Do Prices grow more in Euroland? An investigation using on-line fares.

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Abstract

Using more than 10 million on-line fares, we study the determinants of yearly fares' changes in June 2002-June 2005. We verify whether airlines took advantage, after the Euro introduction, of potential inflationary pressures by increasing their fares more in routes to Eurozone nations. All else equal, fares in such routes declined, although their reduction was smaller than in the case of routes outside the Euro area. The evidence also points at the possibility that the changeover may have enhanced the airlines' ability to engage in inter-temporal price discrimination.

Keywords: Price discrimination; airlines; Euro, changeover.
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1 Introduction

"[...] the European Commission has announced it will investigate allegations that Apple is unfairly charging up to 20 per cent more for music downloads in the UK than it does in the rest of Europe. Apple charges UK users about 83p a track compared with about 52p in France and Germany. Apple says its pricing was based on "the underlying economic model in each country". ***Financial Times****, 4th March 2005*

On the 1st of January 2002, twelve European countries adopted a common currency, the Euro. It was expected that its introduction could enhance transparency of prices, facilitate comparisons across countries and, ultimately, competition. Contrary to these predictions, after the Euro changeover the perception among the Euro area's citizens of a rise in inflation was echoed in countless press articles (Angelini and Lippi, 2005).[1] Even the European Central Bank (ECB) admitted that "...some prices seem to have been strongly affected by the cash changeover. " (ECB, 2003, p. 40).

The ECB points at the services sectors, which are protected by international competition, as those exhibiting the highest price increases, while "...goods prices, which account for close to 60% of private consumption expenditure in the euroarea, ...do not seem to have been greatly affected by the changeover" (European Central Bank, 2003, p. 41). In this paper we put this ECB' statement to a test, by verifying whether the airlines, whose market for transport services is highly competitive, increased their fares for flights to destinations in the Euro area more than for destinations outside the Euro area.[2]

We use primary data obtained by retrieving more than 10 millions on-line fares to study the determinants of annual price changes in the airline industry over the period June 2002-June 2005. The analysis considers both domestic and inter-European flights from the UK. The annual price changes are worked out to remove seasonality, for the same company operating on a given route. We account for possible airlines' heterogeneity in their yield management strategies by comparing fares that were posted a fixed number of days prior to the departure

[1] *"Two out of three eurozone consumers felt they were ripped off by retailers during the changeover... Germany, France and Netherlands were the countries with the highest percentage of people feeling cheated."* (Financial Times, 01 March 2002).

[2] The liberalisation of the European Civil Aviation industry was fully completed in 1997. Since then, a frantic entry and exit activity has taken place, leading to the establishment of many new carriers adopting the "low-cost" business concept. In the period 1999-2003, the main low-cost carriers in Great Britain increased the number of yearly flights they operated from the ten largest U.K. airports by 65% and entered 160 routes (Gil-Molto and Piga, 2005).

date. After controlling for variations in cost, exchange rate, market structure and the airlines' network characteristics, the analysis addresses the following issues.

First, we focus on whether the airlines systematically increased fares more to take advantage of the turmoil following the Euro adoption. Because our period of analysis begins after the changeover, we cannot compare fares pre- and post-changeover as in Baye et al (2005), which finds on-line prices of some electronic goods increased after the changeover within the Euro area, but not outside. Relatedly, we document that the surge in the perceived inflation was mostly noted in the post-changeover period, which is suggestive that the findings in Baye et al (2005) may have persisted during our period of analysis. Therefore we concentrate on discussing some evidence of the changeover's consequences on airlines' pricing, especially with regards to any abnormal increases for destinations in the Eurozone countries.

All else equal, fares to such destinations declined, although their reduction was smaller than in the case of routes outside the Euro area. Thus, our evidence based on the highly competitive airlines sector would seem to support the ECB's statement of no post-changeover inflationary pressure. It is also consistent with the findings in Goldberg and Verboven (2004) of a post-changeover decline in the absolute difference of car prices across European countries.

However, we also find a different pattern in the way the airlines set the fares at different time points before a flight's departure. Our evidence for the Euro area destinations suggests a rise in the late booking fares that on average offset the fall in early booking ones, while for the other destinations the decrease was consistent, although not homogeneous in magnitude, for all the prices posted at different times prior to a flight's departure. The result is a significant difference in the dispersion of fares between the Euro and non-Euro areas, which may be ascribed to the fact that the changeover may have facilitated a more intense use of intertemporal price discrimination on the routes to and from the Eurozone.

Second, we estimate the magnitude of the promotional fares offered by some low cost carriers (henceforth, LCC) when they enter a new route. The estimates reveal an increase in monthly mean fares of about 11-19% twelve months after a new service is launched. However, no evidence of post-entry promotional pricing is found when we use the change in the monthly median fare. This contrasting evidence suggests that the mean monthly fare captures the increase in price dispersion that characterizes the post-entry period, when the airlines probe the market to learn how demand would respond to high and low fares. Finally, our findings indicate that price changes are mostly driven by the characteristics of the market structure and the airlines' network.

2 Impact of the changeover on pricing

After the changeover, a perception spread among the Eurozone citizens that the new monetary system might have been responsible for a rise in inflation (Angelini and Lippi, 2005; Gaiotti and Lippi, 2005). Figure 1 illustrates the perceived inflation in Italy, in Germany and in the Euro area as a whole, as well as in two non-euro countries, Great Britain and Sweden. While the perceived inflation remained stable outside the Eurozone, after January 2002 we observe for the Eurozone a drastic increase in the expectation of higher inflation, which continued for more than two years after the changeover. Figure 2 illustrates how the actual inflation series (left Y axis) tends to be correlated with the perceived inflation one (right Y axis) up until January 2002. Since then, and until June 2004, the two series follow a rather diverging behaviour. They then return to exhibit parallel co-movements.[3] A possible explanation of the rise in the perceived inflation can be found in the ECB 2002 Annual Report (European Central Bank, 2003, p.40-41): "...prices charged for services items, such as restaurant and café services, hairdressing and dry cleaning, seem to have risen noticeably in all euroarea countries following the introduction of euro cash...the changeover may have led to price increases for some "small ticket goods" across countries, which are frequently purchased by private households, such as bakery products and newspapers. Owing to their low price level, any rounding effect can be rather strong in terms of percentage changes".

Arguably, this situation may have made Eurozone consumers better accustomed to rising prices, and may have contributed to an increase in their willingness to pay for air transport. Thus, in this paper we want to test whether the airlines in our sample could take advantage of this by raising their prices more in routes connecting the U.K. to Eurozone destinations relative

[3] A similar behaviour of the two series for the case of Italy is also shown in Angelini and Lippi (2005). They also discuss how the divergence of the two measures spurred criticism and scepticism towards official inflation statistics.

to routes outside the Euroarea. An *a priori* prediction cannot be made as two opposing forces may have affected the airlines' pricing decisions. On the one hand, the airlines may have wanted to increase the fares for those travellers from Eurozone countries who, because of the euro cash changeover, may have become accustomed to paying more for domestic services and goods. On the other, because a flight from, say, Athens to London carries both Greek and British passengers, euro-induced fares' hikes would also imply having to charge the British travellers more, with negative effects on the realised load factors. Furthermore, the post-liberalisation entry activity may have intensified competition, thus putting a cap on fares.

The existing literature only partly supports the ECB's view of inflationary pressures mostly originating in the domestic services sectors. On the one hand, Gaiotti and Lippi (2005) study whether the changeover had an impact on the pricing behaviour of a panel of restaurants, and conclude that part of the price increases in 2002 seems ascribable to the changeover.[4] On the other hand, the evidence from some other markets does not seem to confirm the ECB's statement that "for higher-value goods, particularly durable consumer goods, there seems to have been a tendency towards the downward rounding of prices related to technical progress and rather strong competition in these markets. (p.41)". Indeed, Baye et al (2005) compare on-line electronic goods before and after the changeover, and find that average and minimum prices increased, respectively, by 3% and 7%, despite the obsolescence of these products. In the case of the European car market, Goldberg and Verboven (2004) show that price differentials in Eurozone countries decreased after the Euro introduction, but that cross-country price differences for the same car model remained large, even among euro-adopting members.

3 Data Collection

Our analysis is based on primary data on fares and secondary data on routes traffic, where a route is identified in this study as an airport-pair combination.[5] The fares in this study

[4] Such an effect appears to be stronger in areas where restaurants have more market power, proxied by a local concentration index.

[5] Previous studies on pricing behaviour in the U.S. Airlines industry have used different cohorts of the same dataset, i.e., the Databank of the U.S.A. Department of Transportation's Origin and Destination Survey, which is a 10 percent yearly random sample of all tickets that originate in the United States on U.S. carriers (Borenstein, 1989 and 1991; Evans and Kessides, 1993; Borenstein and Rose, 1994; Stavins, 2001).

were collected using an "electronic spider", which connected directly to the websites of only the main LCC (i.e., Ryanair, Buzz, Easyjet, GoFly) operating in the U.K. at the start of the project (May 2002). Later on, the "spider" was upgraded to retrieve fares from the Bmibaby and MyTravelLite sites. Collection of fares for flights operated by Full Service Carriers (i.e., British Airways, Air Lingus, Air France, Lufthansa, KLM, Alitalia, Iberia, SAS, Tap Portugal, Air Europa and Maersk) started in March 2003: in this case, fares were collected only for flights that Full Service Carriers (FSC) operated on routes similar or identical to those where a LCC also flew.[6] This decision was necessary to reduce the number of queries made by the spider.

