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PRIVATIZATION, REGULATION AND AIRPORT PRICING:
AN EMPIRICAL ANALYSIS FOR EUROPE

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Abstract

This paper examines factors determining prices that airports charge to airlines. Using data for 100 large airports in Europe, we find that they charge higher prices when they move more passengers. Additionally, competition from other transport modes and other nearby airports imposes some discipline on the pricing behaviour of airports. Low-cost carriers and airlines with a high market share seem to have a stronger countervailing power. Finally, we find that private airports not regulated charge higher prices than public or regulated airports. From our analysis, we can infer that market power of each airport is dependent upon its specific characteristics.

Keywords

Privatization; regulation, pricing; air transportation; airports

1. Introduction*

Airport management is undergoing a major reform process in many countries. Indeed, the privatization of management companies, the changes associated with price regulation and the competition between airports in the same geographical area are all very much the current object of discussion. The growing economic importance of airports, the intensity of competition between airlines and the budget restrictions imposed by governments on infrastructure investment explain, to great extent, the reform initiatives in airport policies.

Against this background particular attention should be given to the potential abuse of market power by airport operators, bearing in mind that the extent to which they choose to exploit their market power will depend on the specific characteristics of each airport (Starkie 2002; Gillen 2008). Thus, it is to be expected that airports with the heaviest volume of traffic (particularly if congested) will be most susceptible to such abuse of their market power by fixing high prices for the airline operators. Likewise, it is to be expected that those airports that serve as a hub for an airline network are more likely to abuse their position.

Furthermore, airports with a high volume of long distance traffic and those located on islands are less vulnerable to competition from other modes of transport such as roads or high speed trains. The absence of competition may also derive from the absence of any neighbouring airports with a different management company. In such instances, it is more probable that the airport operator will exploit its market power.

Finally, privately managed airports will have greater incentives to fix higher prices than their publicly owned counterparts, although price regulation can always be used to restrict the abusive behavior of the airport operator.

In this study we conduct an empirical analysis of the determinants of the prices charged by airports to the airlines using a sample comprising the 100 European airports with the highest volumes of air traffic.¹ The great diversity of airports making up this sample in terms of their ownership and regulation, the potential competition from other modes of transport and other airports, and the type of airlines that operate out of them, allows us to evaluate the impact of such factors as the volume and type of traffic, the distributive conflict between airlines and airports, competition and private ownership in the absence of any regulation.

While many studies have analyzed the determinants of the prices that airlines charge passengers, there are virtually no empirical analyses looking at the factors influencing the prices that the airports charge the airlines. The only study to look at this issue, as far as we are aware, is that published by Van Dender (2007), which analyses the determinants of airport revenues for US airports. Our study seeks to contribute to this literature by examining the determinants of the prices charged by airports in a broad sample of European airports, whose institutional framework differs markedly from that which prevails in the US, especially as regards the relationship between airlines and airports. Of even greater relevance is the fact that, in addition to some similar variables previously employed by Van Dender (2007), our study comprehensively considers the influence on prices of factors related to the type of airlines that are predominant at the airport, regulation and ownership structure.

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1 The airports' revenue includes aeronautical charges as well as charges for concessions to exploit commercial activities within the terminal buildings. Here, we focus on aeronautical charges.

Note that generally the elasticity of demand of the airlines to the prices that the airports charge has been considered to be very small, since the former have invested a large volume of sunk costs which prevents them from moving to other airports. However, and while a number of recent relevant studies question the fact that those elasticities are so low (Fu et al. 2006; Van Dender 2007; Basso 2008), there can be no doubt as to the importance of the process of fixing the prices charged by the airports to the airlines. First, these prices greatly condition the volume of revenue of the airport operator. Second, these prices have an impact on the competition between airlines. According to the International Air Transport Association - IATA (2007), airlines and their users pay 42 billion dollars each year to the airports, which represent 11% of the global income of the airlines. Further, increases in the unit rate charged to users can have a direct impact on the levels of profitability of particular flight routes. And finally, the prices have an impact on investment decisions and, in general, on the level of congestion that an airport might suffer.

The remainder of the paper is structured as follows. In section two, we review the most recently published literature examining the problem of airport pricing. Then, we describe the data used in the empirical analysis. In section four, we describe the empirical model and the results of the estimation. The final section examines the main conclusions to be drawn from the study.

2. Market power, locational rents and airport regulation

Airports have traditionally been managed by public firms or administrative bodies dependent on the public sector. Since the middle of the 1980s, countries in all regions of the world have privatized some of the airports handling the greatest volumes of traffic. Often (though not always) this privatization process has been accompanied by price regulation with varying degrees of strictness. The widespread use of public ownership or private ownership subject to regulation in the management of airports is in line with the idea that the airports might abuse their market power, particularly as regards their aeronautical activities.

Here, it should be borne in mind that although an airport operator fixes high prices, this is not necessarily related to monopoly rents derived from operating in industries with falling average costs², but rather it might be the result of scarcity rents derived from being located in geographical areas that are highly attractive and where there is little availability of land (Starkie 2001). The distinction between scarcity and monopoly rents is important, as only in the second case would regulation be necessary to guarantee the efficient operation of the airports. But distinguishing between both sources of extraordinary rents is not easy, especially if we consider non-aeronautical activities (Forsyth 2004). However, the need to regulate aeronautical activities will be determined by the airport's capacity to charge high prices, and the extent to which these high prices are transferred to the airline company or to the passengers.

Various theoretical and empirical studies have analyzed the suitability of different methods for price regulation (i.e. price-caps or rate of return).³ In general, it is believed that price-cap regulation acts as an incentive for cost reduction, although it is not entirely clear that it does not operate in detriment to the incentives appropriate to invest in capacity.⁴

2 Results on scale economies in airports are not unanimous. Gillen and Lall (1997) and Pels et al (2003) find that airports operate under constant returns of scale regarding movements of planes, and under increasing returns to scale regarding movement of passengers. Economies of scale for passengers diminish as long as traffic volume increases and, eventually, decreasing returns of scale set in at large volumes of traffic. Instead, Bazargan and Vasigh (2003) find that diseconomies of scale characterize the airport sector.

