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Xavier Fageda (GiM-IREA)
Jordi Perdiguero (GiM-IREA)

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AN EMPIRICAL ANALYSIS OF A MERGER BETWEEN A NETWORK AND LOW-COST AIRLINES

XAVIER FAGEDA
Department of Economic Policy, Universitat de Barcelona. Research group "Governs i Mercats" (GiM). Av. Diagonal, 690. 08034 Barcelona (Spain). E-mail: xfageda@ub.edu. Tel:+34934039721. FAX: +34934024573.

JORDI PERDIGUERO
Department of Economic Policy, Universitat de Barcelona. Research group "Governs i Mercats" (GiM). Av. Diagonal, 690. 08034 Barcelona (Spain). E-mail: jordi.perdiguero@ub.edu. Tel:+34934039721. FAX: +34 934024573

Abstract: We use a difference-in-difference estimator to examine the effects of a merger involving three airlines. The novelty lies in the examination of this operation in two distinct scenarios: (1) on routes where two low-cost carriers and (2) on routes where a network and one of the low-cost airlines had previously been competing. We report a reduction in frequencies but no substantial effect on prices in the first scenario, while in the second we report an increase in prices but no substantial effect on frequencies. These results may be attributed to the differences in passenger types flying on these routes.

Keywords: Mergers, Airline Market, Low-Cost Carriers, Difference-in-Difference,

JEL Codes: L93; L41; L44.

Address: Department of Economic Policy, Universitat de Barcelona. Research group "Governs i Mercats" (GiM), Institut de Recerca en Economia Aplicada (IREA). C/ Teniente Coronel Valenzuela 1-11. 08034. Barcelona. Spain. Tel. +34934039721. Fax. +34934024573. E-mail: xfageda@ub.edu, jordi.perdiguero@ub.edu.

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1. Introduction

The airline industry has undergone an intense process of liberalization in recent decades with the result that there has been an increase in the number of airlines operating in markets worldwide. Many of these companies today, however, face major financial difficulties in an industry characterized by competition (at least on “thick” routes), excess capacity and cyclical external shocks (oil prices and demand). However, one of the main concerns of the post-liberalization period has been the trend toward consolidation recorded in the US, Europe and Asia with an increase in mergers and the number of coordinated alliances. And while the difficulties airlines face in surviving in a complex market might justify this consolidation process, mergers can be detrimental to the welfare of passengers in terms of higher prices and lower frequencies.

The first wave of mergers took place in the eighties in the US market, and since the beginning of this century a number of mergers have been implemented in Europe and Asia too. The current wave of mergers is affecting both network and low-cost airlines and, thus, examples of mergers in Europe and US can be found between network carriers (Air France and KLM, British Airways and Iberia, Delta and Northwestern, Lufthansa and Swiss, Austrian and BMI, United and Continental, US Airways and American West) and between low-cost carriers (Air Berlin and LTU and Condor, Easyjet and Go Fly, Ryanair and Buzz, Southwest and AirTran). In addition, several low-cost carriers have become subsidiaries of network carriers in Europe (Germanwings and bmibaby of Lufthansa, Transavia of Air France-KLM, Vueling of Iberia) and the largest low-cost carrier in Europe, Ryanair, has attempted to merge with a network carrier, Aer Lingus.

Several papers have examined the effects of mergers in the airline market but the analyses have generally focused on network carriers (Borenstein, 1990; Werden et al., 1991; Kim and Signal, 1993; Morrison, 1996; Veldhuis, 2005; Peters, 2006; Zhang and Round, 2009). Dobson and Piga (2009) analyzed the mergers between low-cost airlines EasyJet and Go Fly, on the one hand, and Ryanair and Buzz, on the other. It is our belief that any analysis of the effects of mergers in the airline market ought to account for the perceived product differentiation between airline types. And, indeed, a number of recent papers have stressed the importance of product differentiation in this market (Oliveira and Huse, 2009; Fu et al., 2011). Drawing on data for Spanish domestic flight routes for the period 2001-2010, we use a difference-in-difference estimator to examine the effects on prices and frequencies of the merger between a network airline (Iberia) and two low-cost airlines (Clickair and Vueling).

The main contribution of our paper is that we provide empirical evidence of the different effects of a merger for different types of airline. On the one hand, we examine the impact of the merger on routes where the two low-cost airlines were previously competing and, on the other, we analyze its effects on routes where the network and one of the two low-cost airlines were competing. As such our results should be relevant for determining the effects of future mergers as long as they involve different types of airline. Note also that we examine the effects both on prices and frequencies of the merger. The consideration of frequencies is less common than that of prices in merger analyses. However, Richard

(2003) and Armantier and Richard (2008) showed that flight frequency also has a significant effect on consumer welfare. The analysis of both aspects allows us to obtain a full overview of the impact of the merger on consumer welfare. Furthermore, the merger was completed at a time when Ryanair substantially increased its operations in the Spanish domestic market. Thus, we can measure how the entry of the major European low-cost airline influenced our empirical results.

