the solution of the second stage game is:

$$J_2^*(J_1, K_1) = \frac{(1+2\delta)(a-c) + 4\delta(1+\delta) J_1 - 2\delta K_1}{4(1+\delta)^2 - 1}$$

Note that the optimal level J_2^* is affected by the costs of adjustment and by the decisions taken in the first stage, namely J_1 and K_1. The first stage instantaneous profit of firm A is given by:

$$\pi_1^A = (b - c - J_1 - K_1) J_1$$

The firms' behaviour in the first stage is drawn by the optimisation of the overall profit described by equation (1). For firm A, it is equivalent to maximise the following equation:

$$\max_{J_1} R\pi_1^A(J_1, K_1) + \pi_2^A(J_2^*, K_2^*, D) \tag{3}$$

where $R = \left(1 - e^{-r\theta}\right)/e^{-r\theta}$, $J_2^* = J_2^*(J_1, K_1)$ and $K_2^* = K_2^*(J_1, K_1)$ are the optimal capacity levels in the second stage respectively of A and B; and D are the adjustment costs of A. The solution of this optimisation problem is the reaction function of firm A in stage one.

First order condition implies that:

$$re^{rt}\frac{d\Pi^A}{dJ_1} = R\frac{d\pi_1^A}{dJ_1} + \frac{d\pi_2^A}{dJ_1} = 0$$

When firm A maximises the overall profit it balances its choice between the short-term effect and long-term effect. The short-term effect is the traditional result of the duopoly theory: $\frac{d\pi_1^A}{dJ_1} = (b - c - 2J_1 - K_1)$, while the long-term effect

$$\frac{d\pi_2^A}{dJ_1} = \frac{\partial\pi_2^A}{\partial J_1} + \frac{\partial\pi_2^A}{\partial J_2}\frac{\partial J_2^*}{\partial J_1} + \frac{\partial\pi_2^A}{\partial K_2}\frac{\partial K_2^*}{\partial J_1} + \frac{\partial\pi_2^A}{\partial D}\frac{\partial D}{\partial J_1} \tag{4}$$

is composed by 4 different impacts. The first and second terms of the RHS of equation (4) are null because J_1 does not directly affect π_2^A and because of the envelope theorem: $\frac{\partial\pi_2^A}{\partial J_2} = 0$. The third term captures the strategic effect and corresponds to the impact of J_1 on π_2^A due to a change in K_2^*: $\frac{\partial\pi_2^A}{\partial K_2}\frac{\partial K_2^*}{\partial J_1} = J_2^*\frac{2\delta}{4(1+\delta)^2-1}$. The sign of the strategic effect is always positive because the second stage actions are strategic substitutes (i.e. the reaction curves are downward

[11]For technical reasons, we assume that the adjsutment costs are persistent, that is they span in the interval $[\theta, \infty)$. Similar results can be obtained under the assumption that they only realyse at time θ.

sloping[12]). In fact, through increasing the capacity in the first stage a firm forces its competitor to reduce its capacity in the second stage. In literature this effect is called **pre-emption**. In the limit case (when $\delta = 0$), the strategic effect is not present.

The fourth term corresponds to the impact of J_1 on π_2 due to a change in D: $\frac{\partial \pi_2^A}{\partial D} \frac{\partial D}{\partial J_1} = 2\delta \left(J_2^* - J_1\right)$ and is positive as soon as $J_2^* - J_1 > 0$. It captures the resistance of a firm in reducing its offer in the first period since they have to bear high costs in the second period for increasing the capacity. Also this term is null when $\delta = 0$.

The presence of adjustment costs D, complicates the optimisation problem. In fact, the equilibrium solution in the first stage is characterised by strategic considerations as well as cost considerations on the choice of the second stage. The optimisation problem is clearly simplified when $\delta = 0$, where the equilibrium solutions are the usual one of a static duopolistic game: $J_1^* = J_b = \frac{b-c}{3}$ and $J_2^* = J_a = \frac{a-c}{3}$. In the general case, when $\delta > 0$, the optimal solution J_1^* is given by:

$$J_1^* = \frac{1}{3} \frac{R\left(1+2\delta\right)\left(2\delta+3\right)^2\left(b-c\right) + 8\delta\left(1+\delta\right)^2\left(a-c\right)}{R\left(1+2\delta\right)\left(2\delta+3\right)^2 + 8\delta\left(1+\delta\right)^2 - \frac{2}{3}\delta\left(2\delta+3\right)} \quad (5)$$

Rearranging previous equation, we have:

$$J_1^* = \left(1+o\right)\left(\lambda J_b + \left(1-\lambda\right)J_a\right) \quad (6)$$

where $\lambda = \frac{R(1+2\delta)(2\delta+3)^2}{R(1+2\delta)(2\delta+3)^2+8\delta(1+\delta)^2}$ and $o = \frac{\frac{2}{3}\delta(2\delta+3)}{R(1+2\delta)(2\delta+3)^2+8\delta(1+\delta)^2-\frac{2}{3}\delta(2\delta+3)}$.

