14 Short- and Long-Term Reaction of European Airlines to Exogenous Demand Shifts[1]

Marco Alderighi[1] and Alessandro Cento[2]

[1] Università della Valle d'Aosta, Aosta, Italy; Università Bocconi , Milan, Italy
[2] KLM Royal Dutch Airlines, Milan, Italy

14.1 Introduction

In less than 10 years, the liberalisation of the European airline industry has moved flag carriers in highly competitive environment. The reason for this clearly follows from the peculiarity of this industry: airline carriers have to produce one of the most perishable goods (passenger transport) in one of the most dynamic industries. This fact has forced carriers to implement and refine practices and strategies to react promptly to the ups and downs of the demand. It is common practice that daily fluctuations are usually controlled by advanced pricing policies, called 'yield management', while long-lasting demand shifts require a reaction in terms of advanced capacity strategies, called 'tactical planning'.

In this paper, we focus on this second aspect. Exploring the behaviour of carriers in such a complex context seems to be very difficult unless it is based on particular situations as important demand shifts. Recently, two terrible events have characterised the world economy: the September 11 terrorist attack on the Twins Towers in New York and on the Pentagon in Washington in 2001, and the SARS epidemic in East Asia which begin in February 2003. These events have produced two dramatic crises especially in the North American and the Asian market, respectively. By analysing these two important demand shifts, we are able to detect some determinants of the carriers' conduct. In particular, we have split the carriers' conduct into short- and long-term determinants to capture information about carrier's strategies (internal policy, expectations for the evolution of the markets, etc.) and its specific characteristics (structure of the network, adjustment costs, financial situation). To be comprehensive, an analysis based on short- and long-term components needs to be both theoretical and empirical. From a theoretical point of view, we show that, if capacity variations are costly, it is optimal to base a

---

capacity reaction on both short- and long-term profitability where the right mix depends upon the importance and duration of the shock. From an empirical point of view, we can explain the carrier's capacity choices with two variables: the passenger reduction due to the shock, and the expected profitability of the market.

To clarify the first point, suppose that an unexpected shock reduces the demand. A carrier can react by decreasing its offer but incurring a cost of adjustment. If the shock is brief, the carrier's choice during the crisis period is mainly based on the expected situation after the crisis. In fact, its reaction aims to limit the costs of reducing and restating the capacity. On the contrary, when there is a long-lasting shock, the carrier focuses on the crisis period as post-crisis profits are far away and their discounted value is low. Adjustment costs also induce carriers to behave strategically. In fact, a carrier that increases (or decreases less) the capacity during the crisis period, forces its competitor to reduce its capacity offer in the post-crisis period. This phenomenon is known in the literature as 'pre-emption'. Pre-emption reduces the reactivity of the carrier to the shock during the crisis.

Theoretical results are based on the assumption that carriers encounter adjustment costs in changing the network configuration, so that their choice depends on short- and long-term variables. Empirically, we observe that any modification of the flight supply involves costs. For instance, a carrier that decides to enter a new route needs to have new rights at the airport (slot), organise new staff, promote and advertise the new route, launch price actions and so on. Moreover, in the short-term, the aircraft for the new route should be moved from another route to the new one, and the logistic activity should be adjusted to the new aircraft rotations. Moreover, reducing frequencies or closing a route is a costly decision seeing that a carrier needs to change the aircraft rotations or definitely ground a plane. 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 from or reduce it.

Adjustment costs are usually high for large carriers (carriers with higher market shares), since they employ local ground staff, but 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, which is more complex and costly for larger carriers. Other factors such as specific network characteristics and the flexibility of the fleet, i.e. the number of aircraft that can operate both on short and long haul routes can have an impact on the importance of the adjustment costs. The existence of adjustment costs motivates the decision to change the capacity supply only few times a year and in the meantime to compete in prices. Data support our conjecture that there is a positive relation between market shares and costs of adjustment, even if this result is clearer for the North American crisis than for the Asian crisis.

In these two crises, the typology of the shocks and the characteristics of the markets are different. Nevertheless, some related results seem to emerge. The empirical analysis confirms that there is a trade-off between short- and long-term goals among carriers facing the same crisis, for both the first and the second crisis. We may note that after the first shock, some carriers: namely British Airways and

Air France, shifted from long-term to short-term reaction. There are many explanations for this unexpected result. For example, it may originate from an underestimation of the duration of the crisis in the first shock and an overestimation in the second shock. Another interpretation may be that carriers believe the American market is more strategic than the Asian market. Alternatively, high operating costs and low margins, combined with continuing turbulences have induced carriers to focus on the short-term rather than on the long term.

Carriers determine the capacity supply through a process called network planning. This process is usually organised on 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, which will takes place every semester; 3) operational actions: pricing strategies and small adjustments of the network to improve operations such as reducing connections time at the hub, ad-hoc changes of the aircraft size on a few days. This process follows the short-term demand fluctuation and competitor moves. Each step of network planning is widely analysed in the literature. Chang and Williams (2002) and Janic (1997) investigate the relation between the liberalisation, alliance and performance of the airlines. Chin and Tay (2001), Smith (1997), and Bruning and Hu (1988) focus on the profitability and investment decision of North American and Asian carriers. Finally, Borenstein (1989), Windle and Dresner (1995, 1999) give attention to operational choices, i.e. pricing equilibrium and market competition.

Our analysis attempts to propose an integrated model which considers operational, tactical and strategic decisions in a crisis situation. 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 plan (i.e. the choice of a strategy to solve the overall game). The empirical model does not consider operational decisions but focuses on tactical and strategic plans that are driven by short- and long-term indicators, respectively.

Recently, the literature has proposed new research in the field of the airline crisis. In particular, Alderighi and Cento (2004) and Hätty and Hollmeier (2003) present a view of the airline crisis after the September 11. The first contribution is strongly related to this paper, being divided into two parts, one dealing with theoretical framework and an other with the results of the North American crisis. The second contribution originates from the internal debate in the crisis management unit at Lufthansa Airlines. In this study, it is shown that the reduction of air traffic demand was matched by industry capacity reduction. When demand declines, capacity can not be adjusted immediately due to the insufficient flexibility. These authors conclude that managing the crisis aims not only to restore the pre-crisis state but rather to form a more healthy business environment. In addition, Gillen and Lall (2003) examine shock transmission in the airline industry after September 11. Their research attempts to identify three main propagation channels: the trade effect; the alliance effect; and the wake-up call effects.

The remainder of this paper is organised as follows: Sect. 14.2 presents a brief description of the airline sector during the North American and Asian crises. In Sects. 14.3 and 14.4, we provide the theoretical model and the empirical analysis, respectively. The final conclusions are presented in Sect. 14.5.

14.2 Exogenous Demand Shifts: The American and Asian Crises

The September 11 terrorist attack on United States and the SARS epidemic in Asia had a strong impact throughout the airlines sector. The North America crisis has been the most tragic shock that the industry has faced in its recent history. The SARS shock strongly hampered the carriers' expectation for the development of the Asian market. In the next two sub-section we provide some facts and figures that describe the shocks and the subsequent reactions of the European carriers. The description is also necessary to support some of the methodological decisions that have been taken in the econometric analysis.

14.2.1 The September 11 Terrorist Attack

On 11 September 2001, one Boeing of American Airlines and one of United Airlines were diverted by terrorists to crash on the Twin Towers in New York City, and a third Boeing of America Airlines was diverted to crash on the Pentagon in Washington. For security reasons the North American air space was closed for the next five days. Eight days after the terrorist attack the Lufthansa Chief Executive Officer Jurgen Weber, made the following statement:

"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, 19 September 2001).