The rest of the paper is organized as follows. In section 2 we review previous analyses of mergers in the literature examining airline markets. In section 3 we develop a model for assessing the effects of the merger and, in section 4, describe the data used in the empirical analysis. In section 5 we present the results of the regressions. Finally, the last section is devoted to conclusions.

2. Literature review: Mergers in the airline market

In this section, we review the literature examining mergers in the airline market. It should, perhaps, be noted from the outset that the number of studies analysing the effects of mergers is small compared to that which focus their attention on alliances and code-share agreements. Recent papers analyzing the price effects of airline alliances include Wan, Zou and Dresner (2009) on parallel routes and Zou, Oum and Yu (2011) on complementary routes. A further paper that examines the effect of alliances on the airline market is that of Bamberger, Carlton and Neumann (2004).[1]

A number of theoretical papers have approximated the effects of mergers in the airline market. Brueckner and Spiller (1991) show that a merger can lead to an increase in social welfare in cases where the firms are network carriers and demand is high. However, Brueckner and Pels (2005) show that if two network airlines from different alliances merge uncompetitive effects prevail. The increase in market power of the merged firms and the decline in competition between alliances trigger price increases, and hence the merger leads to a reduction in social welfare.

The following table summarizes the main results of previous empirical analyses of mergers in the airline market in terms of their effects on flight prices and frequencies (where available).

[1] The effects of code-sharing agreements have been analyzed by Brueckner (2003), Armantier and Richard (2008) and Gayle (2008).

Table 1. Effects of mergers on the airline market

Author(s)	Year	Airlines	Country	Pr. Effect	Fq. Effect
Borenstein (1990)	1986	Northwest & Republic airlines	USA	6%/22.5%	-28.3%/53%
Borenstein (1990)	1986	Trans World Airlines & Ozark Airlines	USA	0%/-12.3%	-25.5%/18.2%
Werden et al. (1991)	1986	Northwest & Republic airlines	USA	5.6%	-23.7%
Werden et al. (1991)	1986	Trans World Airlines & Ozark Airlines	USA	1.5%	-16.2%
Kim and Signal (1993)	1985-1988	Average of mergers	USA	10%	
Morrison (1996)	1986	Northwest & Republic airlines	USA	2.5%	
Morrison (1996)	1986	Trans World Airlines & Ozark Airlines	USA	-15.3%	
Morrison (1996)	1987	US Air & Piedmont Aviation	USA	22.8%	
Veldhius (2005)	2004	KLM & Air France	Europe	0.3%	
Peters (2006)	1986	Northwest & Republic airlines	USA	7.2%	
Peters (2006)	1986	Trans World Airlines & Ozark Airlines	USA	16%	
Peters (2006)	1986	Continental & People Express	USA	29.4%	
Peters (2006)	1986	Delta & Western	USA	11.8%	
Peters (2006)	1987	US Air & Piedmont Aviation	USA	20.3%	
Dobson and Piga (2009)	2003	Easyjet & Go Fly	Europe	-12/-27£	
Dobson and Piga (2009)	2003	Ryanair & Buzz	Europe	-29/14£	
Zhang and Round (2009)	2002	China Southern Airlines; China Northern Airlines & China Xinjiang Airlines	China	-3%	
Zhang and Round (2009)	2002	China Eastern Airlines; China Yunnan Airlines & China Northwest Airlines	China	-4%	
Gaggero and Piga (2010)	2007	Aer Lingus & Ryanair	Ireland	7%/8%	

Source: Authors' own

The first element to highlight in the above table is the dominance of studies conducted for the US market. Very few studies examine mergers outside the United States, probably because of the lack of data. Second, the vast majority of tests have been performed on mergers involving network carriers, while only two examine low-cost airlines: Dobson and Piga (2009) and Gaggero and Piga (2010). Moreover, this latter analysis is, in fact, only a simulation of a merger as eventually it was prohibited by the European Commission.

If we focus on the US market the results almost invariably describe price increases and a reduction in flight frequencies following mergers. While there are a number of instances in which mergers actually increase flight frequencies, it is more common that frequencies fall. However, it is difficult to draw any general conclusions regarding frequencies, as only very few studies have examined this effect of mergers and then always in the US market.

If we examine the impact on fares, in the merger between Northwest and Republic Airlines, Borenstein (1990) reported increases ranging from 6%, when other airlines were competing on the affected routes, to 22.5%, when the new airline monopolized the route. For this same merger, Werden et al. (1991) also found significant price increases (5.6%), as did Peters (2006) who reported an increase of 7.2%. However, the effect was much more modest in the analysis performed by Morrison (1996), not rising above 2.5 %. Whatever the case, it seems clear that the merger did result in a price increase.

For the merger between Trans World Airlines and Ozark Airlines, the result is not unanimous. While Borenstein (1990) and Morrison (1996) found price falls of 12.3% and 15.3% respectively, Werden et al. (1991) and Peters (2006) reported price increases of 1.5% and 16%. Despite the diversity of results obtained for this merger, the results of Kim and Signal (1993) and Peters (2006) suggest that, in general, mergers between legacy carriers in the United States lead to significant price increases.

