ON THE OPTIMAL DISTRIBUTION OF TRAFFIC OF NETWORK AILINES

XAVIER FAGEDA
RICARDO FLORES-FILLOL

FUNDACIÓN DE LAS CAJAS DE AHORROS
DOCUMENTO DE TRABAJO
Nº 628/2011

De conformidad con la base quinta de la convocatoria del Programa de Estímulo a la Investigación, este trabajo ha sido sometido a evaluación externa anónima de especialistas cualificados a fin de contrastar su nivel técnico.

ISSN: 1988-8767

La serie **DOCUMENTOS DE TRABAJO** incluye avances y resultados de investigaciones dentro de los programas de la Fundación de las Cajas de Ahorros.
Las opiniones son responsabilidad de los autores.

ON THE OPTIMAL DISTRIBUTION OF TRAFFIC OF NETWORK AILINES

Xavier Fageda*

Ricardo Flores-Fillol**

Abstract

Network airlines have increasingly focused their operations on hub airports through the exploitation of connecting traffic. However, in this paper we show that they may also have incentives to divert traffic away from their hubs. More precisely, we examine how the optimal distribution of traffic of network carriers can be affected by the two major recent innovations in the airline industry: the regional jet technology and the low-cost business model. On the one hand, we show that a network airline may find it profitable to serve thin point-to-point routes with regional jets when the distance between endpoints is sufficiently short and there is a high proportion of business travelers. On the other hand, we observe that a network airline may be interested in serving thin point-to-point routes by means of a low-cost subsidiary when the distance between endpoints is longer and there is a high proportion of leisure travelers. We conclude that network airlines are using those innovations to provide services on thin routes out of the hubs.

Keywords: regional jet technology; low-cost business model; point-to-point network; hub-and-spoke network.

JEL classification: L13; L2; L93

Corresponding author: Ricardo Flores-Fillol, Dep. d'Economia, Universitat Rovira i Virgili, Avinguda de la Universitat 1, 43204 Reus, Spain.
E-email: ricardo.flores@urv.cat.

* Dep. de Política Econòmica, Universitat de Barcelona.
** Dep.d'Economia, Universitat Rovira i Virgili.

Acknowledgements: The authors acknowledge financial support from the Spanish Ministry of Science and Innovation (ECO2010-19733, ECO2010-17113 and ECO2009-06946/ECON), Generalitat de Catalunya (2009SGR900 and 2009SGR1066) and Ramón Areces Foundation.

1 Introduction

The air transportation industry has witnessed a number of changes since the deregulation of the sector during the 1980s in the US and during the 1990s in Europe. These changes include, among others, the reorganization of routes into hub-and-spoke (HS) networks and the irruption of both regional jet aircraft and low-cost connections.

Network airlines have increasingly focused their operations on hub airports through the exploitation of connecting traffic, which has allowed them to take advantage of the economies of traffic density that characterize the airline industry. Several papers have examined optimal choices of airlines in HS networks. Less attention has been devoted to decisions of network airlines on thin point-to-point (PP) routes, which are those connecting two non-hub airports. PP routes can be served using different aircraft technologies (i.e., turboprops, regional jets and mainline jets) and different business models (i.e., using either the main brand or a low-cost subsidiary).

This paper examines the influence of two major innovations in the distribution of traffic of network airlines. First, the emergence of regional jets constitutes an important technological innovation because these aircraft can provide high-frequency services on longer routes than turboprops. Second, the emergence of a low-cost business model represents an important managerial innovation, making it possible to offer seats at lower fares (with lower flight frequency). With the adoption of these innovations, we investigate whether network airlines may have more incentives to provide services out of the hub.

By means of a theoretical model based on certain empirical facts, we analyze the strategic decision of a network carrier in a position to set up a new PP connection instead of serving this market through a hub airport. The model studies the optimal traffic division when either a regional jet technology or a low-cost business model becomes available. If a regional jet technology is available, when would the airline decide to offer a new regional jet connection? Equivalently, when would the airline decide to establish a new low-cost PP connection (for instance by means of a subsidiary low-cost carrier)? The theoretical model predicts that a network airline may find it profitable to offer services on thin PP routes with regional jets for sufficiently short distances. This service would be aimed at business travelers, since the smaller size of regional jet aircraft may allow airlines to increase service quality (i.e., flight frequency) at higher fares. Additionally, a network airline may find it profitable to provide flights on thin PP routes with a low-cost subsidiary for longer distances to serve leisure travelers who are more fare-sensitive.

To illustrate the predictions of our theoretical model, we elaborate an empirical application with data of the major network airlines in the United States (US) and the European Union (EU). This empirical exercise complements the theoretical model with the analysis of route features that determine airline choices of aircraft and business model.[1]

Our analysis suggests that network airlines may have incentives to divert traffic away from their hubs by making use of either regional aircraft or low-cost subsidiaries. This phenomenon can act as a brake on the *hubbing* network strategy followed by major airlines since the deregulation of the sector, and it has important implications at the regional level.[2] In addition, the empirical application shows that route distance determines the type of aircraft used, and that regional jets are widely used on thin PP routes with a high proportion of business travelers. Finally, European network airlines tend to use low-cost subsidiaries on thin and relatively long PP routes with a high proportion of leisure travelers.

Some previous papers have analyzed airlines' network structure: Brueckner (2004) focuses on the monopoly case, Flores-Fillol (2009) extends this analysis to a duopoly setting, and Barla and Constantatos (2005) examine the effect of capacity decisions under demand uncertainty on network structure.[3] However, even though the research question raised in this paper seems especially relevant, previous studies have not approached the issue taking into account both regional jet and low-cost connections. Bilotkach (2009) endogenizes market segmentation between non-stop and one-stop services, which depends on the the cost savings due to the through-hub service relative to exogenous quality difference between the one-stop and non-stop flights. Brueckner and Pai (2009) argue that regional jets may have important advantages over mainline jets and turboprops: compared with mainline jets, they have smaller capacity with a relatively long range and similar cruising speed and comfort and, compared with turboprops, they have similarly small capacity but longer range, more comfort, and less noise. These advantages may be important in the development of services on thin PP routes that are too long for turboprops and too thin to obtain commercially viable frequency with

[1] The aim of the empirical application is not to make a comparison between the US and the EU markets, which could be the subject of an entirely new paper.

[2] The International Civil Aviation Organization (ICAO) estimates that about 4.5% of the world GDP may be attributed to air transportation and its effects upon industries providing either aviation-specific inputs or consumer products. In simple terms, every US $100 of output produced and every 100 jobs created by air transportation trigger additional demand of US $325, and in turn 610 jobs in other industries (information from the ICAO circular 292-AT/124, 2004).