The revenue passenger kilometres (RPK)[2] and the available seat kilometres (ASK)[3] are two relevant market indicators to understand the impact of the crisis on the airline industries. The indicators refer to the transatlantic traffic generated by European carriers to North Atlantic destinations; they are seasonally adjusted and

---

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

[3] The ASK is the number of seats offered by the carriers on a certain route multiplied the route length (in kilometres).

observed as a year-to-year index. Before the terrorist attacks, the RPK between Europe and North America had a zero growth, afterwards RPK dropped significantly in October (–26%) and reached its lowest point in November (–33%). The European carriers' reacted to adjust their capacity in November (–15%). Afterwards the capacity reduction continued until January 2002, when it reached the lowest point of the crisis (–26%).

The indicators are plotted in Fig. 14.1. The two series are clearly affected by a strong downturn, in October for the RPK, and in November for ASK. The market had fully recovered from the crisis in terms of RPK in February 2003, and in terms of ASK in March 2003. The crisis had therefore lasted about 17 months, but it is clear that the carriers did not know this in September 2001, as at that time Mr. Jurgen Weber (Lufthansa CEO) stated that:

"… there is uncertainty about the length and effect of the crisis and the future developments in the aviation industry."

Nevertheless management expected that the crisis would be long. KLM President & CEO Leo van Wijk reported in a press release that:

"...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..."

In general, carriers reduced their capacity supply by cutting the frequencies and the aircraft size, or closing routes. For example, KLM adjusted its flights to the US by reducing weekly frequencies to New York (from 13 to 11), to San Francisco (from 7 to 6), to Miami (from 7 to 5), and to Detroit (from 4 to 3). 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). The year-to-year index of ASK decreased to below 100 in the last quarter of 2001 (Oct–Dec), immediately after the September demand shift. Some carriers, such as British Airways, Alitalia or KLM, seemed to reduce their capacity already in September 2001, as the index fell lower than 100. Nevertheless, these indexes showed the same negative growth even before the crisis. These carriers were already in a capacity- reduction process, regardless of the forthcoming crisis. On the other hand, other carriers such as Air France, Aer Lingus, and SAS had an index above 100 in the third quarter, since they were registering a positive trend before the crisis. In this perspective, the indices cannot be compared among the carriers but only in terms of the trend over time. In the last quarter of 2001, the carriers reduced their capacity supply, and the cut ranged from –39% of Swiss[4] to – 4% of SAS.

---

[4] The name "Swiss", as opposed to " Swiss Air", has been adopted throughout this paper, as SwissAir went bankrupt after September 11 crisis, after which a new airline with the name Swiss was created.
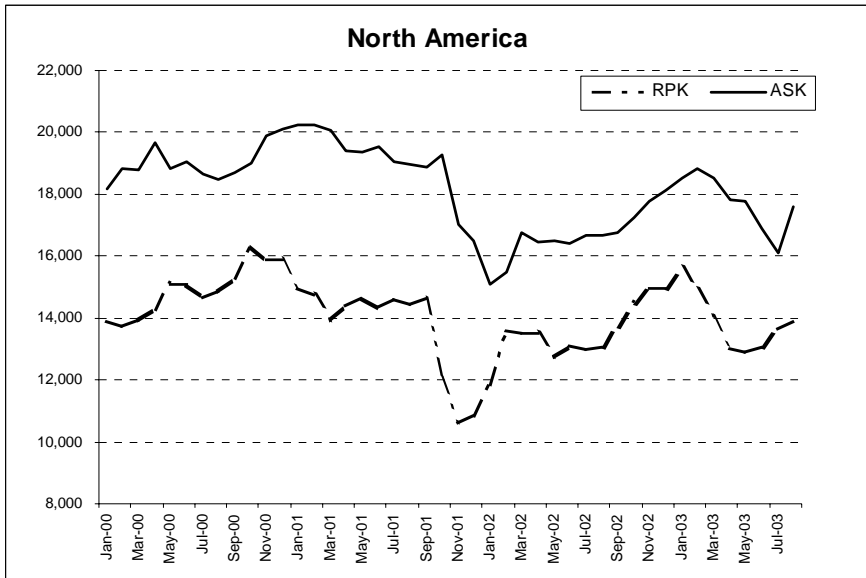
Fig. 14.1. RPK and ASK from Europe to North America (Source: AEA seasonally adjusted)

14.2.2 The SARS Epidemic

The severe acute respiratory syndrome (SARS) is a respiratory illness caused by a virus. SARS was first reported in Asia in February 2003. Over the next few months, the illness spread to more than two-dozen countries in North America, South America, Europe, and Asia. According to the World Health Organisation, during the SARS outbreak of 2003, a total of 8,098 people worldwide became sick with SARS; and of these, 774 died. Most of the SARS cases in Europe were among travellers returning from other parts of the world, particularly from Asia. As the main way that SARS appears to spread is by close person-to-person contact, fears of contagion and the official travel advice to defer non essential travel generated a shock in the demand, mainly for air transport to Asia and Canada.

Before the epidemic spread, the RPK from Europe to Asia was still recovering from previous crises (September 11, the Afghanistan war and the October 2002 Bali terrorist attack) and showed positive growth. After these crisis, the negative trend is again evident in March (–8%), just one month after the first SARS case was reported. During the succeeding months, the demand sank (–22% in the April RPK), and reached its lowest point in May 2003 (–30%). The European carriers reaction is captured by the ASK index. The capacity adjustment started two months later in May 2003 (–15%) and continued in the next two months (June 2003 –15%, July –8%).
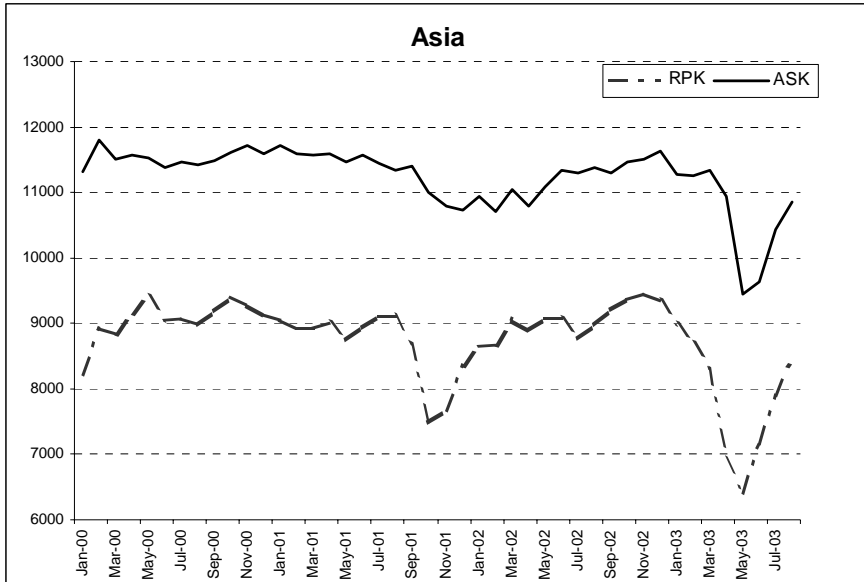
Fig. 14.2. RPK and ASK from Europe and Asia (Source: AEA seasonally adjusted)

The two indicators are plotted in Fig. 14.2. The time path is clearly affected by the two big crises, i.e. September 11 and SARS. Both negative shocks can be detected in the plotted time series; nevertheless, the effects were different in terms of both magnitude and the recovery path to the pre-crisis situations. Due to the September 11 attack, the RPK decreased to the lowest value of 7499, while the lowest point reached in the SARS crisis was even lower (6403). In the first crisis, the downturn of the RPK come in October 2001. A minor shift was registered in December 2002 due to the announcement of the Iraqi war, which generated negative expectations of travel security and economic development in the Asian areas. In the second crisis the drop was in March 2003 and became strong in April 2003. Later, in August 2003, the crisis does not seem to be completely absorbed by the market. Over the first quarter of 2003 (Jan–Mar), the carriers considered were still enjoying a phase of expansion the only exception being British Airways which was stable for almost all 2002 with an index of 81–87. In the second quarter of 2003 (Apr–Jun), ASK fell drastically for every carrier, with different magnitudes, ranging from 18% for Swiss to 8% for KLM and British Airways.