In order to simplify the discussion of (6), we will focus on the second part of the equation[13]. The second bracket indicates that the solution is a combination of the long-term solution and the short-term solution of the static game. The weight λ and $(1-\lambda)$ depend on δ (the adjustment costs) and R (the duration of the crisis). Different values of these parameters modify the weights of short- and long-term solution of the static problem. If λ is close to 0 (R low or δ high) the solution J_1^* is close to J_a that is the long-term solution; contrary, if λ is close to 1 the solution J_1^* is close to J_b, that is the short-term solution.

Hereafter, we investigate the relationship between long-term and short-term profitability and the variation of the capacity offer.

We define $\Delta S = J_1^* - J_0^*$ the variation of the capacity supply, $\Delta P = (b-a)$ the fall in the short-term profitability and $Y = (a-c)$ the long-term profitability. Using equation (5), after some computations we have:

$$\Delta S = \frac{1}{3} \frac{R\left(1+2\delta\right)\left(2\delta+3\right)^2 \Delta P + 8\delta\left(1+\delta\right)^2 Y}{R\left(1+2\delta\right)\left(2\delta+3\right)^2 + 8\delta\left(1+\delta\right)^2 - \frac{2}{3}\delta\left(2\delta+3\right)} \quad (7)$$

[12] See: Fundemberg and Tirole (1984) and Bulow, Geanakoplos and Klemperer (1995).

[13] The first bracket is greater than one when $\delta > 0$ but is approximatly 1 whatever R is not too small, so that we can neglect it from our discussion. In fact $o < 0.01$ when $R > 0.6$ for every value of δ, and $o < 0.1$ when $R > 0.2$.

We define α_S and α_L the reactivity of the capacity variation to a change of the short and long-term indicator, respectively. They are defined as follows:

$$\alpha_S = \frac{\partial(\Delta S)}{\partial(\Delta P)} = \frac{1}{3}\frac{R(1+2\delta)(2\delta+3)^2}{R(1+2\delta)(2\delta+3)^2 + 8\delta(1+\delta)^2 - \frac{2}{3}\delta(2\delta+3)} \tag{8}$$

$$\alpha_L = \frac{\partial(\Delta S)}{\partial(Y)} = \frac{1}{3}\frac{8\delta(1+\delta)^2}{R(1+2\delta)(2\delta+3)^2 + 8\delta(1+\delta)^2 - \frac{2}{3}\delta(2\delta+3)} \tag{9}$$

Hence, replacing α_S and α_L in (7) we have:

$$\Delta S = \alpha_S \Delta P + \alpha_L Y \tag{10}$$

Equation (10) shows that the capacity reduction (or expansion) is a mixture of short- and long-term profitability[14] and equations (8) and (9) indicate that α_S and α_L depend on δ and R.

A change of the adjustment costs and of the duration of the crisis modifies the composition of the optimal reaction of the firms.

The ratio $\alpha_S/\alpha_L = \frac{1}{8}R(1+2\delta)\frac{(2\delta+3)^2}{\delta(\delta+1)^2}$ provides some indications on the responsiveness of the firm to a change in the adjustment costs. It is simple to verify that the ratio is decreasing in δ, meaning that an increase in the adjustment costs shifts the attention from the short-term to the long-term goals. Therefore firms care more about the future situation since that higher adjustment costs imply more pre-emption and more expanses to adjust to the long-term equilibrium.

The ratio α_S/α_L can be also used in order to analyse the impact of the duration of the crisis on the strategy composition. When the duration is short, α_S/α_L is large, while when the duration is long, α_S/α_L is small. This point has a very simple interpretation. If the shock is long, each firm will focus on the crisis period by reacting on the demand reduction. If the shock is short, the decision can be based on the post-crisis prospective, and hence on the long-term market profitability. Therefore when the duration is short the capacity reaction is driven by long-term profitability, whilst if the duration is long, the capacity reaction depends on short-term profitability.

Finally, we have to stress that as δ increases the carriers are less flexible. When carriers have low adjustment costs, they strongly react to a shock and when they have high adjustment costs they weakly react. We will clarify[15] this argument in section 5.3.

[14] In section 5, we will base our empirical analysis on equation (10). In section 5.3, figure 2, we will provide a graphical representation of α_S and α_L as a function of R and δ.