3 Gillen and Niemeier (2008) provide an excellent overview of the strengths and weaknesses of the various methods of regulation.

4 Of relevance here is the debate concerning what the extent of airport regulation should be. The single-till approach, which regulates both aeronautical and non-aeronautical activities, favors cross subsidies between the two types of

However, for the purposes of this article it is perhaps of greater pertinence to refer to the arguments that have been forwarded in defense of price deregulation, even in the case where the management company is controlled by a majority of private investors. Indeed, the management company may have incentives to fix prices below the monopoly level.

First, the airlines also have market power that can counter that of the airport manager (Brueckner 2002; Borenstein and Rose 2007). For this reason, we can expect conflicts of interests between airlines and airports as they seek to appropriate for themselves the monopoly rents at the moment of determining the price levels (for aeronautical activities) that are charged by the airport. It should be borne in mind that the negotiating power of the airline with the airport is closely associated to the airline's share of flights in that particular airport, to the complexity of its network of routes, and to the contribution of connecting passengers that the airline offers to the airport.

Second, the threat of re-regulation can in itself be an element of dissuasion. In Australia a program of deregulation was implemented at the beginning of the present decade using a system of monitoring that included the threat of re-regulation. According to Forsyth (2008), the threat of re-regulation has helped mitigate the potential exploitation of market power by the managers of the airports, which are in the majority controlled by private investors.

Finally, the airport operators can have incentives to charge lower prices to attract more traffic, since the greater the number of passengers they attract the greater will be the volume of revenue associated with the commercial activities offered in the airport terminal (Starkie, 2001).

It is at congested airports where it is most likely that the manager can make use of his market power, and some kind of regulation might therefore be especially necessary in congested airports. Basso (2008) presents a theoretical model in which he shows that deregulation can lead to congested private airports fixing higher prices, while it is unclear as to whether they have greater incentives than a regulated airport to invest in their capacity to alleviate this congestion.

Likewise, Fu et al. (2006) forward arguments in favor of a certain degree of regulation, since airport charges can have a marked impact on competition between airlines. Fu et al. analyze the effects of an increase in the prices that the airports charge the airlines in a context where low cost airlines compete against network airlines. The results of their analysis show that the effect is much more prejudicial for the former, which reduce their prices and quantities more.

In short, several studies present arguments for identifying the extent to which an airport has market power and the extent to which it is necessary to regulate prices. But the sole study to analyse empirically pricing determinants is that undertaken by Van Dender (2007), who examines the determinants of airport revenues for a sample of 55 large US airports between 1998 and 2002. Among the explanatory variables, he includes the degree of competition between airlines, the hub-status of some of the airports for some of the large airlines, the share of domestic traffic, competition from nearby airports and, finally, the existence of restrictions in the allocation of new slots.

Van Dender (2007) finds evidence to suggest that the revenues from aeronautical activities are lower when there is potential competition between airports in the same geographical area, and that they are greater when there are constraints on the allocation of new slots. Moreover, a greater concentration among airlines implies higher prices for the aeronautical activities, which according to Van Dender can be explained by the appropriation by the airport of part of the extraordinary rents that the airlines obtain with their market power. The revenues from aeronautical activities fall as the number of flights operated at the airport increases, while they rise with an increase in the share of international traffic. Thus, international passengers entail both higher costs and higher revenues, while

(Contd.) _____

activity. By contrast, the dual-till approach only regulates aeronautical activities, which are most susceptible to the exploitation of market power.

the negative relation between traffic and prices can be explained by the exploitation of scale economies by the airports with the highest volumes of traffic.

However, it should be borne in mind that Van Dender's study refers to the US where the airport operators adhere to very different regulations to those in place in other countries. In the US, the airlines play a key role in the management and financing of airport installations, which means that the charges they have to pay to the airports are fixed according to the conditions established in the contract signed between the two parties. In most countries, the airports are much less conditioned by the airline companies when it comes to fixing the operational charges for their installations; if at all, the limits are imposed by the corresponding public authority.

3. Data

In this study we analyze empirically the determinants of the prices charged by the airports for their aeronautical activities for a broad sample of European airports with a considerable degree of diversity in their patterns of ownership, regulation, and the type of airlines that operate out of their installations. The empirical analysis is applied to European airports that generate a high volume of traffic: the sample comprises the 100 airports in the European Union, Switzerland and Norway with most passenger traffic in 2007. It is a fairly homogeneous area in economic terms and in terms of air traffic regulation. Moreover, it is an area for which the information required for a study of this nature is available. Table A1 in the appendix lists the airports used in this empirical analysis.

The two main aeronautical charges paid by airline companies are landing fees for the use the airplanes make of the airfield's installations, and charges for the use the passengers make of the terminal building. The sum charged for landing fees is usually based on a unit ratio relative to the plane's maximum take-off weight, while the sum charged for using the terminal building depends on whether the flight is a domestic, from within or outside the European Union.

The data gathered include the different rates that airports charge the airlines based on information provided by *airportcharges.com* for 2008. The prices used have been fixed with reference to an A-320 aircraft with an occupancy factor of 70% (105 passengers). We are dealing therefore with rates per passenger and include the following charges: landing fees, rights to approach and park aircraft, charges for using the terminal, noise and safety surcharges (where applicable). In general, the prices for domestic and EU traffic are identical or very similar, while those for international traffic are higher.

Total traffic data and by geographical area (domestic, intra-EU, international) up to 2007 are available on the Eurostat web page, while market share data for the airlines that operate at the respective airports for 2007 are taken from information supplied by the Official Airlines Guide (OAG).