[3] From a different perspective, Basso and Jara-Díaz (2005 and 2006) study the implications of network structure on aggregate costs.

mainline jets. Testing what they called the "new route hypothesis" through an analysis of data on new routes started by four major US carriers since 1996, Brueckner and Pai (2009) find no empirical evidence for it and conclude that regional jets are mostly used to feed hubs. Similarly, studying the case of Continental Airlines (focusing on its hubs in Cleveland and Houston), Dresner *et al.* (2002) find that regional jets are mainly used on new HS routes (longer than routes served with turboprops), and appear to increase demand on denser routes where they replace turboprops. Regarding the provision of air services by low-cost carriers, the existing literature finds that entry is more likely to occur on dense routes (Bogulaski *et al.*, 2004; Gil-Moltó and Piga, 2008). Our contribution consists in showing the impact of recent innovations on the distribution of traffic of network airlines. More precisely, in contrast to the previous literature, we find that network airlines make use of regional aircraft and low-cost subsidiaries to provide services on thin PP routes.

The plan of the paper is as follows. Some descriptive data on PP routes operated by the main American and European network airlines are provided in Section 2. Then, a theoretical model analyzing the optimal traffic division in a simple network is presented in Section 3. Section 4 uses data of selected carriers to illustrate some of the theoretical results. For readers uninterested in this empirical illustration, this section can be skipped without loss of continuity. Finally, a brief conclusion closes the paper. All the proofs are provided in Appendix *A*.

2 Some descriptive data on PP routes

We use data on American and European routes during 2009. This dataset includes the distance of each route and distinguishes between hub-and-spoke routes (i.e., HS routes) and spoke-to-spoke routes (i.e., PP routes). Overall, the total number of observations in our sample (at the airline-route level) is 5031 for US carriers, and 1033 for EU airlines. Section 4 provides a thorough explanation of the data and the sources of information used in the econometric application.

Focusing on PP routes, Figs. 1 and 2 below show histograms of the distance variable for the US and the EU respectively. More precisely, we observe that the number of PP routes operated by US network carriers is high for routes up to 1200 miles, whereas the number of PP routes operated by EU network carriers is relatively high for routes up to 600 miles. It must be taken into account that the number of observations for EU airlines is lower than that of US airlines and that the mean route distance is much longer in US. Hence, we must use different categories of distance when analyzing which type of airlines are responsible for the

high number of PP routes in those distance ranges. Note also that US network carriers did not have any LC subsidiaries in 2009.

Fig. 1: Histogram of the variable of distance (PP routes – US)

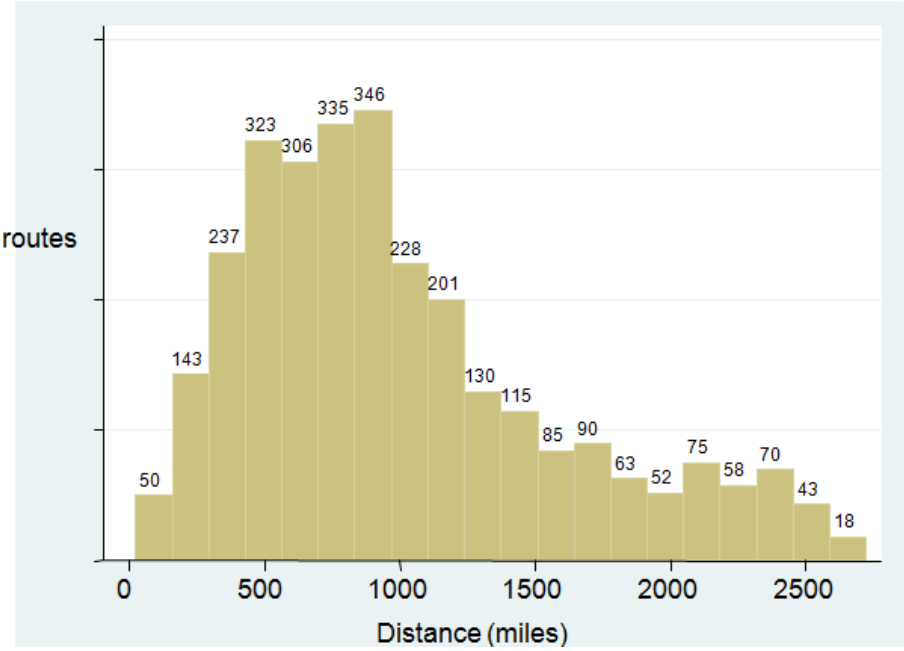


Fig. 2: Histogram of the variable of distance (PP routes – EU)