[15] A formal interpretation of flexibility is as follows. Let $J^*(\delta, R)$ be the capacity when the adjustment costs are δ and a measure of the lasting of crisis is R. For any δ and δ' such that $\delta' < \delta$, for every $R \in (0,\infty)$, there is a $R' \in (0,\infty)$ such that (a) $\frac{d}{da}J^*(\delta, R) < \frac{d}{da}J^*(\delta', R')$ and (b) $\frac{d}{db}J^*(\delta, R) < \frac{d}{db}J^*(\delta', R')$. Moreover, under the same conditions, there is not an R' such that both the inequalities hold if $\delta' > \delta$.

In what follows, we present the main conclusions of the extention of previous analysis in an informal way. We focus on three different situations: (1) when there is uncertainty about the crisis duration, (2) when firms have different adjustment costs and (3) when firm B has a financial constraint. In these cases we also observe different combinations of the short- and long-term indicators for the determination of the equilibrium choice.

First, we consider the case where firms have uncertainty about the duration of the crisis[16]. Each firm can base their predictions on their private information (f.e. the result of their research team and of the task-force created to face up the crisis). Each firm formulates their expectations independently from the other and chooses a capacity level. We assume that there are only two possible states of nature: $\theta = \{\theta_L, \theta_S\}$, where[17] $\theta_L > \theta_S$. We assume that each firm does not have knowledge of the opponent expectations and it bases its choice on its own information. If the firm expects $\theta = \theta_L$ it will focus more on the short-term aspects and hence α_L is low and α_S is large. If it expects $\theta = \theta_S$ it will be the opposite: α_S is low and α_L large.

Second, we consider the case where firms have different adjustment costs, for example $\delta_A > \delta_B$. In this situation, firm A will be more reactive to the long-term while firm B will be more reactive on the short-term.

Finally, we now assume that firm B can not choose to react as before since it has a financial constraint (that may depend on low liquidity or high pressure from investors, high debts and so on). In particular, firm B can find difficult, all things equal, to maintain high K_1^* in correspondence of low short-term profitability even if long-term profitability will be high. Therefore, firm B is characterised by low or null reaction to long-term indicators and strong reaction to short-term indicators that means high values of α_S and low values of α_L. Vice versa, firm A, knowing the situation of B, coeteris paribus, will profit by this situation, keeping higher α_L.

5 Empirical analysis

In this section the hypothesis that the capacity choice on a certain route depends on short- and long-term profitability has been investigated by an econometric analysis. Three cases are analysed. First, we test the basic properties of the theoretical model investigating how the capacity supply reacts to a demand fall and to the potential yield. Second, the impact of a demand fall is decomposed by carriers. Finally, the same procedure is applied to decompose the potential yield by carriers.

5.1 Data

We collected data on number of passengers per flow, available seats, average revenue per destinations and distance in kilometres from Europe to North American

[16] See also Bashyam (1996).

[17] Where L stands for "long" duration and S for "short" duration.

destinations. The database contains information on traffic flows from Europe [18] to the top 10 North American destinations[19] for the top 9 European carriers[20]. Since each carrier operates with hub and spoke structure (so that a intercontinental route decision only concerns with hub-destination and not with every city pair), traffic flows have been aggregated as described in the following example (see: Figure 1).

<<INSERT FIGURE 1>>

A carrier (KLM) flies on the intercontinental route (f.e. Amsterdam-New York) carrying traffic from the hub (Amsterdam) and the spokes (Manchester, Dusseldorf, Venice, etc..) to the final destination (New York). In order to determine the number of intercontinental passengers (Amsterdam-New York) we sum up the passengers originating from hub (Amsterdam) and spokes (Manchester, Dusseldorf, Venice, etc..) to the final destination (New York).

Data on the corresponding capacity supply is retrieved from OAG database.

Finally, data on yield have been collected from BSP database and concern the average revenue generated from Europe to the each North American destination.

Based on the above mentioned data, we compute the following variables:

ΔS_{ij}: CAPACITY (Percentage variation of seats supplied). It is calculated as the total number of seats offered by the carrier i to the North American destination j in November 01 minus the number of seats in September 01 divided by number of seats in September 01.

$$\Delta S_{ij} = \frac{S_{ij}^{NOV01} - S_{ij}^{SEP01}}{S_{ij}^{SEP01}}$$

Y_{ij}: YIELD (Yield per available seat kilometre before the 11th September 01, April-August 01). It is total revenue r_j generated by the total market (all points of sales in Europe) to the US destination j divided by the total passengers p_j flown to the destination j times the distance d_j. Finally, to better approximate the real yield (per flight), we correct this expression by the load factor (lf_{ij}) i.e. the percentage of the occupied seats on the aircraft of airline i flying to destination j.

$$Y_{ij} = \frac{r_j}{p_j d_j} lf_{ij}$$

As already mentioned, in this paper we assume that YIELD is the measure of the long-term profitability. Other authors used a similar measure of long-term profitability. For instance, Bruning and Hu (1988) measured the profit by a

[18] In this analysis we exclude the city pairs with less than 300 bookings per year. It means that we cover more than 95% of the traffic to the top 10 North American destinations.

