Triggering competition in the Spanish airline market: the role of airport capacity and low cost carriers

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Abstract: Airline competition in the post-liberalization period has been usually affected by airport congestion and dominance of former flag carriers. Furthermore, thin routes have been traditionally considered natural monopolies. In this paper, we analyze the influence of two major driving factors for a change in the competitive scenario where airlines operate; a large amount of investments to increase airport capacity and the success of low-cost carriers in short-haul routes. Taking advantage of a rich sample of routes for the period 2001-2006 concerning the Spanish airline market, we examine these issues using parametric and non-parametric techniques. We find that airlines conduct move from collusion to a point equivalent to the Cournot solution when capacity constraints are not binding. However, we also find that the number of competitors in a route is strongly correlated with traffic levels and that the natural monopoly threshold remains constant along time. Finally, low cost carriers have an aggregate moderate effect on competition but travelers benefit from high-price discounts in some flights and a higher number of alternatives to chose even in low-density routes.

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1. Introduction

Airline competition across European markets in the post-liberalization period has been usually affected by airport congestion and dominance of former flag carriers. Furthermore, thin routes have been traditionally considered natural monopolies as long as density economies may be substantial (Caves et al., 1984; Brueckner et al., 1992).

In this paper, we analyze the influence of two major driving factors for a change in the competitive scenario where airlines operate. Indeed, a large amount of investments for increasing capacity of the largest airports have been made all over Europe in last years. Additionally, low-cost carriers have an increasing presence in most of the European markets. These factors may influence both the overall level of prices and the number of effective competitors across routes. The latter aspect is particularly relevant in thin routes as most of these routes have been characterized by a monopoly structure even in the post-liberalization period.

Hence, we want to address the following questions: To what extent airlines conduct is more competitive when they are not subject to capacity constraints? Low-density routes have been benefited from the new competitive scenario? Given some control factors, are prices lower in routes where low-cost carriers operate? Do low cost carriers entry in thin routes?

In order to tackle these questions, we examine the dynamics of airline competition in the Spanish airline market. We make use of parametric and non-parametric techniques taking advantage of a rich sample of routes for the period 2001-2006.

The analysis of the Spanish market for the considered period allows quantifying the influence of the two major drivers of airline competition. To this regard, it is worth noting that the Spanish market is relevant in the European context since it is the largest domestic market and the third one in terms of total traffic according to the data provided annually by the statistical agency office, Eurostat.

The two main Spanish airports, Madrid and Barcelona, were subject to strong congestion until 2004. Indeed, Madrid and Barcelona airports have been among the worst European airports in terms of average delays per movement (Reynolds-Feighan and
Additionally, low cost-carriers have had an increasing presence in this market in the last years. Taking into account that there is an increasing convergence of the business models across different types of airlines, we consider low-cost carriers to be those airlines that use a single-fare class whose prices only vary according to the time of departure in their whole network of routes.\footnote{Traditional airlines uses yield management techniques to segment demand so that they offer different fare-classes associated to different quality conditions, while the use of the single-fare class implies that the airline do not differentiate the product offered to passengers.} It is worth noting here that the two largest low-cost carriers in Europe, Ryanair and Easyjet, have announced a substantial increase of operations in Madrid airport for the winter of 2007. Such increase of operations will include some direct flights in domestic links. From our analysis, it may be possible to obtain some inferences of the impact of these low-cost carrier plans in the Spanish domestic market.

The paper has to do with empirical studies that analyze the influence of market structure variables on airline prices [Borenstein (1989), Evans and Kessides (1993), Marín (1995), Berry et. al. (1996), Carlsson (2004) and others]. Controlling for cost shifters, a typical result in these studies is that route concentration along with airport concentration influences substantially on prices charged by airlines to travelers. Moreover, it is also connected with works that analyze entry choices in airline markets.

However, it is more closely related to several papers that quantify conduct parameters in airline markets [Brander and Zhang (1990, 1993), Oum et al. (1993), Brueckner and Spiller (1994), Fisher and Kamerschen (2003), Fageda (2006a)]. Within this context, it is commonly found that, on average, airlines compete a la Cournot.

The paper it is also related to some papers that analyze the impact of low-cost carriers, most notably Southwest, on prices and entry [Morrison and Winston (1995), Dresner et al. (1996); Morrison (2001), Boguslaski et al., (2004), Goolsbee and Syverson (2005)]. From these studies, it can be inferred that Southwest tends to enter in high-density markets but the price effects of its entry go beyond the routes where actually operates.

This paper adds several insights to the previous literature on airline competition. First, it quantifies how airlines conduct is affected by airport capacity expansions. It is typically
assumed that airlines compete à la Cournot, but this result may be affected by capacity constraints as long as such capacity constraints condition airlines conduct.2

Second, it is considered the important issue of traffic thresholds for natural monopolies, which has received little attention in previous literature about the airline industry. From a social welfare point of view, it is important to examine not only the general dynamics of airline competition but also whether low-density routes also take benefit from such dynamics. To our knowledge, only the work of Bitzan and Chi (2006) examine empirically factors determining prices in airline markets focusing the attention on small communities from US.

And third, the empirical analysis of the influence of low-cost carriers on prices and thresholds for natural monopolies is made for a European market. In this way, the effects of the success of low-cost carriers in Europe have been analyzed in a few number of works. Two unpublished papers [Alderighi et al., (2006); Gil-Moltó and Piga (2006)] analyze some implications of low-cost carriers entry in routes with origin in Italy and United Kingdom airports respectively but these studies do not consider the natural monopoly threshold issue.