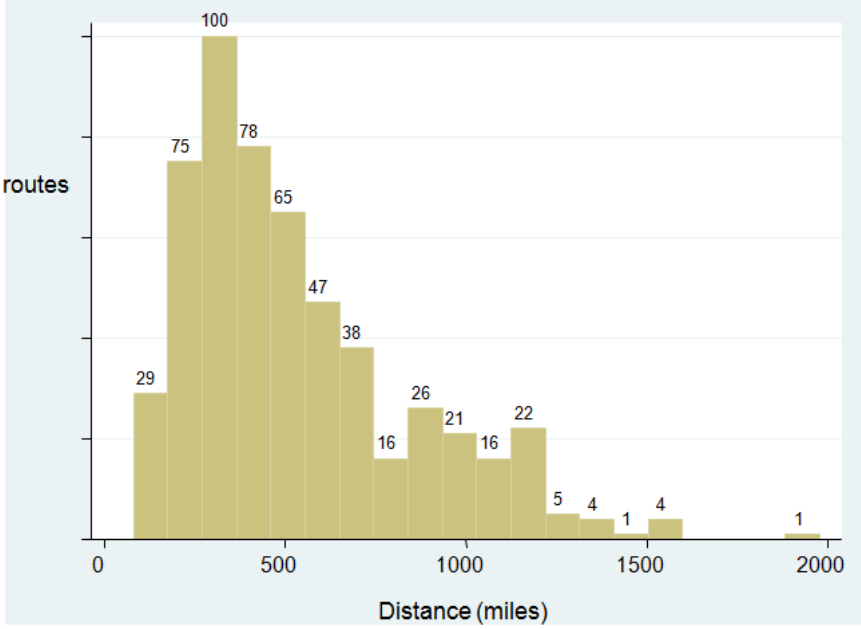
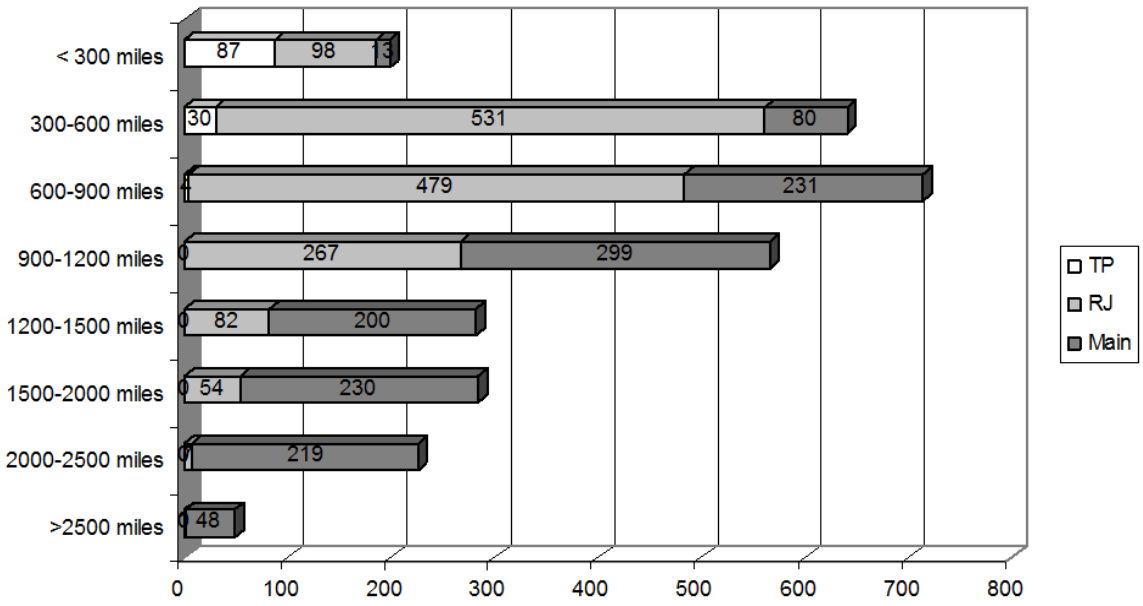


Fig. 3 below shows that regional aircraft are the type most used by the main American network carriers up to a route distance of 900 miles. In fact, US major airlines mainly serve PP routes in the distance range 300-900 miles with RJs, and RJs are still widely used on routes in the distance range 900-1200 miles. Turboprops are widely used on routes shorter than 300 miles. Mainline jets are obviously the dominant type of aircraft on routes longer than 1200 miles. The upshot of this exploratory examination of data is that the high number of PP routes in the distance range of 300-1200 (and particularly in the distance range 300-900 miles), may be related to the advantages that US network airlines have gained from using RJs.

Fig. 3: Aircraft technology by distance (PP routes - US)



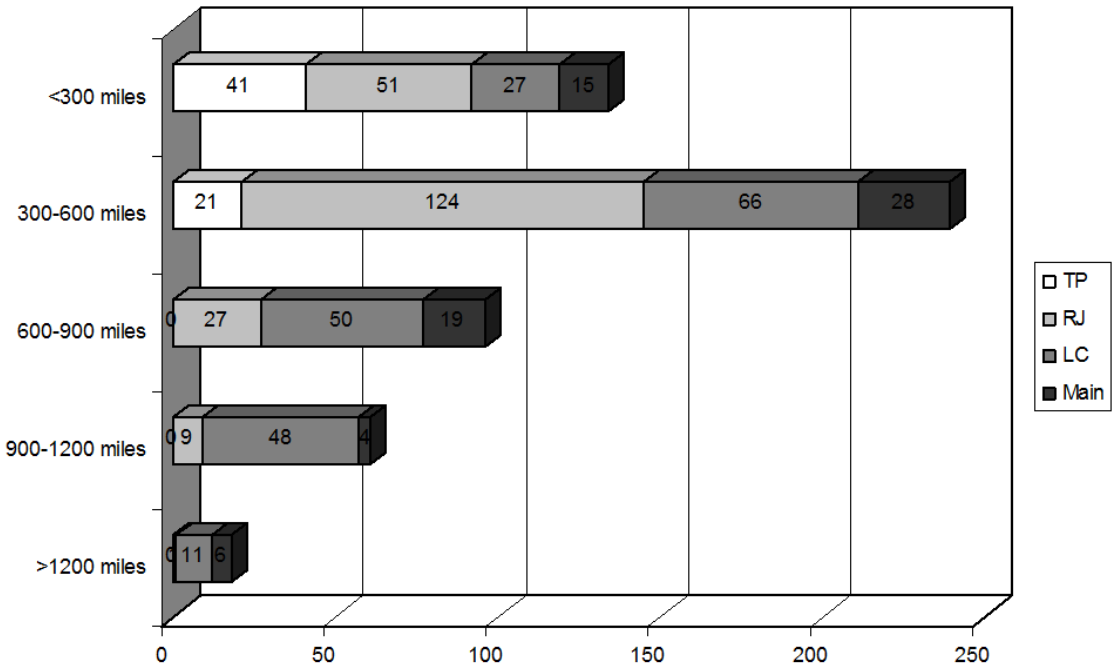
Note 1: Data refer to the number of routes where each considered type of aircraft is dominant.

Note 2: TP are turboprops, RJ are regional jets and Main are mainline jets.

Finally, Fig. 4 shows that RJs are the aircraft most frequently used by the main European network carriers up to a route distance of 600 miles, especially the distance range 300-600 miles. Turboprops are also widely used on routes shorter than 300 miles. Interestingly, the use of mainline jets with a LC subsidiary is the dominant model on routes longer than 600 miles. Thus, these data provide some evidence that the relatively high number of PP routes in the

distance range 300-600 miles has to do with the use of RJs. Furthermore, the viability of PP routes on routes longer than 600 miles seems to be associated (in many cases) with the use of LC subsidiaries.

Fig.4: Aircraft technology and business model by distance (PP routes - EU)



Note 1: Data refer to the number of routes where each considered type of aircraft and business model is dominant.

Note 2: TP are turboprops, RJ are regional jets, LC are mainline jets with a low-cost subsidiary and Main are mainline jets with the main brand.

Both the theoretical analysis and the empirical application below explore this evidence further, with the purpose of understanding the impact of the RJ technology and the LC business model on the distribution of traffic of network airlines.