[19] In our analysis, we define North America as Canada and US only. We exclude Mexican destinations due to the specificity of this market. The destinations are: New York, Chicago, Newark, Toronto, Washington, Atlanta, Los Angeles, Boston, Miami, San Francisco.

[20] Those are: Air France, Alitalia, British Airways, Aer Lingus, KLM, Iberia, Lufthansa, Scandinavian Airlines and Swiss (Air).

passenger profitability index which was the product of the revenue to cost ratio and the load factor. Indeed, information before the crisis is likely the basis to generate forecasting of the market situation after the crisis.

ΔP_{ij}: PAX (Percentage variation of bookings made in September 01 for the carrier i to the destination j vs. September 00):

$$\Delta P_{ij} = \frac{P_{ij}^{SEP01} - P_{ij}^{SEP00}}{P_{ij}^{SEP00}}$$

XX_i: Dummy variable designating the airlines i. It takes the following form: AF=Air France, AZ=Alitalia, BA=British Airways, EI=Aer Lingus, KL=KLM, IB=Iberia, LH=Lufthansa, SK=SAS, SR=Swiss (Air).

<< INSERT TABLE 5 >>

Table 5 presents some descriptive statistics of the main variables included in the econometric analysis. Data are presented per carriers and some extra information such as alliance and market share before and after the crisis are included in the table. Specifically, the third and fourth column provide an insight of the 11th September impact per carrier in terms of capacity (third column), and passenger (fourth column). We notice that Alitalia, Iberia, and Swiss faced the main passenger reduction (about 35%) and as a consequence the capacity was decreased by 24% for Alitalia, by 35% for Swiss but increased by 1% for Iberia. The reason for the Iberia increasing lays in the $first$ reaction of Iberia. The Spanish carrier reduced drastically the frequencies to New York and switch the aircraft to operate to Miami.

The fifth column presents the YIELD variable.

Finally the last three columns provide information on market share pre and post September 11th. Among the European carriers British and SAS gained market share after the crisis and Lufthansa, Aer Lingus and Alitalia lost respectively 8%, 25%, 33% of their market share. Iberia and AirFrance did not change their market position and Swiss lost almost all of the market due to its bankrupting[21]. In the next paragraph we try to explain these carriers conduct by means of econometric tools.

5.2 Econometric analysis

Three models are specified to test the hypothesis that capacity choice on a certain route depends on short- and long-term profitability.

Equation (11) related the capacity change to the variation of the YIELD and PAX variables as presented in equation (10):

$$\Delta S_j = \alpha_0 + \alpha_1 Y_j + \Delta P_j + \epsilon_j \tag{11}$$

[21] Swiss Air and Sabena bankrupted after September the 11 and demerged. Swiss is the new name of Swiss Air. The new company has been established on the old one after a few weeks.

The estimation of this equation, presented in Table 6, emphasises the strong effect of route profitability and demand shock on capacity supplied. The regression analysis explains one third of the variance of ΔS_j. The coefficients present the correct sign and are significant.

PAX coefficient equals to 0.61, which means that a 10% of the total demand reduction in the market induces the carriers to reduce the capacity by 6.1%. PAX variable measures the passenger variation occurred immediately after the crisis. As no carrier has changed their capacity offer in the months after the crisis, PAX does not depend by the change in the capacity offer and hence is exogenous to the model. Consequently, no identification problems are generated due to simultaneous changes in demand and supply behaviour.

YIELD coefficient is 5.7, which means that an increase of 12$ of revenue per passenger on a flight of 6500km will bring to a capacity increase of 1%.

<<INSERT TABLE 6>>

Specific reactions of the carriers to short-term and long-term profitability are computed in the following estimates. In equation (12) we have decomposed PAX by carriers.

$$\Delta S_j = \alpha_0 + \alpha_1 Y_j + \sum_i \beta_i \Delta P_j \cdot XX_i + \epsilon_j \tag{12}$$

The OLS estimation is presented in Table 7. The estimation explains 43% of the variance although not all the coefficients are statistically significant at 95%. The null hypotheses on the dummy coefficients of Air France, British Airways, Lufthansa and SAS are not rejected, which means that the reaction to the demand shock is low or null. The coefficients of Alitalia, KLM, Swiss are significantly different from zero and around 0.7. Iberia and Eer Lingus coefficients are still significant but with a stronger magnitude resulted into a value of around 1.2.