The dataset includes daily flights information from June 2002 up to, and including, June 2005, for a total of 37 months. Fares from the UK for flights to and from the following Euro-adopting countries were obtained: Austria, Belgium, France, Germany, Greece, Ireland, Italy, Netherlands, Portugal and Spain. The countries outside the Euro area were: Czech Republic, Norway, Sweden, Switzerland as well as the UK, whose domestic routes were also considered.

In order to account for the heterogeneity of fares offered by airlines at different times prior to departure, every day we instructed the spider to collect the fares for departures due, respectively, 1, 4, 7, 10, 14, 21, 28, 35, 42, 49, 56, 63 and 70 days from the date of the query. Henceforth, these will be referred to as "booking days".[7] The return flight for both types of directional journey was scheduled one week after the departure. For those routes where an airline operates more than one flight per day, all fares for every flight were collected. Thus, for every daily flight we managed to obtain up to 13 prices that differ by the time interval from the day of departure. The main reason to do so was to satisfy the need to identify the evolution of fares - from more than two months prior to departure to the day before departure – which has been noted to be very variable for the case of LCC (Pels and Rietveld, 2004; Giaume and Guillou, 2004). Furthermore, given the site characteristics of Opodo, it was impossible

[6] The airfares of the traditional companies were collected from the website www.opodo.co.uk, which is owned and managed by British Airways, Air France, Alitalia, Iberia, KLM, Lufthansa, Aer Lingus, Austrian Airlines, Finnair and the global distribution system Amadeus. Thus, fares listed on Opodo are the official prices of each airline, although Opodo may not report promotional offers that each airline may offer on their web sites.

[7] For instance, if we consider London Stansted-Rome Ciampino as the route of interest, and assume the query for the flights operated by a given airline was carried out on March 1^{st} 2004, the spider would retrieve the prices for both the London Stansted-Rome Ciampino and the Rome Ciampino-London Stansted routes for departures on 2/3/04, 5/3/04, 8/3/04, 11/3/04 and so on.

to collect Full Service Carriers' fares 1 and 4 days prior to departure: it was also decided to omit collecting fares from these companies for flights due to depart more than 49 days after the query. Thus, for Full Service Carriers, up to 8 fares per daily flight are available.

The collection of the airfares has been carried out everyday at the same time: in addition to airfares we collected the name of the company, the time and date of the query, the departure date, the scheduled departure and arrival time, the origin and destination airports and the flight identification code.

Fares were collected before tax and handling fees for the case of LCC, but inclusive of them for the Full Service Carriers (henceforth FSC). This is not a problem for two reasons. First, as discussed below, the analysis focuses on the changes made by each airline on the fares posted in the same months of two consecutive years. Thus, differencing would generally cancel out the taxes included in the FSC' fares. Second, while airport taxes were increased over the three years period we consider, these changes were of negligible magnitude (2-5%) and occurred in the great majority of destinations. Furthermore, fares for LCC were one-way, while those for FSC were for a round trip and were therefore halved.

To complement the price data with market structure characteristics, secondary data on the traffic for all the routes and all the airlines flying to the countries indicated above was obtained from the UK Civil Aviation Authority (henceforth, CAA).[8] For each combination of company, route and departure period (i.e., month/year), the CAA provided the number of monthly seats, the number of monthly passengers and the monthly load factors. These were broken down at the flight identification code level, that is, for each flight operated by all the airlines in a given month and route. However, in order to create a more balanced panel, fares and traffic statistics were aggregated at the route level for each airline.

Figure 3 provides a summary of the evolution of total flights and passengers' traffic from the UK to the universe of destinations in the Euro and no Euro areas (the latter including UK domestic flights). Some striking aspects emerge. First, the six main LCC considered in this study operate about a third of flights to both areas: evidence not reported suggests that Ryan Air and EasyJet manage a large share of these flights, especially after the two takeovers. A

[8] See www.caa.co.uk

similar comment can be made with regards to passengers' traffic. Second, LCC seem to benefit from higher load factors, as their Total Passengers (PAX) curve remains above that of Total Flights.[9] In contrast, the FSC' Total Passengers curve is always well below the corresponding Total Flights' one. Finally, traffic to Eurozone destinations tends to be influenced more by seasonal fluctuations.

4 Data analysis

In this Section we present some of the datasets' features that are relevant for the estimation strategy. Table 1 reports average one-way fares by the airlines in different seasons (corresponding to the Summer – April to October- and the Winter - November to March - timetables). Note how more than 10 millions daily fares were used to calculate the monthly averages for each group. About 70% of these observations pertain to flights operated by EasyJet and Ryan Air. The two main British FSC are also highly represented: British Airways with about 1 million observation and BMI British Midland with almost half a million, to which one should add the observations of its low-cost subsidiary, BmiBaby. In any case, routes offered by the FSC were selected only for those markets (identified by city pairs, e.g., London to Rome) where at least one LCC was operating. Thus, Table 1 offers a straightforward way to compare fares by competing companies in differentiated markets. Generally, even accounting for the obvious difference due to the inclusion of airport taxes in the FSC' fares, the latter seem to be higher throughout the period.

Table 2 reports statistics on the number of routes that are served, respectively, by one, two and three or more companies, where the number of airlines is worked out using the CAA data. Three different samples are used. The universe of routes is indicated in the CAA column: throughout the period, about 77% of total routes are monopoly, 18% or more are duopolies and about 5% or less have three or more players. This is a clear indication of an industry in which companies try to avoid direct competition by exploiting the possibility to serve a city pair (say London-Rome) by using different routes that are part of that city pair (e.g.,

[9] The number of total passengers was divided by 100, so that the same scale could be used to represent both types of curves.

Heathrow-Rome Fiumicino and London Stansted-Rome Ciampino).

In Table 2, the Internet columns outline the number of routes for which we have fares information in our Internet-retrieved dataset. It clearly shows that overall we have retrieved fares for about one third of the universe of routes (up to 283 in June 2005 from a universe of 774). These differences are most likely due to the way routes for FSC were chosen, given that we left out routes where FSC do not face direct or indirect competition by LCC. Relative to the universe, monopoly routes tend to be marginally under-represented, while duopolistic routes in particular are over-represented. This is also a reflection of the way the FSC' routes were selected.

The Estimation columns in Table 2 indicate the number of routes used in the econometric analysis. They differ from the Internet price ones for two reasons. First, to calculate the monthly mean we considered only groups (i.e., a combination of airline-route-booking day) where we had at least 11 observations per group per month. This is to avoid a spurious measure of the monthly average obtained from a very limited number of days or flights. Second, a route may have been added at a later stage and so it was not always possible to work out the twelve months' lag difference. Nonetheless, the percentages in the Estimation columns do not differ drastically from those obtained from the CAA data. Furthermore, the estimation sample was intended to mostly represent routes where LCC operate, as well as routes and markets where LCC and FSC compete with each other. This is why the Estimation sample generally represents about 40.0% of the universe of duopoly routes and 50% or more of the universe of routes with 3 or more players.

5 Estimation Strategy and Methodology

Two reduced-form models are estimated. The first is formally represented as follows:

$$\Delta_{12}\ln(P_{ijbt}) = X'_{1jt}\beta_1 + X'_{2ijt}\beta_2 + X'_{3it}\beta_3 + Z'_{1j}\gamma_1 + Z'_{2i}\gamma_2 + Z'_{3b}\gamma_3 + \delta_{ijb} + \epsilon_{ijbt} \qquad (1)$$

where P is the mean (median) price for each ijb group over a month, i=company; j=route (and therefore country of arrival); b=booking days to departure; t=month. Regressors may be time variant (the Xs) and invariant (the Zs), while the errors are given by the sum of an unobserved effect (the δ) and an idiosyncratic component (the ϵ). For each month, average (median) fares for an airline on a given route were calculated by using all the fares' observations in each "booking days" group. Then, to obtain the dependent variable, we computed the year-to-year percentage change of these monthly fares. Such a strategy enables us to compare "likes" (e.g., June 2003) with "likes" (e.g., June 2004) to deal with the presence of seasonal fluctuations and to account for the heterogeneity arising from the airlines' yield management techniques. Indeed, airlines may set their fares differentially across "booking days" (Giaume and Guillou, 2004; Pels and Rietveld, 2004).

The second approach aggregates over "booking days" and therefore considers the percentage change of the mean (median) monthly price, obtained from all the different fares available in a month at different times prior to departure. That is:

$$\Delta_{12} \ln(P_{ijt}) = X^{'}_{1jt}\beta_1 + X^{'}_{2ijt}\beta_2 + X^{'}_{3it}\beta_3 + Z^{'}_{1j}\gamma_1 + Z^{'}_{2i}\gamma_2 + \delta_{ij} + \epsilon_{ijt} \quad (2)$$

Comparisons between the estimates from (1) and (2) are assumed to yield interesting insights into the impact of the variety of fares offered by the airlines before departure.