To this point, it is useful to mention some facts about the Spanish airline market. Data are available for 74 regular pair links for the period 2001-2006, where the origin is the city with the largest airport. Madrid is the origin in 30 routes, Barcelona in 24 and other airports (Palma de Majorca, Valencia, Bilbao, Seville) in 20 routes. The frequency of the data is semi-annual so that we differentiate between the summer and winter season.3 Additionally, we can found several types of airlines that operate in the Spanish domestic market. The two airlines with the largest market share, Iberia and Spanair, are networks carriers that belong to Oneworld and Star alliance, respectively. The third largest carrier, Air Europe, is owned by a tourist operator. Importantly, two low cost carriers have an active and increasing presence in the Spanish market since 2004, Vueling and Air Berlin. Finally, there are other regional airlines that operate in a very few number of routes.4

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2 In short-haul routes, airport dominance in a context of congestion provides several demand and cost advantages to incumbents (Fageda, 2006b). Such advantages are related to the supply of a high flight frequency. Indeed, a high flight frequency allows offering a convenient flight schedule for travellers, a better exploitation of frequent flier programs and a higher annual utilization of planes and crews. Otherwise, cost disadvantages of using smaller planes are modest in short-haul routes.

3 It must be taken into account that inter-season variation for a route can be substantial for relevant aspects, such as the number of competitors, prices or traffic density.

4 At the end of 2006, Air Madrid has collapsed. This airline has been typically considered to be a low-cost carrier but its prices were based on different fare classes. On the other hand, the Iberia group includes a large regional airline, Air Nostrum, and a recently created low-cost carrier, Click air.
The remainder of the paper is organized as follows. In the second section, we estimate a pricing and demand equation system that allows quantifying changes in airlines conduct in the event of airport capacity expansions. Then, an ordered probit model is estimated to measure the relationship between the number of competitors and traffic levels and we make use of spline regressions to examine the evolution of natural monopoly thresholds. Finally, we study the impact of low-cost carriers both on price competition and the natural monopoly threshold through pricing and spline regressions. The last section is devoted to the concluding remarks. In the appendix, we define the variables used in the empirical analysis, and we provide information about data sources and descriptive statistics of such variables.

2. Changes in airlines conduct in the event of airport capacity expansions

As it is done in previous studies (Parker and Roller, 1997; Fageda, 2006), we develop a demand-supply equation system that allows identifying conduct and cost parameters for airline markets.

In this way, the demand function \( Q \) for route \( k \) in period \( t \) is expressed through the following semi-logarithmic function:

\[
\log(Q_{kt}) = a_0 + a_1\log(pop_{kt}) + a_2\log(inc_{kt}) + a_3\log(tour_{kt}) + a_4D_{hub}^k + a_5p_{kt} + \epsilon_{kt},
\]

(1)

The demand function is composed of variables for the mean values of population \( (pop) \), income per capita \( (inc) \), and tourism intensity of the route city pairs \( (tour) \). These variables capture the demographic and economic size of the city-pairs and traffic generation that comes from tourist activities. Additionally, it includes a dummy variable that takes value 1 for routes with origin in Madrid airport \( (D_{hub}) \) in order to consider the high connecting traffic that takes place in this airport. Finally, demand also depends on prices \( (p) \).

Given the inverse demand function, the marginal revenue function of airline \( i \) is:

\[
IM_{ikt} = p_{kt} + \lambda(\partial Q_{ikt}/\partial q_{ikt})q_{ikt},
\]

(2)

where \( \lambda = \partial Q_{ikt}/\partial q_{ikt} \). If we assume a quadratic total cost function, marginal costs \( (MC) \) of airline \( i \) at the route \( k \) in period \( t \) can be expressed as follows:

\[
MC_{ikt} = b_k + b_dist_k + b_g q_{ikt},
\]

(3)

The marginal cost function includes a parameter \( (b) \) that captures the allocation of costs at the firm level. In addition, it includes a variable for distance \( (dist) \) to account for the fact that costs increase less proportionally than the kilometers flown. Finally, the sign of the
parameter \((b_2)\) associated with the number of passengers carried by airlines on the route \((q_{ikt})\) determines the slope of marginal costs.\(^5\)

The equilibrium condition for each airline is the result of equating cost and revenue functions; \(IM_{ikt} = CM_{ikt}\). At the market level, such equilibrium condition comes from the aggregation of the individual equilibrium conditions. Hence, the price equation can be expressed as follows:

\[
p_{ikt} = b_0 + b_1 \text{dist}_{ikt} + b_2 Q_{mkt} - \theta \left( \frac{\partial p_{ikt}}{\partial Q_{ikt}} \right) Q_{ikt},
\]

where \(\theta = \lambda / N\) and \(Q_{mkt}\) is the average market demand. The demand term of the mark-up expression in \((4)\) is dropped due to the form of the price elasticity of demand in a semi-logarithmic equation.\(^6\) Thus, the pricing equation to be estimated can be expressed in the following way:

\[
p_{ikt} = b_0 + b_1 \text{dist}_{ikt} + \beta Q_{mkt} - \theta (1/\alpha_k) + \epsilon_{ikt},
\]

where prices \((p_{ikt})\) are a function of the mark-up \(\left[ \theta (1/\alpha_k) \right]\) on marginal costs \((MC_{ikt} = b_0 + b_1 \text{dist}_{ikt} + \beta Q_{mkt})\). The mark-up is composed of the conduct parameter \(\theta\), and the parameter that determines the price elasticity of demand \((\alpha_k)\) that should take a negative value. \(\epsilon_{ikt}\) is a random error term. Note that the value of the parameter \(\theta\), which measures the average degree of collusion, should be ranked from 0 to 1.