We also use data describing the economic and demographic characteristics of the geographical areas in which the airports are located, including population, GDP per capita, and intensity of tourism. The region of reference is understood to be the geographical area equivalent to the statistical definition used by Eurostat of NUTS 2. The information source here is the *European Regional Prospects* database, published by Cambridge Econometrics.

The IATA classifies the various airports according to the degree of excess demand when establishing the procedures for the allocation of slots. Thus, a distinction is drawn between (1) non-coordinated airports where there is no excess demand and the allocation of slots is at the discretion of the airport operator, (2) airports where flight schedules have to be supervised, and (3) coordinated airports where excess demand requires the application of standard procedures for slot allocation

(“grandfather rights”, “use-it or lose-it”, criteria for new slots and new entrants, etc).⁵ This gives us an approximate idea of the congestion levels at the airports, since we do not have access to more precise data regarding flight delay times.

Finally, we gathered information about the ownership structure of the management companies at all the airports, and of the main characteristics of the price regulation practiced. The sources of information regarding ownership and regulation were the web pages of the airports and the civil aviation authorities and the following studies: Oum et al. (2004), Gillen and Niemeier (2008), and Cunha and Brochado (2008). Of the 100 airports in the sample, 26 are managed by companies in which the majority share is held by a private firm, and in 11 of these the management company is partially controlled by private investors. Moreover, 26 of the airports are not subject to any economic regulation, including among this number several airports that are fully or partially controlled by private firms.

There is a general consensus in the literature that price fixing at each airport should be undertaken on an individual basis (Gillen and Niemeier 2008; Starkie 2004; Gillen 2008). But cases still occur where price-fixing systems are used, so that several airports with markedly distinct characteristics charge airlines the same prices. From the sample of airports analyzed in this study, this system approach is used in Spain, Greece (except Athens), and Norway.

Table 1 shows the country variation in traffic and prices. It can be seen that in the United Kingdom, Germany, and to a lesser extent in France, there is a large difference in prices between airports, even though their prices are higher than the EU average. This suggest that differences in market conditions at the airports might be more clearly reflected in these countries, a feature which is captured, albeit somewhat approximately, in the table by the variations in traffic. By contrast, in Italy and especially in Spain, the very small variations in prices between airports do not correspond to the heterogeneity that exists between these airports, which in addition to the traffic includes other aspects such as the type of airlines that operate there and the dominant traffic type (business, tourism).

5 Coordinated airports are understood to be those where an agent (who may or may not be the airport manager) is responsible for the joint administration of the demands from the various airlines to operate from its installations. In the case of non-coordinated airports, the manager decides on an individual basis whether or not to allow an airline to offer flights from the airport under his or her management.

Table 1. Data about prices, traffic and competition in sample airports

Country	Total number airports	Mean traffic (000 passengers)	Variation Coef. Traffic	Mean Prices (euro)	Variation Coef. Prices	Num. airp. with demand excess	Num airp. with at least other nearby airport
Total	100	11648	1.11	2076	0.37	60	39
United Kingdom	17	13312	1.26	2821	0.31	4	15
Spain	16	11798	1.13	1451	0.02	16	0
Italy	14	7798	1.04	1299	0.12	11	8
Germany	11	15791	0.97	2110	0.29	6	3
France	8	15297	1.27	2207	0.19	4	5
Norway	4	7572	1.01	2344	0	3	0
Greece	4	7439	0.82	1703	0.40	3	0
Ireland	3	10000	1.15	1838	0.02	1	1
Switzerland	3	11686	0.75	2496	0.33	2	3
Portugal	3	7575	0.69	2181	0.02	3	0
Poland	2	6182	0.71	2524	0.22	0	0
Sweden	2	11215	0.86	2051	0.08	1	0
Belgium	2	10188	1.08	1722	1.05	1	2

Note: In Greece, all airports charge the same price except in the case of Athens where prices are much higher. In Norway, there are no differences in prices when considering national and European traffic but prices are lower for Oslo when considering traffic to other continents.

Source: Airportcharges.com and Eurostat

Table 1 also offers information about excess demand and potential competition between airports located in nearby zones. In this regard, note the case of the United Kingdom, where the majority of airports are not subject to excess demand, and most of them have to face potential competition from other airports located in nearby zones. By contrast, all the airports in Spain are subject to excess demand and, due to their integrated management, none of them faces competition from other airports located in nearby zones.

The situation in Italy lies somewhere between these two extremes, with most of its airports subject to excess demand, but with several exposed to potential competition from nearby airports. In Germany, the situation is mixed, there being almost as many airports with excess demand as there are without any problems of congestion, while only a few face any potential competition from other airports. In France, several of the country's airports do not have congestion problems but are exposed to potential competition from other airports.

In the context of the debate regarding the relative market power of the airports and airlines, it is interesting to refer to data describing the market structure of the 100 airports in the sample in terms of the volume of traffic of the various airlines that operate out of them. Thus, Table 2 shows that two low cost airlines, Ryanair and Easyjet, are dominant in the greatest number of airports included in the sample. Ryanair, which is the only airline in the sample that dominates airports in more than one country, appears to enjoy considerable negotiating capacity with the airports, given that the prices fixed for the company are much lower than in the majority of the airports in the sample.⁶ Exposure to the competition of the low cost airlines is particularly important in the case of British Airways and Alitalia. Several airports in their respective countries of origin are controlled by low cost airlines, and in which they are leaders, while the share of traffic controlled by airlines integrated in alliances is less than in that of other network airlines.

⁶ This might also be influenced by the fact that Ryanair is usually based in regional airports with a small amount of traffic.

