DOCUMENTS DE TREBALL

DE LA FACULTAT
DE CIÈNCIES ECONÒMIQUES
I EMPRESARIALS

Col·lecció d'Economia

MEASURING CONDUCT AND COST PARAMETERS IN THE SPANISH AIR TRANSPORT MARKET

Xavier Fageda*

September 2004

Address for correspondence: University of Barcelona (Department of Economic Policy). Av. Diagonal 690. 08034 Barcelona (Spain). E-mail: xfageda@ub.edu

* The author would like to thank all members of the Research Unit on Public Policies and Economic Regulation (University of Barcelona), Javier Campos, Ginés de Rus, Pedro Marín, Anna Matas, Eugenio Miravete and Gustavo Nombela for their useful suggestions. The usual disclaimer applies.

ABSTRACT: This paper estimates a model of airline competition for the Spanish air transport market. I test the explanatory power of alternative oligopoly models with capacity constraints. In addition, I analyse the degree of density economies. Results show that Spanish airlines conduct follows a price-leadership scheme so that it is less competitive than the *Cournot* solution. I also find evidence that thin routes can be considered as natural monopolies.

RESUMEN: Este artículo estima un modelo de competencia para el mercado español de transporte aéreo. Se contrasta la capacidad explicativa de modelos alternativos de oligopolio con restricciones de capacidad. Adicionalmente, se analiza el alcance de las economías de densidad. Los resultados de la estimación muestran que la conducta de las compañías aéreas españolas sigue un esquema de liderazgo en precios, de tal modo que dicha conducta es menos competitiva que la solución de *Cournot*. También se halla evidencia de que las rutas de baja densidad de tráfico son un monopolio natural.

JEL classification: D43, L13, L93, C30
Keywords: Oligopoly, Air Transportation, Multiple Equation Models

I. Introduction

The worldwide liberalisation of air transport services has been considered one of the most successful experiences in the wider process of regulatory reform. However, there is a consensus in the academic literature that benefits of liberalisation depend fundamentally on the existence of an effective competition on the markets where airlines compete; the air routes that link city pairs. In this context, the two typical market structures that have emerged in the domestic markets of the European Union are monopolies and asymmetric oligopolies. The primary objective of this paper is to examine airlines behaviour under these market structures

Route traffic density normally determines the particular strategic scenario. Indeed, oligopoly with a dominant firm is the predominant market structure in thick routes. In addition, airlines (especially non flag carriers) face capacity constraints as long as main European airports are currently congested.[1]

Kreps and Scheinkman (1983) show that the equilibrium in a two-stage oligopoly competition model with endogenous capacity constraints is equivalent to the traditional one-stage *Cournot* model. In this model, firms choose simultaneously capacities in a first stage and then they both choose simultaneously prices. However, Deneckere and Kovenock (1992) find that oligopoly competition with capacity constraints can lead to an outcome less competitive than predicted by a *Cournot* model, regardless there is implicit or explicit collusion. In their model, one firm emerges as a natural price leader due to its relatively large size, so that the price setting moves from a simultaneous to a leader-follower scheme. In addition, the assumptions of Deneckere and Kovenock rely on exogenous capacity constraints and an aggregate demand that is high with respect to aggregate capacity. In spite of the fact that airlines can operate with capacity constraints, service frequency is a crucial competition variable in a context where demand is fluctuating, so that airlines usually have excess of capacity. Taking into account that European flag carriers tend to dominate to great extent their domestic markets, it can be claimed that the European airline industry for domestic markets can meet the assumptions of Deneckere and Kovenock model. Thus, it is relevant to test the explanatory power of these two alternative models on oligopoly routes.

Monopoly is the predominant market structure in thin air routes. In this way, it is generally accepted the existence of density economies in the air transport industry; unit costs fall when route traffic increases (Caves et al., 1984). The degree of density economies determine whether thin routes should be considered as natural monopolies. In that case, Braeutigam (1989) suggests that it is needed to assess if some form of competition for the market, such as potential competition or intermodal competition, could guarantee an efficient allocation of resources. Indeed, air transport services were considered a paradigmatic example of the contestability hypothesis for their proponents (Baumol et al. (1982)) and the majority of routes in the European domestic markets are short-haul routes. Thus, it is of interest to analyse density economies and the influence of competition for the market on monopoly routes.

We deal with all these issues through an empirical model of oligopoly competition that is estimated for the Spanish air transport market in the period 2001-2002. It is needed to mention that the results of this particular study can be expanded to the rest of the European Union because the Spanish market is the largest domestic market in this area, as it is shown in table 1. This is due to the fact that major cities in Spain are far from each other and to the relevance of connections to the islands. In addition, quality of service of alternative transport modes is relatively low. The large size of the Spanish market, along with the strong tradition of charter airlines, allows claiming that the Spanish market is an upper bound in terms of competition opportunities in the European context. Additionally, this market shows a high stability since 1997 so that an oligopoly static framework should not be biased.

Table 1. Number of seats per week supplied in domestic markets. 2000

Market	Seats
Spain	776,435
Italy	742,074
France	733,479
Germany	652,241
United Kingdom	564,961
Norway	412,040
Sweden	265,034
Portugal	97,121

Source: Official Airlines Guide (Reported in Williams, 2003)

It is useful to mention here some facts of the Spanish air transport market. The main competitor of the Spanish flag carrier, Iberia, is Spanair, an airline that is mainly owned by the Scandinavian airline, SAS. The third Spanish competitor, Air Europa, is owned by a firm devoted to tourist activities. Iberia has been privatized in a gradual process that finished in 2001. British Airways is currently one of the Iberia's major shareholders.[2] According to the General Directorate of Civil Aviation (Ministry of Transports), the Spanish market is composed by about 100 routes,

---

[1] In Europe, the allocation of slots in the airports is based on the grandfather right. According to this right, airlines that have traditionally made use of slots are their "owners". Thus, flag carriers, the airlines that had the monopoly (duopoly) in the provision of domestic (international) services in the regulation period, can use the majority of the slots in most airports of their national network.

[2] There is also Air Nostrum, a regional airline that operates as a franchise of Iberia. This airline does not have an independent pricing policy with respect to Iberia.

maintaining Iberia the monopoly on half of them. In routes where Spanair and/or Air Europa offer services, the Iberia's market share lies between 50 and 90 per cent.

The remainder of this paper is organised as follows. In the second section, it is stated the main contribution of this study with regard to the previous literature. In the third section, we develop a model of airline competition in a static framework. In the fourth section, we specify the data used in the empirical analysis. In the fifth section, we proceed to comment the results of the estimation. Finally, the last section focuses on the implications of the results.

II. Literature review

One of the main advances of the New Empirical Industrial Organization (NEIO) is to provide econometric techniques to estimate conduct and cost parameters of firms, even when full data on costs is not available. In this way, the conjectural variations approach allows dealing with several relevant questions, such as measuring the degree of market power or analysing the technology of the industry. The parameter of conjectural variations of the firm *i* (v_i) can be estimated through the following equation:

$$v_i = (p - c_i)\eta/(ps_i) - 1, \tag{1}$$

where v_i is the expected variation of rivals output when output of firm i varies, p is the market price, c_i and s_i are the individual marginal costs and market share respectively, and η is the price elasticity of demand.