The functional form of the demand equation may allow identification of conduct and cost parameters. Additionally our identification procedure should rely on the assumption that \(\theta = 1\) in monopoly routes. Through some mathematical arrangements, the pricing equation can be expressed as follows:\(^7\)

\[
p_{ikt} = c_0 + b_1 \text{dist}_{ikt} + \beta Q_{mkt} + D_{\text{oligopoly}} \gamma + \epsilon_{ikt},
\]

where \(c_0 = b_0 - D_{\text{monopoly}} \alpha (1)\), \(\gamma = \alpha^{-1} (1 - \theta_{\text{oligopoly}})\), \(\theta_{\text{oligopoly}}\) is the conduct parameter in oligopoly, and \(D_{\text{monopoly}}\) is a dummy variable for monopoly routes. In case that the conduct parameter in monopoly routes takes the value 1, then the conduct parameter in oligopoly routes is ranked from 0 (prices equal to marginal costs) to 1 (prices set on a joint profit

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\(^5\) Marginal costs of carrying an additional passenger should include its direct cost plus a random fraction of costs of providing additional capacity. Under this interpretation, marginal costs would be equivalent to average variable costs. The slope of marginal costs would be the sensitivity of average variable costs to traffic density.

\(^6\) The price elasticity of demand in a semi-logarithmic equation is: \(\eta_{ikt} = \alpha_{ikt} p_{ikt}\). This is the case due to the fact that \(\alpha_{ikt} = \partial \log(Q_{ikt}) / \partial p_{ikt}\), and so \(\alpha_{ikt} = \partial Q_{ikt} / \partial p_{ikt} Q_{ikt}\), given that \(\partial \log(Q_{ikt}) = \partial Q_{ikt} / Q_{ikt}\).

\(^7\) See Fageda (2006) for the full development of the mathematical arrangements to obtain equation (6).
maximization setting), whereas under the Cournot assumption $\theta$ would take a value equal to the inverse of the number of competitors.

Fageda (2006a) shows that the assumption that $\theta = 1$ in monopoly routes is essentially correct in a scenario where capacity constraints are binding. Indeed, entry barriers can be high enough to protect incumbents when airport congestion takes place. However, this may not be the case just after airport capacity has been expanded. Thus, the conduct parameter in the period with no capacity constraints for monopoly routes may be lower than 1.

Our aim here is to examine changes in airlines conduct in the event of airport capacity expansions. In this way, we include in the pricing equation (6) a dummy variable that takes value 1 since the winter season of 2004-2005, $D_{\text{capacity}}$. Since that period, the two main Spanish airports have seen increased the maximum number of operations per hour as new runways were working. If the coefficient associated to this variable is statistically significant, we will find evidence of a structural change in the pricing behaviour of airlines when airport congestion does not condition such behaviour.

Additionally, we estimate our equation system for two subperiods differentiating whether capacity constraints are binding or not so that the cutting point is the winter season of 2004-2005. From these estimations, we can see differences in monopoly and oligopoly routes in terms of the mark-ups that airlines charge over costs for the two subperiods. It can also be obtained a rough approximation of the deviation from a Cournot behaviour, which is a common result in previous studies about conduct parameters in airline markets [Brander and Zhang (1990, 1993), Oum et al. (1993), Fisher and Kamerschen (2003)]. It must be said that we cannot provide robust tests of alternative oligopoly models because we are not able to check that the assumption $\theta = 1$ is correct when airport congestion do not take place.

In the appendix, we specify how the variables used in the empirical analysis have been constructed, we provide data sources and descriptive statistics for those variables. Following strict rules for data collection (see appendix), it is worth mentioning here that the variable for prices is the lowest mean price charged by airlines offering services in the route weighted by their corresponding market share. We use the lowest mean price across airlines as one of our main purposes is to analyze the impact of low-cost carriers on prices. In this way, we are particularly concerned on price-sensitive passengers.
Table 1 shows the results of the system equation estimates (equations 1 and 6) using the Generalized-Two stage Least Square technique within the framework of random effects models. It must be said that our estimation procedure takes into account both the panel data nature of the sample and the possible endogeneity of the dummy variable for oligopoly routes.\(^8\) Furthermore, note that we include a dummy variable that takes value 1 for the summer season, \(D_{\text{summer}}\), both for the demand and pricing equations. Such variables account for differences across seasons.

Insert Table 1

The overall explanatory power of the equations is good. Furthermore, all the control variables both for the demand and pricing equations are statistically significant and with the expected signs. Only the dummy variable for routes with origin in Madrid airport, \(D_{\text{hub}}\), is not statistically significant. This means that the connecting traffic does not seem to influence substantially the demand for domestic routes. Interestingly, demand and prices are higher for the summer. In a tourist oriented market as it is the Spanish market, people travel more and they are willing to pay more in the summer season.

The coefficient of the dummy variable for capacity constraints, \(D_{\text{capacity}}\), is statistically significant and with a negative sign. Given the value of the cost shifters, we find that prices are lower after the event of capacity expansions. Furthermore, we find evidence of density economies as long as the variable for demand in the pricing equation is statistically significant and with a negative sign.

Table 2 indicates the structural parameters estimated from the system equation estimates for some relevant variables.

Insert Table 2

Price elasticity of demand lies between -0.55 and -0.90. These values are in the inelastic range of results obtained in previous studies (Oum et al., 1992). We also confirm the existence of distance economies and the estimated elasticity of about 0.39 is similar to that obtained in previous studies (Oum et al. 1993, Brueckner and Spiller, 1994; Fageda, 2006a). Furthermore, our results show that a ten per cent increase in route traffic density implies about a one per cent decrease in prices charged to consumers.

\(^8\) We use as an additional instrument for the dummy variable for oligopoly routes, a variable for airport concentration at both endpoints of the route. The number of competitors in a route should be correlated with the variable for concentration at the airport level as it captures the relative presence of the dominant carrier’s rivals both in the endpoints of the route.
Regarding airlines conduct, the parameter estimated for the whole period takes a value of 0.75 that implies a substantial market power for Spanish airlines. However, we find high differences between both sub-periods.