As in the previous crisis, European carriers reduced their capacity in term of frequencies, aircraft size, and routes. Additionally, airlines also adjusted their capacity also by introducing triangular services. The Asian routes are on average 3000 longer than those in North America, and passengers are willing to tolerate a stop service in order to keep the same number of frequencies. Triangular flights

are one way for a carrier to introduce a temporary modification of capacity supply, as reported in a KLM press release:

   "..the capacity adjustments particularly on routes to Asia and North America are made in response to declining demand resulting from developments surrounding the SARS virus. All schedule adjustments are temporary…"

   The Dutch airlines reduced their capacity by cutting the frequency on the routes: Amsterdam-Shanghai (from 5 to 4 weekly roundtrips),[5] Amsterdam-Beijing (from 4 to 2 weekly circle trips via Shanghai); Amsterdam-Hong Kong (from 7 to 4 weekly round trips) and Amsterdam-Singapore-Jakarta (from 7 to 5 weekly round trips).

   Comparing the SARS crisis in Asia to that of September 11 in North America, we observe that the crises are similar in terms of shock magnitude but different in terms of time duration. Both recorded a demand reduction equal approximately to 30–36%, and while the September 11 crises lasted for 17 months, that of SARS was only 6–7 months long. In terms of capacity reduction, the carriers also reacted similarly to both shocks. Nevertheless, the reaction to September 11 was drastic but delayed by two months, while the reaction to SARS seems quicker and limited (–15% capacity reduction versus a RPK reduction of 30%). The question that arises is: How do the carriers react to crisis situations and how can this be modelled in order to explain their general behaviour?

14.3 The Theoretical Model

We consider duopolistic market[6] consisting of two firms: namely, *A* and *B*. They compete in quantities (capacities), and we assume that firms revise their capacity supply only rarely since, in modifying their flight supply, they incur adjustment costs.

   The model is set in a continuous time framework, and firms are profit maximises. 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 supply only twice, once when the shock has occurred and again 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 has 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 by assuming no uncertainty regarding the duration of the crisis, no financial constraints, and no differences in the adjustment costs. The timing of the game is as follows:

---

[5] A round trip flies there and back on the same route. A circle trip flies from the origin on the outward journey, stopping at one or more places on route, and it flies straight back from the final destination without stopping on route.

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

- (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 Cournot game.[7] 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 a certain duration $\theta > 0$. Firms change their capacity.[8] The outcome is J_1, K_1 and 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.[9] In this case, the outcome is J_2, K_2 and p_2.

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

We will only focus on the behaviour of firm A, since there is an analogous solution for firm B. The overall profit of firm A can be described as the sum of the discounted instantaneous profits. We call π_1^A and π_2^A the instantaneous profit of firm A at Stage 1 and 2, respectively.[10] The overall profit for firm A, namely Π^A, is:

$$\Pi^A = \int_0^\theta e^{-rt}\pi_1^A dt + \int_\theta^\infty e^{-rt}\pi_2^A dt = r^{-1}\left(1 - e^{-rt}\right)\pi_1^A + r^{-1}e^{-rt}\pi_2^A \tag{14.1}$$

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

The Stage 2 equilibrium is computed assuming that firms have already chosen their capacity in the first stage.

The inverse demand in the second Stage 2 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 Stage 1. At time $t = \theta$, they choose the capacity J_2 and K_2 to maximise their profits.

In the Stage 2 , the period profit of firm A is:

$$\pi_2^A = \left(b - c - J_2 - K_2\right)J_2 - D\left(J_1, J_2, \delta\right) \tag{14.2}$$

---

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

[8] For simplicity, in Stage 1, the capacity adjustment is costless.

[9] See, a. g. Gould (1968).

[10] Because firms can not change their capacity supply during these stages, their per period profit is constant.

where c is the unit-cost for the installed capacity and $D(J_1, J_2, \delta) = (J_2 - J_1)^2$ 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 2 as a function of J_1 and K_1. Hence, after some computations, the solution of the Stage 2 of the game is:

$$J_2^*(J_1, K_1) = \frac{(1 + 2\delta)(a - c) + 4\delta(1 + \delta)J_1 - 2\delta K_1}{4(1 + \delta)^2 - 1}. \tag{14.3}$$

Note that the optimal level J_2^* is affected by the costs of adjustment and by the decisions taken in Stage 1: namely, J_1 and K_1. The Stage 1 instantaneous profit of firm A is given by:

$$\pi_1^A = (b - c - J_1 - K_1)J_1 \tag{14.4}$$

The firms' behaviour in the Stage 1 is determined by the optimisation of the overall profit described by Eq. (14.1). For firm A, this is equivalent to maximisation of the following equation:

$$\max_{J_1} R\pi_1^A(J_1, K_1) + \pi_2^A\left(J_2^*, K_2^*, D\right), \tag{14.5}$$

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 of A and B respectively, in Stage 2 and D are the adjustment costs of A. The solution of this optimisation problem is the reaction function of firm A in Stage 1.

The first order condition implies that:

$$re^{rt}\frac{d\Pi^A}{dJ_1} = R\frac{d\pi_1^A}{dJ_1} + \frac{d\pi_2^A}{dJ_1} = 0. \tag{14.6}$$

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: $\dfrac{d\pi_1^A}{dJ_1} = (b - c - 2J_1 - K_1)$, while the long-term effect

---

[11] For technical reasons, we assume that the adjustment costs are persistent, i.e. they span the interval $[\theta, \infty)$. Similar results can be obtained under the assumption that these costs are only realised at time θ.

$$\frac{d\pi_2^A}{dJ_1} = \frac{\partial \pi_2^A}{\partial J_1} + \frac{\partial \pi_2^A}{\partial J_2}\frac{\partial J_2^*}{\partial J_1} + \frac{\partial \pi_2^A}{\partial K_2}\frac{\partial K_2^*}{\partial J_1} + \frac{\partial \pi_2^A}{\partial D}\frac{\partial D}{\partial J_1} \tag{14.7}$$

is composed of 4 different impacts. The first and second terms of the RHS of Eq. (14.7) 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 Stage 2 actions are strategic substitutes (i.e. the reaction curves are downward sloping[12]). In fact, through increasing the capacity in Stage 1, a firm forces its competitor to reduce its capacity in Stage 2. In the literature, this effect is called 'pre-emption'. In the limit case (when δ=0), the strategic effect is not present.