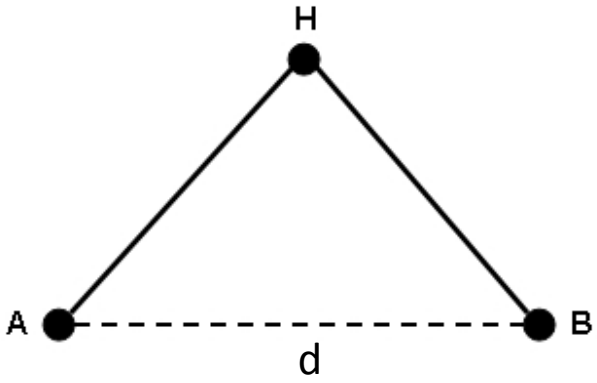
3 The model

We consider a monopoly model based on the analysis of Brueckner and Pai (2009) to study the impact of regional jet aircraft. The main novelties of our analysis are: the extension of

the model to consider new low-cost PP connections, the explicit consideration of PP routes as thin routes, and the introduction of the distance between endpoints as an important element conditioning airlines' choices. As explained below, following Bilotkach *et al.* (2010), route distance is introduced in the model by means of a distance-dependent cost function. Since network airlines use different aircraft and business models depending on the characteristics of each city-pair market (and route distance is an important element), we identify the optimal network choice for different distance ranges. This also provides us with some predictions to test in the econometric application in Section 4.

We assume the simplest possible network with three cities (A, B and H) and three city-pair markets (AH, BH and AB) as shown in Fig. 5.[4]

Fig. 5: Network



AH and BH are "local" markets, which are always served nonstop, and market AB can be served either directly or indirectly with a one-stop trip via hub H, depending on the airline's network choice. The distance of routes AH and BH is assumed to be constant and equal to 1, whereas the distance of route AB is given by d, with $d \in (0, \infty)$. The magnitude of d is an important factor influencing the airline's network choice.

As in Brueckner (2004), utility for a consumer traveling by air is given by *consumption* + *travel benefit*− *schedule delay disutility*. *Consumption* is $y-p$ where y denotes income and p is the airline's fare. *Travel benefit* is denoted by b. Letting T denote the time circumference of the circle, consumer utility then depends on expected schedule delay (defined as the difference

[4]The same network is considered in Oum *et al.* (1995), Brueckner (2004), Flores-Fillol (2009), and Brueckner and Pai (2009) since it is the simplest possible structure allowing for comparisons between hub-and-spoke (HS) and fully-connected (FC) configurations.

between the preferred and actual departure times), which equals $T/4f$, where f is number of (evenly spaced) flights operated by the airline. The *schedule delay disutility* is equal to a disutility parameter $\delta > 0$ times the expected schedule delay expression from above, thus equaling $\delta T/4f = \gamma/f$, where $\gamma \equiv \delta T/4$. Hence, utility from air travel is $u_{air} = y - p + b - \gamma/f$.

As in Brueckner and Pai (2009), we assume that the network airline is a perfectly discriminating monopolist able to extract all surplus from the consumer. Letting u_o denote the utility of the outside option (which might represent an alternative transport mode such as automobile, train or ship or not traveling at all), surplus extraction implies $u_{air} = u_o$ and thus $p = z - \gamma/f$, where $z \equiv y + b - u_o$ is constant. Note that an increase in f reduces the *schedule delay disutility*, allowing the airline to raise p. Additionally, we suppose that connecting passengers incur an extra time cost at the hub. Let us denote this layover time disutility by μ, which enters as a negative shift factor in the utility of connecting passengers since they dislike waiting, and thus $p = z - \mu - \gamma/f$ for connecting passengers.

To address the question at hand, this setup is expanded to admit two types of consumers: H-types (business travelers) and L-types (leisure travelers). With respect to the L-types, the H-types have higher income, higher layover-time disutility and a stronger aversion to schedule delay, i.e., $z_H > z_L$, $\mu_H > \mu_L$ and $\gamma_H > \gamma_L$.

Fares charged by the perfectly discriminating monopolist to AB passengers depend on their type and routing. Denoting d and c superscripts direct and connecting services, AB fares are

$$p_H^d = z_H - \gamma_H/f^d, \tag{1}$$

$$p_H^c = z_H - \mu_H - \gamma_H/f^c, \tag{2}$$

$$p_L^d = z_L - \gamma_L/f^d, \tag{3}$$

$$p_L^c = z_L - \mu_L - \gamma_L/f^c, \tag{4}$$

where f^d and f^c are the flight frequencies for the two routings,[5] and type-H fares respond more than type-L to changes in flight frequency since $\gamma_H > \gamma_L$.

Turning our attention to local passengers in markets AH and BH, we assume that there is a share λ of type-H passengers and a share $1 - \lambda$ of type-L passengers. Therefore

$$\widetilde{p} = \widetilde{z} - \widetilde{\gamma}/f^c, \tag{5}$$

[5] As argued in Flores-Fillol (2010), connecting passengers care about schedule delay on both routes and thus the relevant frequency for these passengers is $min\{f_{AH}^c, f_{BH}^c\}$. In the symmetrical case $f_{AH}^c = f_{BH}^c = f^c$, the *schedule delay disutility* is equal to γ_H/f^c for H-types and γ_L/f^c for L-types.

with $\widetilde{z} = \lambda z_H + (1-\lambda)\, z_L$ and $\widetilde{\gamma} = \lambda \gamma_H + (1-\lambda)\, \gamma_L$.

Passenger population size in market AB is normalized to unity, whereas population in markets AH and BH is given by N, with $N > 1$ since local spoke-to-hub markets (and hub-to-spoke markets) are normally denser than spoke-to-spoke markets. Thus, the route AB can be considered as a thin route, and we will study the profitability of new PP air services on this route. In market AB, we assume that there is a share δ of type-H passengers and a share $1-\delta$ of type-L passengers. Further, the shares of H-types and L-types flying direct are θ_H and θ_L, respectively. Therefore the direct traffic on route AB and the connecting traffic on routes AH and BH are given by

$$q^d = \delta\theta_H + (1-\delta)\theta_L, \tag{6}$$

$$q^c = N + 1 - q^d. \tag{7}$$

Naturally, as θ_H and/or θ_L increase, q^d also increases while q^c decreases. The number of flight departures on route AB is given by $f^d = q^d/n^d$, where n^d is the *number of passengers per flight* on route AB. Both aircraft size and load factor determine the number of passengers per flight, which is given by $n^d = l^d s^d$, where s^d stands for aircraft size and $l^d \in [0,1]$ for load factor. Equivalently, flight frequency on routes AH and BH is $f^c = q^c/n^c$, with $n^c = l^c s^c$ being the number of passengers per flight on each of these routes.[6]