The conjectural variations approach has been criticized for capturing a dynamic concept in a static framework. However, Bresnahan (1989) argues that the interpretation of the conduct parameter in empirical models does not refer to an expectative but an indicator of the average degree of collusion in the market. Although Corts (1999) replies Bresnahan's argument through the distinction between marginal and average degree of collusion, the conjectural variations approach is still considered a useful tool to measure the degree of market power. In this way, Genovese and Mullin (1998) test the validity of the NEIO in an oligopoly static framework for the refining industry in the period 1890-1914. They show that NEIO approximates reasonably well the mark-ups on marginal costs, even when full data on costs is not available. The results of Genovese and Mullin are robust to different functional forms of demand. Klay and Troesken (2003) obtain similar results for the whiskey industry at the turn of century XIX.

In the case of the airline industry, there is an extensive empirical literature that analyses market power.[3] Nevertheless, there are very few studies that estimate explicitly conduct parameters of airlines and all of them refer to the US domestic market. Brander and Zhang (1990, 1993), Oum et al. (1993) and Fisher and Kamerschen (2003) estimate such conduct parameters for a group of routes departing from Chicago airport (Atlanta in the study of Fisher and Kamershen).[4] The most common competitive scenario in such routes is a symmetric duopoly. Thus, it is not surprising that these studies find evidence that airline competition can be explained, on average, by a traditional *Cournot* model. Moreover, these studies have two possible shortcomings. First, the estimation process is sequential so that they estimate (or assume) the price elasticity of demand at a first stage, and then they estimate the conjectural variations parameter at a second stage. This estimation process could be inconsistent as long as both parameters should vary in a simultaneous way. And second, it is needed to make some assumptions to approximate route specific marginal costs given that cost data is not generally available at the route level. In particular they assume constant marginal costs regardless the level of route traffic density, although previous studies (Brueckner, Dyer and Spiller (1992), Brueckner and Spiller (1994)) show that marginal costs can be decreasing.[5]

In this paper, we estimate conduct and cost parameters for the Spanish air transport market through a simultaneous estimation of demand and pricing equations. We use the information provided by routes in different competitive scenarios, taking into account the sensitivity of costs to traffic density. Given that the availability of data does not allow estimating parameters for each route, our estimation procedure distinguishes across routes according to the two main specific market characteristics; traffic density and distance.

III. The empirical model

Estimation of an empirical model in a NEIO framework requires assumptions on demand and cost functions along with assumptions on the nature of the oligopolistic interaction between firms. Such assumptions are made for airline i ($i = 1,.....,N$) that operate on route k in period t. Demand function (Q) at the route level is expressed through a linear function that is derived from a gravity model:

$$Q_{kt} = a_{kt} + \alpha_k p_{kt} \tag{3}$$

$$\text{where } a_{kt} = a_0 + a_1 pop_{kt} + a_2 inc_{kt} + a_3 D^{island}{}_k \text{ and } \alpha_k = \alpha_0 + \alpha_1 D^{intermodal}{}_k$$

---

[3] Relevant contributions are due, among others, to Borenstein (1989), Evans and Kessides (1993), Marín (1995) and Berry et. al. (1996).

[4] There are other studies that estimate conduct parameters using data at the level of airlines, such as the work of Roller and Sickles (2000). However, our approach relies on considering air routes as separate markets.

The intercept term of the demand function includes variables for population (*pop*) and income per capita (*inc*) of the route city pairs, which approximate its demographic and economic size. It also includes a dummy variable that takes value 1 for routes with an island as an endpoint (D^{island}) as the main "impedance" effect. This latter variable also captures traffic generation that comes from tourist activities. Demand also depends on prices (*p*). It should be restrictive to assume that the price elasticity of demand does not vary across routes. Indeed, it can be expected that travellers are less sensitive to prices in routes where supply of other transport modes is not available or it is available with a much lower quality of service. Hence we include a dummy variable for intermodal competition ($D^{intermodal}$) that interacts with prices. This variable takes value 1 in routes with an island as an endpoint and/or in routes whose distance is more than 650 kilometres. In this way, it is generally assumed that ground transport modes are not able to compete with planes in distances that lay between 600 and 700 kilometres.

According to equation (3), it is possible to derive the inverse demand function, and hence the marginal revenue function of airline *i*:[6]

$$(4) \qquad IM_{ikt} = p_{kt} + \lambda(\partial p_{kt}/\partial q_{ikt})q_{ikt}\,,$$

where $\lambda=\partial Q_{kt}/\partial q_{ikt}$, which can be interpreted as the average degree of collusion. If $\lambda = 0$ the market is perfectly competitive, if $\lambda = 1$ competition is *à la Cournot*, and if $\lambda = N$ firms are jointly maximizing profits where N is the number of firms that operate in the market. If we assume a quadratic total cost function, marginal costs of airline *i* can be expressed as follows:

$$(5) \qquad CM_{ikt} = b_k + \beta q_{ikt} \qquad \text{where } b_k = b_{oi} + b_1 dist_k.$$

The intercept term of the marginal cost function includes a parameter (b_{oi}) that captures the allocation of costs at the firm level. It can be expected that this parameter differ across airlines due to the lower labour costs of the new entrants in the market. However, we assume that this term does not vary across airlines ($b_{io} = b_o$). This assumption should not affect our estimation because we exploit differences across routes. That is, lower labour costs of Spanair and Air Europa with respect to Iberia are by the same amount in all the routes.

---

[5] Brueckner and Spiller (1994) also estimate the conduct parameter in a structural model, whose identification requires an adhoc procedure for routes with several segments. They find that airlines behaviour is relatively competitive in a sample of routes that excludes air services departing from airport hubs. Their model is not applicable to markets based on non stop services.

[6] From the inverse demand function, we know that prices depend on demand and some exogenous variables (Z_{kt}); $p_{kt}=f(Q_{kt},Z_{kt})$. We simplify notation so that we express $p_{kt}=f(.)$ as p_{kt}.

In addition, the intercept term of the marginal cost function includes a variable for distance (*dist*). This variable generally explains to great extent airline prices. In this way, there are several reasons that explain that costs increase less than proportionally than the kilometres flown. Indeed, long-haul routes involve for airlines a higher average speed of planes, a less intense consumption of fuel and some fixed cost (such as airport fees) are charged less often.