Table 2. Data for the sample airports according to the dominant airline

Dominant airline	Number airports	Traffic (000 passengers)	Mean price (euros)	Share dominant airline	HHI	Share airlines in alliances
Ryanair	10	7752	1394	0.66	0.53	0.07
EasyJet	9	6486	2636	0.42	0.27	0.18
Iberia	9	14315	1455	0.46	0.28	0.64
Lufthansa	9	17426	2279	0.38	0.21	0.62
Air France	8	19981	2378	0.61	0.40	0.77
SAS	7	10588	2278	0.45	0.27	0.58
British Airways	6	25519	2568	0.32	0.16	0.53
Alitalia	4	16544	1308	0.39	0.23	0.53
Binter Canarias	4	5945	1459	0.42	0.22	0.13
Olympic airlines	3	8529	1816	0.51	0.38	0.06
TAP	2	8655	2187	0.40	0.25	0.57
Air One	2	4200	1247	0.24	0.14	0.31
LOT	2	6182	2524	0.44	0.27	0.67
Meridiana	2	2830	1161	0.40	0.27	0.23
Other airlines	22	8002	2351	0.37	0.23	0.36

Note: Data about traffic, prices, and airlines share make reference to the mean value for the corresponding sub-sample of routes.

Source: Eurostat, Airportcharges.com, OAG

4. Estimation and results

In this section, we estimate the determinants of the prices charged by the airports to the airlines. The choice of explanatory variables in the prices equation takes into consideration the underlying hypotheses considered in the studies discussed above. Particular attention is given to questions concerning market power. Indeed, it is expected that the greater an airport's market power, the higher the prices that airport will charge those airlines that operate from its installations. Thus, we estimate the following pricing equation charged by airport a to the airlines that operate from its installations:

$$PR_a = \alpha + \beta_1 Total_Traffic_a + \beta_2 \%National_Traffic_a + \beta_3 Number_nearby_airports_a + \beta_5 HHI_a + \beta_6 \%Airline_alliance_traffic + \beta_6 Private_Non-Regulated_a + \beta_7 D^{island}_a + \beta_8 D^{system}_a + \epsilon \quad (1),$$

where the variable to be determined are the prices charged by the airports to airlines for traffic within the EU, PR_a . European Union traffic is used as the reference, since prices for domestic and EU traffic are generally identical or very similar, while in most of the airports in the sample there are no flights involving traffic from outside the EU, or where there are its volume is very low. Furthermore, the A-320 aircraft is typically used on medium-distance routes. However, our results remain unaltered when taking domestic traffic as reference. The explanatory variables in equation (1) are:

1. The airport's total volume of traffic, $Total_Traffic_a$. The coefficient associated with this variable is expected to present a positive sign. In other words, the greater the volume of traffic is, the higher the prices that will be charged by the corresponding airport. Here, higher prices may refer either to the greater monopoly or the scarcity rents. However, the effect in terms of costs of the number of passengers channelled from the corresponding airport is unknown.

These costs will depend on the degree of use of the airport's capacity.⁷ If this use is high, the airport can exploit the scale economies derived from the sharing of fixed costs among a greater number of output units. But, in turn, a high use of its capacity can also give rise to higher costs due to greater congestion.

Note that we can expect a simultaneous determination of the price and demand levels of an airport. Therefore, in order to avoid the problem of endogeneity in the estimation of the pricing equation, we need to include demand instruments within this estimation. As instruments, we use the following variables: the market potential of the region of reference of the airport (NUTS 2) which is constructed as the sum of the GDP of all the regions of all the airports in the sample weighted by the distance to the region of airport a : $\sum \text{PIBa}'/\text{Distaa}'$. We also include as instruments income per capita and the population of the region of reference and, finally, the rate of employment in hotels and restaurants as a percentage of overall employment in the region in which the airport is located as an indicator of the intensity of tourism there.

2. Domestic traffic as a percentage of the airport's total traffic, %National_Traffic. The coefficient associated with this variable is expected to present a negative sign, since the greater the proportion of domestic traffic, the lower the airport's market power should be, owing to greater competition from other modes of transport. Furthermore, the airport policy might favor lower prices should the importance of domestic traffic be relatively higher.⁸
3. The number of airports that lie fewer than 100 km from airport a , and which are managed by different operators, Number_nearby_airports. We only consider airports with passenger traffic greater than 150,000 individuals. This traffic threshold is the same as that used by Eurostat for differentiating between main and small commercial airports. The coefficient associated with this variable is expected to present a negative sign, since the higher the number of nearby airports with commercial traffic, the lower will be the airport's market power due to possible competition among airports seeking to attract the traffic that a shared geographical area generates.
4. The Hirschman-Herfindalh index of concentration at the airport in terms of the number of flights offered by the airlines operating out of it, HHI a . The greater the concentration among the airlines that operate out of the airport, the lower the market power that airport should have, because the airlines with the greatest market share will enjoy greater negotiating power.
5. The percentage of traffic channelled by the airlines integrated within intercontinental airline alliances; Oneworld, Star Alliance and SkyTeam, %Airline_alliance_traffic. The coefficient associated with this variable is expected to present a positive sign, given that the network airlines should have a lower capacity to negotiate than the low cost airlines. The network airlines channel their traffic by exploiting connecting traffic, which involves a complex structuring of routes and a heavy dependence on its hub airports.⁹ It is more expensive and difficult for the network airlines than it is for the low cost airlines to make significant changes in the airports that they use as the base of their operations. Low cost airlines, with their simpler

7 Gillen and Lall (1997) claim that we should speak of density economies rather than of economies of scale in relation to the airports' cost structures. Thus, the airports operate in an environment of economies of density that are derived from the greater use of indivisible assets. By contrast, doubling the number of runways will not necessarily reduce average costs, while doubling the number of terminals can even mean falling returns due to the increased complexity involved in their management.

8 Bel and Fageda (forthcoming) report evidence of airport investment policies that include cross subsidies from international users to domestic users.

9 However, and for airports with a high volume of traffic channelled by airlines integrated in alliances, the greater the share of connecting traffic (that is, traffic whose final destination is not the airport in question) the greater the airline's negotiating power. The lack of data on connecting traffic, however, prevents us from testing this hypothesis.

point to point route structures as opposed to hub-and-spoke network of routes, have a greater margin to delocalize their operations to other airports.