Indeed, the conduct parameter estimated in the period with capacity constraints is 0.94, whereas it takes the value 0.64 in the period with no capacity constraints. In terms of oligopoly models, conduct in the period with capacity constraints would be equal to a joint profit maximization behavior so that mark-up over costs in oligopoly routes are similar to mark-ups charged in monopoly routes. Otherwise, conduct in the period with no capacity constraints would be roughly equivalent to the Cournot solution, as it has been found in several previous studies.9

To this point, it must be taken into account that price differences between both sub-periods are likely higher than the amount that we can capture in our estimates. As we mention above, the conduct parameter should be 1 in monopoly routes when airport congestion takes place, while the conduct parameter in the period with no capacity constraints for monopoly routes may be lower than 1.

On the other side, our aim in this paper is not to examine the sensitivity of airlines conduct to variables for market structure. In any case, it is interesting to note that results of additional specifications of the demand and pricing equation system, which account for the determinants of the conduct parameters, show that airlines conduct is less competitive when both airport and route concentration is higher (results of these estimates are available upon request to authors).

To sum up, as expected the scenario where airlines compete is much more competitive in the event of airport capacity expansions. The overall impact for price-sensitive consumers must be strong.

Once we have found that mark-ups over costs in oligopoly routes are significantly lower when capacity constraints do not condition airlines conduct, other questions must be addressed. In a context characterized by density economies, it must be analyzed which type of routes take benefit of the more competitive scenario. In other words, it must be examined to what extent low-density routes are still monopoly routes even when airport

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9 Using a non-linear test ($\chi^2(1)$), we reject that the conduct parameter takes value 0.57 (the inverse of the mean number of competitors) but we do not reject that takes value 1 in the period with capacity constraints. Otherwise, we do not reject that the conduct parameter takes value 0.48 (the inverse of the mean number of competitors) but we reject that takes value 1 in the period with no capacity constraints.
congestion do not prevent the entry of new air carriers. We deal with this question in the following section.

3. Entry patterns and route traffic density

Entry choices of airlines across routes are determined by the expected profitability of these choices. The empirical literature about entry in airlines markets typically account for several route characteristics as major factors explaining the profitability of entry. In this way, route traffic density and different variables that capture the competitive position of incumbents (route concentration, airport presence, service quality of incumbents and so on) are commonly considered to be the main determinants of entry choices by airlines not still operating the route. Given data unavailability, few studies also include in their empirical analysis some indicator of the prices charged in the route.

In our context, the determinants of the number of competitors in route \( k \) at period \( t \) can be analyzed through the following equation:

\[
\text{Num_ competitors} = d_0 + d_1 p_{k,t} + d_2 Q_{k,t} + d_3 \text{HHI}_{k,t} + d_4 D_{k,t}^{\text{modal}} + d_5 D_{t}^{\text{capacity}} + e_{k,t} \tag{7}
\]

where the number of competitors in a route is made dependent of the following explanatory variables. First, the number of route competitors should depend positively both on the prices per kilometer charged, \( p_{k,t} \), and route density, \( Q_{k,t} \). Indeed, higher prices and demand should imply higher profitability rates for airlines operating there.

Second, entry choices are also influenced by the level of competition at the route level. In this way, we include a variable for concentration at the airport level instead of the variable of concentration at the route level. The use of the variable for airport concentration allows avoiding a possible simultaneous bias that could arise from using route concentration. Indeed, airport concentration refers to all the routes departing from the city-pairs endpoints. In addition to this, airport concentration can be considered to be a good proxy for route concentration and it also may capture some possible entry deterrence effects derived from airport dominance.

Furthermore, we also include a variable that refers to routes where other transport modes may determine airline profits. In this way, we include a dummy variable for intermodal competition, \( D_{k,t}^{\text{modal}} \), that takes the value 1 in routes that do not have an island as an endpoint and/or in routes whose distance is less than 450 kilometers. To this regard, the

\[10 \text{ We use prices per kilometres as a explanatory variable instead of prices because the former is a more appropriate indicator of profitability. Prices in absolute terms are highly dependent on the distance flown between the origin and destination.}\]
supply of other transport modes to link the corresponding city-pairs may harm the profitability of air services in the route, at least for some airlines.

To this point, it is worth mentioning that our aim here is not to make a complete analysis of airline entry choices as long as such analysis would require considering the dynamics of the airlines decision process. What we want to analyze is which types of routes are affected by the competition benefits derived from several airlines operating there. Such benefits refer particularly to the period that follows investments in airport capacity. In this way, we also include in equation (7) the dummy variable that takes value 1 when airport congestion does not take place, $D_{\text{capacity}}$. This variable should capture the expected increase in the number of route competitors due to the reduction (maybe even withdrawal) of the entry barriers associated to airport access for non-incumbent airlines.

Table 3 shows the results of the estimates concerning the determinants of the number of competitors in a route. The estimation has been made using the ordered probit technique within the framework of random effects models. In this way, we account both for the panel data nature of the sample and the discrete form of the dependent variable. Additionally, the possible endogeneity of the variables for demand and prices are considered in our estimation procedure. As it has been done previously, we include a dummy variable that takes value 1 for the summer season to account for differences across seasons.

**Insert Table 3**

The overall explanatory power of the equation is high. All the explanatory variables are significant, with the exception of the dummy variables for intermodal competition and summer season. In general terms, the number of competitors is higher after the event of airport capacity expansions. Thus, travelers seem to have more alternatives to choose (and likely at lower prices) in this latter period.

As it could be expected, the number of competitors is higher when route prices per kilometer are higher and also when route traffic density is higher.

Additionally, the number of competitors decreases as long as it increases the degree of airport concentration at the airport level. This means that airport dominance deters the entry of new airlines.