Substituting these expressions for f on Eqs. (1)-(5), revenue is

$$\begin{aligned} R \;=\; & \underbrace{2N\left(\widetilde{z} - \frac{\widetilde{\gamma} n^c}{q^c}\right)}_{local} + \underbrace{\theta_H \delta \left(z_H - \frac{\gamma_H n^d}{q^d}\right)}_{direct\ H\text{-}types} + \underbrace{\theta_L(1-\delta)\left(z_L - \frac{\gamma_L n^d}{q^d}\right)}_{direct\ L\text{-}types} + \\ & \underbrace{+(1-\theta_H)\delta\left(z_H - \frac{\gamma_H n^c}{q^c}\right)}_{connecting\ H\text{-}types} + \underbrace{(1-\theta_L)(1-\delta)\left(z_L - \frac{\gamma_L n^c}{q^c}\right)}_{connecting\ L\text{-}types}, \end{aligned} \tag{8}$$

where the 2 factor arises because there are two local markets, i.e., AH and BH.

Similarly to Bilotkach *et al.* (2010), a *flight's operating cost* on route AB is given by $\omega(d) + \tau^d n^d$, where the parameter τ^d is the marginal cost per seat of serving the passenger on the ground and in the air, and the function $\omega(d)$ stands for the cost of frequency (or cost per departure), which captures the aircraft fixed cost (including landing and navigation fees, renting gates, airport maintenance and the cost of fuel). The function $\omega(d)$ is assumed to be continuously differentiable with respect to $d > 0$ with $\omega'(d) > 0$ because fuel consumption

[6] We extend the approach in the existing literature, which typically assumes 100% load factor (see Brueckner, 2004; Flores-Fillol, 2009; Brueckner and Pai, 2009; Flores-Fillol, 2010; and Bilotkach *et al.*, 2010).

increases with distance. Note that cost per passenger, which can be written $\omega(d)/n^d + \tau^d$, visibly decreases with n^d capturing the presence of economies of traffic density (i.e., economies from serving a larger number of passengers on a certain route), the existence of which is beyond dispute in the airline industry.[7] In other words, having a larger traffic density on a certain route reduces the impact on the cost associated with higher frequency. Further, to generate determinate results, $\omega(d)$ is assumed to be linear, i.e., $\omega(d) = \omega d$ with a positive marginal cost per departure $\omega > 0$.[8] Therefore, the airline's total cost from operating on route AB is $C^d = f^d\left[\omega d + \tau n^d\right]$ and, using $f^d = q^d/n^d$, we obtain $C^d = q^d\left(\frac{\omega d}{n^d} + \tau^d\right)$. Proceeding analogously for routes AH and BH, we obtain $C^c = q^c\left(\frac{\omega}{n^c} + \tau^c\right)$ since distance of routes AH and BH is assumed to be constant and equal to 1. Therefore, the *airline's total cost* from operating all routes is

$$C = \underbrace{2q^c\left(\frac{\omega}{n^c} + \tau^c\right)}_{C^c} + \underbrace{q^d\left(\frac{\omega d}{n^d} + \tau^d\right)}_{C^d}. \tag{9}$$

Quite naturally, as d increases and the triangle in Fig. 5 flattens, direct connections between cities A and B become less profitable. The airline's objective is to maximize profits, which are given by $\pi = R - C$.

As in Brueckner and Pai (2009), we assume that airline's only choice variables are θ_H and θ_L, i.e., the division of H-type and L-type traffic between direct and connecting service (note that q^c and q^d depend on θ_H and θ_L). On the one hand, we observe that $\pi(\theta_H, \theta_L)$ is a strictly convex function of θ_H for γ_H sufficiently large with respect to γ_L,[9] so that the optimal θ_H is a corner solution, equal to either 0 or 1. On the other hand, it can be checked that $\pi(\theta_H, \theta_L)$ is a strictly concave function of θ_L, meaning that the optimal θ_L lies in the interval $[0, 1]$.

Starting from a situation in which the airline operates a hub-and-spoke network (i.e., AB passengers make a one-stop trip via hub H and $q^d = 0$), in the two following subsections we will consider other simple divisions of traffic between direct and connecting traffic when either a regional jet (RJ) or a low-cost (LC) direct connection between A and B is established by the

[7] Empirical studies confirming presence of economies of traffic density in the airline industry include Caves *et al.* (1984), Brueckner and Spiller (1994) and Berry *et al.* (2006).

[8] Since fuel consumption is higher during landing and take off operations, $\omega"(d) < 0$ might be a natural assumption. Assuming a concave function of the type $\omega(d) = \omega d^r$ with $r \in (0, 1)$ would have no qualitative effect on our results; the critical distances that will be computed would simply need to be raised to the power $1/r$. Swan and Adler (2006) study the linearity of airlines' costs with respect to distance.

[9] As in Brueckner and Pai (2009), strict convexity requires $\gamma_H > 2\widetilde{\gamma}$ or, equivalently, $\gamma_H(1-2\lambda) > 2\gamma_L(1-\lambda)$. This condition requires γ_H sufficiently large with respect to γ_L and $\lambda < 1/2$, i.e., there are more L-types than H-types among local passengers. Computations are available upon request.

network airline. Even though the AB market is relatively thin (as compared to local markets, which are denser),[10] the network airline may be interested in sending either H-types or L-types direct (or both). The result $(\theta_H, \theta_L) = (0, 0)$ represents a hub-and-spoke (HS) network, and $(1, 1)$ denotes a fully-connected (FC) network. Finally, passenger segmentation occurs when only one type of passengers flies direct: $(1, 0)$ occurs when only H-types fly direct, and $(0, 1)$ occurs when only L-types fly direct.