Outside the United States the results have been quite different. Mergers completed in China in 2002 led to fare reductions of between 3 and 4% (Zhang and Round, 2009), while in Europe significant falls in price have also been found, with the exception of the proposed merger between Ryanair and Aer Lingus (Gaggero and Piga, 2010). Likewise, Veldhius (2005) reports that the merger between KLM and Air France would probably not lead to significant price increases on routes connecting Northwest Europe with Singapore.

If we examine the few cases in which the firms that merged were low-cost carriers, the results are equally mixed. Dobson and Piga (2009) analyzed the mergers carried out between Ryanair and Buzz, on the one hand, and between EasyJet and Go Fly, on the other. In the first case, they report that the merger led to a change in Buzz's price structure, as it was adapted to that offered by Ryanair. While before the merger Buzz had offered similar fares at all dates prior to the flight, once the deal had gone through the company significantly reduced the price of tickets purchased more than ten days in advance (by up to 29.2£) and significantly increased the price of those bought the day before scheduled takeoff (by 13.9£). Thus, the merger resulted in lower prices for passengers who purchase their tickets in advance, but it proved detrimental to those buying them just a few days before. In the case of the Go Fly and EasyJet merger, the authors reported a significant reduction in fares independently of when tickets were purchased.

A further study examining the possible effect of a merger on the airline market in which low cost airlines operate was undertaken by Gaggero and Piga (2010). This study measured the level of competition between Aer Lingus and Ryanair and the pricing changes should the merger have gone ahead. The authors report that Aer Lingus fares are between 7 and 8% lower as a result of competition with Ryanair, and so had these two companies merged fares on these routes would have increased by that percentage.

A number of other empirical approaches have been adopted to examine the impact of mergers on prices or on other strategic variables in the airline industry. In examining price effects, Martin (2011) simulates potential mergers between United and US Airways, on the one hand, and between Delta and Northwest, on the other. His results show that these mergers would generate a welfare loss, due principally to the loss of producer surplus. In the Japanese market, Mizutani (2011) reports that the merger between Japan Airlines and Japan Air System increased competition and reduced the equilibrium price. In examining the impact on other variables, Clougherty (2002a, 2002b) shows how mergers in domestic markets can enhance the position of airline companies in international markets.

In short, the above review of the literature shows that mergers between network airlines in the US have caused significant price increases and reductions in flight frequencies, while the impact on prices of mergers in other countries is less clear. Moreover, mergers would appear to result in price reductions when low-cost carriers are involved, with the exception of those tickets bought just a few days in advance.

No previous studies have examined the effects of mergers on flight frequencies outside the US market. And, as mentioned above, all previous research has focused its attention on mergers of two network carriers or those involving two low-cost carriers. Uniquely, therefore, this paper presents empirical evidence of the effect of mergers on both prices and frequencies in a European market, and moreover the merger analysed involved that of a network and two low-cost airlines.

3. The empirical model

The merger under analysis in this paper involved three airlines; (1) Iberia, a network carrier belonging to the Oneworld alliance; (2) Clickair, a low-cost subsidiary of Iberia; and (3) Vueling, an independent low-cost carrier. In July 2008, the three agreed a two-step merger deal: first, Clickair was taken over by Vueling (with Clickair ceasing to operate) and, second, Iberia became the main shareholder in the new firm (now called Vueling). Iberia thus obtained 45.8% of the shares and effective control of the board of directors. In January 2009, the European Commission agreed to the merger between Iberia, Clickair and Vueling on the condition that certain slots on given routes were transferred to other airlines (case no. COMP/M-5364 – Iberia/Vueling/Clickair). The merger was completed in July 2009.

Here, our empirical strategy involves identifying the effects of the merger in different competition scenarios associated with the pre-merger period: (1) routes on which the two low-cost airlines formerly competed and (2) routes on which the network company and one of the two low-cost airlines formerly competed.

We do not have access to data on the proportion of business and leisure travellers using the different routes. However, we assume that the proportion of leisure travellers (who are price sensitive but not so time sensitive) will be higher on routes dominated by low-cost carriers. By contrast, the proportion of business travellers (who are time sensitive but not so price sensitive) is assumed to be higher on routes dominated by the network carrier.

To analyse the effect that the merger has had on prices and frequencies, we use a difference-in-difference estimator. This technique has been frequently used in the analysis of mergers in a number of different markets[2]. In the airline industry, the difference-in-difference estimator was first used by Kim and Singal (1993) and the use of this technique has become generalized since Peters (2006). This study showed that the results of the simulation models are highly sensitive to assumptions about

[2] Examples include: Karikai, Brown and Nadji (2002) in the railroad market, Prager and Hannan (1998) and Focarelli and Panetta (2003) in the bank sector, Taylor and Hosken (2007) and Simpson and Taylor (2008) in the oil market, and Vita and Sacher (2001) and Dafny (2009) in the hospital market.

demand, costs and level of competition. Thus, the difference-in-difference estimator is considered the most appropriate method for examining the price effect of a merger.