However, high prices are affected by market structure features. In this way, a high market concentration could likely attract the entry of other airlines as they can find
opportunities for capturing extraordinary profits. Otherwise, the number of airlines offering services seems to be lower in routes that have more opportunities for intermodal competition, although this effect is not statistically significant.

In short, travelers of high-density routes and travelers of routes with lower opportunities for intermodal competition seems to take benefit of the competition derived from several airlines offering services there. To this regard, the supply of other transport modes may compensate for the lower number of airlines offering services in the route. However, more concerns arise for routes that are not able to generate enough traffic to attract more than one airline. Moreover, high-priced routes seem to favor the presence of more airlines. In this way, a major factor that can explain the ability to charge higher prices is a strong degree of concentration both at the airport and route level. Hence, a competitive scenario characterized by no entry barriers, at least in terms of airport access, should promote gradually a decrease in market concentration.

Thus, the main concern that can be inferred from the estimates of the equation of the determinants of the number of route competitors is referred to low-density routes. Indeed, travelers of low-density routes may not take benefit from airline competition as long as just one airline may monopolize the supply of air services.

A central issue here is to identify the natural monopoly thresholds and the evolution of these thresholds. Density economies imply that average costs (and even marginal costs as we found above) decrease with increases in the number of passengers moved at the route level. Hence, competition may be neither efficient nor possible for low-density routes. However, pressures for cost reduction coming from competition could reduce the amount of route traffic needed for making optimal that more than one airline operate in this route. In such a case, travelers of low-density routes would also benefit from airline competition even though the number of competitors is strongly correlated with the traffic levels at the route.

The analysis of the natural monopoly thresholds is made through non-parametric analysis. Non-parametric analysis does not impose a functional form to the relation estimated between different variables. Additionally, it allows considering results across different ranges of values for at least one of the variables of interest.

Figure 1 shows the spline regression that relates the number of competitors with the traffic levels for low-density routes. We use as criterion to define low-density routes to routes that have a traffic lower than 183,627 passengers per season, which is the mean
number of passengers of our sample of routes for the considered period (see appendix for details). In order to see the evolution of the natural monopoly thresholds along time, we present the results of the spline regression for the first year of the considered period (summer of 2001 and winter of 2001-2002) and for the last period (summer of 2006 and winter of 2006-2007).

For 2001-2002, the natural monopoly threshold seems to break up definitely at the traffic level of about 110,000 passengers per season. From that amount of passengers, the mean number of competitors is always higher than two. In routes with a traffic that lies between 50,000 and 110,000 passengers, the mean number of competitors ranges from 1 to 1,5 so that some routes within these traffic levels are monopoly routes but other are duopoly routes. Routes with less than 50,000 passengers are monopoly routes in most of cases, while the mean number of competitors for routes with more than 110,000 passengers ranges from 2 to 3.

For 2006-2007, the natural monopoly threshold seems to break up definitely at the traffic level of about 120,000 passengers per season. In routes with a traffic that lies between 75,000 and 125,000 passengers, the mean number of competitors is always higher than 1,5. Routes with less than 75,000 passengers are monopoly routes in most of cases, while the mean number of competitors for routes with more than 120,000 passengers ranges from 2,5 to 3,2.

Thus, the more competitive scenario in which Spanish airlines operate after the increase of airport capacity at the main airports has not altered substantially the traffic thresholds that determine the existence of a natural monopoly. However, the number of competitors has generally increased in the latter period for routes with more than 75,000 passengers per season. For lower-density routes, we do not find significant changes across periods.

**Insert Figure 1**

Price competition and an increase in the number of competitors even in low-density results seems to be the performance of a liberalized airline market in which airport congestion do not become a strong entry barrier. However, are the capacity expansions at major airports the only driving factor for the increase in competition?. A current central issue in the European airline industry is the success of low-cost carriers to compete in short-haul routes. Hence, it is critical to examine the role of low-cost carriers with regard to the more competitive scenario that characterize the Spanish airline market in last years.
4. The impact of low-cost carriers on airline competition

In Europe, former flag carriers and other airlines integrated in international alliances are progressively concentrating their main business in long-haul air services, whereas low-cost carriers are exploiting some cost-advantages to be competitive in short-haul routes. Indeed, low-cost carriers tend to operate with lower labour costs than legacy carriers. Additionally, they take advantage of a more simple business structure as long as they usually use a unique type of plane (with the maximum seat configuration), they concentrate operations in non-stop services and offer a single-fare class. Some low-cost carriers, most notably Ryanair, also benefit from the lower costs that involves operating from secondary airports.

Along with these cost advantages, a major factor for a low-cost carrier to be competitive is that they may exploit density economies derived from a high utilisation of the planes and crew. However, this could require developing a network of short-haul routes but also operating in routes with a minimum amount of traffic. In this way, it is generally accepted that low-cost carriers contribute to the reduction of prices in the routes in which they operate [Morrison and Winston (1995); Morrison (2001)]. However, some studies about entry patterns of low cost carriers reveal that they prefer to operate on high-density routes, particularly in the first years of operation ((Boulaski et al, 2004; Gil-Moltó and Piga, 2006).

Here we analyze not only the impact of low-cost carriers on prices but also their influence on the relationship between traffic and number of competitors in low-density routes.