In equations (1) and (2), many explanatory variables, such as country dummies, are time invariant. In a fixed-effects model, these variables are not identified and therefore it is not possible to make comparisons between countries within and outside the Euro area. Using a random-effects model is not appropriate in our case, where some of the regressors are potentially correlated with the unobserved effects. To obtain coefficients for the time-invariant explanatory variables in (1) and (2), we rely on the two-stage FE estimation procedure presented in Polachek and Kim (1994) and further studied in Oaxaca and Geisler (2003).[10] Recently, Bilotkach (2006) has applied it in a study of price dispersion in the U.S. airline market.

The two-stage FE estimation procedure operates in the following manner:

[10] Oaxaca and Geisler (2003) demonstrate the equivalence between the two-stage FE GLS estimates and the OLS coefficient estimates from a pooled cross-section, time –series model. However, because the estimated standard errors differ, they derive a test to discriminate between the two methods. However, given the potential endogeneity of some explanatory variables with the unobserved effects, we will employ only the two-stage FE estimator.

- Estimate each of our models by FE to obtain the ${\beta_k}^{FE}$, k=1..3.

- Use these to estimate a heteroskedastic-robust OLS:

$$\Delta_{12}\ln(P_{ijb\bullet}) - X_{K\bullet}^{'}\beta_k^{FE} = Z_{1j}^{'}\gamma_1 + Z_{2i}^{'}\gamma_2 + Z_{3b}^{'}\gamma_3 + \delta_{ijb} + \epsilon_{ijb},$$

where $\Delta_{12}\ln(P_{ijb\bullet})$ and $X_{K_\bullet}$ are the group means of the time variant dependent and explanatory variables.

Initially the first stage was also estimated using an IV approach, assuming that one regressor could be endogenously correlated with the idiosyncratic error. A Hausman's test rejected such hypothesis.[11] Thus, the first stage FE estimates were obtained using heteroskedastic and panel autocorrelation-consistent variance estimates.

Price variations may be induced by the change in the capacity offered by an airline. Therefore, for both models, we only considered those routes where the percentage change in the total number of flights operated by an airline in the same month of two subsequent years remained below or equalled 30%.[12] Indeed, the decision to, say, double the number of flights in a route is also likely to have obvious repercussions on an airline's fare levels. While we could account for such changes in the econometric models, capacity (or the number of passengers) is clearly an endogenous variable for which we could not find a suitable instrument. Thus, the results from the econometric analysis are to be interpreted as conditional on an airline's capacity remaining sufficiently stable.

Table 3 shows yearly changes for the mean, median and minimum price in each month, broken down by area of destination and "booking days". A first point is the greater fluctuation of the minimum fares, suggesting that these may be often used to gauge demand. Another noteworthy distinction regards how late booking fares (1 to 4 days to departure) have generally increased throughout the period, while the largest variations are shown for fares retrieved 35 up to 14 days prior to departure. This may be indicative of a more intense competition triggered

[11] The regressor was the Herfindhal Index at the route level: see below for a discussion. The test results are not reported to save space, but are available on request.

[12] We also used the percentage change in the total number of passengers flown by an airline in the same months of two subsequent years. The percentage changes in the number of flights and passengers are highly correlated and indeed, no meaningful differences are noted in the econometric analysis.

by the airlines' interest to maximise load factors. Relatedly, fares remained relatively stable when they were posted 10 up to 7 days to departure. Table 3 does not show any indication of larger increases in the Eurozone.

6 Model Specification

In this section, we describe the variables used to estimate equations (1) and (2) and the hypotheses underlying their inclusion. In our model, we assume four types of factors may be responsible for fare changes. First, the airlines' price setting behaviour may differ depending on the seasonal timetable. Second, we account for countries specific effects, in particular with regards to the countries within and outside the Euro area. Third, the competitive structure of a route and a city pair, as well as the characteristics of an airline's network, are considered important determinants of airline pricing (Borenstein, 1989; Borenstein and Rose, 1994; Evans and Kessides, 1993; Giaume and Guillou, 2004). Fourth, we control for changes in some exogenous macroeconomic variables that are generally thought to influence pricing decisions in an international setting (Goldberg and Knetter, 1997).

6.1 Temporal Effects

In order to control for different pricing behaviour in the Winter and Summer seasons, we introduced the five dummy variables *Jun03-Oct03, Nov03-Mar04, Apr.04-Oct04, Nov04-Mar05 and Apr05-Jun05*, where the first constitutes the base period. Note how the first three correspond to the periods with the widest divergence between perceived and actual inflation (see Figure 1 and 2). Each of these dummies captures the percentage change in price relative to the corresponding period a year earlier.

6.2 Country effects.

The dummy "*Eurozone*" is included to capture common trends among the countries in the Euro currency area. It is interacted with the seasonal dummies to evaluate possible differences across seasons using the first stage, fixed effect estimation. Furthermore, in the second stage, a dummy for each country is also included to assess potential systematic differences among countries that may complement the fact of being or not being member of the Euro area. These are of paramount relevance in the evaluation of the impact of the Euro introduction, as structural characteristics of each member country's economy may have exacerbated or facilitated the post-changeover transition.

6.3 Effects due to market structure and the airlines' network.

The dummy "*D_ Own Entry in route*" indicates the twelfth month (and the subsequent two) after an airline enters a new route. Thus we try to capture the magnitude of the promotional fares an airline offers when launching a new service, by ascertaining whether and by how much fares have increased a year after entry. The dates of entry were obtained from the CAA dataset using the first period an airline is recorded on a route. A similar approach was followed in Gil Molto and Piga (2005) for the study of entry and exit in European routes and Berry (1992) for the case of entries in U.S. routes.

"City-pair Size", obtained as the share of total flights in a city pair over the total flights to a country, provides an index of a market size and its potential demand. The "*Route HHI*" is the HHI index obtained by summing the squares of the market shares of the airlines in a route, where the market shares are obtained in terms of number of flights each airline offers in a month. However, given that we model fare changes, in the empirical model we test whether changes in the level of concentration are correlated with changes in fares. Thus, we create the variable "Δ *Route Herfindhal Index*" which measures the change in the Herfindhal index at the route level between the same months of two consecutive years. This is not correlated with the entry variable as it includes all the entries and not only those of the airlines in our sample. We expect the sign of both *"City-pair Size"* and "Δ *Route Herfindhal Index*" to be positive. The latter variables identify market structure characteristics and are therefore potentially endogenous with the decision to set fares. However, the number of flights an airline offers is decided a season in advance, when timetables are prepared. Fares are set in a more flexible way and can be adapted to reflect intervening circumstances. Thus the number of flights is likely to influence fares, but not be influenced by them. In other words, it is unlikely that

both "*City-pair Size*" and "*Route HHI*" are correlated with the idiosyncratic errors ϵ_t. It is on the other hand possible that they are correlated with the unobserved effect δ_{ij}: e.g., where airlines can charge higher fares they will also increase their capacity. Such form of endogeneity is dealt with a robust fixed-effect estimation in the first stage of the estimation process.

We also include variables to control for an airline's network characteristics (Brueckner and Zhang, 2001; Morrison and Winston, 1990). Using a high number of UK departure airports to serve a given destination (variable "*N departures airline to arrival*") indicates that the airline is trying to differentiate its service. This should facilitate price increases. However, the need to realise high load factors in a situation where demand is fragmented over several routes may limit an airline's ability to increase prices. Similarly, the number of routes an airline serves within a city pair (variable "*N routes airline in citypair*") may capture the effects of an airlines' dominant position in the market, as well as its need to keep fares low in order to maximise its flights' load factors. Hence, for both variables we do not have a prior expectation on their signs.

Finally, we identify the two most important U.K. airports for each airline, in order to provide a measure of dominance in the U.K. endpoint of a route (Borenstein, 1991). To obtain this, we consider the total number of flights each airline operates from every U.K. airport. A dummy was used to identify the two most used airports (variable *"D_ Departure is a hub"*). Note that such a variable is time invariant, at least in our dataset where the airlines exhibit a tendency to occupy a dominant position in certain airports.[13]

In the second stage, we try to capture any remaining heterogeneity due to an airline's specific yield management strategy in two ways. First, we include a set of airlines' dummies. Second, "Booking days" effects are taken into account by allowing the following values for b in the ijb groups in equation (1): 1-4; 7-10; 14-21; 28-35; 42-49; 56-70. These numbers represent the number of days prior to departure the fares were retrieved. For each of these values a dummy variable was constructed, leaving the first as the base case.

[13] E.g., London Stansted and Glasgow Prestwick are the two most used UK airports by Ryan Air, Stansted and London Luton by EasyJet. Generally, the hubs thus defined correspond to the expectation an industry expert might have. For British Airways, the two hubs are, not surprisingly, Heathrow and Gatwick.

6.4 Macroeconomic variables.

Potential international and country-level determinants of the annual change in the airline prices are represented by the exchange rate and the price of oil. Table 4 shows the sample mean and standard error for the variable "% Δ Exchange rate", calculated as the percentage yearly change in a country's exchange rate with respect to the U.K. Sterling: the latter depreciated in the first two periods while remaining generally stable afterwards. A similar pattern is found also for the exchange rate between the Euro and the British Sterling. The likely impact of changes in the exchange rates on airlines' pricing is two-fold. Firstly, an appreciation of the European currencies with respect to the sterling pound may imply higher costs for goods and services denominated in European currencies. Goldberg and Verboven (2005) report that about 24% of an exchange rate change gets passed through onto local car prices in the short run. Secondly, this variable is likely to capture differences in the inflation rates in the countries of the route's endpoints. The variable "% Δ Exchange rate" is interacted with the seasonal dummies to account for the fact highlighted in Table 4 that the British Sterling exchange rate was more volatile in certain periods: this may induce the airlines to fine tune their fares in order to adjust them more closely to the changing circumstances.
Over the last three seasons in Table 4, jet-fuel prices have increased at a rate well above 35%, relative to the same months a year earlier (see variable "% Δ Fuel Cost").[14]. Although this has likely had strong repercussions on the fare settings, the consumption of fuel varies with the different phases of the flight: when the aircraft flies at cruising speed fuel consumption is much lower than when the airplane takes off or lands. Thus, in order to capture these economies of scale we interact the variable "% Δ Fuel Cost" with the logarithm of the route distance in miles (variable "Fuel*distance").