The fourth term corresponds to the impact of J_1 on π_2^A due to a change in D: $\frac{\partial \pi_2^A}{\partial D}\frac{\partial D}{\partial J_1} = 2\delta(J_2^* - J_1)$, and is positive as soon as $J_2^* - J_1 > 0$. It captures the resistance of a firm in reducing its capacity in Stage 1 since it has to bear high costs in Stage 2 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 Stage 1 is characterised by strategic considerations as well as cost considerations regarding the choice of Stage 2. The optimisation problem is clearly simplified when $\delta = 0$, where the equilibrium solutions are the usual ones 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:

$$J_1^* = \frac{1}{3}\frac{R(1+2\delta)(2\delta+3)^2(b-c) + 8\delta(1+\delta)^2(a-c)}{R(1+2\delta)(2\delta+3)^2 + 8\delta(1+\delta)^2 - \frac{2}{3}\delta(2\delta+3)} \tag{14.8}$$

Rearranging previous equation, we have:

$$J_1^* = (1+o)(\lambda J_b + (1-\lambda)J_a) \tag{14.9}$$

where

$$\lambda = \frac{R(1+2\delta)(2\delta+3)^2}{R(1+2\delta)(2\delta+3)^2 + 8\delta(1+\delta)^2}, \tag{14.10}$$

and

---

[12] See Fundemberg and Tirole (1984), and Bulow et al. (1995).

$$o = \frac{\frac{2}{3}(2\delta + 3)}{R(1 + 2\delta)(2\delta + 3)^2 + 8\delta(1 + \delta)^2 - \frac{2}{3}(2\delta + 3)}. \tag{14.11}$$

In order to simplify the discussion of Eq. (14.9), 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 weights λ and $(1 - \lambda)$ depend on θ (the adjustment costs) and R (the duration of the crisis). Different values of these parameters modify the weights of the short- and long-term solution of the static problem. If λ is close to 0 (R low or θ high) the solution J_1^* is close to J_a, i.e. the long-term solution; on the other hand, if λ is close to 1 the solution J_1^* is close to J_b, i.e. the short-term solution.

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

We define $\Delta S = J_1^* - J_0^*$ as 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 Eq. (14.8), after some computations, we have:

$$\Delta S = \frac{1}{3} \frac{R(1 + 2\delta)(2\delta + 3)^2 \Delta P + 8\delta(1 + \delta)^2 Y}{R(1 + 2\delta)(2\delta + 3)^2 + 8\delta(1 + \delta)^2 - \frac{2}{3}(2\delta + 3)}. \tag{14.12}$$

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

$$\alpha_S = \frac{\partial(\Delta S)}{\partial(\Delta P)} = \frac{1}{3} \frac{R(1 + 2\delta)(2\delta + 3)^2}{R(1 + 2\delta)(2\delta + 3)^2 + 8\delta(1 + \delta)^2 - \frac{2}{3}\delta(2\delta + 3)} \tag{14.13}$$

and

$$\alpha_S = \frac{\partial(\Delta S)}{\partial Y} = \frac{1}{3} \frac{8\delta(1 + \delta)^2}{R(1 + 2\delta)(2\delta + 3)^2 + 8\delta(1 + \delta)^2 - \frac{2}{3}\delta(2\delta + 3)}. \tag{14.14}$$

Hence, replacing α_S and α_L in Eq. (14.12), we have:

$$\Delta S = \alpha_S \Delta P + \alpha_L Y \tag{14.15}$$

---

[13] The first bracket is greater than 1 when $\delta > 0$, but is approximately 1 whenever 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 $R > 0.2$.

   Equation 14.15 shows that the capacity reduction (or expansion) is a mixture of short- and long-term profitability,[14] and Eqs. (14.13–14) 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 $\alpha_S/\alpha_L = \dfrac{1}{8}\dfrac{R(1+2\delta)(2\delta+3)^2}{\delta(1+\delta)^2}$ provides some indications of the firm's responsiveness 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 higher adjustment costs imply more pre-emption and more expenditure 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 to the demand reduction. If the shock is short, the decision can be based on the post-crisis perspective, and hence on the long-term market profitability. Therefore, when the duration is short the capacity reaction is driven by long-term profitability, while if the duration is long, the capacity reaction depends on short-term profitability.

   Analogously, an increase of the interest rate r affects the α_S/α_L ratio positively.

   Finally, we have to stress that as δ increases the carriers are less flexible. When carriers have low adjustment costs, they react strongly to a shock, and when they have high adjustment costs they react weakly. We will clarify[15] this argument in Sect. 14.4.3.

---

[14] In Sect. 14.4, we will base our empirical analysis on Eq. 14.15. In Sect. 14.4.3, Fig. 14.3, we will provide a graphical representation of α_S and α_L as a function of R and δ. Note that the model we propose fits for the duopolistic case, but in the empirical part there are situations including different market structures, e.g. in the North American case there are some routes with more than two carriers. As qualitative results do not change, we assume that the model holds in any situation.

[15] A formal interpretation of flexibility is as follows. Let $J^*(\delta, R)$ be the capacity when the adjustment costs are δ and the length of the 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

$$\text{(a)} \quad \frac{d}{da}J^*(\delta, R) < \frac{d}{da}J^*(\delta', R')$$

and

$$\text{(b)} \quad \frac{d}{db}J^*(\delta, R) < \frac{d}{db}J^*(\delta', R').$$

Moreover, under the same conditions, there is no R' such that both the inequalities hold if $\delta' > \delta$.

In what follows, we present the main conclusions of the extension of the previous analysis in an informal way. We focus on four different situations: (1) when there is uncertainty about the crisis duration; (2) when carriers have different discount factors; (3) when firms have different adjustment costs; and (4) 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 its predictions on its private information (for example, the result of their research team and of the task-force created to tackle the crisis). Each firm formulates its expectations independently from the other and chooses a capacity level. We assume that there are only two possible states of nature with known probabilities: $\theta = \{\theta_L, \theta_S\}$, where $\theta_L > \theta_S$.[17] We assume that each firm does not have knowledge of the opponent's expectations and 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 the firm expects $\theta = \theta_S$, it will be the opposite: α_S is low and α_L large.

Second, firms may have different discount factors, for example $r_A > r_B$. This situation occurs when carrier A values its future profits more (and hence is more interested in being on the market in future) than carrier B. Clearly, carrier A will focus more on the long-term aspects and less on short-term aspects than carrier B.

Third, 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 to the short-term.

Finally, we now assume that firm B cannot 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 it difficult, all things being equal, to maintain high K_1^* in conditions of low short-term profitability, even if long-term profitability is high. Therefore, firm B is characterised by low reaction to long-term indicators and strong reaction to short-term indicators, which means high values of α_S and low values of α_L.

14.4 The Empirical Analysis

The hypothesis that the capacity choice on a certain route depends on short- and long-term profitability is tested in two different markets: Asia and North America. The empirical procedure in divided into three steps: 1) the basic properties of the theoretical model are tested (the capacity-supply reaction to a demand shift and to

---

[16] See also Bashyam (1996).
[17] Where L stands for 'long' duration, and S for 'short' duration.

the potential yield; 2) the impact of a demand shift is decomposed per carrier; 3) the impact of the potential yield is decomposed per carrier.