The sign of the parameter (β) associated with the number of passengers carried on the route (q) determines the slope of marginal costs. As it has been mentioned above, it is generally accepted the existence of density economies on the supply side. Density economies, which involve decreasing average costs, can come from sharing out fixed costs between more units of output or from decreasing marginal costs (Tretheway and Oum, 1992). In this way, marginal costs can be understood as the sum of costs of moving an additional passenger for a given capacity plus the costs of providing additional capacity. It can be stated that the first of the marginal cost components does not vary with route traffic density. However, the costs of providing additional capacity can be decreasing to the extent that this additional capacity requires the use of bigger planes or a higher service frequency. Efficiency of planes generally increases with its size, while a high service frequency allows a high annual utilisation of planes and the crew.[7] In fact, it is difficult to distinguish if these effects refer to average or marginal costs, but it is sensible to argue that the shape of the airlines marginal cost function should be tested empirically.

The equilibrium condition for each airline is the result of equating cost and revenue functions; $IM_{ikt} = CM_{ikt}$, which lead to the following oligopoly supply relationship:

$$(6) \qquad p_{kt} + \lambda(\partial p_{kt}/\partial q_{ikt})q_{ikt} = b_k + \beta q_{ikt},$$

Given that monopoly is the market structure of a high proportion of routes in the Spanish market, the empirical analysis takes the route as unit of observation in order to compare between monopoly and oligopoly scenarios. In fact, the use of the information contained in monopoly routes allows identifying the conduct parameter in oligopoly routes. Hence our interest relies on the equilibrium condition at the market level, which comes from the aggregation of the individual equilibrium conditions in (6):

$$(7) \qquad N_{kt}p_{kt} + \lambda(\partial p_{kt}/\partial Q_{kt})Q_{kt} = N_{kt}b_k + \beta Q_{kt}$$

---

[7] A high service frequency also allows a cumulative exploitation of density economies as long as increases demand through a lower waiting time. Waiting time is the difference between the most preferred flight schedule by the traveller and the actual flight schedule. The cost reducing effects of service frequency can be particularly relevant in markets based on short-haul routes because the cost diseconomies derived from using smaller planes increases with distance.

According to equation (3), we have the following supply relationship for monopoly routes because by definition $N_{kt}=1$ and $\lambda = 1$:

$$p_{kt} + (1/\alpha_k)Q_{kt} = b_k + \beta Q_{kt} \tag{8a}$$

The supply relationship in oligopoly routes can be expressed as follows:

$$p_{kt} + \theta(1/\alpha_k)Q_{kt} = b_k + \beta Q_{mkt}, \tag{8b}$$

where $\theta = \lambda/N$ and Q_{mkt} is the average market demand. In turn, the term $\theta(1/\alpha_k)Q_{kt}$ approximates the mark-up that airlines charge on marginal costs. The empirical implementation of this model requires estimating simultaneously equations (1) and equations (8a) or (8b). Thus, the equation system to estimate is the following:

$$q_{kt} = a_0 + a_1 pop_{kt} + a_2 inc_{kt} + a_3 D^{island}{}_k + \alpha_0 p_{kt} + \alpha_1 D^{intermodal}{}_k p_{kt} + \delta_t + e^d{}_{kt} \tag{9}$$

$$p_{kt} = b_0 + b_1 dist_k + \beta Q_{mkt} - \theta(1/\alpha_k)Q_{kt} + \delta_t + e^s{}_{kt} \tag{10}$$

where δ_t is a dummy variable that captures time season and e_{kt} is a random term.

In the aggregation process, we assume cost symmetry across airlines. In fact, Iberia has a market share much higher than rivals in the majority of oligopoly routes. In order to test the possible bias of assuming symmetry, we also estimate the equation system using exclusively Iberia's data.

The estimation of this equation system does not allow identify conduct and cost parameters without additional assumptions. An identification procedure takes as reference the study of Parker and Roller (1997) for the US mobile telephone industry, where it is assumed a semilogarithmic demand function. Indeed, our equation can be expressed as follows:

$$log(q_{kt}) = a_0 + a_1 log(pop_{kt}) + a_2 log(inc_{kt}) + a_3 D^{island}{}_k + \alpha'_0 p_{kt} + \alpha'_1 D^{intermodal}{}_k p_{kt} + e^d{}_{kt} \tag{9'}$$

$$p_{kt} = b_0 + b_1 dist_k + \beta Q_{mkt} - \theta(1/\alpha'_k) + e^o{}_{kt} \tag{10'}$$

where $\alpha'_k = (\partial q_{kt}/\partial p_k)_t q_{kt}$. Taking into account that $\theta = 1$ in monopoly routes, we can identify the conduct parameter in oligopoly routes.[8] Indeed, the supply relationship can be expressed as follows:

$$p = b_0 + b_1 dist + \beta Q_m - D^M \alpha'^{(-1)} - D^{NM} \theta^{NM} \alpha'^{(-1)} + e^o{}_{kt}, \tag{11}$$

---

[8] For simplicity, subindexes k and t are omitted.

where D^M and D^{NM} are dummy variables that refer to monopoly and oligopoly routes respectively. The intercept term (c_o) in monopoly routes is $c_o^M = b_0 - \alpha'^{(-1)}$, whereas it is $c_o^{NM} = b_0$ in oligopoly routes. Hence we can obtain the following expression:

$$(12) \qquad p = c_0 + b_1 dist + \beta Q_m - D^{NM}(-\alpha'^{(-1)} + \theta^{NM}\alpha'^{(-1)}) + e^o_{kt},$$

where $c_0 = b_0 - D^M\alpha'^{(-1)}$, which can not be identified. Rearranging terms, the pricing equation can be expressed as follows:

$$(13) \qquad p = c_0 + b_1 dist + \beta Q_m + D^{NM}\gamma + e^o_{kt} \qquad \text{where} \qquad \gamma = \alpha'^{(-1)}(1-\theta^{NM})$$

The estimation of this supply relationship allows measuring the average degree of collusion in oligopoly routes. In turn, it is needed to estimate the conduct parameter differentiating between two types of markets (m) according to the opportunities of intermodal competition. Indeed, airlines behaviour can be more collusive in markets where other transport modes do not compete with air services. Thus, we differentiate between two submarkets. A submarket based on peninsular routes with a distance of less than 650 kilometres ($m = a$) and a submarket based on routes with an island as endpoint and/or routes whose distance is more than 650 kilometres ($m = b$). Thus, θ takes the following form:

$$(14) \qquad \theta \left| \begin{array}{l} \theta^M = 1 \\ \theta_a^{NM} = \theta_o \\ \theta_b^{NM} = \theta_o + \theta_1 D^{intermodal} \end{array} \right.$$

where $D^{intermodal}$ refers to a dummy variable that differentiate between both submarkets. On the other hand, it is also of interest to analyse not just the degree of market power and density economies but also the determinants of conduct and cost parameters. Indeed, airlines behaviour should depend on market structure variables, such as concentration at the route and airport level, and on market characteristic variables, such as the intensity of tourist activities. In this case, θ takes the following form:[9]

---

[9] In this case, the supply relationship is as follows: $p = c_0 + b_1 dist + \beta Q_m - D^{NM}\alpha'^{(-1)} (\theta_1 HH_{ruta} + \theta_2 HH_{aerop} + \theta_3 D^{cim})$, where $c_0 = b_0 - \alpha'^{(-1)} (D^M + D^{NM}\theta_o)$. Thus, we can not identify θ_o. Our goal here is not measuring the average degree of collusion but the influence of different market features on it.