The empirical approach is defined by the following expression:

$$Y_{kt} = \beta_0 + \beta_1 pam_{kt} + \beta_2 ram_{kt} + \beta_3 (pam * ram)_{kt} + \beta X_{kt} + \varepsilon_{kt} \qquad (1)$$

The endogenous variable Y_{kt} is the weighted average price of route *k* at time *t* when analysing the impact of the merger on prices, and alternatively the number of weekly flights offered on route k at time *t* when analysing its impact on flight frequencies. The following variables were then introduced as regressors:

- The variable *pam* (period after the merger) is a dummy variable that takes the value 1 for all routes in the periods after the merger and 0 otherwise. This variable reflects the change in prices and frequencies after the merger on all the routes.
- The variable *ram* (routes affected by the merger) is a dummy variable that takes the value 1 for all periods of time only on those specific routes affected by the merger and 0 otherwise. We understand routes affected by the merger as those on which Clickair and Vueling, on the one hand, and those on which Iberia and Vueling, on the other, had previously been offering services. No one route was previously operated by all three airlines at the same time. This variable reflects the effects on routes affected by the merger in relation to those that are unaffected. When analysing separately the effects of the merger on the two types of route previously being operated, we use two dummy variables: *Click-Vue*, which takes the value 1 if Clickair and Vueling previously operated on that route and zero for all other routes, and *Ib-Vue*, which takes the value 1 if Iberia and Vueling previously operate that route and zero otherwise.
- The variable (*pam*ram*) is a dummy variable that takes the value 1 only in the periods after the merger process and only for routes affected by the merger, and 0 otherwise. The coefficient accompanying this variable is our difference-in-difference estimator. If the coefficient is negative and significant then the merger led to a reduction in prices or frequencies, while if the coefficient is positive and significant then it led to an increase in prices or frequencies. As for the previous variable we differentiate the effect of the merger on routes previously operated by Clickair and Vueling and that on the routes where Iberia and Vueling operated. To do this we multiply the dummies *Click-Vue* and *Ib-Vue* by the dummy variable *pam*, obtaining (*pam*Click-Vue*) and (*pam*Ib-Vue*). The coefficients associated with these two variables show the effects of the merger on routes operated by Clickair and Vueling and those operated by Iberia and Vueling, respectively.
- Finally, we introduce a set of control variables that might affect prices or flight frequencies (*X*). Since the seminal Borenstein's (1989) paper, several studies have estimated pricing equations that include explanatory variables related to demand, competition and other route characteristics. Less attention has been paid to estimating frequency equations but, in general, the variables used are similar to those used in pricing equations (see Bilotkach et al., 2010 for a recent example). Hence, we estimate the following equations.

Pricing equation. The price of route k at time t (*PR*) can be explained by the following equations:

$PR_{kt} = \beta_0 + \beta_1 pam_{kt} + \beta_2 ram_{kt} + \beta_3 (pam*ram)_{kt} + \beta_4 Demand_{kt} + \beta_5 Distance_k + \beta_6 HHI_{kt} + \beta_7 D^{Ryanair}_{kt} + \beta_8 D^{high\_speed\_train}_{kt} + \beta_9 D^{island}_k + \beta_{10} D^{summer}_t + \beta_{11} TimeTrend_t + e_k$
(2a)

$PR_{kt} = \beta_0 + \beta_1 pam_{kt} + \beta_{2a} Click\text{-}Vue_{kt} + \beta_{2b} Ib\text{-}Vue_{kt} + \beta_{3a} pam*Click\text{-}Vue_{kt} + \beta_{3b} pam*Ib\text{-}Vue_{kt} + \beta_4 Demand_{kt} + \beta_5 Distance_k + \beta_6 HHI_{kt} + \beta_7 D^{Ryanair}_{kt} + \beta_8 D^{high\_speed\_train}_{kt} + \beta_9 D^{island}_k + \beta_{10} D^{summer}_t + \beta_{11} TimeTrend_t + e_k$
(2b)

Frequency equation. The estimation of the frequency equations for route k at time t (*FQ*) takes the following form:

$FQ_{kt} = \beta_0 + \beta_1 pam_{kt} + \beta_2 ram_{kt} + \beta_3 (pam*ram)_{kt} + \beta_4 Demand_{kt} + \beta_5 Distance_k + \beta_6 HHI_{kt} + \beta_7 D^{Ryanair}_{kt} + \beta_8 D^{high\_speed\_train}_{kt} + \beta_9 D^{island}_k + \beta_{10} D^{summer}_t + \beta_{11} TimeTrend_t + e_k$
(3a)

$FQ_{kt} = \beta_0 + \beta_1 pam_{kt} + \beta_{2a} Click\text{-}Vue_{kt} + \beta_{2b} Ib\text{-}Vue_{kt} + \beta_{3a} pam*Click\text{-}Vue_{kt} + \beta_{3b} pam*Ib\text{-}Vue_{kt} + \beta_4 Demand_{kt} + \beta_5 Distance_k + \beta_6 HHI_{kt} + \beta_7 D^{Ryanair}_{kt} + \beta_8 D^{high\_speed\_train}_{kt} + \beta_9 D^{island}_k + \beta_{10} D^{summer}_t + \beta_{11} TimeTrend_t + e_k$
(3b)