14.4.1 Data

Two databases referring respectively to the 11 September 2001 crisis and the SARS crisis were collected. They contain information on the number of passengers per city-pair (traffic flow), available seats, average revenue per destination and distance in kilometres from Europe to the top 10 North American and the top-20 Asian destinations. Data are related to European carriers, which are selected by network (max. 1 stop on route service) and high market share. Every carrier operates with a hub and spoke configuration. Therefore, the traffic flows have been aggregated, as described in the following example (see: Fig. 14.3).
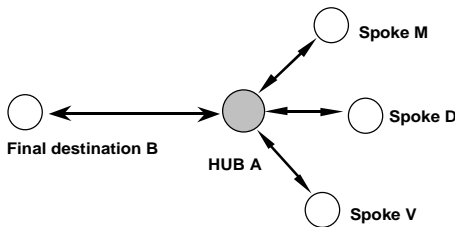

Fig. 14.3. Hub and spoke airline network

One carrier flying to destination B carries passengers from the hub A and the spokes M, D, V. In order to determine the number of intercontinental passengers flying on the route A-B, we add up the passengers originating from points A, M, D and V.

Data on capacity supply is retrieved from the Official Airline Guide (OAG database). The yield information is collected from the Bank Settlement Payment (BSP) database and concern the average revenue generated from Europe to the each North American and Asian destination.

On the basis of the above mentioned data, we compute the following variables:

- ΔS_{ij} : CAPACITY (percentage variation of seats supplied) is the percentage variation of the number of seats offered by carrier i to destination j due to the crisis.

Table 14.1. Variables description

Variable	Description	September 11th	SARS epidemic
ΔS_{ij} : CAPACITY Percentage variation of seats supplied	Total number of seats offered by carrier i to destination j during the crises versus the period before the crisis	$\Delta S_{ij} = \dfrac{S_{ij}^{NOV01} - S_{ij}^{SEP01}}{S_{ij}^{SEP01}}$	$\Delta S_{ij} = \dfrac{S_{ij}^{JUN03} - S_{ij}^{NOV02}}{S_{ij}^{NOV02}}$
Y_{ij} : YIELD Yield per available seat kilometre before crises	Total revenue divided by the total passengers flow from Europe to the destination j times the distance d_{ij} and the If_{ij} for the carrier i	$Y_{ij} = \dfrac{r_{ij}^{APR-AUG01}}{p_{ij}^{APR-AUG01} d_j} If_{ij}^{APR-AUG01}$	$Y_{ij} = \dfrac{r_{ij}^{MAR02-FEB03}}{p_{ij}^{MAR02-FEB03} d_j} If_{ij}^{MAR02-FEB03}$
ΔP_{ij} : PAX Percentage variation of Passengers due to the crises	Percentage variation of bookings made during the lowest downturn of the crisis for the carrier i to the destination j versus the same period of previous year	$\Delta P_{ij} = \dfrac{P_{ij}^{NOV01} - P_{ij}^{NOV00}}{P_{ij}^{NOV00}}$	$\Delta P_{ij} = \dfrac{P_{ij}^{MAY03} - P_{ij}^{MAY02}}{P_{ij}^{MAY02}}$
XX_i : AIRLINES Dummy variable	Dummy variable designating the airlines i included in the analysis	AF=Air France; AZ=Alitalia; BA=British Airways; EI=Aer Lingus; KL=KLM; IB=Iberia; LH=Lufthansa; SK=SAS; LX=Swiss	AF=Air France; AZ=Alitalia; BA=British Airways; KL=KLM; OS=Austrian Airlines; LH=Lufthansa; LX=Swiss

- Y_{ij}: YIELD (yield per available seat kilometre before the crisis) is calculated as the total revenue r_j generated by the total market (all points of sale in Europe) to destination j divided by the total passengers p_j flown to destination j times the distance d_j. Finally, to better approximate the real yield (per flight), the expression is corrected for the load factor (lf_{ij}), i.e. the percentage of the occupied seats in the aircraft of airline i flying to destination j. In the empirical analysis, we assumed that the YIELD per ASK (see Sect. 14.2.1) is the measure of the long-term profitability. Other authors have used a similar measure of long-term profitability. For instance, Bruning and Hu (1988) measured the profit by a passenger profitability index, which was the product of the revenue to cost ratio and the load factor. Indeed, information before the crisis is likely to be the basis to generate a forecasting of the market situation after the crisis.
- $\tilde{P}_{ij}$: PAX (percentage variation of bookings) is the percentage variation of bookings generated during the lowest downturn of the crisis for carrier i to destination j. This variable provides a measure of the exogenous demand shift.
- XX_i: Dummy variable designating airlines with AF=Air France, AZ=Alitalia, BA=British Airways, EI=Aer Lingus, KL=KLM, IB=Iberia, OS=Austrian Airlines, LH=Lufthansa, SK=SAS, LX=Swiss.

Table 14.1 provides a summary of those descriptions of the variables related to the two crisis periods.

The third and fourth columns present, respectively, the market share and the number of destinations in the carrier's network. In North America, Lufthansa and British Airways are the major European players, with 10.8% and 10.1% Table 14.2 presents some descriptive statistics of the main variables for both crises (North America, Asia). Specifically, two columns display the capacity and passenger percentage reduction per carriers for both crises. We observe for the September 11 crisis that Alitalia, Iberia, and Swiss faced the highest passenger reduction (about 35%) and as a consequence their capacity was decreased by 24% for Alitalia, and by 35% for Swiss, but increased by 1% for Iberia. The reason for the Iberia increase lies in the first reaction of Iberia. The Spanish carrier drastically reduced the frequencies to New York and switched the aircraft to operate to Miami instead.

The third and fourth columns present respectively the market share and the number of destinations in the carrier's network. In Asia, the major players are Air France and KLM, with 4.6% and 4%, respectively of the market share, and 14 and 12 direct-service destinations. Different market positions can influence the carrier strategy. If market share is a proxy variable of adjustment costs, then, in Asia, carriers can reduce their capacity at lower costs than they can in North America.

Table 14.2. Descriptive statistics

	Sept.11				SARS			
Carrier	Capacity[a]	Passengers[b]	Dests in North America	Market shares[c]	Capacity[a]	Passengers[b]	Dests in Asia	Market shares[d]
AF	–18%	–20%	10	6.6%	–22%	–24%	14	4.6%
AZ	–24%	–36%	7	3.0%	–15%	–4%	3	1.8%
BA	–17%	–22%	10	10.1%	4%	–23%	11	7.1%
EI	–15%	–10%	5	1.6%				
IB	1%	–37%	3	1.8%				
OS					–19%	–49%	9	3.0%
KL	–18%	–20%	10	5.2%	–12%	–28%	12	4.0%
LH	–8%	–16%	10	10.8%	–8%	–15%	13	3.4%
SK	–12%	–6%	3	1.5%				
LX	–35%	–34%	8	3.2%	–11%	–25%	5	2.3%

Source: elaboration of OAG and KLM data.
[a]Difference in number of seats after and before the crises.
[b]Percentage difference in bookings before the crisis.
[c]Apr01-Jun01.
[d]Jul02-Feb02.