Table 4 reports a list of the regressors described above, as well as the data sources. The average number of departure airports used by an airline to serve a destination has increased from 3.0 in the first period to 4.8 in the last, thereby suggesting a tendency to reduce bureaucratic costs at the destination level by exploiting economies of scale (Berry, 1992). In

[14]The statistic on the Rotterdam (ARA) Kerosene-Type Jet Fuel Spot Price from the U.S. Department of Energy's web site was used. Because this was reported in USD cents per gallon, before calculating the annual changes, the prices were converted using the euro/dollar exchange rate from Datastream.

contrast, the number of routes an airline serves within a city pair tended to remain stable. The airlines in our sample entered new routes mostly during the period November 03 – March 05. As one would expect in a liberalised industry, the mean value of the HHI in our sampled routes declined throughout the periods, from 9278 to 8030. This is further confirmed by the average decreases in seasons 3, 5 and 7 (see variable "Δ *Route Herfindhal Index*"), although the high standard errors indicate that both increases and decreases feature in the sample. Finally, about two-thirds of the observations pertain to flights departing from a UK airport deemed as a hub.

7 Results

Table 5 reports the coefficients from the estimation of equations (1) and (2) using the percentage change in monthly mean prices as the dependent variable. In the Appendix, we include Table A1, where the dependent variable is the yearly percentage change in monthly median prices. The results are qualitatively similar, suggesting that aggregating many daily fares posted in a month into a single statistic (the mean) is practically equivalent to modelling a single observation, i.e., the median price. The following comments are based on the evidence for the mean prices. To account for possible biases induced by the different methods used to collect the data for the Full Service Carriers (FSC), Tables 5 and A1 include both estimates from the full sample (FSC + LCC) and the LCC sample only. Generally, similar implications could be drawn, so the following discussion is based on the full sample's results.

7.1 Did fares grow more in the Eurozone?

Relative to the base-period, the seasonal dummies confirm the increasing trend presented in Table 3: in Table 5, fares were up by about 20% in seasons 6 and by more than 50% in season 7. Such a trend holds for all the destinations, although a significantly lower increment is found in season 7 only for the destinations within the Eurozone.

Relative to the UK base-case, in Table 5 the countries' dummies are generally insignificant or significantly negative, with the exception of Spain and Ireland in the estimation of equation

(2). We observe, however, generally larger negative coefficients for the countries outside the Euro area: Switzerland, Sweden, Norway and Czech Republic. This seems to hold even when the mean impact of the interaction between the seasonal and the Eurozone dummies is taken into account.[15] The evidence therefore suggests two related points. First, the fact that the fares to the Eurozone destinations fell more than those for the U.K. domestic routes may simply indicate that the latter may have remained low throughout the period of analysis, in line with the view that the U.K. market is highly competitive (Gil-Molto and Piga, 2005). Second, the highly negative magnitude of the dummies for the non-Eurozone contries, as well as their stability across samples, suggests that fares to the Eurozone destinations may have fallen less than they could have. However, because the evidence indicates that the mean and median fares inside and outside the Eurozone have moved in a similar direction, we find little support to the hypothesis of asymmetric pricing behaviour across countries.

Further interesting insights are obtained by comparing the estimates of columns A-B with those in columns C-D, where in the latter fares are aggregated across booking days. First, we find a large difference between the coefficients of the Eurozone countries' dummies, even when we consider the impact of the interaction between the seasonal and the Eurozone dummies from the first stage estimation. Furthermore, the Eurozone's coefficients in equation (2) become insignificant. The coefficients of the non-Euro member countries are also somewhat smaller when we estimate equation (2), but they retain a significant negative sign. This result suggests that a different distribution of fares across booking days for Euro and non-Euro member countries. Second, and relatedly, note how the estimates for the "booking days" effects show price changes monotonically increasing as the day of departure approaches, with prices posted 56-70 days prior to departure being 13% cheaper than those available in the last week.[16] Combining the two results indicates that fares decreased across all booking days for the countries outside the Eurozone, although the late booking fares fell by a lesser amount. On the contrary, in the Euro area, it would seem that only the early booking fares decreased, with the opposite holding for late booking ones. Such an increase in the price dispersion for

[15] Goldberg and Verboven (2004) also report a post-changeover reduction in car price differentials in both areas, with a faster decrease occuring in the non-Euro countries.

[16] Piga and Bachis (2007) find, however, that the monotonic property is often violated when one considers the fares on a flight by flight basis.

the Eurozone's routes is consistent with two, non-mutually exclusive, explanations. On the one hand, dispersion can be ascribed to the airlines' yield management techniques, aimed at dealing with peak-load situations, rather than to the application of a country or area specific pricing rule. However, because we consider routes where the airlines' capacity remained stable, and given the common regulatory framework operating in all the countries, it is unlikely that, over a 35 months period, demand fluctuated almost exclusively only on the routes to and from the Eurozone. On the other, the enhanced inflationary expectations that accompanied the changeover may have induced the airlines to make their inter-temporal pricing profile steeper by increasing more their late booking fares, i.e., a more intense use of inter-temporal price discrimination strategies may actually be determined by the changed circumstances following the changeover and in particular by the attempt to extract a larger surplus from the group of the Eurozone's consumers with a more inelastic demand (Piga and Bachis, 2007).

7.2 Promotional fares, market structure and other control variables

The coefficient for "*D_ Own Entry in a route*" in Table 5 reveals how the entrants charged on average between 15% and 19% more twelve months after the entry in a new route. This could be explained by promotional pricing aimed at making the new service known to potentially interested travellers. When early booking fares are averaged with late booking ones, as in the case of equation (2), a similar conclusion can be reached. However, this is the only variable for which the estimates obtained using the mean price as a dependent variable differ drastically from those obtained using the median price. Arguably, the airlines are likely to probe the market by offering different fares, in order to gauge the potential demand on the route. When launching a new route, the airlines may offer some very low fares, but they may also raise them to evaluate how the sales respond. The ensuing price dispersion is captured in the mean fare, but not in the median.

As expected, fares increase as the route becomes more concentrated. Moreover, the estimates for market size point out to higher fare rises in larger and denser markets. Furthermore, on average, fares in routes departing from an airline's hub increased 9-14% less than in routes where the departure airport is not a hub. This seems in contrast with previous studies revealing the existence of a "hub premium" (Borenstein, 1989). However, given the prevalence of observations from LCC in our sample, this is hardly surprising because these companies do not use any of the marketing strategies (e.g., Frequent Flyer programmes or incentivizing travel agent commissions rising with sales volume) that have been deemed as the source of the strategic advantages that hubs conferred to U.S. traditional airlines (Borenstein, 1991). Rather, the negative coefficient suggests how the principal reason why most European airlines operate as many flights as possible from a limited number of departure airports is to save on overhead costs (Berry, 1992). Further support to the hypothesis of the importance of network characteristics is found in the negative estimates for the number of routes an airline serves in a city-pair and for the number of departure airports in the UK that the airline uses to serve a given destination. Such evidence suggests important cost savings from operating slightly differentiated routes that may have one of the two endpoints in common.

Our findings therefore indicate that both the competitive structure of the route and the characteristics of an airline's network play a crucial role in determining how fares evolve over time. However, we find no similar evidence in favour of the exchange rate and of the change in fuel costs. The latter may be due to the fact that during the period of analysis the airlines were not affected by the steep increase in the oil price because their supply of fuel was managed via earlier forward contracts.

8 Conclusions

Using a dataset of more than 10 million fares collected on-line, we have investigated whether in the immediate periods following the Euro changeover the airlines increased their fares more for flights to and from destinations within the Euro area. We find that fares followed a similar temporal pattern during the period June 2002-June 2005, i.e., they generally declined until October 2004 and then sharply increased. Such a finding holds regardless of whether the fares concerned routes to Eurozone destinations or not. Thus, our evidence supports the European Central Bank's view that the observed increase in prices after the introduction of the Euro may have been mostly confined to sectors not exposed to international competition. It is also consistent with the findings in other studies on the car market, in which a reduction in price differentials was observed in the period 2002-2003 (Goldberg and Verboven, 2004 and 2005). Interestingly, both the aviation and the automobile sectors have been central to the European Commission's strategy to improve European integration over the last two decades.