Price effects of low-cost carriers are considered through a price equation for oligopoly routes $k'$. In this way, we put the attention on non monopoly routes to isolate the low-cost carriers impact on prices from the global effect associated to the increase in the number of airlines offering services in the route (with respect to a monopoly scenario). This price equation accounts for the main cost shifter; demand at the route level, $Q$, and route distance, $dist$. In addition to this, it includes a dummy variable that takes value 1 for routes with presence of low cost carriers, $D_{low\_cost}^{k'}$. The equation to estimate is as follows:

$$p_{k'} = \epsilon_0 + \epsilon_1 dist_{k'} + \epsilon_2 Q_{k'} + \epsilon_3 D_{low\_cost}^{k'} + \epsilon_{k'}$$

(8)
Table 4 shows the results of the pricing equation estimates using the Generalized-Two stage Least Square technique within the framework of random effects models. Again it is worth noting that our estimation procedure takes into account both the panel data nature of the sample and the possible endogeneity of the variables for demand and presence of low cost carriers.\(^{11}\) As in previous estimations, we also include a dummy variable that takes value 1 for the summer season, \(D_{\text{summer}}\).

**Insert Table 4**

The overall explanatory power of the equation is high, and all the variables are significant with the expected sign. For oligopoly routes, the presence of low cost carriers seems to reduce prices in a statistically significant way. In terms of elasticities, the decrease of prices in oligopoly routes due to the presence of low-cost carriers is about 4 per cent.

The amount of the price reduction related to low-cost carriers seems to be modest but we must take into account that our price indicator refers to the mean average prices weighted by the market share of each airline. Since the market share obtained by low cost carriers in Spanish routes is generally low, the price discounts of low-cost carriers with regard to other airlines must be substantial. Thus, some travelers may benefit from very low prices in specific flights although the aggregate effect of low-cost carriers on prices is small.

Even though the aggregate effect of low-cost carriers on prices is small, travelers may still enjoy of great benefits from low-cost carriers presence if they offer services in low-density routes.

Figure 2 shows the spline regression that relates the number of competitors with the traffic levels for low-density routes, which are the routes with traffic lower than the mean number of passengers of our sample of routes for the considered period. Here we differentiate between all the routes and routes with presence of low-cost carriers. The analysis is restricted to the period after the increase in capacity at major airports because most of low-cost carriers entries have taken place in this period.

Note that we consider the number of competitors in the period before the increase in airport capacity. This allows avoiding any possible endogeneity bias related to the simultaneous determination of low-cost carriers presence and number of competitors.

\(^{11}\) Recall that we use as an additional instrument for the dummy variable for the presence of low cost carriers, the variable for airport concentration at both endpoints of the route. This variable accounts for the relative presence of the rivals of largest carriers, among them low cost-carriers, both in the endpoints of the route.
From figure 2, it can be observed that low-cost carriers alter substantially the relationship between the number of competitors and traffic levels at the route. This is particularly true in routes which traffic ranges from 75,000 to 125,000 passengers per season. For these routes, the presence of low-cost carriers implies more than double the mean number of competitors according to traffic levels. Such mean number lies from 1 to 1.5 for all routes and from 2 to 4 for the restricted sample to routes with presence of low-cost carriers. Otherwise, low-cost carriers usually do not offer services in lower-density routes and they do not affect the analyzed relationship for routes with more than 125,000 passengers per season.

This result fits well with our previous finding that the mean number of competitors has increased for routes which traffic ranges from 75,000 to 125,000 passengers per season after the airport capacity expansions. It seems that low-cost carriers have played a major role concerning this effect.

In short, travelers have taken two benefits from the success of low-cost carriers in the Spanish market. First, they may take advantage of low prices in specific flights. And second, low-cost carriers allow travelers to have a higher number of alternatives to choose in low-density routes.

5. Concluding remarks

This paper has dealt with the dynamics of airline competition in the Spanish airline market, which is one of the largest markets in the European context. Our main purpose has been to measure the role of two major driving factors for the Spanish market becoming more competitive; the withdrawal of capacity constraints at main airports and the increasing presence of low-cost carriers there.

The main empirical findings of the paper are the following. First, we find that airlines conduct is near to a joint profit maximization setting when capacity constraints are binding, whereas such airlines conduct is roughly equivalent to the Cournot solution when airport congestion at the main airports do not take place.

Additionally, our results show that the number of route competitors is strongly correlated with traffic levels. To this regard, we obtain evidence that the natural monopoly threshold remains constant along time, being in the traffic range from 110,000 to 120,000 passengers per season. However, the average number of competitors seems to be higher
after the increase in airport capacity for routes which traffic range goes from 75,000 to 125,000 passengers per season.

Finally, the presence of low-cost carriers has a modest effect on aggregate prices but they may provide substantial price discounts in specific flights. Furthermore, low cost-carriers alter the relationship between the number of competitors and traffic levels so that they contribute to the increase in the number of competitors in routes which traffic ranges from 75,000 to 125,000 passengers per season.

In this way, tough competition in airline markets requires providing enough capacity at main airports. In other case, incumbents may take advantage of airport dominance as a major source of demand and cost advantages and as a strong entry barrier. However, efficiency effects of tougher competition must be compared with the possible social and environmental costs of increasing airport capacity.

In addition to this, low-cost carriers have a positive impact on the traveler welfare as long as they provide lower-prices in some flights and more alternatives to chose even in low-density routes. Nevertheless, their market share is still low in most of routes so that competition concerns are still in place in the post-liberalization period. To this regard, a great number of low-density routes remain operated by just one airline.

To sum up, policies for maximizing the impact of the airline industry on the social welfare should involve preventing airport congestion and promoting the entry of low-cost carriers in short-haul routes.

References


Fageda, X. (2006b), Infrastructure dominance in short-haul air transport markets, University of Barcelona, Mimeo.


Appendix: Variables description and data sources:

- **Prices** (p): The lowest mean round trip price charged by airlines offering services weighted by their corresponding market share. Information has been obtained from airlines websites following these homogeneous rules. Price data refer to the city pair link that has as its origin the city with the largest airport. Additionally, it has been collected one month before travelling, the price refers to the first trip of the week, and the return is on Sunday.