3.1 The emergence of a RJ technology

The RJ technology is characterized by a lower aircraft size and a higher marginal cost per seat. Let us consider a network airline that operates in a HS manner (i.e., there is no direct service between A and B). In this situation, when a RJ technology becomes available, the emergence of a new direct service on route AB to carry type-H passengers seems natural, since the lower aircraft size implies a higher flight frequency (because $f^d = q^d/n^d$, with $n^d = l^d s^d$) and H-types are more sensitive to schedule delay. Therefore, assuming that load factor remains the same in the three routes of the network (i.e., $l^d = l^c$), then $n^d < n^c$ and $\tau^d > \tau^c$. Hence, as pointed out in Brueckner and Pai (2009), for the outcome $(\theta_H, \theta_L) = (1, 0)$ to be optimal, the following conditions need to be met

$$\frac{\partial \pi(1,0)}{\partial \theta_L} < 0, \tag{10}$$

$$\pi(1,0) - \pi(0,0) > 0, \tag{11}$$

$$\frac{\partial \pi(0,0)}{\partial \theta_L} < 0, \tag{12}$$

where Eqs. (10) and (11) ensure that there is no incentive to either increase θ_L or reduce θ_H (remember that $\theta_H = \{0, 1\}$), and Eq. (12) is needed to rule out $\pi(1, 0) < \pi(0, \theta_L)$ for $\theta_L \in [0, 1]$.

Carrying out the needed computations, Eq. (10) becomes

$$\Omega \equiv (1-\delta)\left[\mu_L + 2\tau^c - \tau^d + \omega\left(\frac{2}{n^c} - \frac{d}{n^d}\right) + n^d \frac{\gamma_H - \gamma_L}{\delta} - N n^c \frac{2\widetilde{\gamma} - \gamma_L}{(N+1-\delta)^2}\right], \tag{13}$$

which shows the gains and losses for the network airline from increasing θ_L (i.e., sending more L-types direct). On the one hand, the airline saves the connecting discount to compensate for layover time disutility (μ_L) and the costs corresponding to routes AH and BH: the passenger cost ($2\tau^c$) and the cost of frequency ($\frac{2\omega}{n^c}$). Note that the cost of frequency decreases in s^c (since

[10] Remember that passenger population size in market AB is normalized to unity, whereas population in markets AH and BH is given by N, with $N > 1$.

$n^c = l^c s^c$) because there is a negative relationship between flight frequency and aircraft size. On the other hand, it incurs the costs associated to the new direct service on route AB: the passenger cost (τ^d) and the cost of frequency ($\frac{\omega d}{n^d}$), which increases with distance since longer routes are more costly to serve. The two last terms capture the gain of sending more L-types direct as aircraft size is larger on route AB and smaller on routes AH and BH. Thus, there is an advantage associated to larger aircraft, which implies lower flight frequency and lower fares, since L-types are fare-sensitive.

Equivalently, Eq. (11) reduces to

$$\Phi \equiv \delta \left[\mu_H + 2\tau^c - \tau^d + \omega \left(\frac{2}{n^c} - \frac{d}{n^d} \right) - n^d \frac{\gamma_H}{\delta} + n^c \frac{(1-\delta)(\gamma_H - \gamma_L) + N(\gamma_H - 2\widetilde{\gamma})}{(1+N)(1+N-\delta)} \right], \quad (14)$$

which indicates that the gain from sending all the H-types direct increases with their layover time disutility (μ_H) and with the costs corresponding to routes AH and BH ($2\tau^c + \frac{2\omega}{n^c}$). In contrast, the network airline incurs the costs associated to the new direct service on route AB ($\tau^d + \frac{\omega d}{n^d}$). The negative effect $n^d \frac{\gamma_H}{\delta}$ shows that the benefit from shifting all the H-types to direct service decreases with aircraft size and thus increases with frequency, capturing the advantage in terms of schedule delay stemming from a higher flight frequency and a smaller aircraft size. The last positive term, which increases with n^c and thus decreasing with f^c, captures the fact that sending all the H-types direct is more beneficial if the service quality (i.e. flight frequency) of the connecting service is poor.

Finally, Eq. (12) yields this condition

$$\Lambda \equiv (1-\delta) \left[\mu_L + 2\tau^c - \tau^d + \omega \left(\frac{2}{n^c} - \frac{d}{n^d} \right) - n^c \frac{\delta(\gamma_H - \gamma_L) - N(2\widetilde{\gamma} - \gamma_L)}{(1+N)^2} \right], \quad (15)$$

which has a similar interpretation as Eq. (13), except for the last term that has a more complex intuitive explanation.

At this point, as in Brueckner and Pai (2009), we can analyze the emergence of a direct connection to serve H-type passengers. We consider an initial situation in which all aircraft are mainline jets with similar characteristics, i.e., $n^d = n^c$ and $\tau^d = \tau^c$. In this situation, it seems reasonable to assume that it is optimal for the airline to operate a HS network, so that $\theta_H^* = \theta_L^* = 0$. For this situation to hold, the inequalities $\Omega, \Phi, \Lambda < 0$ need to be satisfied.

We therefore consider the adoption of a new RJ technology, so that the airline sends the H-types direct on route AB by implementing a new business model characterized by lower aircraft size (and thus higher flight frequency) and higher cost per passenger. Therefore, we can define $\Delta n^d = n^d - n^c < 0$ and $\Delta \tau^d = \tau^d - \tau^c > 0$. In this situation, the expressions Ω and

Λ remain negative since they decrease in τ^d and increase in n^d, and only Φ may change sign. More precisely, Φ will become positive when

$$-\delta\Delta\tau^d - \frac{\delta\omega d}{\Delta n^d} - \gamma_H \Delta n^d > 0, \tag{16}$$

where the first and the second terms have a negative impact, whereas the third term has a positive effect. When Φ reverses its sign from negative to positive, then $\theta_H^* = 1$, $\theta_L^* = 0$ becomes an optimal decision. On the one hand, a higher cost associated to route AB and a longer distance between cities A and B make the emergence of a direct connection to serve H-types more difficult. On the other hand, type-H passengers' aversion to schedule delay makes a new direct connection easier.