(15) $$\theta \left| \begin{array}{l} \theta^{M} = 1 \\ \theta^{NM} = (\theta_o + \theta_1 HH + \theta_2 tour) \end{array} \right.$$

where *HH* is the concentration index of Hirschman-Herfindahl and *tour* is a variable for tourist intensity. We use two alternative measures of market concentration. Concentration in terms of the number of passengers carried in the route (HH_{route}) and concentration in terms of the number of total departures in the corresponding airport (HH_{airp}). It can be stated here an endogeneity bias as long as concentration levels depend on pricing choices of firms. However, this endogeneity bias should not be relevant for airport concentration because pricing choices refer to the route level and airport concentration refers to all the routes departing from the corresponding airport. We use data of the previous year in order to account for the possible endogeneity bias when testing the effects of route concentration. Regarding the cost function, an alternative disaggregated specification is as follows:

(5’) $$CM_{ikt} = b_k + \beta_1 fq_{ikt} + \beta_2 equip_{ikt} + \beta_3 lf_{ikt} + \delta D^{hub}{}_k$$

In this way, the number of passengers carried on a route comes from the product of service frequency (*fq*), size of the plane (*equip*) and load factor (*lf*). Additionally, the more efficient coordination of flights that Iberia (and to some extent Spanair) can obtain in Madrid airport, as its main hub, could involve lower costs in routes departing form this airport. We approximate this possible effect through the use of a dummy variable (D^{hub}) that takes value 1 in routes departing from Madrid.

We must be cautious in the interpretation of the results of this latter model because we only consider load factor as an endogenous cost variable, given that additional instruments are not available. Nevertheless, it is expected a relatively weak (if existent) endogeneity bias regarding the size of the planes and service frequency. First, there are very few types of planes that are profitable in each route according to distance. And second, service frequency depends on airport presence which, in turn, depends on the slots that an airline has in the corresponding airport. In this way, it must be taken into account that the allocation rules of slots in Europe, where the main airports are congested, are very rigid. The latter argument also works when analysing the possible endogeneity bias of airport concentration

IV. Data

The sample used in the empirical analysis includes observations for the Spanish market of regular flights in the period 2001-2002. Such sample is composed of 67 routes, with a similar number of monopoly and oligopoly routes. This group of routes represent all the routes of the Spanish market with a traffic density of more than 50,000 passengers and 55 per cent of routes with a traffic density that lies between 10,000 and 50,000 passengers. We differentiate between the summer and winter time. In this way, we include dummy variables for season (*win01*, *sum02*) in all the equations to estimate. In general terms, the structure of prices (in the full fare classes) and flight schedule of airlines vary between but not within seasons. Such inter-season variation is especially important in the Spanish case because it is a strongly tourist oriented market.

Information referred to the total number of passengers carried by airlines has been obtained from the "Boletín de la Oferta por Tramos y Mercados del Programa de Vuelos Regulares" that publishes the General Directorate of Civil Aviation (Ministry of Transport). Information referred to service frequency and aircraft size has been obtained from Official Airlines Guide (OAG) website. The round trip prices charged for each airline has been obtained from their respective website. Data on frequency, aircraft size and prices have been obtained for a sample week.

The variable population is measured by the total population in the provinces that are origin and destination of the route, according to the population census at the first of January that publishes the Statistics National Institute (INE). Data on the percentage of departures of each airline in the airports that are origin and destination of the route have been obtained from the "Anuario Estadístico de Tráfico" that publishes Spanish Airports and Air Navigation (AENA). The variable for tourist intensity has been obtained from the "Anuario Económico de España" that publishes the private financial entity "La Caixa". This variable is an index that is calculated according to the tariff share that the provinces of the route city pairs have regarding the Economic Activity Tax (IAE). The tariff of this tax includes the number of rooms and the category of tourist establishments.

It is needed to mention here an important aspect of the demand data. Such data refers to non stop services, without distinguishing between connecting and final traffic. Services with intermediate points in a market based fundamentally on short-haul routes have much higher demand inconvenience and higher costs than non stops services. However, it must be taken into account the possible network effect that arises from this type of traffic. Hence we also estimate the equation system for a subsample of routes departing from Madrid airport. This airport is the main hub of Iberia and Spanair and it is placed in the geographic centre of Spain. Thus, we can isolate the possible effect of services with intermediate points through this estimation.

In turn, our sample of routes includes a wide range of traffic densities. In this way, density economies can be exhausted for high levels of traffic density and conduct can be more collusive in thinner routes as long as entrants have more difficulties to obtain a scale of operation sufficiently high to be competitive. In order to account for these differences, we estimate the equation system for a subsample of routes with less than 200,000 passengers carried per season, which is the mean number of passengers carried in the full sample.

A special attention is needed for the fare class used to approximate the average prices charged by airlines. First, it must be said that it is not available the weighted distribution of passengers carried for the different fare classes paid. This fact could affect our results if this distribution varies substantially across routes and airlines. The use of variables that make reference to route characteristics can help in controlling for these differences. In any case, the interpretation of the results should take this possible bias into account.

In general terms, we can distinguish between three different fare classes; the lowest fare class, the (unrestricted) economy class and the business class.[10] The lowest fare class and the business class are commonly understood as a discount and mark-up on the economy class respectively, so that prices in the economy class can be considered as a reference for all fare classes. In addition, the amount of that discount and mark-up is determined on demand rather than cost features. Hence the use of prices in the economy class would seem to be suitable to approximate the mark-up that airlines try to charge on marginal costs. However, the majority of passengers obtain some discount when purchasing air fares. Thus, we use average prices in the lowest fare class and the economy class in order to have the closest available approximation to the mark-ups that airlines effectively charge on marginal costs.[11]

Table 2 show the 67 non-stop routes used in the empirical analysis. Tables 3 and 4 show the descriptive statistics and correlation matrix of the variables used in the empirical analysis.

---

[10] There is a high variability in the prices charged by airlines in the lowest fare class. In order to account for this variability, we have obtained this data in homogeneous conditions for each airline. That is, data have been collected one month before travelling, the price refers to the first trip of the week and the return is on Sunday.

[11] It must be said that estimation results are reported using the simple average of prices across airlines. There are no significant changes in case of using the weighted average of prices across airlines according to their market share.