- **Demand** (Q): Total number of passengers carried by airlines in the route, including direct and connecting traffic. Information has been obtained from the website of Spanish Airports and Air Navigation (AENA) agency.

- **Number of competitors** (Num_competitors): Number of airlines offering more than one flight per week in the route. Service frequency of airlines operating in the route has been obtained from Official Airlines Guide (OAG) website.

- **Population** (pop): Total mean population in a route’s origin and destination provinces. Data has been obtained from the census of the first of January published by the National Statistics Institute (INE).

- **Income** (inc): Mean Gross Domestic Product per capita in a route’s origin and destination provinces. Data has been obtained from the National Statistics Institute (INE).

- **Tourism** (tour): Number of tourists per capita in the destination region. Data has been obtained from the Institute of Tourist Studies (IET).

- **Distance** (Dist): Number of kilometers that are needed to flown between the origin and destination airport of the route. Data has been collected from WebFlyer site.

- **Airport concentration** (HHI): Index of Herfindahl-Hirschman at the airport level. The concentration index is calculated in terms of airlines’ national departures both in the origin and destination airports of the route. Then we obtain the mean value of the Hirschman-Herfindahl index regarding both endpoints. Data on the percentage of departures of each airline in origin and destination facilities have been obtained from Spanish Airports and Air Navigation (AENA) agency.

- **D_capacity**: Dummy variable that takes value 1 since the winter season of 2004-2005, which is the period when the two main Spanish airports, Madrid and Barcelona airports, had new runways working.

- **D_doligopoly**: Dummy variable that takes value 1 for routes with more than one airline offering services.

- **D_hub**: Dummy variable that takes value 1 for routes with origin in Madrid.

- **D_modal**: Dummy variable that takes value for routes with no islands as an endpoint and/or less than 450 kilometers.

- **D_summer**: Dummy variable that takes value 1 for the summer season that goes from October 26th to 26th April.
<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>Standard deviation</th>
<th>Minimum value</th>
<th>Maximum value</th>
</tr>
</thead>
<tbody>
<tr>
<td>prices ($p$) : euros</td>
<td>196.60</td>
<td>98.58</td>
<td>49.85</td>
<td>829.67</td>
</tr>
<tr>
<td>demand ($Q$) : Number of passengers</td>
<td>203,790.3</td>
<td>305,831.2</td>
<td>1,361</td>
<td>2,366,178</td>
</tr>
<tr>
<td>Num_competitors: Number of airlines</td>
<td>1.89</td>
<td>1.02</td>
<td>1</td>
<td>6</td>
</tr>
<tr>
<td>population ($pop$) : Number of inhabitants</td>
<td>2,801,138</td>
<td>898,927.7</td>
<td>841,668</td>
<td>5,595,249</td>
</tr>
<tr>
<td>income ($inc$): euros</td>
<td>14,157.74</td>
<td>1,302.18</td>
<td>10,988</td>
<td>17,935</td>
</tr>
<tr>
<td>tourism ($tour$): Number of tourists per capita</td>
<td>2.52</td>
<td>3.40</td>
<td>0.11</td>
<td>11.34</td>
</tr>
<tr>
<td>distance ($dist$): Number of kilometers</td>
<td>644.70</td>
<td>485.08</td>
<td>131</td>
<td>2,190</td>
</tr>
<tr>
<td>Airport concentration ($HHI$): index</td>
<td>0.54</td>
<td>0.12</td>
<td>0.27</td>
<td>0.76</td>
</tr>
<tr>
<td>(D_{capacity})</td>
<td>0.44</td>
<td>0.50</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>(D_{oligopoly})</td>
<td>0.51</td>
<td>0.50</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>(D_{hub})</td>
<td>0.41</td>
<td>0.49</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>(D_{modal})</td>
<td>0.31</td>
<td>0.46</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>(D_{summer})</td>
<td>0.50</td>
<td>0.50</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>
### TABLES AND FIGURES

**Table 1. Pricing Equation Estimates (G2SLQ random effects – IV regression);**

<table>
<thead>
<tr>
<th></th>
<th>(1) Baseline</th>
<th>(2) Period with capacity restrictions</th>
<th>(3) Period without capacity restrictions</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Demand equation (dependent variable: Q)</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>prices (p)</td>
<td>-0.0040 (0.0011)***</td>
<td>-0.026 (0.0011)***</td>
<td>-0.055 (0.002)***</td>
</tr>
<tr>
<td>population (pop)</td>
<td>0.44 (0.19)***</td>
<td>1.11 (0.22)***</td>
<td>0.79 (0.32)***</td>
</tr>
<tr>
<td>income (inc)</td>
<td>2.26 (1.06)***</td>
<td>0.28 (0.81)</td>
<td>-2.29 (2.14)</td>
</tr>
<tr>
<td>tourism (tour)</td>
<td>0.16 (0.07)***</td>
<td>0.39 (0.06)***</td>
<td>0.32 (0.12)***</td>
</tr>
<tr>
<td>(D_{hub})</td>
<td>0.32 (0.30)</td>
<td>0.30 (0.21)</td>
<td>0.39 (0.40)</td>
</tr>
<tr>
<td>(D_{summer})</td>
<td>0.40 (0.07)***</td>
<td>0.29 (0.06)***</td>
<td>0.60 (0.21)***</td>
</tr>
<tr>
<td>Intercept</td>
<td>-16.38 (10.84)</td>
<td>-7.61 (8.22)</td>
<td>22.29 (19.94)</td>
</tr>
<tr>
<td>(R^2)</td>
<td>0.21</td>
<td>0.38</td>
<td>0.25</td>
</tr>
<tr>
<td>(\chi^2) (joint sig.)</td>
<td>125.45***</td>
<td>135.32</td>
<td>35.35***</td>
</tr>
</tbody>
</table>