3.2 The emergence of a LC business model

Compared to the standard HS business model (using mainline jets), the LC business model is characterized by a higher load factor and a lower marginal cost per seat. As before, let us consider a network airline that initially operates a HS network (i.e., there is no direct service between A and B). In this situation, we consider that the network airline can set up a subsidiary LC carrier to serve route AB.[11] In this framework, the emergence of a new direct service to carry type-L passengers seems natural, since the higher load factor implies a lower flight frequency and thus a lower fare (because $p_L^d = z_L - \gamma_L / f^d$) and L-types are less sensitive to schedule delay and more fare-sensitive. Since the airline uses similar mainline jets on all routes, aircraft size is also the same (i.e., $s^d = s^c$), then $n^d > n^c$ and $\tau^d < \tau^c$. Although these two considerations are favorable to the adoption of a LC business model, there is still a trade-off since setting up a new direct connection implies a new cost element, as shown in Eq. (9). For the outcome $(\theta_H, \theta_L) = (0, 1)$ to be optimal, the following conditions need to be observed

$$-\frac{\partial \pi(0,1)}{\partial \theta_L} < 0, \tag{17}$$

$$\pi(1,1) - \pi(0,1) < 0, \tag{18}$$

[11] It could also be the case that the network airline creates its own LC direct connection by offering less frequency at lower fares on market AB (without any LC subsidiary), since this market is thinner than local markets. In this case, it could be argued that the assumption of the lower marginal cost per seat on route AB may not be realistic. This assumption can easily be relaxed since it is not needed to obtain the results that follow. In any case, the managerial operations that a network carrier needs to carry out to implement a LC business model on route AB (with or without a LC subsidiary) remain beyond the scope of this paper.

$$-\frac{\partial \pi(1,1)}{\partial \theta_L} < 0, \tag{19}$$

where Eqs. (17) and (18) ensure that there is no incentive either to decrease θ_L or to raise θ_H (remember that $\theta_H = \{0,1\}$), and Eq. (19) is needed to rule out $\pi(0,1) < \pi(1,\theta_L)$ for $\theta_L \in [0,1]$. Carrying out the necessary computations, Eq. (10) becomes

$$\Psi \equiv (1-\delta)\left[-\mu_L - 2\tau^c + \tau^d - \omega\left(\frac{2}{n^c} - \frac{d}{n^d}\right) + n^c \frac{\delta\left(\gamma_H - \gamma_L\right) + N\left(2\widetilde{\gamma} - \gamma_L\right)}{\left(N+\delta\right)^2}\right], \tag{20}$$

which shows the gains and losses for the network airline from decreasing θ_L (i.e., sending fewer L-types direct). First, the airline incurs the connecting discount to compensate for layover time disutility (μ_L) for those passengers who switch from the direct to the connecting service. Second, the airline incurs the passenger cost ($2\tau^c$) and the frequency cost ($\frac{2\omega}{n^c}$) associated to routes AH and BH, whereas it saves the passenger cost (τ^d) and the frequency cost ($\frac{\omega d}{n^d}$) associated to the direct service on route AB. Finally, the last term captures the fact that savings from sending fewer L-types direct increase with load factor of connecting aircraft, capturing the cost advantage in terms of economies of traffic density stemming from larger aircraft size (and lower frequency), which leads to lower fares.

Equivalently, Eq. (18) reduces to

$$\Gamma \equiv \delta\left[\mu_H + 2\tau^c - \tau^d + \omega\left(\frac{2}{n^c} - \frac{d}{n^d}\right) - n^d\left(\gamma_H - \gamma_L\right) + n^c \frac{\gamma_H - 2\widetilde{\gamma}}{N+\delta}\right], \tag{21}$$

which indicates that the gain from sending all the H-types direct logically increases with their layover time disutility (μ_H) and with the costs corresponding to routes AH and BH ($2\tau^c + \frac{2\omega}{n^c}$). In contrast, the network airline incurs the costs associated to the direct service on route AB ($\tau^d + \frac{\omega d}{n^d}$). The last two terms show the preference of H-types for service quality (i.e., flight frequency). Thus, the higher the load factor on route AB (which increases n^d), the lower the frequency and the higher the cost for H-types to fly direct. Equivalently, the higher the load factor on routes AH and BH (which increases n^c), the lower the frequency and the higher the savings from switching to a direct connection.

Finally, Eq. (19) yields this condition

$$\Upsilon \equiv (1-\delta)\left[-\mu_L - 2\tau^c + \tau^d - \omega\left(\frac{2}{n^c} - \frac{d}{n^d}\right) - \delta n^d\left(\gamma_H - \gamma_L\right) + n^c \frac{2\widetilde{\gamma} - \gamma_L}{N}\right], \tag{22}$$

which has a similar interpretation to Eq. (20).

At this point, we can analyze the emergence of a direct connection to serve L-type passengers. We consider an initial situation in which all routes have similar characteristics, i.e.,

$n^d = n^c$ and $\tau^d = \tau^c$. In this situation, the optimal division of passengers is $(\theta_H^*, \theta_L^*) = (0, \theta_L^*)$ with $\theta_L^* \in [0, 1)$, so that the airline operates a HS network where all H-types and at least some L-types fly connecting, where θ_L^* approaches 0 as the distance between A and B increases.[12] To sustain this distribution of passengers, we need to observe $\Psi, \Upsilon > 0$, so that $\theta_L = 1$ is not optimal, meaning that (at least) some L-types travel connecting through the hub. Concerning H-types, the airline will send them connecting when $\Sigma \equiv \pi(1, \theta_L) - \pi(0, \theta_L) < 0$ with $\theta_L \in [0, 1]$. Note that Γ is a particular case of Σ with $\theta_L = 1$ (the expression for Σ is given in Appendix A) and thus $\Sigma < 0$ implies $\Gamma < 0$. Therefore, $\Psi, \Upsilon > 0$ and $\Sigma < 0$ are assumed to hold.

In this framework, the network airline establishes a new LC connection on route AB, so that it can operate a higher load-factor aircraft with a lower cost per passenger on direct flights between cities A and B, i.e., $\Delta n^d = n^d - n^c > 0$ and $\Delta \tau^d = \tau^d - \tau^c < 0$. A new LC direct connection on route AB would imply that Γ remains negative (i.e., H-types still fly connecting), whereas Ψ and Υ become negative. The expression Σ (and thus Γ) remains negative as long as $-\Delta\tau^d - \frac{\omega d}{\Delta n^d} - \frac{\gamma_H - \gamma_L}{\delta + \theta_L(1-\delta)}\Delta n^d < 0$, where the first and the second terms have a positive impact, whereas the third term has a negative effect. The interpretation of this expression is similar to that of Eq. (16). Finally, this new business model has an unambiguous negative impact of on Ψ and Υ since they increase in τ^d and decrease in n^d, and $\Psi, \Upsilon < 0$ will occur if Δn^d and $\Delta \tau^d$ are sufficiently important.

3.3 The effect of distance

After studying the setting in which either a RJ or a LC direct connection may arise, our attention now shifts to the effect of distance between endpoints on PP routes because network airlines may use different aircraft and business models depending on the characteristics of each city-pair market (and route distance is an important element). We discern distance intervals in which a new PP connection can optimally arise, analyzing the differences between the two types of connection (either RJ or LC).