14.4.2 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 14.16 relates the capacity change to the variation of the YIELD and PAX variables, as presented in Eq. (14.15):

$$\Delta S_j = \alpha_0 + \alpha_1 Y_j + \Delta P_j + \varepsilon_j .$$
(14.16)

In the next two equations, the specific reactions of the carriers to short-term and long-term profitability are decomposed by means of the dummy variables *XX*. In Eq. (14.17), the dummies are multiplied by the PAX variable:

$$\Delta S_j = \alpha_0 + \alpha_1 Y_j + \sum_j \beta_i \Delta P_j XX_i + \varepsilon_j .$$
(14.17)

In Eq. (14.18), the dummies are multiplied by the YIELD variable in order to decompose its impact per carrier:

$$\Delta S_j = \alpha_0 + \alpha_1 P_j + \sum_j \beta_i Y_j XX_i + \varepsilon_j .$$
(14.18)

Table 14.3. Estimated coefficients of Eqs. (14.11–13) for the September 11 and SARS crises

	Equation 1		Equation 2		Equation 3	
	Sept.11	SARS	Sept.11	SARS	Sept.11	SARS
Variable	A	B	C	D	E	F
Intercept	–0.37 (0.14)	–0.34 (0.08)	–0.45 (0.15)	–0.25 (0.08)	–0.43 (0.14)	–0.39 (0.07)
YIELD	5.96 (1.94)	3.60 (0.08)	6.51 (2.12)	2.91 (1.05)	-	-
PAX	0.61 (0.14)	0.49 (1.06)	-	-	0.75 (0.15)	0.45 (0.08)
AF	-	-	0.43 (0.51)	0.65 (0.18)	7.31 (2.69)	3.82 (1.45)
AZ	-	-	0.62 (0.33)	–0.10 (0.22)	9.15 (2.47)	1.48 (1.71)
BA	-	-	0.00 (0.31)	0.29 (0.17)	10.55 (3.33)	7.50 (1.36)
EI	-	-	1.12 (0.48)	-	7.42 (2.95)	-
IB	-	-	1.19 (0.40)	-	8.96 (6.12)	-
OS	-	-	-	0.93 (0.13)	-	2.14 (1.32)
LH	-	-	0.43 (0.54)	0.44 (1.70)	5.75 (2.4)	4.48 (1.26)
KL	-	-	0.70 (0.29)	0.39 (0.21)	5.81 (2.09)	5.49 (1.68)
SK	-	-	0.45 (0.71)	-	6.10 (3.49)	-
LX	-	-	0.69 (0.37)	0.47 (0.32)	2.31 (2.85)	3.56 (1.43)
Statistics	$R^2 = 0.29$	$R^2 = 0.49$	$R^2 = 0.43$	$R^2 = 0.61$	$R^2 = 0.44$	$R^2 = 0.60$
	AdjR² = 0.27	AdjR² = 0.47	AdjR² = 0.32	AdjR² = 0.56	AdjR² = 0.33	AdjR² = 0.55
	Obs = 67	Obs = 70	Obs = 67	Obs = 70	Obs = 67	Obs = 70

Note: standard error is in brackets

The equations are estimated by means of Ordinary Least Squares, and the results are presented in Table 14.3. The adjusted R^2 value ranges from 0.29 to 0.56.

The R^2 is higher for the three SARS related equations than for the equations referring to September 11 crisis. The reasons can be either that the models better fit the SARS crisis than that of September 11, or they are related to a better data collection. In both cases, we can confirm the validity of our methodology to analyses two crises over different time periods and markets (North America vs. Asia). We take it as the first result that reinforces our theoretical conjectures. Furthermore we proceed to investigate the specific carriers' conduct.

Hereafter we compare the coefficients for each equation:

Equation 14.16: both PAX and YIELD are significantly different from zero, and their magnitude is higher for the September 11 crisis than for that of the SARS.

The PAX variable measures the passenger variation that occurred immediately after the crisis. As no carrier has changed its capacity supply in the months after the crisis, PAX does not depend on the change in the capacity supply[18] as it cap-

---

[18] To be more precise, in certain cases, data on the PAX variation may present some endogeneity as some capacity variations had already occurred at the date on which we measure passenger reduction. Nevertheless, the endogeneity issue does not seem too severe since passengers usually take decisions in advance, and hence before capacity change. Passengers who have booked for a time schedule that is not available are reallocated to another flight. Usually, for low fares, there is no reimbursement. For highest

tures an exogenous demand shift. Consequently, no identification problems are generated due to simultaneous changes in demand and supply behaviour. For the North American destinations, when the coefficient PAX equals 0.61, it means that a 10% reduction of the total demand in the market induces the carriers to reduce their capacity by 6.1%. This value decreases to 4.9% for the Asian destinations. The YIELD coefficient is 5.7 for September 11 and 3.6 for SARS, which means that to have a capacity increase of 1%, the yield per passenger (average price) should increase by €12 on a flight of 6500 km for North America and by €18 on a flight of the same length for Asia. This difference increases if we take into account that the average distance from Europe to North America is 6500 km and to Asia 9100 km. In the latter case, the yield per passenger has to increase by €24 in order to have a capacity increase of 1%.

Equation 14.17: the regression explains, 43% and 61% respectively of the variance of the dependent variable although not all the coefficients are statistically significant at 90%. The dummy coefficients of the September 11 equation can be clustered in three groups with similar reactions to the demand shift (short-term reaction). The first group, composed of Air France, British Airways, Lufthansa and 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 had the strongest reaction. In the SARS equation, where the number of carriers is smaller, we are able to identify two groups, one, including British Airways, Lufthansa, KLM and Swiss, with a low reaction, and a second including Air France and Austrian Airlines with a stronger reaction. Therefore, Air France, KLM and Alitalia have reacted differently to the SARS crisis than to the September 11 crisis. A theoretical interpretation of this result is provided in the next section.

Equation 14.18: the regression analysis explains, respectively, 44% and 60% of the variance of the dependent variable. As in Eq. (14.12), we identify 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 a medium reaction to the YIELD variable: and the last group, formed by Aer Lingus, Air France, Alitalia, British Airways, with a strong reaction. On the SARS equation we are able to identify one group including Air France, Austrian Airlines, Swiss and Lufthansa with low reaction to long term profitability and a second group including British Airways and KLM, with stronger reaction. In this case we notice that again that KLM, Air France and Alitalia have reacted to this second crisis differently.

In the next section, the results are discussed and interpreted in relation to the theoretical framework, in order to draw a picture of the airlines conduct during exogenous demand shift

fares, carriers usually provide extra-benefits to counterbalance the discomfort of the change of departure time. Alternatively, we note that the carriers' decisions are based on the observed demand, as well as on the expected demand. Thus, we need to use the realised passenger demand as a proxy for the expected demand.

14.4.3 Results

The main outcomes of the theoretical model can be explained by means of a simple scatter plot[19] (Fig. 14.4).

The sensitivity of the carriers to short- and long-term profitability is displayed, respectively, on the horizontal 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 is to the origin, the higher the adjustment costs. The first line on the left side represents a carrier with high adjustment costs; the second 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 (or different interest rates[20]) but with the same adjustment costs. The upper-left plot on the line indicates expectation of short crisis duration, the lowest plot on the same line indicates expectation of long crisis duration. The financial situation also modifies the markers' location in the graph: the stronger is the financial constraint, the higher the sensitivity to short-term profitability, and the lower the sensitivity to long-term profitability.

The main factors affecting the carriers' conduct and hence their positioning on the graph are adjustment costs and expectation of the crisis duration. We expect that flexible carriers are located on an upper line, while non-flexible carriers are on a lower line.

As mentioned in the Introduction, market shares[21] are a proxy for the costs of adjustment. We observe the market shares of the nine European carriers flying between Europe and the North Atlantic over the period April–June 2000. Lufthansa and British Airways are the carriers with the highest adjustment costs in the North American market (with 10.8% and 10.1% of the market, respectively), followed by Air France (6.6%), KLM (5.2%), Swiss (3.2%), Alitalia (3.0%), and, finally, Iberia (1.8%), Aer Lingus (1.6%) and Scandinavian Airlines (1.5%).