6. A variable that is the result of the interaction between the percentage of private property owned by the management company and a dummy variable that takes a value of 1 for those airports not subject to regulation, *Private_Non-regulated*. As such, this variable takes a value of 0 for airports managed by public firms or by private firms subject to regulation, while it takes a value equivalent to the percentage of the firm's capital that is in the hands of private firms in the case of private airports free of regulation. The coefficient associated with this variable is expected to present a positive sign, so that the higher the percentage of private property of management companies not subject to regulation the higher the prices charged by the airport.
7. A dummy variable for airports with an island location, *Disland*. The coefficient associated with this variable is expected to present a positive sign, since the market power of airports located on islands should be high because of the fewer opportunities for intermodal competition.
8. A dummy variable for airports in countries that operate a price-fixing system, *Dsystem*. Such countries are considered as being those that operate a centralized management system in which the airports charge identical prices; Spain – based on three traffic categories, Greece –except Athens, and Norway. In these countries, price fixing by each individual airport might be distorted, but it is not clear what the sign of the coefficient associated with this variable should be, nor whether this variable should be significant. Indeed, the prices in some of these airports controlled by a system of this kind can be higher than those that would be applied in an individual pricing scheme while in other airports in the system they might be lower.

The relation between the regulation mechanism (rate of return, maximum prices, etc) and prices is *a priori* ambiguous. In fact, Starkie (2004) suggests that, in practice, there are not substantial differences between price-cap and rate of return regulation since price-caps usually take into account historic costs of the airport management company.

Unfortunately, we do not have complete and reliable data indicating which countries adopt a single-or dual-till approach in their price regulation. In this regard, we should expect that prices may be higher in airports subject to regulations following the dual-till approach.

In any case, what is clearer is that private airports not subject to regulation can fix higher prices. Indeed, the typical behaviour of private firms is to maximize profits, while that of public firms or institutions is guided more by social and political objectives. Therefore, prices can be expected to be higher in airports controlled by private investors if they are not subject to any regulation, although it is not clear whether this is prejudicial to the airlines, to the passengers or to both.

It is also interesting to estimate the factors that explain the likelihood of a airport being subject to an excess demand as regards the slots that give the right to use its system of landing and takeoff runways, according to the classification of airports established by the IATA. As we mentioned above, this factor gives an indication of the congestion levels at the airport.

In this regard, it is of particular interest to analyze the extent to which prices influence an airport's excess demand. In instances where this is the case, we find evidence of a certain sensitivity on the part of the airlines to the prices charged by the airports. Thus, we also estimated the following equation:

$$\begin{aligned}
 D^{\text{excess_demand}}_a = & \alpha + \beta_1 PR_a + \beta_2 \text{Market_Potential}_a + \beta_3 \text{Income per capita}_a + \beta_4 \text{Intensity_tourism} + \\
 & + \beta_5 \text{Number_nearby_airports}_a + \beta_6 \text{HHI}_a \\
 & + \beta_7 \% \text{Airline_alliance_traffic}_a + \epsilon,
 \end{aligned}
 \tag{2}$$

where the dependent variable is a dummy variable that takes a value of 1 in the case of airports categorized by the IATA with the maximum level of excess demand, which corresponds to grade 3; D^{excess_demand} .

As regards the explanatory variables, the levels of excess demand should be lower in those airports in which the prices are highest. Therefore, we would expect the sign of the coefficient associated with the pricing variable to be negative. Moreover, the levels of excess demand should be higher the greater the potential traffic that an airport can generate. As determinants of the traffic that an airport can generate, we include the following variables: the market potential of the airport's region, which is the sum of the GDP of all the regions of the airports in the sample weighted by the distance of the airports in these regions from airport a : $\sum \text{PIB}_a / \text{Dist}_{aa}$, GDP per capita and the intensity of tourism in the region in question.

The competition between airports to attract airlines can be made through lower prices as well as through the availability for increased capacity (Starkie, 2004). Should the competition in capacity be relevant, we would expect the excess demand at the corresponding airport to be lower, the greater the number of airports in a nearby zone with a different management firm. Indeed, competition between neighboring airports can lead to greater incentives to invest in capacity. Further, the aggregate demand that a particular geographical area generates will be shared out among a greater number of airports. Therefore, the coefficient associated with the number of nearby airports is expected to present a negative sign.

Several studies though have found a negative relation between the degree of congestion and the degree of concentration, and a positive relation between the degree of congestion and the hub status of the airport (Brueckner, 2002; Mayer & Sinai, 2003). Here too we analyse the relation between excess demand and variables related to the concentration and the type of airlines that operate out of the airport, although given the limitations of the excess demand variable as an indicator of congestion we should consider other possible interpretations of the expected results for these variables related to the airlines that operate out of the airport.

Thus, high concentration levels of airlines conducting a large share of their operations at the airport can serve as a disincentive for other airlines to offer flights from that infrastructure, since the dominance over the airport enjoyed by the former grants them certain advantages both in terms of costs and demand. Thus, we would expect the sign of the coefficient associated with the Hirschman-Herfindalh index of concentration to be negative. Finally, the levels of excess demand should be higher in those airports with the greatest presence of airlines integrated in alliances, given that this type of airline generally offers greater frequency of flights on the routes that they operate than is offered by other airlines such as the low-cost companies.

Table 3 shows the descriptive statistics of the variables used in the empirical analysis where the high degree of variability in all the variables that are continuous is evident. On the other hand, Table 4 shows the correlation matrix between variables.