The dependent variable in the pricing equation is the lowest mean round trip price charged by airlines weighted by their corresponding market share, while the dependent variable in the frequency equation is the total weekly frequency offered by airlines on each route. We use the following control variables in the price and frequency equations:

1. *Demand:* Total number of passengers carried by airlines on the route, including direct and connecting traffic. Note that prices and demand and frequencies and demand may be simultaneously determined. In order to correct for any possible bias in the estimated coefficients of demand, we apply an instrumental variables procedure. Thus, we use the following instruments for the variable of demand:

- Population: (*Pop*): Mean population in the provinces of the route's points of origin and destination.
- Gross domestic product per capita (*GDPc*): Mean gross domestic product per capita in the regions of the route's points of origin and destination

The expected sign of the coefficient of this variable is ambiguous in the pricing equation. Intense traffic in a route means it is possible to gain density economies, as airlines can use larger planes at higher load factors and optimise the use of crew. In a competitive environment this should lead to lower prices. However, equally, more traffic might lead to higher mark-ups over costs, if capacity constraints are present.

The expected sign of the coefficient of the demand variable in the frequency equation is positive. In fact, this should be the variable with the strongest influence on the frequency choices of airlines, since supply must adjust (at least at a certain point) to the levels of demand.

2. *Distance*: Number of kilometres separating the airports of origin and destination on the route.

Route length is a major determinant of airline costs and its coefficient in the price equation is expected to be positive and lower than one. This means that the increase in costs is less than proportional to the increase in the number of kilometres flown. Long-haul routes involve higher average speeds, less intense consumption of fuel, and lower airport charges per kilometre. By contrast, a negative relationship is expected between frequency and route length. On longer routes airlines may prefer to reduce flight frequency and use larger planes whose efficiency increases with distance. In addition, since on long-haul routes intermodal competition with cars, trains and ships is weak, airlines may offer lower frequencies.

3. *HHI*: Concentration index measured as the Herfindahl-Hirschman index at the route level in terms of frequencies.

Route concentration can be determined simultaneously with prices and frequencies and, as such, we should take into account any possible bias due to the endogeneity of this variable. This problem is dealt with by adopting the same procedure as described in Fageda (2006). Thus, we instrument concentration at the route level using the Herfindahl-Hirschman index at the airport level. This formulation may, however, carry an endogeneity bias if the concentration levels depend on the firms' pricing decisions. However, the bias should be greatly diluted for concentration at the airport level since pricing and frequency decisions affect only the route level, whereas concentration at the airport level would affect all the routes departing from a given airport.

The Herfindahl-Hirschman index at the route level indicates how competition affects the prices charged by airlines on a given route. A positive sign for the coefficient associated with this variable is expected in the pricing equation, since less competition should result in higher prices being charged. In the case of the frequency equation, by contrast, a negative sign is expected, since fewer flights will be offered as competition on the route falls.

4. $D^{Ryanair}$: Dummy variable that takes the value 1 on routes where Ryanair offers flights at time *t*.

A negative sign is expected for the coefficient associated with this variable in the pricing equation. Several papers show that the entry of a low-cost carrier can reduce prices significantly (see, for example, Dresner et al., 1996, Morrison, 2001; Hofer et al, 2008; Murakami, 2011). In this regard, Ryanair usually fixes very low charges, thus inducing other route competitors to reduce prices. Less clear, however, is the expected effect of the presence of Ryanair in the frequency equation.

Note that Ryanair established an operating base in Madrid airport in the winter of 2007-2008 (albeit recording the most significant impact on the domestic market beginning in the winter of 2008-2009) and in Barcelona airport in the summer of 2010. Furthermore, Ryanair has become more active at other Spanish airports since the winter of 2010-11. Thus, the period during which the merger was made coincides with the period in which Ryanair, the leading low-cost carrier in Europe, substantially expanded its operations in the Spanish airline market.

5. $D^{high\_speed\_train}$: Dummy variable that takes the value 1 on routes where high-speed trains may be used by passengers as an alternative to air transport.

A negative sign is expected for the coefficient associated with this variable in the pricing equation, since competition from high-speed trains can oblige airlines to reduce fares. Less clear, however, is the expected effect on the frequency equation given that airlines are required to maintain high frequencies if they wish to compete with high-speed trains.

6. D^{island}: Dummy variable that takes the value 1 on routes that have an island as endpoint.

The coefficient associated with this variable is a priori ambiguous in the pricing equation. The proportion of leisure travellers may be higher on routes that have islands as endpoints, but airlines may charge higher prices on these routes because of the lack of intermodal competition. By contrast, a negative sign is expected for the coefficient associated with this variable in the frequency equation, since leisure passengers are moderately influenced by flight frequency and the lack of intermodal competition may also induce airlines to reduce flight frequencies.