Hence, three groups with similar reactions to the demand shock can be identified. The first group, composed of Air France, British Airways, Lufthansa, SAS presented a low or null reaction, a second group including Alitalia, KLM and Swiss had a medium reaction and a third group formed by Aer Lingus and Iberia resulted the most sensible.

In equation (13) we have decomposed YIELD by carriers.

$$\Delta S_j = \alpha_o + \alpha_1 \Delta P_j + \sum_i \beta_i Y_j \cdot XX_i + \epsilon_j \tag{13}$$

The OLS estimation of the equation (12) is presented in Table 8. The coefficients of the specific carrier variables are all significant except for Swiss and Iberia. Based on the value of these coefficients we can identify again three groups. The first group includes Swiss and Iberia, with no significant YIELD coefficients (low or null reaction), the second includes KLM, SAS, Lufthansa with medium reaction to the YIELD and the last group formed by Eer Lingus, AirFrance, Alitalia, British Airways with high reaction.

<< INSERT TABLE 8 >>

In the next section the results are commented and interpreted in order to draw a picture of the airlines conduct.

5.3 Results

The main outcomes of the theoretical model can be explained by means of a simple scatter plot[22] (Figure 2).

<<INSERT FIGURE 2>>

The sensitivity of the carriers to short- and long-term profitability are displayed respectively on the horizontal axis and on the vertical axis. A point located on the upper left side identifies a carrier with long-term goals. On the other hand, a point plotted in the lower right side identifies a carrier which pursues short-term goals. Carriers plotted in the middle adopt a mixed conduct.

The graph shows three different lines, each one referring to a different level of adjustment costs. The closer the line to the origin and the higher the adjustment costs. The first line on the left side represents a carrier with high adjustment costs, the second one represents a carrier with intermediate adjustment costs and the third represents a carrier with low adjustment costs. The three markers on each line identify carriers with different expectations of crisis duration but with the same adjustment costs. The left upper plot on the line indicates expectation of short duration, the lowest on the same line indicates expectation of long crisis duration. Also a financial situation modifies the markers location in the graph: the stronger is the financial constraint and the higher is the reactivity to short-term profitability and the lower is the reactivity to long-term profitability.

The main factors affecting the carriers conduct and hence their positioning on the graph are adjustment costs and expectation on the crisis duration.

Adjustment costs reduce the flexibility of a carrier into three ways. Firstly, they decrease the mean flexibility making firms less respondent to short- and long-term variables. Indeed the line corresponding to high adjustment costs is the closest to the origin. Secondly, they decrease the discretional flexibility since different expectations on the crisis duration have low impact on the carrier's conduct. Indeed the length of the line is short. Finally, adjustment costs reduce the short-term flexibility, because firms become more interested in long-term profitability. Therefore, the line is close to the vertical axis. For these reasons, we define **a flexible carrier**, a carrier with low adjustment costs and a **non-flexible carrier** a carrier with high adjustment costs.

In this perspective, we expect that flexible carriers are located on a upper line whilst non-flexible carriers on a lower line.

<<INSERT TABLE 9>>

[22] This graph is generated assuming $R = 0.1, 0.2, 0.3$ and $\delta = 0.5, 1, 1.5$.

Table 9 presents two indicators, which provide information on the financial condition and the adjustment costs of the 9 European carriers. The financial indicator is presented in the first column. It consists in a qualitative judgement of the balance sheet based on debt to turnover ratio, cash flow to turnover. The second column presents the market shares for the traffic between Europe to North Atlantic over the period April-June 00 of the 9 European carriers.

As mentioned in section 2, market shares are a proxi for the costs of adjustment. Following this assumption, Lufthansa and British Airways are carriers with the highest adjustment costs (with a 10.8% and 10.1% of the market respectively), followed by Air France (6.6%) and KLM (5.2%), then Swiss (3.2%), Alitalia (3.0%) and finally Iberia (1.8%), Air Lingus (1.6%) and Scandinavian Airlines (1.5%).

Hereafter we present the result of econometric analysis. We assumed in the previous paragraphs that the YIELD is the measure of the long-term profitability and the PAX variation is the measure for short-term profitability. Therefore, we can use the framework of figure 2 and by displaying on the horizontal axis the PAX coefficients of equation (12) and on the vertical axis the YIELD coefficients of equation (13).The estimated coefficients are ploted in figure 3

<<INSERT FIGURE 3>>

Assuming a linking line is created between British Airways and Lufthansa and moving out of the origin with other parallel lines we can order the different behaviour of carriers depending on their flexibility. On the lowest line we locate Lufthansa and British Airways. On the next lines we locate Air France and KLM, followed by Alitalia. Aer Lingus and Iberia are located on the highest lines.