---

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

[20] We present the results as depending on different expectations of the duration of the crisis but, looking at the interest rate the conclusions are exactly the same. In fact, the discount factor depends on both these variables and it is not possible to separate the two effects.

[21] A referee suggested that the cost of adjustment should reflect the opportunity cost. This means that fleet flexibility, network structure and other relevant variables should also be included in the explanation of the adjustment costs. In this paper we limit our analysis to consider market share as a proxy for adjustment costs, but we agree with the point.
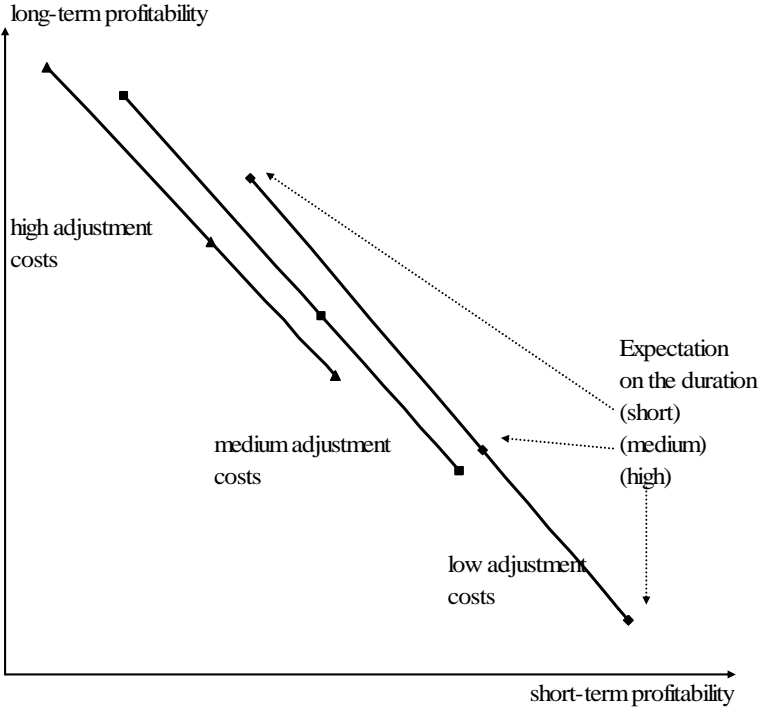
Fig. 14.4. Expected impact of short and long-term profitability reaction depending on the adjustment costs and the duration of the crisis

In the Asian market, British Airways has the largest market share (7.1%,) followed by Air France (4.6%), KLM (4.0%), Lufthansa (3.4%), Austrian Airlines (3%), Swiss (2.3%) Alitalia (1,8%). The relationship between market shares and adjustment costs seems less strong in the Asian market.[22]

---

[22] As suggested by a referee, it is possible to estimate the impact of market shares (*MS*) on the capacity choice. Equations. (14.19–20) present the results of September 11 and SARS, respectively:

$$\Delta S = -0.49 + 5.56Y + 0.61\Delta P + 1.97MS \tag{14.19}$$

and

$$\Delta S = -0.40 + 3.53Y + 0.51\Delta P + 0.53MS \tag{14.20}$$

All the coefficients have the correct sign and are significant at 5% with the exception of *MS* for the Asian Crisis.

Hereafter, we present the results of the econometric analysis. We assumed in the previous paragraphs that the YIELD variable is the measure of the long-term profitability, and the PAX variable is the measure for short-term profitability. Therefore, we can use the framework of Fig. 14.4 and by displaying the PAX coefficients of Eq. (14.17) on the horizontal axis and the YIELD coefficients of Eq. (14.18) on the vertical axis. The estimated coefficients are plotted in Fig. 14.5. Black diamonds represent the carriers' reaction to the US crisis and the white diamonds their reaction to Asian crisis.[23]

To investigate the functioning of the model, we focus on the carriers' reaction to the shock of September 11. 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.

The behaviour of Swiss and Scandinavian Airlines does not fit the model. 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 position of Swiss on the graph might be explained by the financial situation that the carrier was facing at the time of the American crisis. In fact, the theoretical model suggests that the financial constraints move carriers towards a short-term strategy. This is evident from the scatter: Swiss reacts to the crisis with a short-term strategy.

The expectation of the crisis duration is the second factor that affects the carrier' conduct. In December 2001, no carrier revealed its network planning for the next 12 months. As the crisis prediction is a strategic variable the carriers avoided as much as possible giving 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 Figs. 14.4–5, we notice that British Airways expected a much shorter duration than Lufthansa. They lie on the same line, but have opposite behaviour. 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 a longer duration of the crisis than KLM, and KLM expected a shorter duration than that of Lufthansa. Swiss should have the shortest expected duration of the crisis but again its strategy

---

[23] Alitalia conduct for the SARS crisis is out of the graph (the PAX coefficient is negative). We do not provide any interpretation of this result, but we see that Alitalia has only two routes.

might result from the financial problems of the company that forced its reaction in the short-term.
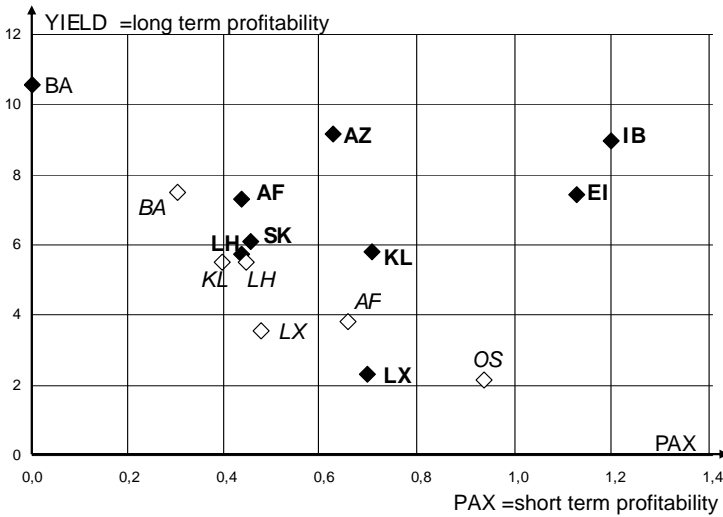

Fig. 14.5. Classification of firms in terms of short- and long-term reaction. The black diamonds indicate the carrier's reaction due to September 11, while the white diamonds indicates the carrier's reaction due to SARS

Alternatively, we can interpret a different positioning on the line as a different evaluation of the 'strategic' importance of the market. A carrier evaluating a market as 'very strategic' has a low discount rate on this market, and hence it will focus on the long-term more than the short-term returns. This could explain the positioning of British Airways with respect to the other large carriers. Since the North American market is very strategic for British Airways, it reacts only to long-term but not to short-term aspects.

Figure 14.5 also provides a representation of carriers' conduct induced by the Asian crisis. Before analysing specifically the behaviour of the carriers, we try to emphasise the main differences between the first and the second crisis.

As a general remark, we observe that compared with the North American crisis where only 1/3 of the capacity choice variation is explained by the PAX and the YIELD variables, in the Asian crisis about 2/3 of the capacity variation is explained by the same variables. This is due either to better data collected on the Asian crisis or to the fact that carriers' strategies are based more on the short- and the long-term variable in Asian crisis than in the North American crisis. If the second point is true, it may mean that carriers in the second crisis had gained experience of the previous crisis and therefore they could better calibrate their strategies on short- and long-term parameters. There are also other interpretations of a better fit of the second model, such as the fact that carriers in the North American market

have a more complex strategy involving other variables more strongly than in the Asian market.