Table 2. Sample of routes

*Oligopoly routes**	*Monopoly routes*
Madrid-Barcelona	**Madrid-Pamplona**
Madrid -Málaga	**Madrid-Granada**
Madrid-Valencia	**Madrid-San Sebastián**
Madrid-Santiago	**Madrid-Zaragoza**
Madrid-Bilbao	**Madrid-Murcia**
Madrid-Vigo	**Madrid-Almería**
Madrid-Alicante	**Madrid-Melilla**
Madrid-Sevilla	**Madrid-León**
Madrid-Oviedo	**Barcelona-Alicante**
Madrid-La Coruña	**Barcelona-Valencia**
Madrid-Jérez	**Barcelona-Oviedo**
Madrid-Santander	**Barcelona-Vigo**
Madrid-Palma de Mallorca	**Barcelona-Granada**
Madrid-Las Palmas	**Barcelona-La Coruña**
Madrid-Tenerife	**Barcelona-Almería**
Madrid-Ibiza	**Barcelona-San Sebastián**
Madrid-Lanzarote	**Barcelona-Pamplona**
Madrid-Fuerteventura	**Barcelona-Santander**
Madrid-La Palma	**Barcelona-Jerez**
Barcelona-Sevilla	**Barcelona-Valladolid**
Barcelona-Málaga	**Barcelona-León**
Barcelona-Bilbao	**Barcelona-Murcia**
Barcelona-Santiago	**Barcelona-Zaragoza**
Barcelona-Vitoria	**Valencia-Ibiza**
Barcelona-Palma de Mallorca	**Valencia-Bilbao**
Barcelona-Ibiza	**Valencia-Sevilla**
Barcelona-Menorca	**Valencia-Málaga**
Barcelona-Tenerife	**Valencia-Menorca**
Barcelona-Las Palmas	**Sevilla-Las Palmas**
Palma de Mallorca-Valencia	**Sevilla-Bilbao**
Palma de Mallorca-Alicante	**Bilbao-Santiago**
Palma de Mallorca-Málaga	
Palma de Mallorca-Bilbao	
Palma de Mallorca-Menorca	
Palma de Mallorca-Ibiza	

* Note: Oligopoly routes in at least some season of the period considered

Table 3. Descriptive statistics

Variable	Mean	Standard deviation	Minimum value	Maximum value
prices	281.63	95.82	120.84	530
demand	204,044	322,423	2,662	2,413,967
population	2,756,264	788,071	841,668	5,216,635
income	18,297	1,837	14,153	22,376
distance	650	510	131	2,190
num. competitors	1.81	0.88	1	3
D^{island}	0.31	0.46	0	1
$D^{intermodal}$	0.48	0.50	0	1
frequency	46	60	3	445
equip	106.82	42.58	50	209
load factor	0.64	0.10	0.21	0.85
HH_{route}	0.76	0.25	0.335	1
$HH_{airport}$	0.47	0.11	0.34	0.74
tourism	1.84	2.30	0.26	7.46
D^{hub}	0.42	0.49	0	1

Table 4a. Correlation Matrix (demand equation)

	demand	prices	population	income	D^{island}	D^{cim}
demand	1					
prices	-0.24	1				
population	0.16	-0.11	1			
income	0.28	-0.29	0.16	1		
D^{island}	0.1	0.09	0.14	0.28	1	
$D^{intermodal}$	-0.01	0.29	-0.06	-0.08	0.70	1

Table 4b. Correlation Matrix (pricing equation)

	demand	prices	dist.	freq.	D^{nm}	equip.	load fact.	HH_{route}	$HH_{airport}$	tour.	D^{hub}	$D^{intermod.}$
demand	1											
prices	-0.21	1										
distance	0.01	0.78	1									
frequency	0.93	-0.37	-0.14	1								
D^{nm}	0.46	-0.23	0.17	0.47	1							
equipment	0.53	0.09	0.46	0.41	0.61	1						
load factor	0.22	0.24	0.40	0.14	0.26	0.47	1					
HH_{route}	-0.50	0.11	-0.21	-0.50	0.93	-0.60	-0.28	1				
$HH_{airport}$	-0.27	0.38	0.22	-0.34	0.54	-0.28	-0.06	0.55	1			
tourism	0.22	-0.06	0.18	0.22	0.51	0.33	0.34	-0.63	-0.34	1		
D^{hub}	0.33	-0.10	0.06	0.29	0.26	0.35	0.10	-0.26	0.07	0.06	1	
$D^{intermodal}$	-0.01	0.32	0.47	-0.06	0.25	0.31	0.39	-0.32	-0.26	0.57	-0.26	1

V. Estimation and results

Our estimation procedure for identifying the conduct parameter in oligopoly routes relies on the information provided by monopoly routes. Indeed, we impose that the conduct parameter is 1 in monopoly routes. To what extent this assumption is correct?. It can be argued that competition for the market could discipline the behaviour of the monopolist firm. In order to tackle this question, we estimate a pricing equation for the subsample of Iberia’s monopoly routes through the Two Stage Least Squares (TSLQ) estimator. The variables that capture competition for the market are, first, the dummy variable that distinguishes across routes according to the possibilities of intermodal competition ($D^{intermodal}$). And second, we include a dummy variable for potential competition ($D^{potential\ comp.}$) that takes value 1 in routes where Spanair and/or Air Europa offer services in the corresponding airports of the route but not on the route. The results of the equation estimated (with the standard errors in parenthesis) are as follows[12]:

$$\begin{array}{llllllll} p_{kt} = 258.84+ & 0.17dist_k & -0.0009Q_{kt} & -2.42D^{potential\ comp.} & -22.64D^{intermodal} & -19.28win01 & +36.79sum02+ & e^{s}_{kt} \\ \quad (22.21) & (0.023)^{**} & (0.0001)^{**} & (8.30) & (16.76) & (15.86) & (36.79)^{*} & \end{array}$$

$R^2 = 0.50$
Number of observations: 96
Note: Significance at the 1% (**), 5% (*).

Our results show that variables for competition for the market are not significant. Thus, we find some evidence against the Spanish air transport market as a contestable market[13] and a weak influence of other transport modes on Iberia. We also find that density economies can be strong. Indeed, prices fall by about 2 per cent for every 10 per cent increase in route traffic.

It is needed to point out here that our finding of substantial density economies could mean that monopoly routes are natural monopolies because these routes show a low traffic density.[14] Furthermore, imposing value 1 in the conduct parameter of monopoly routes is basically correct to the extent that competition for the market does not play an important role. Additional data in the period 1997-2002 for our sample of monopoly routes also supports this argument. Indeed, there has been new entry in 3 of the 37 monopoly routes in the winter time and in 7 of the 35 monopoly routes in the summer time. New entry, which has been generally accompanied by the exit of the entrant in the following year without an apparent reaction of the monopolist, refers to one of the years of the period 1997-2002. Thus, it seems that Iberia does not need to implement an entry deterrence strategy in these routes in a context characterised by an increasing congestion of the three main Spanish airports; Madrid, Barcelona and Palma de Mallorca. Indeed, airport congestion

---

[12] Instruments for the variable of demand are population and income per capita.

[13] Empirical studies for the US air transport market also tend to reject the contestability hypothesis. See for example Graham et al. (1983), Morrison and Winston (1987), Hurdle et al. (1989) or Whinston and Collins (1992).