Table 3. Descriptive statistics of variables used in the empirical analysis

Variable	Mean	Standard deviation	Minimum value	Maximum value
PR (euros)	2076.40	760.12	441	4310.23
Total traffic (000 passengers)	11648.15	12937.78	2420.71	68279.36
%National_Traffic	0.31	0.24	0	0.95
Tourism_Intensity (%)	0.06	0.04	0.018	0.215
Number_nearby_airports	0.67	1.005	0	5
HHI	0.28	0.17	0.07	0.93
%Traffic_airlines_alliances	0.43	0.28	0	0.90
D ^{Private_NoRegulated}	0.13	0.33	0	1
D ^{demand_excess}	0.60	0.49	0	1
Market potential (euro)	103453	95619.58	9975	487957
GDP per capita (100=EU27)	119.29	37.74	47	236

Table 4. Matrix of correlations of variables used in the empirical analysis

Variable	PR	Total Traffic	% National	Tourism Int.	Nearby airports	HHI	%Alliances	D ^{Priv}	Ex_dem.	MP	GDPc
PR	1										
Total Traffic	0.29	1									
%National_Traffic	-0.29	-0.22	1								
Tourism Intensity	-0.20	-0.05	0.03	1							
Nearby Airports	0.19	0.03	-0.18	-0.11	1						
HHI	-0.12	-0.09	-0.06	0.02	0.08	1					
%Traffic_alliances	0.24	0.42	0.14	-0.20	-0.20	-0.15	1				
Private_NoRegulated	0.35	-0.13	0.006	0.04	0.41	0.11	-0.28	1			
Demand_excess	-0.24	0.39	0.11	0.25	-0.29	-0.12	0.17	-0.41	1		
Market Potential (MP)	0.22	0.53	-0.05	-0.20	0.38	0.05	0.16	0.06	0.21	1	
GDP per capita (GDPc)	0.27	0.45	-0.20	-0.13	0.27	0.13	0.25	0.07	0.12	0.45	1

Tables 5 and 6 show the results of the estimation that considers the determinants of the prices that the airports charge the airlines. The estimation was made using the estimator of Instrumental Variables (two-stage least squares regression – 2SLS), which considers the possible endogeneity of the variable relative to total airport traffic to the extent that there might be a simultaneous determination of the price and demand variables. As instruments of the demand variable, we used market potential, population and the GDP per capita in the region in which the airport is located (NUTS 2). Additionally, we take into consideration the fact that the traffic might be greater in airports located in regions with a high intensity of tourism. The instrument suitability tests, the partial R2 of the first stage regression and Hansen’s J test of the possible endogeneity of the instruments show a high correlation between the variables instrumented and the instruments and the exogeneity of the latter.

Table 5. Estimates of the pricing equation (IV-2SLS)

Explanatory variable: PR	All sample	We exclude airports with a system approach	We exclude airports with a system approach & islands
Total_Traffic	0.013 (0.005)***	0.012 (0.004)***	0.008 (0.006)
%National_Traffic	-777.97 (381.66)**	-1210.39 (298.35)***	-1181.51 (344.38)***
Number_nearby_airports	-42.00 (37.55)	-61.89 (40.13)	-137.96 (65.41)**
HHI	-479.49 (415.87)	-692.40 (494.92)	-902.29 (530.29)*
%Traffic_airlines_alliances	869.84 (310.50)***	1123.92 (317.23)***	1432.95 (202.70)***
Private_Noregulated	10.87 (1.74)***	10.40 (1.06)***	13.66 (2.40)***
D _{island}	134.45 (135.91)	357.36 (93.90)***	-
D _{System}	-284.67 (286.19)	-	-
Intercept	1828.45 (180.33)***	1871.49 (215.25)***	1853.54 (218.09)***
N	100	77	55
R ²	0.44	0.47	0.58
F (Joint significance)	77.64***	59.51***	86.06***
Tests of instruments			
R ² parcial	0.39	0.43	0.54
Hansen J	3.44	2.85	1.78

Note 1: Standard errors in parenthesis (robust to heteroscedasticity and adjusted for correlation between airports of a same country)

Note 2: Statistical significance at 1% (***), 5% (**), 10% (*)

Note 3: Instruments for the demand variable (Total_Traffic) are the following: Market potential, GDP per capita, population and the dummy variable for airports located in islands (the latter variable is not included in the third estimation).

Table 6. Elasticities evaluated at sample means

Dependent variable: PR	All sample	We exclude airports with a system approach	We exclude airports with a system approach & islands
Total_Traffic	0.08***	0.07***	0.04
%National_Traffic	-0.12**	-0.14***	-0.14***
Number_nearby_airports	-0.01	-0.03	-0.04**
HHI	-0.07	-0.09	-0.12*
%Traffic_airlines_alliances	0.18***	0.22***	0.35***
Private_NoRegulated	0.07***	0.08***	0.02***
D _{island}	0.02	-0.05***	-
D _{System}	-0.03	-	-

It should be pointed out that the differences in the institutional and regulatory policy frameworks of the airports in the various countries will influence the results of the empirical analysis. For example, in

countries such as Spain and Greece, various airports charge the same prices even though their characteristics might be very different in terms of their geographical location, type of traffic and the airlines that operate there, etc. This could distort the testing of some of the hypotheses stated. Moreover, the extraordinary economic and social importance of the airports located on islands means there is a need to consider the significant differences that might exist between the decision-taking procedures of airport management companies in continental Europe with respect to those located on islands.

Therefore, we performed three estimations of equation (1) based on the sample of airports considered here. First, we estimated the equation by taking into consideration all the airports in the sample. Second, we estimated equation (1) excluding the airports from the same country that charged the same prices (Spain – according to three categories of traffic, Greece –except Athens, and Norway). Finally, we estimated equation (1) excluding both those airports in countries that adhere to a price-fixing system and those airports located on islands. Note that this last estimation allows us to consider the most homogenous sample of airports possible, namely the airports of continental Europe where price fixing is carried out independently of all the other airports in the country.

It is also necessary to bear in mind the common factors that might affect the airports in the same country. Therefore, the estimation takes into account the possible correlation between the standard errors of airports that belong to the same country by considering clusters for each country. Finally, the standard errors can be corrected for a possible problem of heteroscedasticity derived from an inconstant variance between very different observations.