7. D^{summer}: Dummy variable that takes the value 1 in the summer season to account for differences across seasons.

8. *TimeTrend*: A time trend is also included in the model to account for changes over time that cannot be captured by the variables considered in the empirical model.

4. Data

We have data for 73 routes. The airport of origin is Madrid on 30 routes, Barcelona on 23 routes, Palma de Mallorca on 7, Valencia and Bilbao on 5, and Sevilla on 3. The frequency of the data is semi-annual, as we differentiate between summer and winter seasons in a time period that starts in the summer of 2001 and finishes in the winter of 2010-11. Note that our panel is unbalanced, either because data were not available for some periods or because there was no air traffic. Overall, we have 1314 observations for the pricing regression and 1387 observations for the frequency regression.

The merger between Iberia, Clickair and Vueling was completed in summer 2009 so that our data contain observations for four post-merger periods (from summer 2009 to winter 2010-11). Twenty-two routes were affected by the merger. On twelve of these, Clickair and Vueling had been competing before the merger, while on ten Iberia and Vueling had previously been in competition. No one route was previously operated by all three airlines at the same time.

Our data refer to the route that has as its origin the larger of the two airports. For example, we include the route Madrid-Barcelona-Madrid but not the route Barcelona-Madrid-Barcelona. However, since airline supply is virtually identical in both directions, treating airline services on a given route as directional would contribute little to the analysis.

Price information was collected for a sample week of each half year in the period 2001-2010. We considered the lowest mean round trip price charged by all airlines operating the route weighted by their corresponding market share. The data were obtained from the airlines' web sites using a homogenous procedure: information was collected one month before travelling and the price refers to the first flight of the week with the return leg on a Sunday. Prices are corrected for inflation.

The flight frequency variable shows the weekly number of flights offered by the airlines on each route. This information was obtained from the web site of the Official Airlines Guide (OAG) and refers to the same sample week as the prices.

Demand data refer to the number of passengers carried by airlines on a particular route, including direct and connecting traffic. This information was obtained from the web site of the Spanish Airports and Air Navigation agency (AENA). Among the instruments of the demand variable, note that population was constructed as the mean population in the provinces (NUTS 3) of the route's points of origin and destination, while gross domestic product per capita (GDPc) is the mean GDP per capita in the regions (NUTS 2) of the route's points of origin and destination. The data for these variables were obtained from the Spanish National Statistics Institute (INE).

Distance is the number of kilometres between the airports of origin and destination on the route. Data were collected at the WebFlyer site.

The Herfindahl-Hirschman Index at the route level (HHI) is computed as the sum of the share squared in terms of flight frequencies of airlines operating the route. Recall that we instrument this variable with the Herfindahl-Hirschman index at the airport level. This variable is constructed as follows: we calculate the concentration index in terms of airline departures both from the airports of origin and destination on the route. Then we obtain the mean value of the Hirschman–Herfindahl index for both endpoints. Data for this variable were obtained from the web site of the Spanish airport operator, AENA.

The dummy variable for high-speed trains includes four routes that leave from Madrid airport and two that leave from Barcelona airport. In most instances, high-speed trains have only recently become an alternative for travellers. Finally, the dummy variable for those routes on which Ryanair is operating takes the value 1 on twelve routes leaving from Madrid (in general, since winter 2008-09), on nine routes leaving from Barcelona (since summer 2010) and on eight routes leaving from other airports (since winter 2010-11).

The dummy variable for the summer season was constructed on the understanding that the summer season starts on the last Sunday of March and finishes on the last Saturday of October, both inclusive. Finally, the Time Trend was constructed as an index that takes the value 1 in 2001, the value 2 in 2002 and so on. Table 2 shows the descriptive statistics of the variables used in the empirical analysis.

Table 2. Descriptive statistics

Variable	Mean	St. Dev.	Minimum	Maximum
Price (PR)	193.917	106.462	43.77	887.35
Frequency (FQ)	45.458	54.750	0	6
Pam	0.250	0.433	0	1
Ram	0.301	0.459	0	1
Click-Vue.	0.164	0.371	0	1
Ib-Vue.	0.137	0.344	0	1
Demand	212851.4	296991.5	674	2514338
HHI_route	0.701	0.276	0.2	1
Distance	645.372	480.868	131	2190
$D^{Ryanair}$	0.051	0.221	0	1
$D^{high\_Speed\_Train}$	0.047	0.211	0	1
D^{Island}	0.329	0.470	0	1
D^{Summer}	0.499	0.500	0	1
Time_trend	5.5	2.873	1	10
Population	2863531	968725.3	841668	6681930
GDP per capita	22748.82	3360.282	14064	31622
HHI_Airport	0.470	0.147	0	1

5. Estimation and results

We estimated the pricing and frequency equations by applying an instrumental variables procedure in a random effects setting. Given that the demand and route concentration variables might be endogenous, we need to account for any possible bias in the estimation by using the two-stage least squares estimator. Furthermore, as we are working with panel data, the choice between random effects or fixed effects in this context is straightforward. Indeed, the use of a fixed-effects model is inappropriate since this technique discards any time-invariant variables (such as route distance or the fact of being an island) from the model. In fact, the Hausman test cannot be applied here because the within variation of several variables is particularly low. Thus, our estimations must be made using the random-effects model if we wish to take into account the panel data nature of our sample.