[14] Indeed, the mean number of passengers carried for the full sample of routes is 200,000 passengers, while it is 50,000 passengers for the subsample of monopoly routes.

along with density economies prevents entrants to develop a scale of operations sufficiently high to be competitive in thin routes.[15]

We estimate the demand and pricing equation system through the Three Stage Least Squares (3SLS) estimator. Table 5 shows the results for different models of the equation system. Table 6 shows the corresponding structural parameters that can be inferred from estimates.

---

[15] It must be said that airlines also must develop a high scale of operations in terms of quality because service frequency is the main

---

determinant of such quality.

TABLE 5a. SYSTEM EQUATION ESTIMATES (3SLQ)

	(1) Full sample (Baseline)	(2) Subsample (Madrid origin)	(3) Subsample (<200000 passengers)	(4a) Full sample (θ determinants)	(4b) Full sample (θ determinants)
Num. observations	190	79	132	190	190
Demand eq.					
prices (p)	-0.0067(0.0014)**	-0.005 (0.0021)**	-0.0037(0.0013)**	-0.0051 (0.0010)**	-0.0049 (0.0010)**
$D^{intermodal}*p$	0.0012 (0.0008)	-	0.0014 (0.0007)*	-	-
population (pop)	2.00 (0.29)**	6.61 (1.02)**	0.81 (0.23)**	2.05 (0.22)**	2.04 (0.22)**
income (inc)	-0.60 (0.89)	-0.97 (1.51)	0.57 (0.88)	-0.91 (0.90)	-0.76 (0.90)
D^{island}	1.27 (0.25)**	1.57 (0.36)**	0.73 (0.26)**	1.48 (0.19)**	1.46 (0.19)**
winter01	-0.53 (0.18)**	-0.70 (0.26)**	-0.16 (0.18)	-0.53 (0.18)**	-0.52 (0.18)**
summer02	0.13 (0.18)	0.04 (0.28)	0.13 (0.19)	0.13 (0.18)	0.11 (0.18)
Intercept	-10.71 (8.39)	-76.23 (20.82)**	-6.08 (8.34)	-8.89 (8.59)	-10.27 (8.63)
R^2	0.46	0.54	0.26	0.45	0.44
χ^2 (joint sig.)	154.84**	86.38**	40.36**	141.54**	138.68**
Pricing equation					
demand (Q_m)	-0.24e-3 (0.8e-4)**	-0.12e-3(0.4e-4)**	-0.63e-3 (0.2e-3)**	-0.24e-3 (0.7e-4)**	-0.26e-3 (0.7e-4)**
distance ($dist$)	0.15 (0.007)**	0.14 (0.009)**	0.16 (0.009)**	0.16 (0.007)**	0.15 (0.007)**
D^{nm}	-53.16 (12.68)**	-41.64 (11.48)**	-50.95 (17.51)**	-	-
$D^{intermodal}*D^{nm}$	1.28 (11.84)	-	-8.08 (19.57)	-	-
Tourism ($tour$)	-	-	-	-3.48 (1.68)*	-4.80 (1.58)**
$HH_{airport}$	-	-	-	-69.08 (17.87)**	-
HH_{route}	-	-	-	-	-58.84 (16.26)**
winter01	-25.21 (9.18)**	-26.23 (12.02)*	-21.07 (10.86)$^{+}$	-23.94 (8.74)**	-24.76 (8.79)**
summer02	19.94 (8.76)*	22.13 (11.79)$^{+}$	28.16 (11.17)*	21.83 (8.37)**	20.84 (8.48)*
Intercept	233.23 (9.92)**	214.68 (12.53)**	241.52 (18.47)**	225.35 (9.76)**	229.11 (9.73)**
R^2	0.74	0.79	0.73	0.75	0.75
χ^2 (joint sig.)	550.49**	296.68**	351.31**	557.71**	576.48**

Note 1: Standard errors in parentheses   Note 2: Significance at the 1% (**), 5% (*), 10% ($^{+}$)

TABLE 5b. SYSTEM EQUATION ESTIMATES (3SLQ)

	(5) **Full sample (Cost Determinants)**	**(6)** **Full sample (Iberia's Residual demand)**
Num. observations	190	190
Demand equation (*Q*)		
Prices (*p*)	-0.0087 (0.0013)**	-0.0066 (0.014)**
$D^{intermodal}*p$	0.0019 (0.0007)*	0.0014 (0.0008)$^{+}$
Population (*pop*)	1.97 (0.21)**	2.02 (0.21)**
Income (*inc*)	-0.51 (0.91)	-0.71 (0.89)
D^{island}	1.16 (0.26)**	0.64 (0.25)*
winter01	-0.55 (0.17)**	-0.51 (0.17)**
summer02	0.15 (0.18)	0.14 (0.17)
Intercept	-10.71 (8.50)	-10.19 (8.34)
R^2	0.45	0.46
χ^2 (joint sig.)	174.66**	140.63**
Pricing equation (*p*)		
demand (Q_m)	-	-0.3e-4 (0.1e-3)
distance (*dist*)	0.17 (0.08)**	0.14 (0.01)**
D^{nm}	-17.98 (20.90)	-34.11 (13.53)*
$D^{intermodal}*D^{nm}$	-11.15 (26.65)	0.76 (14.53)
frequency (*fq*)	-0.26 (0.09)**	-
equipment (*equip*)	-0.98 (0.28)**	-
load factor (*lf*)	259.05 (316.58)	-
D^{hub}	1.94 (9.08)	-
excess	-	-0.00018 (0.3e-3)
winter01	-13.95 (11.29)**	-27.06 (10.13)**
summer02	23.17 (10.39)*	13.50 (9.33)
Intercept	136.68 (168.41)	222.10 (10.29)**
R^2	0.71	0.69
χ^2 (joint sig.)	437.23	421.68**

Note 1: Standard errors in parentheses

Note 2: Significance at the 1% (**), 5% (*), 10% ($^{+}$)

TABLE 6. ESTIMATED STRUCTURAL PARAMETERS
(Evaluated at sample means)

	(1)	(2)	(3)	(4a)	(4b)	(5)	(6)
Demand equation							
$\eta_{\alpha(a)}$	-1.88	-1.44	-1.10	-1.45	-1.38	-2.45	-1.86
$\eta_{\alpha(b)}$	-1.55	-	-0.66	-	-	-1.91	-1.46
Pricing equation							
η_{β}	-0.08	-0.06	-0.10	-0.08	-0.08	-	-0.014
η_{dist}	0.35	0.36	0.34	0.36	0.35	0.37	0.33
θ_a	0.64	0.77	0.81	-	-	0.84	0.78
θ_b	0.70	-	0.87	-	-	0.80	0.83
Test $\theta_a = \theta_b$	0.61	-	0.56	-	-	0.04	0.35
tour (θ_2)	-	-	-	0.017*	0.023**	-	-
$HH_{airp}^{nm}(\theta_1)$	-	-	-	0.36**	-	-	-
$HH_{route}^{nm}(\theta_1)$	-	-	-	-	0.28**	-	-
Test *Cournot* (θ_a)	5.73*	13.52**	20.84**	-	-	6.56*	15.29**
Test Collusion (θ_a)	10.37**	4.63*	4.03*	-	-	0.76	4.89*
Test *Cournot* (θ_b)	23.21**	-	54.76**	-	-	19.19**	24.36**
Test Collusion (θ_b)	16.94**	-	3.99*	-	-	4.25*	3.59^{+}