Swiss and Scandinavian Airlines do not fit this ordering. Scandinavian Airlines has 1.5% of the market share and should be plotted somewhere closer to Iberia and Aer Lingus. However, the Nordic carrier is plotted very close to Lufthansa. This might be explained by the strong commercial relationship between the two carriers. Apparently SAS is mimicking the Lufthansa strategy and the partnership affects not only commercial activities but also strategic actions.

The graphical position of the Swiss airlines might be explained by the financial situation that the carrier was facing at the time of the crisis. In fact, the theoretical model suggests that the financial constraints move carriers toward a short-term strategy. This is evident from the scatter, Swiss reacts to the crisis with a short-term strategy.

The expectation on the crisis duration is the second factor that effect the carrier conduct. In December 2001 no carrier has revealed their network planning for the next 12 months. As the crisis prediction is a strategic variable the carriers avoided as much as possible to give any external signal to the competitors. For this reason it was impossible to collect reliable data to measure this variable. We have no choice but to assume that the theoretical model is correct and make some kind of qualitative considerations. Combining figures 2 and 3 we notice that

British Airways expected a much shorter duration than Lufthansa. They lay on the same line but with opposite behaviours. Air France and Alitalia were more optimistic than Lufthansa. If it is not the case, the YIELD reaction of the two carriers should be lower than the one of Lufthansa. The same considerations can be applied to the other carriers. For example, Iberia and Aer Lingus expected longer duration of the crisis than KLM and KLM shorter than Lufthansa. Swiss should have the shorterst expected duration of the crisis but again its strategy might result from the financial problems of the company that forces its reaction in the short-term.

In table 10, we have classified the carriers' conduct by flexibility and expectations.

<<INSERT TABLE 10>>

British Airways expected a quick recovering of the crisis and is classified as non-flexible carrier. This can be deducted from the dominance of long-term conduct and a high market share. Lufthansa is classified as a non-flexible carrier with long expectations. Indeed its reaction was low. Air France and KLM seem to have similar reactions, i.e. a conduct balancing long-term and short-term profitability. They are both classified as medium flexible carriers with medium expectations on crisis duration. Small carriers like Iberia and Aer lingus are flexible. They expected the crisis to be short and therefore they also reacted on long-term profitability. Alitalia is a medium-high flexible carrier with short lasting expectations. We have excluded from our classification SAS and Swiss. SAS conduct could be easily included in our model only if we assume that the commercial agreement with Lufthansa involves also strategic cooperation implying a mimicking behaviour to the German carrier. Swiss conduct is explaned by its financial situation which reduced the set of strategic choices to the disadvantages of long-term component. For this reason we omit it as we can not easily discover its prediction on the duration.

6 Conclusions

This paper provides a theoretical and empirical analysis of the conduct of European carriers after September 11th. An important assumption of the model is the existence of positive adjustment costs, that is carriers face difficulties to reinstate the closed route. Adjustment costs introduce some rigidities in the carriers' conduct reducing their flexibility. Indeed, non-flexible carriers typically present small reaction to short- and long-term variables and a conduct oriented to long-term component. This behaviour results from the fact that a non-flexible carrier sets high capacity levels during the crisis to push the competitors out of the market and to reduce the set-up costs of re-entering. On the other hand, flexible carriers present high responsiveness to both short- and long-term profitability and a conduct driven by short-term goals. They can be small during the crisis period to reduce the losses and free to expand in the post-crisis period. Carriers' strategies are also affected by expectations on the crisis duration. If a carrier expects a long duration then its conduct shifts to the short-term indicator. If the expected duration is short then the carrier bases its strategy on the long-term variable.

In general, carriers' conduct, except for SAS, Swiss, fits the theoretical framework. As expected, the conduct of larger carriers as British Airways and Luthansa is in accordance with a profile of non-flexible carrier, the conduct of medium-sized carriers as AirFrance, KLM and Alitalia corresponds to a profile of medium flexible carrier and finally the behaviour of Iberia and Aer Lingus, the smaller carrier corresponds to a situation of high flexibility. Observing the mix of short- and long-term goals, we also find that British Airways, Alitalia, Iberia and Aer Lingus are optimistic about the duration of the crisis whilst Air France, KLM and especially Lufthansa are more pessimistic expecting a long duration of the crisis.