The main results of the pricing and frequency equations are shown in Table 3. The first two columns show the results for the impact analysis on prices, while the next two columns show the results on flight frequencies. In all the regressions the model is jointly significant and provides a reasonable good fit, between 0.42 and 0.93 for prices and frequencies, respectively. Hansen's J test of the possible endogeneity of the instruments points to the exogeneity of the instruments and the LR test shows that the equations are not under-identified.

Table 3. Econometric results (two-stage least squares)

	Prices		*Frequencies*	
Constant	-17.156	-2.087	17.724**	22.730***
	(40.107)	(46.065)	(7.178)	(7.711)
Pam	-13.719	-12.760	3.492***	3.806***
	(8.877)	(8.774)	(1.319)	(1.281)
Ram	-6.618		-1.226	
	(8.064)		(1.875)	
Click-Vue		-7.271		-0.500
		(10.388)		(2.547)
Ib-Vue		-4.460		-1.650
		(14.541)		(3.638)
pam*ram	20.889*		-2.899*	
	(11.880)		(1.688)	
pam*Click-Vue		7.470		-6.505***
		(14.424)		(1.968)
pam*Ib-Vue		33.110**		0.481
		(15.810)		(2.215)
Demand	0.00003	0.00002	0.0002***	0.0002***
	(0.00003)	(0.00004)	(7.33e-06)	(9.34e-06)
HHI route	186.445***	172.136***	6.486	1.631
	(37.274)	(42.536)	(6.573)	(6.916)
D^{Summer}	54.622***	54.835***	-3.638***	-3.566***
	(4.418)	(4.366)	(0.671)	(0.655)
D^{Island}	46.855***	44.491***	0.411	-0.436
	(9.813)	(11.107)	(2.040)	(2.407)
Distance	0.121***	0.120***	-0.016***	-0.016***
	(0.008)	(0.009)	(0.002)	(0.002)
Ryanair	-28.484**	-30.126**	-1.656	-2.407
	(11.956)	(11.867)	(1.745)	(1.687)
$D^{high\_Speed\_Train}$	-8.590	-3.456	1.634	2.826
	(13.326)	(13.786)	(2.247)	(2.313)
Time_trend	-8.122***	-8.381***	-0.651***	-0.722***
	(1.293)	(1.306)	(0.204)	(0.200)
No. Obs.	1314	1314	1387	1387
Wald Test (Chi^2)	786.82***	740.01***	2232.43***	1504.60***
(H_0: No joint significance)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
R^2	0.4216	0.4305	0.9271	0.9272
Anderson LR Statistic (Chi^2) (H_0: Equation is under-identified)	124.406***	93.889***	127.359***	95.374***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Hansen J Statistic (Chi^2)	2.523	2.575	0.939	0.987
(H_0: Instruments Exogenous)	(0.1122)	(0.1086)	(0.3326)	(0.3205)

Note: *** (1%), ** (5%), * (10%). Robust Standard Deviation in brackets.

We find that the difference-in-difference estimator is positive and significant for the impact of the merger on prices, representing a significant increase in the fares paid by consumers of 20.89 euros on average. However, if we distinguish the price effect between those routes on which Clickair and Vueling were competing before the merger and those on which Iberia and Vueling were competing, it can be seen that the latter have been much more markedly affected by the merger. Thus, on routes where Iberia and Vueling were operating before the merger the price increase is 33.11 euros, while the increase on those where Clickair and Vueling were previously operating is only 7.47 euros and is not significantly different from zero.

If we examine the control variables, we find that the coefficient associated with the demand variable is not statistically significant. In all likelihood, the better exploitation of density economies on thicker routes is compensated for by the stronger market power of airlines.

Several variables have a positive effect on the fares that airlines charge. Here, the Herfindahl-Hirschman Index is positive and statistically significant at the 1% level showing that less competition results in higher prices. Likewise, the coefficients associated with the dummy variables for the summer season and for routes that have an island as an endpoint are positive and statistically significant at the 1% level. These results suggest that travellers are willing to pay more on routes with major tourist destinations and during the summer.

As expected, the coefficient associated with the distance variable is positive and statistically significant at the 1% level, but it is lower than one. Airline costs are obviously higher on longer routes, but the distance economies discussed above account for the fact that the distance variable coefficient is less than one.

Variables having a negative impact on fares include the presence of Ryanair, which significantly increases competition on the route leading to a reduction in fares. Thus, the coefficient associated with the Ryanair dummy variable is negative and statistically significant at the 5% level. By contrast, intermodal competition from high-speed trains does not seem to affect the airlines' pricing behaviour.