The joint significance of the equation estimated is reasonable considering the high degree of heterogeneity of the airports making up the sample. In this regard, the R2 is much higher in the estimation that excludes airports in countries that adhere to a price-fixing system and those airports located on islands. The sign of the coefficients of the explanatory variables is as expected although some of these coefficients are not statistically significant in all the estimations made.

We confirm that prices are higher in airports with the greatest volumes of traffic, be it because of their greater scarcity or monopoly rents, or their higher costs. However, the total traffic variable is no longer significant in the estimation that excludes airports in countries that adhere to a price-fixing system as well as those located on islands. The lack of data concerning the capacity available at the airports under consideration means we are unable to define better the relation between prices, monopoly rents and congestion levels. However, the positive effects on prices derived from the higher monopoly rents or from the greater costs due to congestion are more significant than the negative effects that might be derived from a better exploitation of the scale economies. This result contrasts with that reported by Van Dender (2007) for a sample of large US airports where he found evidence of a negative relation between prices and traffic.

The share of domestic traffic has a negative influence on the prices charged by the airports and its effect is statistically significant in the three estimations performed. Likewise, the dummy variable for airports located on islands is positive and statistically significant in the estimation that excludes airports operating a price-fixing system. We can therefore confirm that the possible competition from other modes of transport has an impact on the capacity of the airports to fix high prices. In turn, airport policy may favour lower prices in those cases where the percentage of travellers resident in the country is high.

The number of nearby airports has a negative influence on the prices charged by the airports but its effect is only statistically significant in the estimation that excludes airports that adhere to a price-fixing system and those located on islands. Therefore, we find evidence that the competition derived from the presence of other nearby airports has a negative influence and one that is statistically significant on the prices fixed by airports in the countries of continental Europe that fix their prices individually.

In the case of variables related to the characteristics of the airlines, their negotiating capacity seems to be determined by the type of airline that is predominant at the airport as well as by the levels of concentration. Indeed, the low cost airlines seem to have a greater negotiating capacity than the airlines integrated in alliances and this effect is statistically significant in all three estimations. Moreover, greater levels of concentration seem to be associated with lower prices (in contrast with the findings reported by Van Dender, 2007) and, therefore, with a greater airline negotiating capacity with higher market shares, although this effect is only statistically significant in the estimation that considers airports in the countries of continental Europe that fix their prices on an individual basis. Note that this might be explained by the greater homogeneity of this particular sample, since the economic impact of concentration is notable in all three estimations when we consider the elasticities evaluated according to the sample mean in Table 6.

Moreover, the prices are higher in the case of non-regulated airports with a greater percentage of private property. This does not necessarily imply the exploitation of market power but rather it can also indicate a bias in favour of the airports in their conflict with the airlines to obtain extraordinary rents.

Finally, the airports that adopt a price-fixing system appear to fix lower prices than the rest of the airports although the estimated effect is not statistically significant.

Table 7 shows the results of the estimations of the factors that affect the probability of an airport finding itself in a situation of excess demand, or not, as regards the rights to use its landing and takeoff strips. Note that this excess demand variable might be seen as an approximate indicator, in the absence of better data, for the level of airport congestion.

Table 7. Estimates of the equation for excess of demand (Logit)

Dependent variable: D ^{excess_demand}	Coefficients estimated	Marginal effects
PR	-0.002 (0.0006)***	-0.0004***
MP	0.000016 (3.95e-06)***	3.39e-06***
GDP per capita	0.015 (0.01)	0.003**
Tourism_Intensity	34.27 (15.38)**	7.32**
Number_nearby_airports	-1.29 (0.45)***	-0.27***
HHI	-3.64 (1.61)**	-0.77**
%Traffic_airlines_alliances	2.71 (1.65)*	0.57*
Intercept	0.35 (1.39)	-
N	100	
R²	0.38	
F (Joint significance)	53.27***	

Note 1: Standard errors in parenthesis (robust to heteroscedasticity and adjusted for correlation between airports of a same country)

Note 2: Statistical significance at 1% (***), 5% (**), 10% (*)

Note 3: Instruments for the variable of prices are the following: the percentage of national traffic, tourism intensity, and the variable of PrivateNoRegulated.

Given that the explanatory variable is of a binary nature, the estimation is performed using a logistic regression. A problem of endogeneity is expected in the price variable since a simultaneous determination might be occurring both in the levels of excess demand and in the prices. As instruments we consider the explanatory variables of equation (1) that do not appear as explanatory variables in equation (2). Thus, we use the percentage share of domestic traffic at the airport, a dummy

variable for airports with an island location, and a variable that is the result of the interaction between the percentage of private property of the management company and the dummy variable that takes a value of 1 for non-regulated airports.

The R^2 of the estimation is reasonably high considering the sample's heterogeneity. Note that the logit estimation with instrumental variable does not allow us to test instrument suitability as was possible earlier.

The results in Table 7 confirm that the airports with the highest prices have the lowest levels of excess demand. Therefore, high prices imply a greater cost for the airlines (or perhaps for the passengers) but, in turn, they may also alleviate the problems that the airports suffer of insufficient capacity to handle greater volumes of traffic. Thus, it would seem that the airlines are sensitive to the prices that the airports charge to the extent that levels of excess demand fall when the airport charges higher prices. This relationship between prices and traffic is more difficult to identify if we consider total traffic moved by the airport as the dependent variable, as prices tend to be higher in airports with more traffic.

Note also that in airports without excess demand, the allocation of slots depends on market mechanisms; these slots are used by those airlines that are actually prepared to pay a high price for them. By contrast, in airports with excess demand the allocation of slots depends on mechanisms of coordination of an administrative nature based on historical rights. In some ways, therefore, this might be acting to distort airline competition.

The remaining variables are statistically significant and present the expected sign, with the exception of the GDP per capita variable whose sign is positive but not significant. The market potential and intensity of tourism variables have a positive influence on the levels of excess demand and are statistically significant. Moreover, we find a certain amount of evidence that the airports appear to compete also in terms of capacities, since the greater the number of neighboring airports, the less likely is the airport in question to have excess capacity.