Note 1: η_{α}: Price elasticity of demand. η_{β}: Price elasticity with respect to traffic. η_{dist}: Price elasticity with respect to distance.
Note 2: Subindex *a* refers to the submarket based on peninsular routes where distance is less than 650 kilometres, whereas subindex *b* refers to the submarket based on routes with an island as an endpoint and/or routes where distance is more than 650 kilometres. In model (2) subindex *a* refers to the whole market
Note 3: *Cournot* test; $\theta = 0.38$ (which is the inverse of the mean number of competitors in oligopoly routes). Collusion test; $\theta = 1$
Note 4: Significance at the 1% (**), 5% (*),10% ($^{+}$)

In model (1), we estimate the equation system for the full sample of routes. All the explanatory variables have the expected signs, except the variable for income per capita that is not significant. Price elasticity of demand lies between -1.88 and -1.55. This result is consistent with previous studies, taking into account that we are not able to separate in an appropriate way leisure and business passengers.[16] We find evidence of decreasing marginal costs. In this way, an increase in the mean number of passengers carried in the amount of the sample standard deviation would involve that average prices fall by about 25 euros. Although this price reduction seems to be small, it must be said that this is a conservative measure of density economies. Indeed, we are not able to capture how fixed costs are shared between more units of output and so our results indicate that density economies can be substantial. In turn, we also find evidence of distance economies so that costs increase less than proportionally to the kilometres flown. The elasticity estimated is 0.35 that is similar to the result obtained in Brueckner and Spiller (1994) but lower than the estimates in Oum et al. (1993). The conduct parameter estimates, which is larger than 0.60, shows that market power of Spanish airlines is strong. In particular, their behaviour is less competitive than predicted by a *Cournot* model but more competitive than the joint profit maximization case. We do not find significant differences between the two submarkets considered so that opportunities of intermodal competition do not seem influence airlines behaviour.

In model (2), we estimate the equation system for a subsample of routes with origin in Madrid airport [17] in order to identify any network effect that could distortion results in model (1). Although results are not substantially different to model (1), conduct seems to be slightly more collusive for this subsample of routes. A possible explanation of this result is that Iberia can charge higher mark-ups in routes departing from its main hub and rivals take advantage of it.

In model (3), we estimate the equation system for a subsample of routes with less than 200,000 passengers in order to analyse if low traffic density routes have different conduct and cost parameters. The fare reduction from an increase in route traffic is slightly larger than in model (1) and conduct is much more collusive. However, we reject the joint profit maximization hypothesis.

In model (4), we estimate the equation system including market specific variables in the pricing equation as possible determinants of airlines behaviour. We find that conduct is slightly more collusive in tourist oriented routes. This result could be explained by the fact that most tourist routes have an island as an endpoint, taking into account that we do not control for price elasticity in this model. We also find that measures of market concentration, both at the airport and route level, influence to great extent airlines conduct. Given that market shares at the route level are fundamentally determined by airport presence, it can be claimed that concentration at the airport level is the main determinant of airlines behaviour.

In model (5), we estimate the equation system including different cost variables in the pricing equation. We find that bigger planes influences to greater extent than a higher service frequency in the cost reducing effect that arises from providing additional capacity. However, it is needed to point out the fact that a high service frequency (which depends fundamentally on airport presence)

---

[16] See Oum et al. (1992).

[17] We do not differentiate between submarkets according to the opportunities of intermodal competition because the number of observations is scarce.

has a cost reducing effect because it is a major determinant of service quality. The variables for load factor and the hub effect are not significant.[18]

In the aggregation process of the individual equilibrium conditions, we make the assumption of symmetry across airlines. In model (6), we use exclusively data of Iberia in order to estimate the (inverse) demand function of Iberia through a similar procedure as it is developed in Baker and Bresnahan (1988).[19] The residual demand function is understood as the relationship between prices and output of a firm, given the possible reaction of rivals. In our model, this function can be estimated including a variable for excess of capacity (*excess*), which is the difference between the supply of seats and the number of passengers carried by Spanair and Air Europa. This variable shows a high correlation with the variable for Iberia's demand, which explains that both variables are not significant. However, the main interest of this model is to estimate the conduct parameter. We find that conduct of Iberia is more collusive than the average of Spanish airlines. In fact, Iberia's behaviour is near to the joint profit maximization hypothesis.[20]

In short, Iberia's dominance of a market much thinner than the US market can explain that our results differ from those obtained in previous studies. In this way, it is sensible to claim that Iberia is the airline that really has market power, while rivals behave as followers. The excellent financial performance of Iberia since 1999 also could support this argument.

VI. Concluding remarks

In this paper, we analyse Spanish airlines behaviour in monopoly and oligopoly strategic scenarios. In this way, we make a simultaneous estimation of demand and pricing equations, using the cost and demand information that provides a representative sample of routes.

We find evidence that conduct of Spanish airlines in oligopoly routes is less competitive than predicted by a *Cournot* model. In addition to this, airport concentration arises as the main determinant of airlines mark-ups. The results of our analysis also show that density economies are substantial. Thus, routes with a low traffic density can be considered as natural monopolies. Furthermore, the two main forms of competition for the market in the air transport industry, potential competition or intermodal competition, does not seem to impose a disciplining effect on airlines behaviour.

---

[18] It must be said that airlines normally operate with an average load factor that lies between 60 and 70 per cent. High load factors reduce average costs but at the same time reduce the probability of capturing last minute travellers who are price insensitive.

[19] Given that our conduct parameter identification is based on the information provided by monopoly routes, we are not able to identify it for Spanair and Air Europa. Spanair does not offer exclusively services in any route and Air Europa has the monopoly in a reduced group of routes characterised by a very low and fluctuating traffic. We consider that it would be biased to identify the conduct parameter for Spanair and Air Europa using data of Iberia's monopoly routes.

[20] It must be taken into account that we make the implicit assumption $b_0^{NM} = b_0^{M}$ in previous estimates (eg; the intercept term of the marginal cost function is equal in oligopoly and monopoly routes). This assumption could involve an underestimation of market power in oligopoly routes to the extent that $b_0^{NM} < b_0^{M}$.

The result that conduct of Spanish airlines is not generally competitive can be surprising. In fact, travellers that purchase air tickets in advance can obtain significant discounts. We argue that airlines, particularly entrants in the post-liberalisation period, operate with capacity constraints due to the limits that airport access imposes. Nevertheless, service frequency is a crucial competition variable in a context with fluctuating demand, so that airlines usually operate with excess of capacity. This fact explains that airlines charge reduced prices in the first seats that sell of a particular flight. Indeed, they need to obtain load factors that make profitable their services in the corresponding route.