**Pricing equation (dependent variable: p);**

<table>
<thead>
<tr>
<th></th>
<th>(1) Baseline</th>
<th>(2) Period with capacity restrictions</th>
<th>(3) Period without capacity restrictions</th>
</tr>
</thead>
<tbody>
<tr>
<td>demand ((Q_m))</td>
<td>-0.00022 (0.7e-4)***</td>
<td>-0.00036 (0.00008)***</td>
<td>-0.00006 (0.0001)</td>
</tr>
<tr>
<td>distance (dist)</td>
<td>0.12 (0.008)***</td>
<td>0.12 (0.010)***</td>
<td>0.11 (0.010)***</td>
</tr>
<tr>
<td>(D_{doligopoly})</td>
<td>-48.25 (13.52)**</td>
<td>-24.94 (16.39)</td>
<td>-65.98 (17.41)***</td>
</tr>
<tr>
<td>(D_{capacity})</td>
<td>-24.70 (5.42)**</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>(D_{summer})</td>
<td>66.66 (5.09)***</td>
<td>51.23 (6.41)***</td>
<td>73.44 (8.13)***</td>
</tr>
<tr>
<td>Intercept</td>
<td>136.65 (8.29)***</td>
<td>149.77 (10.73)***</td>
<td>120.29 (10.49)***</td>
</tr>
<tr>
<td>(R^2)</td>
<td>0.44</td>
<td>0.46</td>
<td>0.37</td>
</tr>
<tr>
<td>(\chi^2) (joint sig.)</td>
<td>472.61***</td>
<td>256.03***</td>
<td>207.09***</td>
</tr>
</tbody>
</table>

Note 1: Instruments for prices in the demand equation: Distance, Airport concentration
Note 2: Instruments for demand and \(D_{doligopoly}\) in the pricing equation: population, income, tourism, Airport concentration, \(D_{hub}\)
Note 3: Standard errors in parentheses
Note 4: Significance at the 1% (***) , 5% (**), 10% (*)

**Table 2. Estimated structural parameters (Evaluated at sample means)**

<table>
<thead>
<tr>
<th></th>
<th>(1) Baseline</th>
<th>(2) Period with capacity restrictions</th>
<th>(3) Period without capacity restrictions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price elasticity of demand to prices: (\eta_\delta)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Price elasticity to density: (\eta_\theta)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Price elasticity to distance: (\eta_\theta)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conduct parameter: (\theta)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(-0.80***)</td>
<td>-0.55**</td>
<td>-0.90**</td>
<td></td>
</tr>
<tr>
<td>(-0.10***)</td>
<td>-0.016***</td>
<td>-0.03</td>
<td></td>
</tr>
<tr>
<td>(0.39***)</td>
<td>0.37***</td>
<td>0.39***</td>
<td></td>
</tr>
<tr>
<td>(0.75***)</td>
<td>0.94***</td>
<td>0.64***</td>
<td></td>
</tr>
</tbody>
</table>

Note: Significance at the 1% (***) , 5% (**), 10% (*)
Table 3. Number of competitors equation estimates  
(Random effects ordered probit). N= 821

<table>
<thead>
<tr>
<th>Demand ($Q_m$)</th>
<th>2.13e-06 (6.57e-07)***</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prices ($p$)</td>
<td>2.14 (0.86)**</td>
</tr>
<tr>
<td>$D_{modal}$</td>
<td>-0.29 (0.33)</td>
</tr>
<tr>
<td>$D_{capacity}$</td>
<td>0.50 (0.16)***</td>
</tr>
<tr>
<td>$D_{Summer}$</td>
<td>0.26 (0.16)</td>
</tr>
<tr>
<td>Airport Concentration (HHI)</td>
<td>-15.76 (1.06)***</td>
</tr>
<tr>
<td>Intercept</td>
<td>-11.62 (0.96)***</td>
</tr>
<tr>
<td>Log likelihood</td>
<td>-258.84</td>
</tr>
<tr>
<td>LR $\chi^2$ (joint sig.)</td>
<td>817.93***</td>
</tr>
</tbody>
</table>

Note 1: Instruments for prices and demand: distance, population, income, tourism
Note 2: Significance at the 1% (***) , 5% (**) , 10% (*)

Figure 1. Evolution of the natural monopoly threshold: Spline of number of entrants respect to pax (if pax less than 183,627)
Table 4. Pricing equation Estimates (G2SLQ random effects – IV regression);

<table>
<thead>
<tr>
<th>Non monopoly routes</th>
<th>N = 422</th>
</tr>
</thead>
<tbody>
<tr>
<td>demand ((Q_m))</td>
<td>-0.0005 (0.6e-4)***</td>
</tr>
<tr>
<td>distance ((d_{\text{dist}}))</td>
<td>0.11 (0.008)***</td>
</tr>
<tr>
<td>(D_{\text{low_cost}})</td>
<td>-33.37 (17.09)**</td>
</tr>
<tr>
<td>(D_{\text{Summer}})</td>
<td>78.62 (5.71)***</td>
</tr>
<tr>
<td>Intercept</td>
<td>92.54 (11.26)***</td>
</tr>
<tr>
<td>(R^2)</td>
<td>0.61</td>
</tr>
<tr>
<td>(\chi^2) (joint sig.)</td>
<td>207.09***</td>
</tr>
</tbody>
</table>

Note 1: Instruments for demand and \(D_{\text{low\_cost}}\) in the pricing equation: population, income, tourism, Airport concentration, \(D_{\text{hub}}\)

Note 2: Standard errors in parentheses

Note 3: Significance at the 1% (***) , 5% (**), 10% (*)

Figure 2. Comparison between low cost and all carriers: Spline of number of entrants respect to pax (if pax less than 183,627)