There are three main differences in the carriers' conduct in the two crises.

First, the reaction in the Asian crisis was lower than in the North American crisis. This emerges by comparing column 1 with column 2 of Table 14.3 where PAX values are respectively, 0.49 and 0.61, and YIELD values are respectively 3.60 and 5.96. On the graph, the white diamonds are closer to the origin than the black diamonds. Following our conceptual framework, it means that, on average, the adjustment costs of carrier are higher in the Asian market.

Second, the reaction to the Asian crisis was focused on short-term aspects and not on long-term aspects. There are many explanations for this result. A first explanation that we do not entirely believe is that the expectation of the crisis duration was shorter for the American crisis that for the Asian crisis. This is true if we think that carriers underestimate the duration of the crisis in the first shock and overestimate the duration of the crisis in the second shock. A slightly different interpretation can be provided by assuming that carriers can learn from the past, and thus a sort of mimicking behaviour of carriers emerges. Hence, British Airways having had a wrong reaction to the first shock has decided to recalibrate its conduct in the second shock. KLM having been too much reactive to the PAX variable after September 11 chose to adopt a strategy similar to Lufthansa after the SARS epidemic. The same argument is valid for Swiss. Lufthansa having been right has decided not to change. A third explanation for the different behaviour in the two crises is given by the fact that Asian market is not so crucial as the North American market for European carriers. This explains the shift towards the short-term choice of British Airways and Air France. Finally, a more fundamental explanation for the short-term attention of carriers is in the differences of the markets. The Asian market is characterised by higher operating costs and lower margins, meaning that the reduction of profitability (revenue – costs) when there is a demand shift in the short term is higher for the Asian market than for the North American market. Moreover, the crises affecting the Asian market before March 2003 (i.e. not only September 11 but also the Afghanistan war and the October 2002 Bali terrorist attack) might have induced carriers not to focus on the long-term indicators.

Thirdly, it does not seem that there are important adjustment-costs differences among carriers since they lie very close to the same line. Just as in the American crisis, during the SARS epidemic, we see that there were some carriers which followed the ordering as expected from the model, but there are some exceptions. Here, British Airways, KLM and Lufthansa are on the same line with Air France slightly higher and Austrian Airlines a little bit higher still. Swiss is out of the scheme and has the same behaviour as in the first shock. Financial constraints forced this carrier to focus on the short-term rather than long term.

Applying the theoretical framework to detect the behaviour during the Asian crisis, we note that all carriers can be easily sorted in terms of expectation of the crisis duration. Austrian Airlines expected longer crisis duration than Air France. Lufthansa and KLM have similar expectations. Then British Airways expected the crisis would have a short duration. Finally, assuming that Swiss was financially

constrained, its expected duration was closest to those of Lufthansa and KLM. As already mentioned, expectation of the crisis duration can be also interpreted as the strategic or non-strategic goals of the carriers.

Now we compare the conduct of the four main carriers in the two situations. First of all, we observe that Lufthansa did not change its behaviour. British Airways that was very optimistic in the North American crisis has changed its strategy, and aligned with the one of other players. Also, KLM aligned with its main competitor, Lufthansa. These three carriers moved towards or kept on a balanced conduct by mixing short- and long-term goals. On the contrary, Air France did not seem to be confident of a quick recovers from the crisis and assumed a longer duration of the crisis

14.5 Conclusions

This paper provides a theoretical and empirical analysis of the conduct of European carriers during the North American and Asian crises. An important assumption of the model is the existence of positive adjustment costs, i.e. the costs required to re-expand capacity. Adjustment costs introduce rigidity in the carriers' conduct. Indeed, non-flexible carriers typically present, a small reaction to short- and long-term variables. This behaviour results from the fact that a non-flexible carrier sets high capacity levels during the crisis to push its 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. They can be small during the crisis period to reduce the losses, and free to expand in the post-crisis period. In the North American market, we observe that the conduct of non-flexible carriers is oriented to long-term profitability, while in the Asian market they have a more balanced choice. Carriers' strategies are also affected by expectations of the crisis duration and on the strategic importance of the market. If a carrier expects the crisis to have a long duration (or the market is not strategically important), then its conduct shifts to the short-term variable. If the expected duration is short (or the market is strategically important), then the carrier bases its strategy on the long-term variable.

Empirical analysis suggests that the theoretical model is useful to interpret both crises. The main differences we find for the two crisis situations are: the carriers' reaction to the Asian crisis was lower than in the North American crisis; it was focused on short-term aspects; and there were less adjustment costs differences among carriers.

An open question is whether or not carriers gain experience from the past events. We think that it is possible, and this is supported by our results. If we assume that carriers base their strategies only on short- and long-term gains, we see that these two variables explained 2/3 of the capacity choice in the Asian crisis but only 1/3 in the North Atlantic crisis. Hence, carriers have been more consistent in managing the Asian crisis than the North American crisis. Some more evidence comes from the behaviour of British Airways. In fact, it seems that British Air-

ways modified its strategy by changing from a situation where it only cared about long-term variables toward a more balanced situation, closer to the Lufthansa/KLM strategy.

References

Alderighi M, Cento A (2004) European airlines conduct after September 11. Journal of Air Transport Management 10: 97–107

Bashyam TCA (1996) Competitive capacity expansion under demand uncertainty. European Journal of Operational Research 95: 89–114

Borenstein S (1989) Hubs and high fares: dominance and market power in the US airline industry. RAND Journal of Economics 20: 344–365

Bruning RE, Hu MY (1988) Profitability, firm size, efficiency and flexibility in the U.S. domestic airline industry. International Journal of Transport Economics XV

Bulow J, Geanakoplos J, Klemperer P (1993) Multimarket oligopoly: strategic substitutes and complements. Journal of Political Economy 93: 488–511

Chang Y, Williams G (2002) European major airlines' strategic reaction to the Third Package. Transport Policy 9: 129–142

Chin ATH, Tay JH (2001) Development in air transportation: implication of investment decisions, profitability and survival of Asian airlines. Journal of Air Transportation Management 7: 219–330

Fudenberg D, Tirole J (1984) The fat-cat effect, the puppy-dog ploy, and the lean and hungry look. American Economic Review 74: 361–366

Gould JP (1968) Adjustment costs in the theory of investment of the firm. Review of Economic Studies 35: 47–55

Gillen D, Lall A (2003) International transmission of shocks in the airline industry. Journal of Air Transportation Management 9: 37–49

Hätty H, Hollmeier S (2003) Airline strategy in the 2001/2002 crisis: the Lufthansa example. Journal of Air Transportation Management 9: 51–55

Janic M (1997) Liberalisation of European aviation: analysis and modelling of the airline behaviour. Journal of Air Transportation Management 4: 167–180

Smith GH (1997) The European airline industry: a banker's view. Journal of Air Transportation Management 4: 189–196

Windle R, Dresner M (1995) The short and long run effects of entry on US domestic air routes. Transportation Journal 35: 14–25

Windle R, Dresner M (1999) Competitive responses to low cost carrier entry. Transportation Research Part E: Logistics and Transportation Review 35, 59–75

Part D: Sustainable Transport and Policy Perspectives