The argument that airlines operate with capacity constraints along with excess of capacity seems to be a contradiction. The main point here is that rigidities in the allocation (and expansion) of space in airports prevent that rivals of the largest airline can increase substantially their capacity. Thus, it is not rational for them to be involved in some form of war prices when the best possible outcome would be selling its capacity, in any case limited, to lower prices. What is really relevant is that just the largest airline can absorb a high proportion of demand. However, this argument depends on the relationship between demand and capacity. In particular, it depends on the degree of airport congestion. In the Spanish case, recent forecasts for the main airports predict an important traffic increase for the period 2000-2015. In this way, it is planned to double the capacity of the main airports of the Spanish network and, therefore, competition conditions can change in this market.

A well known result in the industrial organization literature is that oligopoly competition in markets characterised by capacity constraints leads to *Cournot* outcomes. In fact, previous empirical studies about air transport competition find that, on average, airlines compete *à la Cournot*. However, the most frequent oligopoly setting in those studies is a symmetric duopoly. Deneckere y Kovenock (1992) show that oligopoly competition in a market with capacity constraints but with a natural leader in prices can lead to an equilibrium less competitive than the *Cournot* solution. Our findings could be capturing the prediction of the model of Deneckere and Kovenock.

The existence of a natural monopoly in thin routes along with a conduct generally not competitive of airlines could justify economic regulation in the former case and a more proactive competition policy in the latter case. Regardless the suitability of these two policy measures, we claim that the improvement of competition conditions in the Spanish market requires fundamentally a more balanced allocation of the airport slots. In turn, given that a high proportion of monopoly routes are short-haul routes it is desirable to promote intermodal competition.

VII. References

- Baker, J. B. and T. F. Bresnahan, (1988), "Estimating the residual demand curve facing a single firm", *International Journal of Industrial Organization*, 6 (3), pp. 283-300.

- Baumol, W. J., J.C Panzar and R.D. Willig (1982), *Contestable markets and the theory of industrial structure* (Harcourt Brace Jovanovich, New York).
- Berry, S., M. Carnall, and P. Spiller, (1996), “Airline hubs: costs, markups and the implications of customer heterogeneity”, *NBER Working Paper*, 5561, pp. 1-38.
- Borenstein, S. (1989), “Hubs and high fares: dominance and market power in the U.S airline”, *Rand Journal of Economics*, 20 (3), pp. 344-365.
- Braeutigam, R.R. (1989), “Optimal policies for natural monopolies”, en R.Schamalensee y R.D. Willig, eds, *Handbook of Industrial Organization*, Vol.2, (North Holland, New York)
- Brander, J. A and A. Zhang (1993), "Dynamic oligopoly behaviour in the airline industry", *International Journal of Industrial Organization,* 11(3), pp. 407-433.
- Brander, J.A and A. Zhang (1990), “A market conduct in the airline industry: An empirical investigation”, *Rand Journal of Economics*, 21(4), pp. 567-583.
- Bresnahan, T. F. (1989), “Empirical studies in industries with market power” en R. Schmalensee and R. D. Willig (eds.), *Handbook of Industrial Organization*, (North Holland, New York)
- Brueckner, J.K and P. Spiller, (1994), “Economies of traffic density in the deregulated airline industry”, *Journal of Law and Economics,* vol. 37, pp.379-415.
- Brueckner, J.K., N.Dyer and P. Spiller, (1992), ‘Fare determination in airline hub-and-spoke networks’, *Rand Journal of Economics,* 23 (3), pp. 309-333.
- Caves, D.W, L.R. Christensen and M.W. Tretheway (1984), “Economies of density versus Economies of Scale: Why trunk and locals service airline costs differ”, *Rand Journal of Economics*, vol. 15(4), pp. 471-489.
- Clay, K. and W. Troesken (2003), "Further tests of static oligopoly models: Whiskey, 1882-1898", The *Journal of Industrial Economics*, 51(2), pp. 151-166.
- Corts, K. S. (1999), “Conduct parameters and the measurement of market power”, *Journal of Econometrics*, 88 (2), pp. 227-250.
- Deneckere, R. J. and D. Kovenock (1992), “Price leadership”, *Review of Economic Studies*, 59 (1), pp. 143-162.
- Evans, W.N. and I. Kessides, (1993), “Localized market power in the U.S. airline industry”, *The Review of Economics and Statistics,* 75 (1), pp. 66-75.
- Fisher, T. and D.R. Kamerschen (2003), “Price-cost margins in the U.S airline industry using a conjectural variation approach”, *Journal of Transport Economics and Policy*, 37 (2), 227-259.
- Genesove, D. and W.P. Mullin (1998), “Testing static oligopoly models: conduct and cost in the sugar industry, 1890-1914”, *Rand Journal of Economics,* 29 (2), pp. 355-377.

- Graham, D.R, D.P. Kaplan and D.S. Sibley (1983), “Efficiency and competition in the airline industry”, *Bell Journal of Economics*, 14 (1), pp. 118-138.
- Hurdle, G., R. L. Johnson, A. S. Joskow, G. J. Werden and M. A. (1989), “Concentration, potential entry, and performance in the airline industry”, *The Journal of Industrial Economics*, 38 (2), pp. 119-139.
- Kreps, D. and J. Scheinkman (1983), “Quantity precommitment and Bertrand competition yield Cournot outcomes”, *Bell Journal of Economics*, 14 (2), pp. 326-337.
- Marin, P.L. (1995), “Competition in European Aviation: Pricing policy and market structure”, *The Journal of Industrial Economics*, 43 (2), pp. 141-159.
- Morrison, S. and C. Winston (1987), “Empirical implications and tests of the contestability hypothesis”, *Journal of Law & Economics*, 30, pp. 53-66.
- Parker, P. M. and L.H. Roller (1997), “Collusive conduct in duopolies: multimarket contact and cross-ownership in the mobile telephone industry”, *Rand Journal of Economics,* 28 (2), pp. 304-322.
- Roller, L. H. y R. C. Sickles (2000), “Capacity and product market competition: measuring market power in a ·puppy-dog· industry”, *International Journal of Industrial Organization*, 18 (6), pp. 845-865.
- Oum, T.H, W.G. Waters and Y.J Say (1992), “Concepts of price elasticities of transport demand and Recent empirical estimates”, *Journal of Transport Economics and Policy,* 26 (2), pp. 139-154.
- Oum,T.H, A. Zhang and Y. Zhang (1993). “Interfirm rivalry and firm-specific price elasticities in deregulated airline markets”, *Journal of Transports Economic and Policy***,** 27 (2), pp. 171-192.
- Whinston, M. and S.C. Collins (1992), “Entry and competitive structure in deregulated airline markets: an event study analysis of People Express”, *Rand Journal of Economics,* 23 (4), pp. 445-462.
- Williams, G. (2003), *Airline competition: Deregulation’s mixed legacy* (Ashgate, London).