However, the investigation of the fares posted at different time point before departure suggests that, net of common trends, late booking fares increased in the Euro area, thereby offsetting, to a large extent, the decrease in early booking fares. On the contrary, outside the Eurozone, all fares across different booking days fell, although more sharply for the case of fares posted at least four weeks prior to departure. Such a contrasting finding may reflect an enhanced volatility for the demand to Eurozone destinations that the airlines managed by increasing the price dispersion across booking days. It is also indicative of a different pricing tactic capturing "the underlying economic model in each country", as in the case of Apple. That is, the higher price hikes imposed by the airlines for the fares posted only a few days prior to departure may reflect the perception of rising prices that pervaded the consumers in the Euro area for at least 18-24 months after the Euro introduction. Indeed, such price hikes were not observed for the fares to destinations outside the Eurozone. The changeover seems therefore to have heightened the airlines' possibility to engage more profitably in inter-temporal price discrimination in order to take advantage of the change in consumers' willingness to pay driven by the new, post-changeover economic conditions. Indeed, the price hikes pertain to late booking fares, which are often associated to consumers with a more inelastic demand.

A similar conclusion is reinforced by the findings pertaining to the post-entry pricing behaviour. Twelve months after the entry we find a significant increase in the mean price, but no change in the median price, which suggests a larger dispersion of fares around a fixed median value in the immediate post-entry periods. Dispersion may be ascribed to a learning strategy where the airlines post both low prices for promotional purposes and high fares to probe the consumers' response.

Gil-Molto and Piga (2005) find that entry in a route is less likely to occur in large markets. In this paper, we find that such markets record larger price increases, which are also positively correlated with changes in route concentration. Whether this is a transitory result due to the infant state of the liberalisation process is something that is left to future research. We observe that the liberalisation has produced two companies, Ryan Air and Easyjet, that after having consolidated their positions in the U.K. markets in the early post-liberalisation years, have expanded by creating hubs in practically every European country. They were also the first to enter massively in the East European countries that have recently enlarged the European Union, by connecting them with most other member States. Unfortunately, the dynamism of the U.K. market constitutes an isolated case in Europe, as no "low-frills company" equivalent in size to Ryan Air or Easyjet, has emerged in such countries as Germany, France, Italy or Spain. This may be due to the dominant position in each of these domestic markets still maintained by their former flag carriers. As discussed by Lee (2003), in the U.S. concentration dropped in the years immediately following deregulation, but then rose steadily starting in the mid 1980s reaching its peak in the early 1990s: this might also happen in Europe unless more effective competition is enabled in every national market.

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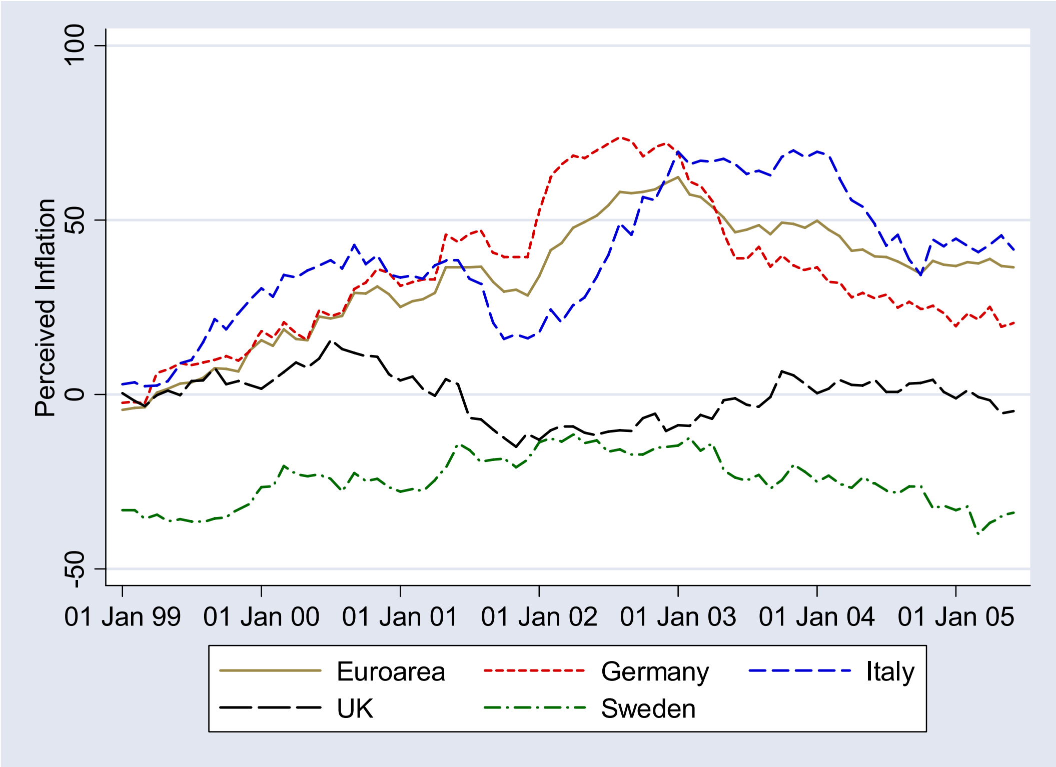
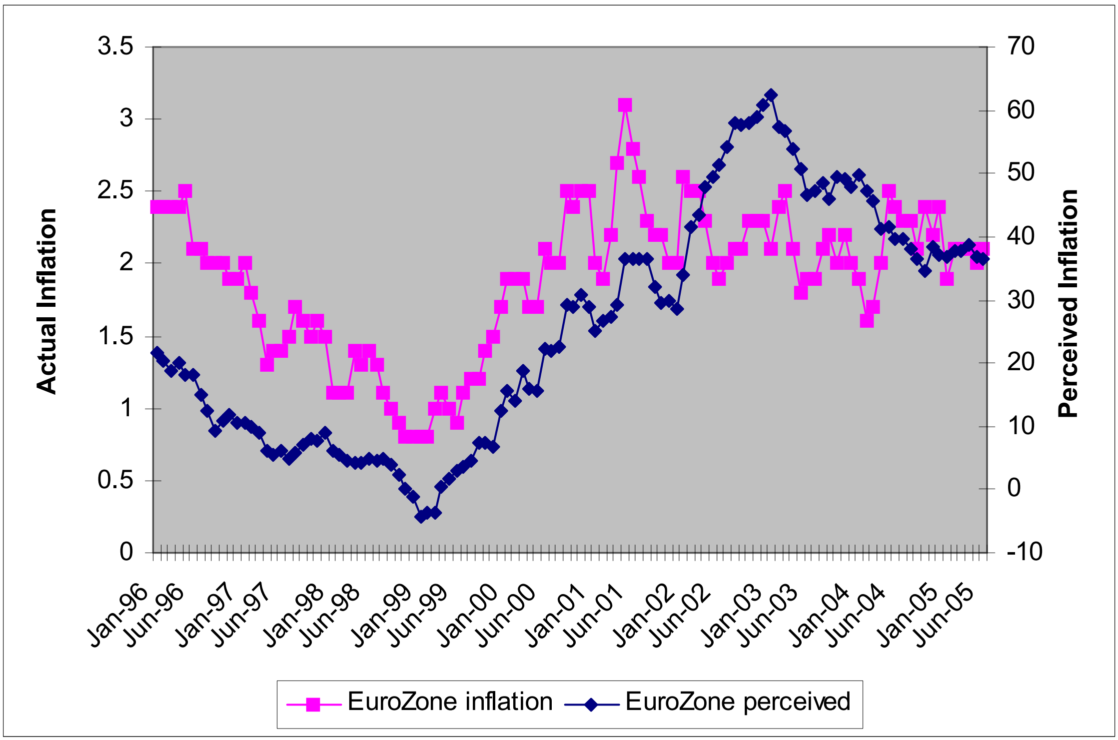
Figure 1 – Perceived inflation inside and outside the Eurozone.



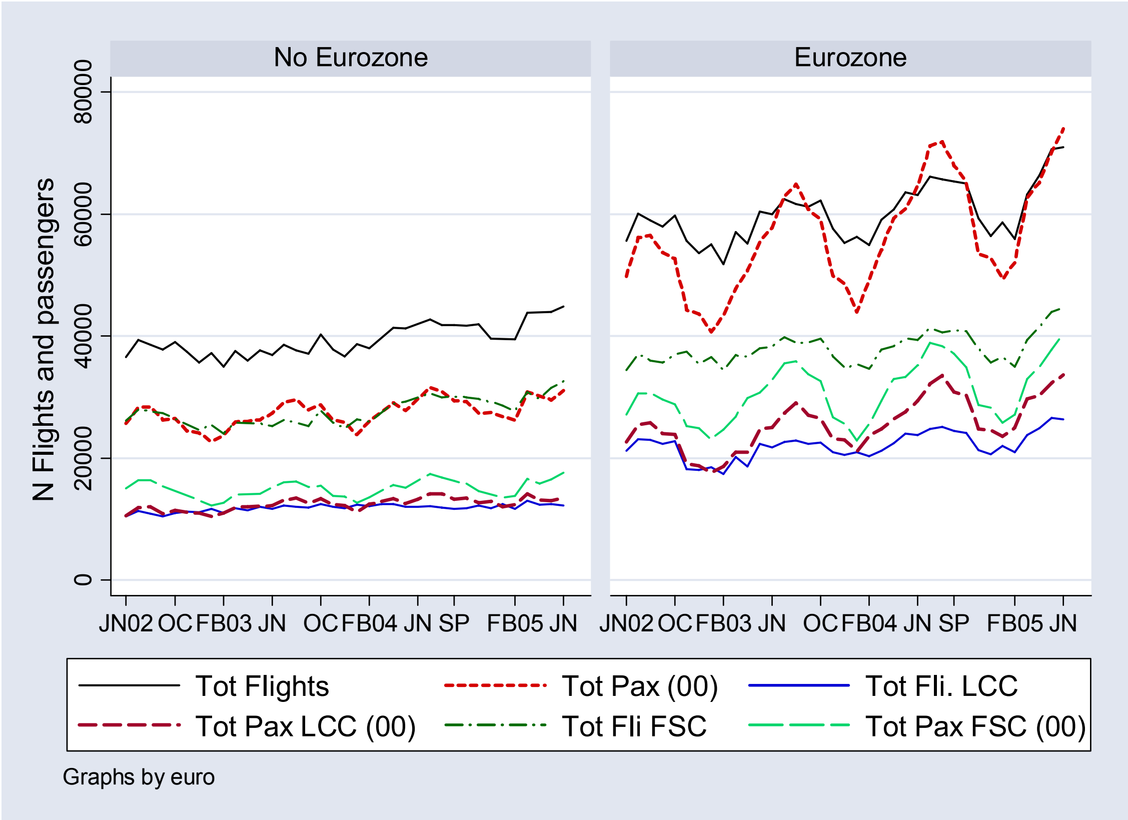
Source: European Commission – Business and Consumer Survey.
http://europa.eu.int/comm/economy_finance/indicators/businessandconsumersurveys_en.htm
Note: Perceived Inflation is computed as the difference between the share of respondents reporting that prices "strongly or moderately increased" and the share of respondents reporting "stable" or "decreased" prices.