The greater the concentration in terms of the airlines' share at the airport, the lower is the probability of the airport in question having excess demand. This probably reflects the effect of the lower degree of attraction of airports with a strong dominance of one, or a few airlines, or even a certain collusion between the airport manager and airlines with a larger share of traffic in that airport.

Finally, and as expected, excess demand is greatest in airports with a greater proportion of traffic from airlines integrated in alliances. Such airlines need to exploit in the best way possible their connecting traffic and this means having to offer a greater frequency of service than that provided by low cost airlines.

5. Concluding remarks

Our analysis contributes to this area of the literature by undertaking a study of the determinants of airport pricing in a broad sample of European airports. In addition to the variables employed by Van Dender (2007) for US airports, our study has also given comprehensive consideration to the influence on pricing of factors related to the predominant airline type at the airport, pricing regulation and to ownership structure.

Our empirical analysis suggests that airports with the highest volumes of traffic charge higher prices to the airlines, be it because of higher extraordinary rents or because of their higher overall costs. Moreover, the amount of domestic traffic as a proportion of total traffic has a negative influence on airport charges, since this traffic is more vulnerable to competition from other transport modes or to the fact that the country's airport policy might favour lower prices. At the same time, island-based airports charge the airlines higher prices, which can be accounted for in terms of the fewer opportunities that exist for intermodal competition.

We have also found some evidence to indicate that an airline's negotiating power with the airport is greater the larger the market share this airline enjoys at that particular airport. This negotiating capacity also seems to be greater for low cost airlines, in comparison to that enjoyed by network airlines, since prices are higher the greater the percentage of traffic that is channelled by airlines integrated in alliances.

The competition that might be exercised by other airports located in nearby areas and managed by different companies seems to discipline the behaviour of the corresponding airport operator, while the airports controlled by private companies that are not subject to regulation fix higher prices than the airports managed by public firms or private firms subject to regulation.

Private sector participation seems set to increase in the next few years, given the pressure exercised by other agents on airport activity. Indeed, the airlines operate today in a highly competitive environment, and demand sufficient capacity from the airports at which they carry out most of their operations. And, often, governments face the need to finance significant investments in airports at a time of major budgetary restrictions.

Privatization grants greater importance to regulation to the extent that private managers might have greater incentives than public managers to abuse their possible market power. Our analysis suggests that this is particularly true in certain circumstances, which include the airports' potential to generate traffic, the competition that might be exercised by nearby airports and the degree of dependence on one or more airlines.

Nevertheless, the fixing of high prices by the airports is not necessarily prejudicial in terms of social welfare. Apart from the distributive conflict between airports and airlines, which will have a varying impact on passengers depending on the intensity of competition between airlines, high price fixing by airport operators can also help mitigate congestion problems be it by a rationing of demand or by providing incentives for investment in additional capacity. However, in certain circumstances, such high prices can be prejudicial to the extent that they represent the securing of extraordinary monopoly rents.

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Annex

Table A1. Sample of airports used in the empirical analysis

Airport	Airport	Airport
Aberdeen (ABZ)	Helsinki (HEL)	Stuttgart (STR)
Alicante (ALC)	Heraklion (HER)	Tegel (TXL)
Arlanda (ARN)	Ibiza (IBZ)	Tenerife North (TFN)
Amsterdam (AMS)	Lanzarote (ACE)	Tenerife South (TFS)
Athens (ATH)	Larnaca (LCA)	Thessalonica (SKG)
Basel (BSL)	Leeds (LBA)	Tolouse (TLS)
Barcelona (BCN)	Linate (LIN)	Trondheim (TRD)
Belfast (BFS)	Lisboa (LIS)	Turin (TRN)
Bergamo (BGY)	London-Heathrow (LHR)	Valencia (VLQ)
Bergen (BGO)	London City (LCY)	Warsaw (WAW)
Bilbao (BIO)	Liverpool (LPL)	Venice (VCE)
Birmingham (BHX)	Luton (LTN)	Verona (VRN)
Bologna (BLQ)	Lyon (LYS)	Vienna (VIE)
Budapest (BUD)	Madrid (MAD)	Zurich (ZRH)
Bucharest (OTP)	Málaga (AGP)	
Bordeaux (BOD)	Malta (MLA)	
Bristol (BRS)	Milan-Malpensa (MXP)	
Brussels (BRU)	Manchester (MAN)	
Cagliari (CAG)	Marsella (MRS)	
Catania (CTA)	Menorca (MAH)	
Krakow (KRK)	Munich (MUC)	
Copenhague (CPH)	Nantes (NTE)	
Köln-Bonn (CGN)	Naples (NAP)	
Cork (ORK)	Newcastle (NCL)	
Charleroi (CRL)	Nice (NCE)	
Ciampino (CIA)	Nuremberg (NUE)	
Dublin (DUB)	Oslo (OSL)	
Dusseldorf (DUS)	Palma de Mallorca (PMI)	
East Midlands (EMA)	Palermo (PMO)	
Edimburgh (EDI)	Paris-Charles de Gaulle (CDG)	
Faro (FAO)	Paris-Orly (ORY)	
Fiumicino (FCO)	Porto (OPO)	
Fuerteventura (FUE)	Praga (PRG)	
Frankfurt (FRA)	Pisa (PSA)	
Gatwick (LGW)	Prestwick (PIK)	
Gran Canaria (LPA)	Rhodes (RHO)	
Glasgow (GLA)	Riga (RIX)	
Girona (GRO)	Schonefeld (SFX)	
Ginebra (GVA)	Seville (SVQ)	
Gothenburg (GOT)	Shannon (SNN)	
Hahn (HNN)	Sofia (SOF)	
Hamburg (HAM)	Stansted (STN)	
Hannover (HAJ)	Stavanger (SVG)	

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