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Table 1

Bookings Index Europe - US (all carriers)

Month	Economy	Business	Total
Jun. 01	102	94	101
Jul. 01	98	86	97
Aug. 01	98	87	97
Sep.01	89	69	87
Oct. 01	77	58	74
Nov. 01	76	66	74
Dec. 01	83	72	81
Gen. 01	83	75	82
Feb. 01	83	81	83
Mar. 01	84	76	83
Apr. 01	73	84	74
May. 01	79	79	79

Source: KLM internal dB

Table 2

RPK/ASK Index (European carriers)

Month	RPK	ASK
Jun. 01	96	101
Jul. 01	94	101
Aug. 01	99	102
Sep.01	97	101
Oct. 01	96	101
Nov. 01	74	85
Dec. 01	67	82
Gen. 01	69	74
Feb. 01	79	76
Mar. 01	83	76
Apr. 01	87	77
May. 01	85	77

Source: AEA

Table 3

Scheduled and planned capacity per gateways (index)

Gateways	III-01	IV-01	I-02	II-02	III-02	IV-02
Atlanta	78	53	64	78	84	129
Boston	110	70	73	90	102	127
Chicago	103	90	99	87	90	106
Los Angeles	93	95	89	102	89	98
Miami	103	110	92	102	100	107
New York	98	71	75	86	82	120
Newark	102	82	61	96	83	103
San Francisco	105	84	76	84	70	106
Toronto	124	89	92	89	92	122
Washington	122	79	83	97	105	134

Source: OAG

Table 4

Scheduled and planned capacity per carriers (index)

Carriers	III-01	IV-01	I-02	II-02	III-02	IV-02
AF	115	82	85	86	89	117
AZ	113	76	66	91	57	106
BA	98	83	89	94	94	111
EI	110	85	79	66	65	86
IB	112	113	90	93	94	80
KL	100	80	81	83	89	119
LH	110	92	82	104	95	112
SK	116	88	88	97	94	128
SR	109	65	65	69	78	122

Source: OAG

Table 5

Descriptive Statistics

Carrier	Alliance	Capa-city[1]	Passen-gers[2]	YIELD[3] in euro	Destin-ations[3]	Market Shares[4] (A)	(B)	(C)
AF	Sky Team	-18%	-20%	702	10	6.6%	6.6%	100
AZ	Sky Team	-24%	-36%	574	7	3.0%	2.0%	67
BA	OneWorld	-17%	-22%	673	10	10.1%	11.8%	116
AL	OneWorld	-15%	-10%	674	5	1.6%	1.2%	75
IB	OneWorld	1%	-37%	726	3	1.8%	1.8%	100
KL	Wings	-18%	-20%	683	10	5.2%	5.3%	102
LH	Star	-8%	-16%	687	10	10.8%	9.9%	92
SA	Star	-12%	-6%	679	3	1.5%	2.0%	131
SR	Qualiflyer	-35%	-34%	690	8	3.2%	0.5%	17

Note: [1] difference Nov01vs.Sep01 in nr.of seats, [2] % difference Sep01vs.Sep00 in bookings, Before the 11th September, [4] (A) Apr01-Jun01, (B) Apr02-Jun02, (C) index

Table 6

Estimation results of equation 11

Variable	Coeff.	Std. Error	t Stat.	P-value
Intercept	-0.37	0.14	-2.71	0.0087
YIELD	5.68	1.94	2.92	0.0048
PAX	0.61	0.14	4.50	0.0000

R^2=0.29 AdjR^2=0.27 Obs.=67

Table 7

Estimation results of equation 12

Variable	Coeff.	Std. Error	t Stat.	P-value
Intercept	-0.45	0.15	-2.97	0.00
YIELD	6.51	2.12	3.06	0.00
AF	0.43	0.51	0.85	0.40
AZ	0.62	0.33	1.90	0.06
BA	0.00	0.31	0.02	0.99
EI	1.12	0.48	2.33	0.02
IB	1.19	0.40	2.97	0.00
LH	0.43	0.54	0.78	0.44
KL	0.70	0.29	2.39	0.02
SK	0.45	0.71	0.63	0.53
SR	0.69	0.37	1.85	0.07

R^2=0.43 AdjR^2=0.32 Obs.=67

Table 8

Estimation results of equation 13

Variable	Coeff.	Std. Error	t Stat.	P-value
Intercept	-0.43	0.14	-2.82	0.01
PAX	0.75	0.15	5.27	0.00
AF	7.31	2.69	2.72	0.01
AZ	9.15	2.47	3.71	0.00
BA	10.55	3.33	3.17	0.00
EI	7.42	2.95	2.51	0.01
IB	8.96	6.12	1.46	0.15
LH	5.75	2.40	2.40	0.02
KL	5.81	2.09	2.78	0.01
SK	6.10	3.49	1.75	0.09
SR	2.31	2.85	0.81	0.42

R^2=0.44 AdjR^2=0.33 Obs.=67

Table 9

Carriers' characteristics and expected conduct.