Figure 2 – Actual and Perceived inflation in the Eurozone.



Source: European Central Bank and European Commission – Business and Consumer Survey.

Figure 3: Evolution of total flights and passengers by geographical location and type of carrier.



Source : UK Civil Aviation Authority. Note: all Tot.Pax divided by 100.

TABLE 1 - Average one-way fares by airline and season

	Jun02-Oct02	**Nov02-Mar03**	**Apr03-Oct03**	**Nov03-Mar04**	**Apr04-Oct04**	**Nov04-Mar05**	**Apr05-Jun05**	**Tot.Obs.**
Bmibaby		46.0 (21963)	48.9 (115201)	29.8 (61486)	38.3 (160972)	31.2 (129706)	40.7 (55685)	545013
RYANAIR	44.9 (133127)	30.3 (304771)	35.7 (715953)	25.5 (407605)	34.9 (784571)	23.9 (470781)	31.2 (500256)	3317064
EASYJET	47.9 (104427)	38.3 (316854)	47.7 (685381)	33.7 (457398)	42.7 (1022782)	37.3 (504738)	48.4 (590450)	3682030
BUZZ	59.0 (43198)	33.7 (67724)						110922
Go Fly	73.9 (74288)	44.6 (50988)						125276
MyTravelLite				41.8 (12103)	59.1 (37382)	36.1 (30667)	57.2 (19708)	99860
Aer Lingus			56.5 (31008)	53.2 (15437)	59.1 (26765)	99.5 (56791)	103.4 (17336)	147337
Air Europa			51.7 (2147)	54.1 (811)	96.6 (1947)	94.1 (16356)	86.5 (4867)	26128
Air France			41.4 (11938)	43.8 (6019)	60.2 (15354)	42.2 (14382)	45.2 (4993)	52686
Alitalia			75.2 (11308)	68.1 (10138)	91.3 (29633)	74.6 (42798)	82.2 (14129)	108006
BMI BritiMidland			54.3 (64187)	51.7 (49858)	57.4 (147038)	55.5 (143308)	58.7 (48109)	452500
British Airways			70.8 (136088)	69.3 (89712)	76.5 (286210)	77.7 (333628)	79.2 (110520)	956158
Czech Airlines			86.8 (1701)	71.6 (1687)	78.5 (8343)	73.5 (15318)	82.0 (5084)	32133
Iberia			91.3 (15976)	77.1 (11892)	101.9 (36503)	67.8 (47611)	72.7 (15855)	127837
KLM			70.8 (14553)	73.3 (8782)	82.3 (22030)	85.2 (21189)	64.0 (7031)	73585
Lufthansa			62.5 (19426)	66.5 (12551)	72.9 (47498)	57.7 (39913)	59.7 (13256)	132644
Scandin. Airlines			69.0 (12982)	82.8 (10262)	72.7 (30943)	69.8 (40141)	66.7 (13569)	107897
Swiss			70.3 (18476)	85.1 (10704)	83.2 (39190)	79.1 (47690)	83.9 (15600)	131660
Tot.Obs.	355040	762300	1856325	1166445	2697161	1955017	1436448	10228736

Source: our calculations based on the Internet retrieved fares. (Number of observations used to calculate the average is in parentheses).

Table 2 - Samples composition by period and number of companies per route

	Route with one airline (%)			Route with two airlines (%)			Route with 3 or more airlines (%)		
Samples	CAA	Internet	Estimation	CAA	Internet	Estimation	CAA	Internet	Estimation
Jun 03	438 (78.5)	131 (69.7)	25 (89.3)	99 (17.7)	45 (23.9)	2 (7.1)	21 (3.8)	12 (6.4)	1 (3.6)
Jul 03	443 (79.4)	132 (70.2)	36 (87.8)	96 (17.2)	44 (23.4)	3 (7.3)	19 (3.4)	12 (6.4)	2 (4.9)
Aug 03	432 (77.8)	153 (70.8)	33 (84.6)	107 (19.3)	51 (23.6)	4 (10.3)	16 (2.9)	12 (5.6)	2 (5.1)
Sept 03	441 (78.8)	164 (74.2)	42 (85.7)	103 (18.4)	48 (21.7)	4 (8.2)	16 (2.9)	9 (4.1)	3 (6.1)
Oct 03	446 (77.3)	162 (72.0)	43 (84.3)	112 (19.4)	49 (21.8)	5 (9.8)	19 (3.3)	14 (6.2)	3 (5.9)
Nov 03	434 (78.3)	160 (72.4)	45 (84.9)	101 (18.2)	46 (20.8)	5 (9.4)	19 (3.4)	15 (6.8)	3 (5.7)
Dec 03	447 (78.3)	163 (70.9)	50 (84.7)	105 (18.4)	53 (23.0)	6 (10.2)	19 (3.3)	14 (6.1)	3 (5.1)
Jan 04	453 (78.2)	162 (71.7)	67 (74.4)	107 (18.5)	52 (23.0)	19 (21.1)	19 (3.3)	12 (5.3)	4 (4.4)
Feb 04	446 (78.2)	163 (70.3)	70 (74.5)	105 (18.4)	55 (23.7)	20 (21.3)	19 (3.3)	14 (6.0)	4 (4.3)
Mar 04	461 (78.1)	165 (70.8)	69 (78.4)	105 (17.8)	52 (22.3)	14 (15.9)	24 (4.1)	16 (6.9)	5 (5.7)
Apr 04	485 (78.2)	169 (71.9)	86 (72.3)	110 (17.7)	51 (21.7)	27 (22.7)	25 (4.0)	15 (6.4)	6 (5.0)
May 04	498 (78.8)	164 (72.6)	99 (70.2)	111 (17.6)	49 (21.7)	34 (24.1)	23 (3.6)	13 (5.8)	8 (5.7)
Jun 04	504 (78.9)	164 (71.0)	99 (67.3)	106 (16.6)	50 (21.6)	37 (25.2)	29 (4.5)	17 (7.4)	11 (7.5)
Jul 04	518 (79.1)	163 (72.1)	105 (69.5)	109 (16.6)	47 (20.8)	33 (21.9)	28 (4.3)	16 (7.1)	13 (8.6)
Aug 04	515 (79.0)	166 (71.9)	126 (72.8)	111 (17.0)	49 (21.2)	36 (20.8)	26 (4.0)	16 (6.9)	11 (6.4)
Sept 04	528 (79.3)	188 (74.3)	129 (74.1)	112 (16.8)	48 (19.0)	37 (21.3)	26 (3.9)	17 (6.7)	8 (4.6)
Oct 04	532 (80.0)	194 (74.0)	127 (73.4)	109 (16.4)	52 (19.8)	36 (20.8)	24 (3.6)	16 (6.1)	10 (5.8)
Nov 04	510 (79.6)	192 (74.1)	117 (73.6)	111 (17.3)	51 (19.7)	35 (22.0)	20 (3.1)	16 (6.2)	7 (4.4)
Dec 04	510 (79.3)	192 (75.3)	116 (74.8)	112 (17.4)	52 (20.4)	33 (21.3)	21 (3.3)	11 (4.3)	6 (3.9)
Jan 05	524 (78.8)	195 (71.2)	110 (72.8)	121 (18.2)	67 (24.5)	33 (21.9)	20 (3.0)	12 (4.4)	8 (5.3)
Feb 05	528 (78.6)	194 (71.3)	114 (69.5)	120 (17.9)	64 (23.5)	41 (25.0)	24 (3.6)	14 (5.1)	9 (5.5)
Mar 05	554 (77.5)	193 (70.2)	103 (68.2)	131 (18.3)	64 (23.3)	36 (23.8)	30 (4.2)	18 (6.5)	12 (7.9)
Apr 05	584 (78.9)	203 (71.5)	108 (65.1)	131 (17.7)	63 (22.2)	45 (27.1)	25 (3.4)	18 (6.3)	13 (7.8)
May 05	591 (78.2)	208 (72.0)	126 (71.2)	138 (18.3)	62 (21.5)	40 (22.6)	27 (3.6)	19 (6.6)	11 (6.2)
Jun 05	601 (77.6)	200 (70.7)	120 (69.0)	145 (18.7)	63 (22.3)	44 (25.3)	28 (3.6)	20 (7.1)	10 (5.7)

Source: our calculations based on United Kingdom Civil Aviation Authority data (CAA), on Internet-retrieved fares Data (Internet) and the resulting Estimation sample.