The difference-in-difference estimator shows that frequencies on the routes affected by the merger have been reduced by 2.9 flights a week. If we differentiate this effect between the routes operated by Clickair and Vueling and those operated by Iberia and Vueling before the merger, we find that in the case of the two low-cost airlines the merger has led to a reduction in frequency of 6.5 flights a week, while in the case of the network company and the low-cost airline frequencies have been increased by 0.5 flights a week, though the effect is not statistically significant. Therefore, the merger has resulted in a decrease in flight frequencies solely on those routes where Clickair and Vueling were operating before the merger. This reduction in frequencies has had a significant negative impact on consumer welfare since it represents an increase in the schedule delay cost (i.e. the difference between the desired and actual times of departure).

If we examine the control variables, we find frequencies are, as expected, higher on thicker routes. Indeed, the coefficient associated with this demand variable is positive and statistically significant at the 1% level. By contrast, flight frequencies are lower on longer routes. The coefficient associated with the distance variable is negative and statistically significant at the 1% level. On longer routes, airlines do not suffer from intermodal competition and may prefer to use larger planes.

Furthermore, airlines offer lower flight frequencies in the summer since the coefficient associated with the dummy variable for the summer season is negative and statistically significant at the 1% level. Controlling for demand, it is presumably the case that the proportion of leisure passengers is higher in the summer. We also find a time tendency towards a reduction in flight frequencies.

Our results for the other control variables are not statistically significant. Frequency competition does not seem to be strong because the coefficient associated with the route concentration variable is not statistically significant. Likewise, neither competition from Ryanair or form high-speed trains seems to have had a substantial impact on frequencies. The inertia that the restrictive system of allocation of slots (based on rules such as “grandfather rights” and “use-it-or-lose-it”) implies may account for these results. Finally, we have found no substantial differences in frequency when one of the endpoints is located on an island.

Based on the foregoing analysis, we can conclude that the merger has led to an increase in prices for passengers on those routes that Iberia and Vueling operated before the merger, while passengers on the routes that Clickair and Vueling were operating have suffered a reduction in service quality owing to lower weekly flight frequencies. In general, therefore, the overall effect on consumers has been negative as is shown by the following table.

Table 4. Effect of merger in percentage terms

	All routes affected	Clickair-Vueling	Iberia-Vueling
Price	10.50%*	4.01%	15.46%**
Frequency	-4.15%*	-12.01%***	0.56%

As shown in Table 4, the merger has caused prices to increase by 10.50% and the weekly frequency to fall by just over 4%. However, as discussed above, the effects are markedly different on the two types of route affected. Passengers on the routes operated by Clickair and Vueling have suffered only a slight price increase as a result of the merger, but have been affected by a drop in flight frequency of just over 12%. By contrast, passengers on the routes operated by Iberia and Vueling have not had to face significantly different flight frequencies, although following the merger there has been a price increase of over 15%.

6. Conclusions

In this paper, we have examined the effects of a merger between a network and low-cost airlines on prices and frequencies. We find that the merger has been detrimental to consumers, but that the impact varies depending on the prior competition between companies on specific routes.

The merger has resulted in a marked reduction in the frequency of flights but no substantial changes in pricing on the routes for which the two low-cost carriers where previously competing. By contrast, the merger has resulted in a considerable price hike but with no substantial changes in frequency on routes for which the network carrier and one of the two low-cost carriers were previously competing. Thus, consumers have suffered a negative impact as a result of the merger either because of a lower flight frequency or higher fares. This result remains even after considering the effect of the entry of Ryanair on many routes.

The behaviour of the airlines following the merger may be related to the different passenger types that are the predominant users of the routes affected by the merger. It would appear that the proportion of leisure travellers (price sensitive and less time sensitive) is higher on routes where the two low-cost airlines previously operated. By contrast, the proportion of business passengers (time sensitive and less price sensitive) appears to be higher on routes where the network carrier and one of the low-cost carriers previously operated. Thus, business passengers would seem to be more sensitive than are leisure passengers to the increase in the schedule delay cost that implies lower flight frequency.

Therefore, the efficient response by the airlines involved in the merger would be to reduce flight frequencies but not to increase prices on the routes served by the two low-cost airlines. The high elasticity of demand to prices and the low elasticity of demand to frequencies of the typical passenger on these routes would account for the choices made by these airlines as they attempt to maximize profits. On the routes served by the network and one of the low-cost airlines, the efficient response would be to increase prices but not to change frequencies. On these routes, the typical passenger would appear to have a low elasticity of demand to prices but a high elasticity to frequencies.

As we have noted, the completion of the merger studied here coincided with the increased presence of Ryanair in the Spanish airline market. It seems likely that it is the low-cost carriers that will be more strongly affected by the increase in price competition introduced by Ryanair, since the network airline focuses its business on exploiting connecting traffic at the hub airport. This may also provide an explanation for our results.

In short, the differences in the impact of the merger are substantial depending on the type of airline involved. Thus, we conclude that any assessment of a merger needs to account for the perceived product differentiation between network and low-cost airlines. In this regard, both prices and frequencies must be considered as the effects of the merger can depend on the type of traveller (business or leisure) that is the most frequent user of the route.

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