Carrier	Adjustment costs [market share]	Financial Situation [CF/turn,Debt/MP]
AF	medium [6.6]	high [10.82, 1.3]
AZ	low [3.0]	low [0.8, 1.2]
BA	high [10.1]	high [8.9, 2.2]
EI	low [1.6]	medium [n.a., 2.2]
IB	low [1.8]	high [8.4, 1.8]
KL	medium[5.2]	medium [7.5, 2.3]
LH	high [10.8]	high [10.1, 2.0]
SK	low [1.5]	medium/low [2.5, 1.7]
SR	low [3.2]	low [n.a., n.a.]

Source: Amadeus dB.

Table 10

Expectation on crisis duration and flexibility

	long duration	medium duration	short duration
non-flexible	Lufthansa		British Airways
medium flexible		AirFrance - KLM	Alitalia
flexible			Iberia - Aer Lingus

Swiss and SAS are not classified.

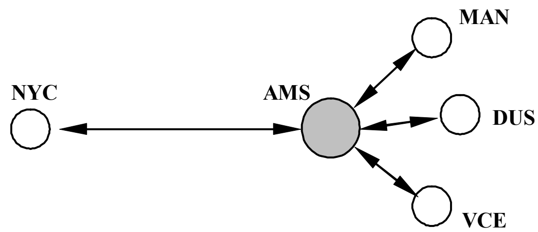

Figure 1: Hub and Spoke structure

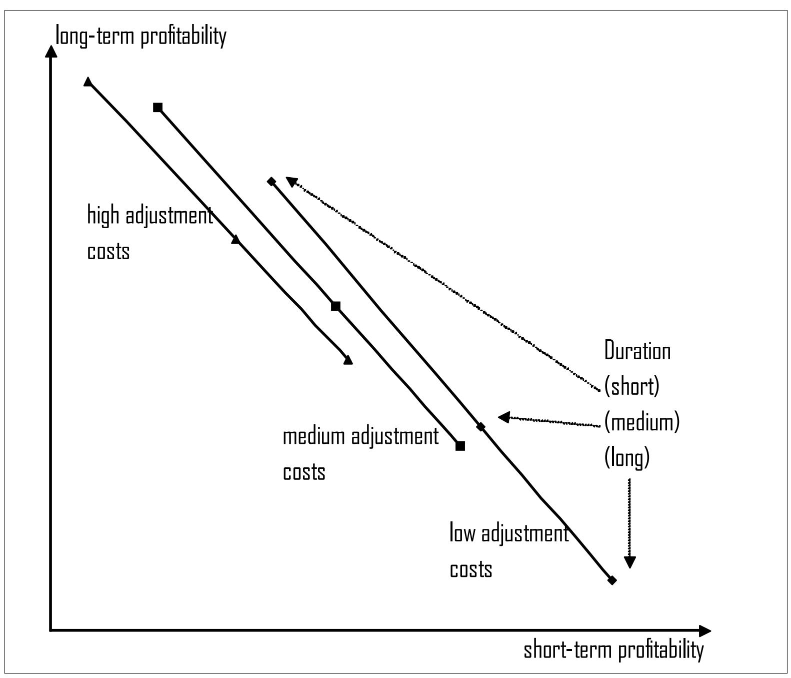

Figure 2: Expected impact of short and long-term profitability reaction depending on the adjustment costs and the duration of the crisis

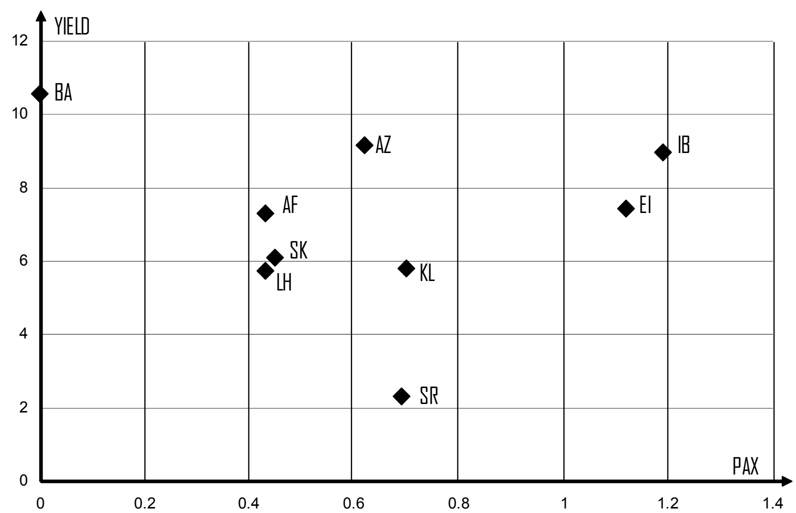

Figure 3: Classification of firms in terms of short- and long-term reaction