Table 3 - Percentage fare changes by days of query prior to departure, season and geographical location

	Jun03-Oct03		Nov03-Mar04		Apr04-Oct04		Nov04-Mar05		Apr05-Jun05	
Days	No Ezone	Ezone	No Ezone	Ezone	No Ezone	Ezone	No Ezone	Ezone	No Ezone	Ezone
	% Δ Mean Monthly price									
1-4	10.2	1.1	2.2	-0.3	-3.2	2.4	7.1	5.8	8.4	-5.6
7-10	-17.0	-31.6	-12.5	-22.7	1.8	5.9	6.0	11.1	5.0	-7.1
14-21	-32.3	-40.7	-26.1	-36.5	0.0	0.5	8.5	9.6	3.8	-8.1
28-35	-27.2	-30.5	-27.8	-33.2	-3.4	-5.9	6.5	6.5	-2.5	-8.1
42-49	-29.6	-23.5	-23.9	-28.4	-5.3	-10.2	3.5	0.3	0.4	-4.9
56-70	-22.9	-17.6	-38.6	-31.1	-16.6	-19.8	-2.1	-8.5	5.1	-10.1
	% Δ Median Monthly price									
1-4	10.1	1.6	0.7	-0.6	-2.8	3.6	4.2	2.1	5.8	-9.4
7-10	-20.8	-41.4	-17.2	-35.3	1.5	7.0	-1.3	7.9	1.7	-8.4
14-21	-40.6	-51.5	-35.6	-56.0	-1.4	1.0	8.5	6.7	-1.3	-11.1
28-35	-38.0	-37.6	-40.6	-51.8	-4.8	-7.0	12.0	8.9	-5.2	-10.9
42-49	-36.3	-26.7	-33.3	-39.6	-8.3	-11.0	7.1	-1.7	0.5	-9.0
56-70	-25.3	-21.1	-49.5	-40.7	-20.6	-21.9	-1.4	-21.8	5.5	-11.3
	% Δ Minimum Monthly price									
1-4	25.5	4.1	2.9	9.0	3.3	15.8	12.9	18.6	11.8	-2.1
7-10	-35.5	-79.9	-71.7	-125.5	16.2	30.9	12.2	25.2	3.6	2.8
14-21	-72.5	-100.4	-85.1	-101.5	-8.8	-8.6	16.7	8.9	-2.0	-1.0
28-35	-57.6	-78.4	-109.4	-137.1	-13.6	-20.7	29.5	31.0	-5.5	-8.4
42-49	-44.7	-66.2	-97.9	-94.4	-20.3	-23.2	16.6	2.3	14.3	1.0
56-70	-25.7	-51.7	-88.3	-86.5	-33.7	-49.7	30.3	-6.5	40.3	19.7

Source: our elaboration on the Internet-retrieved fares' dataset.

Table 4- Descriptive statistics of regressors by season.

	Season 3 Jun03-Oct03 N=1072		Season 4 Nov03-Mar04 N=1963		Season 5 Apr04-Oct04 N=7289		Season 6 Nov04-Mar05 N=4855		Season 7 Apr05-Jun05 N=3420	
	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
% Δ Exchange rate	-8.7	2.8	-4.7	4.0	3.8	2.1	-0.5	1.8	-2.4	1.7
% Δ Exchange rate in Euroarea	-8.0	4.0	-4.8	4.0	3.2	2.0	-1.7	1.0	-1.8	1.0
% Δ Fuel Cost	-8.1	6.2	-12.0	12.9	38.8	11.8	34.9	8.6	36.0	8.5
Citypair Size	0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.1
N departures for arrival	3.0	2.9	4.4	3.9	4.6	4.2	4.5	4.2	4.8	4.5
N routes airline in market	1.8	1.0	1.8	1.0	1.8	1.0	1.9	1.1	1.9	1.2
D_ Own Entry in route	0.00	0.00	0.01	0.07	0.02	0.12	0.01	0.09	0.00	0.00
Route HHI	9278	1843	8919	2044	8084	2462	7980	2475	8030	2474
Δ Route HHI	-16	274	142	844	-50	652	1	998	-193	1125
D_Departure is a hub	0.83	0.37	0.64	0.48	0.63	0.48	0.63	0.48	0.62	0.49

Source: Datastream for the Exchange rates data; U.S. Department of Energy for Jet-Fuel data (excel file: PSW14VDJT.xls); UK Civil Aviation Authority for the remaining variables. D_ denote a Dummy variable. Exchange rates are measured in term of currency per UK sterling: a negative value reflects a devaluation of the latter.

Table 5 - Panel Estimates. Dependent Variable: % Δ Mean Monthly price. t-statistics in round brackets

	Equat. (1): Full Sample A	Equat. (1): LCC Sample B	Equat. (2): Full Sample C	Equat. (2): LCC Sample D
D_Season4: Nov03-Mar04	-0.04 (1.03)	-0.05 (1.37)	0.07 (1.23)	0.07 (1.19)
D_Season5: Apr04-Oct04	-0.04 (1.00)	-0.13 (3.53)[a]	0.03 (0.53)	-0.07 (1.12)
D_Season6: Nov04-Mar05	0.18 (4.53)[a]	0.20 (4.66)[a]	0.04 (0.55)	0.06 (0.91)
D_Season7: Apr05-Jun05	0.48 (11.4)[a]	0.57 (12.91)[a]	0.57 (7.62)[a]	0.68 (8.53)[a]
D_Season4 * D_Eurozone	-0.06 (1.48)	-0.07 (1.88)[c]	-0.15 (2.39)[b]	-0.16 (2.53)[b]
D_Season5 * D_Eurozone	0.00 (0.13)	0.04 (1.15)	-0.02 (0.27)	0.03 (0.46)
D_Season6 * D_Eurozone	0.03 (0.81)	0.01 (0.29)	-0.05 (0.80)	-0.08 (1.22)
D_Season7 * D_Eurozone	-0.07 (1.83)[c]	-0.11 (2.75)[a]	-0.16 (2.57)[a]	-0.19 (2.99)[a]
D_Italy‡	-0.12 (2.78)[a]	-0.10 (1.89)[c]	0.03 (0.63)	0.06 (0.99)
D_France‡	-0.10 (2.62)[a]	-0.09 (1.68)[c]	0.06 (1.35)	0.07 (1.25)
D_Spain‡	-0.06 (1.71)[c]	0.01 (0.17)	0.10 (2.36)[b]	0.16 (3.10)[a]
D_Austria‡	-0.21 (4.42)[a]	-0.20 (3.29)[a]	-0.02 (0.40)	0.00 (0.06)
D_Holland‡	-0.21 (3.63)[a]	-0.08 (1.70)[c]	-0.01 (0.24)	0.04 (0.85)
D_Germany‡	-0.16 (2.99)[a]	-0.21 (2.72)[a]	-0.02 (0.25)	-0.06 (0.69)
D_Belgium‡	-0.70 (4.87)[a]	-0.64 (6.44)[a]	-0.47 (4.97)[a]	-0.44 (5.66)[a]
D_Greece‡	-1.35 (40.7)[a]	-1.25 (32.6)[a]	-1.08 (20.6)[a]	
D_Ireland‡	-0.07 (1.22)	0.19 (2.57)[b]	0.05 (0.87)	0.23 (3.12)[a]
D_Portugal‡	-0.25 (2.62)[a]	-0.17 (1.90)[c]	-0.04 (0.49)	-0.02 (0.25)
D_Switzerland‡	-0.29 (7.01)[a]	-0.27 (4.54)[a]	-0.16 (2.82)[a]	-0.17 (2.56)[b]
D_Sweden‡	-0.48 (4.29)[a]	-0.39 (3.38)[a]	-0.35 (3.21)[a]	-0.28 (2.67)[a]
D_Norway‡	-0.55 (6.58)[a]	-0.44 (4.38)[a]	-0.43 (3.84)[a]	-0.31 (2.74)[a]
D_Czech Republic‡	-0.33 (4.33)[a]	-0.29 (4.33)[a]	-0.17 (2.36)[b]	-0.18 (2.52)[b]
D_7-10 days prior departure‡	-0.02 (1.84)[c]	0.01 (0.84)		
D_14-21 days prior depart. ‡	-0.05 (3.69)[a]	-0.04 (3.26)[a]		
D_28-35 days prior depart. ‡	-0.07 (5.40)[a]	-0.09 (6.17)[a]		
D_42-49 days prior depart. ‡	-0.08 (6.05)[a]	-0.10 (7.23)[a]		
D_56-70 days prior depart. ‡	-0.13 (7.98)[a]	-0.13 (7.97)[a]		
N departures airline to arrival	-0.01 (1.33)	-0.03 (6.27)[a]	-0.01 (0.84)	-0.02 (2.59)[a]
N routes of airline in citypair	-0.06 (7.34)[a]	-0.07 (7.11)[a]	-0.06 (4.60)[a]	-0.09 (5.64)[a]
D_ Own Entry in route	0.15 (3.79)[a]	0.19 (4.58)[a]	0.11 (1.90)[c]	0.18 (3.07)[a]
Citypair Size	1.39 (8.25)[a]	1.24 (6.63)[a]	1.25 (3.88)[a]	1.28 (3.59)[a]
Δ Route Herfindhal Index	0.19 (5.38)[a]	0.17 (4.43)[a]	0.24 (3.51)[a]	0.09 (1.35)
D_Departure is a hub‡	-0.09 (3.43)[a]	-0.14 (4.19)[a]	-0.09 (3.25)[a]	-0.12 (3.58)[a]
% Δ Exchange rate	0.08 (0.14)	0.27 (0.51)	0.87 (1.02)	1.00 (1.16)
--*D_Season4: Nov03-Mar04	0.01 (0.02)	-0.24 (0.43)	-1.62 (1.75)[c]	-1.74 (1.87)[c]
--*D_Season5: Apr04-Oct04	1.31 (2.38)[b]	0.84 (1.54)	0.37 (0.41)	0.19 (0.21)
--*D_Season6: Nov04-Mar05	-1.80 (3.01)[a]	-2.89 (4.51)[a]	-1.20 (1.23)	-2.21 (2.15)[b]
--*D_Season7: Apr05-Jun05	0.62 (1.01)	0.28 (0.43)	1.18 (1.10)	0.83 (0.72)
% Δ Fuel Price†	0.75 (0.50)	0.72 (0.48)	1.62 (0.67)	1.25 (0.51)
Fuel*distance†	-0.09 (0.36)	-0.08 (0.33)	-0.26 (0.67)	-0.20 (0.51)
N	18558	14950	3386	2775
N second stage	1602	1217	253	204
R^2 first stage	0.08	0.10	0.09	0.14
R^2 second stage	0.58	0.56	0.55	0.55

Note: [a,b,c]denotes significance at 1%, 5% and 10% level, respectively. D_ identifies a Dummy variable. Models include a constant and dummies for each airline, not reported to save on space. Standard Errors are robust to heteroskedasticity and auto-correlation. ‡ Based on Oaxaca and Geisler (2003) and Polachek and Kim (1994), the estimates from these time invariant dummies in the FE models are obtained from a second stage OLS estimation with White standard errors clustered over routes. † The coefficients from the interaction of this variable with the seasonal dummies not reported to save on space.

Appendix

Table A1 - Panel Estimates. Dependent Variable: % Δ Median Monthly price. t-statistics in round brackets

	Equat. (1): Full Sample A	Equat. (1): LCC Sample B	Equat. (2): Full Sample C	Equat. (2): LCC Sample D
D_Season4: Nov03-Mar04	-0.08 (1.69)[c]	-0.09 (1.99)[b]	0.07 (1.00)	0.07 (0.95)
D_Season5: Apr04-Oct04	-0.05 (1.12)	-0.16 (3.50)[a]	0.03 (0.47)	-0.08 (1.13)
D_Season6: Nov04-Mar05	0.19 (3.65)[a]	0.21 (3.70)[a]	-0.04 (0.50)	-0.03 (0.37)
D_Season7: Apr05-Jun05	0.50 (9.39)[a]	0.60 (10.48)[a]	0.59 (6.50)[a]	0.71 (7.13)[a]
D_Season4 * D_Eurozone	-0.10 (1.99)[b]	-0.12 (2.34)[b]	-0.17 (2.15)[b]	-0.18 (2.26)[b]
D_Season5 * D_Eurozone	0.03 (0.62)	0.07 (1.57)	0.01 (0.16)	0.06 (0.90)
D_Season6 * D_Eurozone	0.02 (0.45)	-0.01 (0.19)	-0.09 (1.15)	-0.13 (1.63)
D_Season7 * D_Eurozone	-0.07 (1.31)	-0.10 (2.00)[b]	-0.15 (1.98)[b]	-0.17 (2.23)[b]
D_Italy‡	-0.15 (2.82)[a]	-0.14 (1.93)[c]	0.02 (0.31)	0.05 (0.74)
D_France‡	-0.13 (2.36)[b]	-0.11 (1.48)	0.07 (1.25)	0.08 (1.24)
D_Spain‡	-0.05 (1.00)	0.03 (0.51)	0.14 (2.71)[a]	0.21 (3.38)[a]
D_Austria‡	-0.30 (4.54)[a]	-0.29 (3.36)[a]	-0.06 (1.04)	-0.04 (0.49)
D_Holland‡	-0.22 (3.41)[a]	-0.08 (1.21)	-0.04 (0.60)	0.06 (1.01)
D_Germany‡	-0.20 (3.12)[a]	-0.27 (2.68)[a]	-0.05 (0.65)	-0.09 (0.93)
D_Belgium‡	-0.79 (3.36)[a]	-0.72 (3.95)[a]	-0.56 (4.34)[a]	-0.51 (4.94)[a]
D_Greece‡	-1.45 (31.6)[a]	-1.36 (26.5)[a]	-1.25 (21.0)[a]	
D_Ireland‡	-0.01 (0.16)	0.28 (2.74)[a]	0.11 (1.44)	0.32 (3.19)[a]
D_Portugal‡	-0.24 (1.85)[c]	-0.15 (1.17)	-0.03 (0.20)	0.02 (0.17)
D_Switzerland‡	-0.33 (6.68)[a]	-0.31 (4.45)[a]	-0.17 (2.76)[a]	-0.18 (2.35)[b]
D_Sweden‡	-0.57 (4.74)[a]	-0.48 (3.53)[a]	-0.44 (3.47)[a]	-0.34 (2.75)[a]
D_Norway‡	-0.67 (10.4)[a]	-0.61 (7.44)[a]	-0.49 (3.99)[a]	-0.35 (2.57)[b]
D_Czech Republic‡	-0.37 (4.40)[a]	-0.32 (4.12)[a]	-0.17 (1.99)[b]	-0.15 (1.72)[c]
D_7-10 days prior departure‡	-0.04 (2.69)[a]	-0.01 (0.68)		
D_14-21 days prior depart. ‡	-0.07 (3.83)[a]	-0.07 (3.63)[a]		
D_28-35 days prior depart. ‡	-0.08 (4.45)[a]	-0.10 (4.84)[a]		
D_42-49 days prior depart. ‡	-0.10 (5.42)[a]	-0.12 (6.13)[a]		
D_56-70 days prior depart. ‡	-0.16 (7.23)[a]	-0.16 (7.22)[a]		
N departures airline to arrival	-0.02 (3.62)[a]	-0.05 (7.79)[a]	-0.01 (1.93)[c]	-0.03 (3.54)[a]
N routes of airline in citypair	-0.08 (6.96)[a]	-0.08 (6.39)[a]	-0.08 (4.86)[a]	-0.09 (5.34)[a]
D_ Own Entry in route	0.03 (0.48)	0.07 (0.95)	0.06 (0.90)	0.11 (1.47)
Citypair Size	1.46 (6.71)[a]	1.28 (4.99)[a]	1.46 (3.90)[a]	1.42 (3.16)[a]
Route Herfindhal Index	0.24 (5.79)[a]	0.21 (4.65)[a]	0.29 (3.65)[a]	0.12 (1.52)
D_Departure is a hub‡	-0.12 (3.38)[a]	-0.19 (4.15)[a]	-0.11 (3.28)[a]	-0.16 (4.03)[a]
% Δ Exchange rate	-0.15 (0.22)	0.07 (0.10)	0.64 (0.61)	0.79 (0.75)
--*D_Season4: Nov03-Mar04	0.06 (0.08)	-0.23 (0.31)	-1.67 (1.40)	-1.81 (1.51)
--*D_Season5: Apr04-Oct04	1.60 (2.23)[b]	1.21 (1.67)[c]	0.34 (0.31)	0.21 (0.19)
--*D_Season6: Nov04-Mar05	-1.62 (1.92)[c]	-2.71 (2.87)[a]	0.09 (0.07)	-0.73 (0.59)
--*D_Season7: Apr05-Jun05	1.60 (1.98)[b]	1.31 (1.51)	2.52 (1.98)[b]	2.34 (1.72)[c]
% Δ Fuel Price†	1.29 (0.57)	1.22 (0.54)	1.68 (0.52)	1.08 (0.33)
Fuel*distance†	-0.13 (0.38)	-0.12 (0.34)	-0.25 (0.48)	-0.15 (0.29)
N	18558	14950	3386	2775
N second stage	1602	1217	253	204
R^2 first stage	0.06	0.07	0.08	0.11
R^2 second stage	0.56	0.55	0.58	0.58

Note: [a,b,c]denotes significance at 1%, 5% and 10% level, respectively. D_ identifies a Dummy variable. Models include a constant and dummies for each airline, not reported to save on space. Standard Errors are robust to heteroskedasticity and auto-correlation. ‡ Based on Oaxaca and Geisler (2003) and Polachek and Kim (1994), the estimates from these time invariant dummies in the FE models are obtained from a second stage OLS estimation with White standard errors clustered over routes. † The coefficients from the interaction of this variable with the seasonal dummies not reported to save on space.