3.3.1 RJ technology

Focusing on the effect of distance, from $\Omega < 0$ and $\Lambda < 0$ we can derive two lower bounds, i.e., $d > d_\Omega$ and $d > d_\Lambda$. In the same way, from $\Phi > 0$, we can obtain the upper bound $d < d_\Phi$ (note

[12] Since $\pi(\theta_H, \theta_L)$ is a strictly concave function of θ_L, although the result $\theta_L^* = 0$ is a possibility, the only statement that can be made is that $\theta_L^* \in [0, 1)$.

that d_Ω, d_Λ and d_Φ can be trivially computed and are provided in Appendix A).[13] Therefore, the following lemma can be stated.

Lemma 1 *Focusing on the effect of distance between endpoints A and B, for a sufficiently low* n^d *relative to* n^c*, the optimal division of passengers is*
i) $(\theta_H^*, \theta_L^*) = (1, 0)$*, for* $d \in (\max\{d_\Omega, d_\Lambda, 0\}, d_\Phi)$*, and*
ii) $(\theta_H^*, \theta_L^*) = (0, 0)$*, for* $d > d_\Phi$*.*

The condition requiring a sufficiently low n^d relative to n^c (i.e., RJs are sufficiently small as compared to mainline jets) ensures that $d_\Phi > \max\{d_\Omega, d_\Lambda\}$. The result in Lemma 1$(i)$ suggests that the network airline would segregate passengers for moderately short distances, by sending H-types direct and L-types connecting. Thus, a network airline may find it profitable to offer services on PP routes with RJs (for business travelers) for sufficiently short distances, since the smaller size of RJ aircraft may allow airlines to increase service quality (i.e., flight frequency) at higher fares. We will see in the empirical application that this strategy seems to be followed by the main European network carriers and by some American network carriers. As we observed in Figs. 3 and 4 in Section 2, regional aircraft are the aircraft most frequently used by the main American network carriers up to a route distance of 900 miles (although RJs are still widely used on routes in the distance range 900-1200 miles), whereas RJs are the type most used by the main European network carriers up to a route distance of 600 miles. Naturally, as captured in Lemma 1(ii), sending passengers direct becomes less profitable as distance increases, and the airline operates in a HS manner for sufficiently long distances.

In addition, whenever $\max\{d_\Omega, d_\Lambda\} > 0$, it could happen that $d \in (0, \max\{d_\Omega, d_\Lambda\})$ for short distances. In this case, both high and low types may fly direct, as captured in the following corollary.

Corollary 1 *When* $d_\Omega > 0$ *and* $d \in (0, \min\{d_\Omega, d_\Sigma\})$*, then the optimal division of passengers is* $(\theta_H^*, \theta_L^*) = (1, \theta_L^*)$ *with* $\theta_L^* \in (0, 1]$*.*

The condition $d < d_\Sigma$, which implies $\pi(1, \theta_L) > \pi(0, \theta_L)$ for $\theta_L \in [0, 1]$, ensures that all H-types still fly direct (the bound d_Σ is explained in Appendix A); and $d < d_\Omega$, which implies $\frac{\partial \pi(1,0)}{\partial \theta_L} > 0$, guarantees that the network airline sends (at least) some L-type passengers direct.[14]

[13] As mentioned in footnote 6, a more realistic modeling of the cost per departure would be $\omega(d) = \omega d^r$ with $r \in (0, 1)$. This assumption would have no qualitative effect on our results; the critical distances d_Ω, d_Λ and d_Φ would simply need to be raised to the power $1/r$.

[14] Note that the condition $d < d_\Lambda$ (which implies $\frac{\partial \pi(0,0)}{\partial \theta_L} > 0$) is no longer needed with $d < d_\Sigma$ (which implies $\pi(1, \theta_L) > \pi(0, \theta_L)$ for $\theta_L \in [0, 1]$).

Therefore, the result in the corollary above states that the network airline would send all H-types and a certain number of L-types direct for short distances, because connecting becomes increasingly inefficient. Although the existence of alternative transportation modes for very short distances makes this result unlikely, it is a plausible outcome for viable short air routes.[15]

3.3.2 LC business model

Focusing on the effect of distance, from $\Gamma < 0$, $\Psi < 0$ and $\Upsilon < 0$, we can derive the lower bound $d > d_\Gamma$ and the upper bounds $d < d_\Psi$ and $d < d_\Upsilon$ (note that d_Γ, d_Ψ and d_Υ can be trivially computed and are provided in Appendix A). Therefore, the following lemma can be stated.

Lemma 2 *Focusing on the effect of distance between endpoints A and B, for a sufficiently high n^d relative to n^c, the optimal division of passengers is*
i) $(\theta_H^*, \theta_L^*) = (1, 1)$, *for* $d < d_\Gamma$, *and*
ii) $(\theta_H^*, \theta_L^*) = (0, 1)$, *for* $d \in (d_\Gamma, \min\{d_\Psi, d_\Upsilon\})$.

The condition requiring a sufficiently low n^d relative to n^c (i.e., the load factor in the LC flights on route AB is sufficiently high as compared to the load factor in regular flights on routes AH and BH) ensures that $\min\{d_\Psi, d_\Upsilon\} > d_\Gamma$. When a LC business model is set up on route AB, the result in Lemma 2(i) suggests that the airline would send all passengers direct for short distances. For longer distances, the network airline would segregate passengers sending only L-types direct, as captured in Lemma 2(ii). We will see in the empirical application that this strategy seems to be followed by the main European network airlines. As we observed in Fig. 4 in Section 2, European network airlines seem to offer services on PP routes longer than 600 miles by means of LC subsidiaries. Naturally, as distance increases, sending passengers direct becomes less profitable and airlines end up adopting HS networks for sufficiently long distances, as captured in the following corollary.

Corollary 2 *When $d > \max\{d_\Psi, d_\Sigma\}$, then the optimal division of passengers is $(\theta_H^*, \theta_L^*) = (0, \theta_L^*)$ with $\theta_L^* \in [0, 1)$.*

[15] Although the turboprop technology is still used for very short routes (as we will see in the empirical application), our theoretical analysis focuses only on the use of RJs on routes initially served with mainline jets, to have a more tractable setting.

The condition $d > d_\Sigma$, which implies $\pi(1, \theta_L) < \pi(0, \theta_L)$ for $\theta_L \in [0, 1]$, ensures that all H-types still fly connecting (the bound d_Σ is explained in Appendix A); and $d > d_\Psi$ implies $-\frac{\partial \pi(0,1)}{\partial \theta_L} > 0$, so that the airline sends (at least) some L-type passengers connecting.[16]

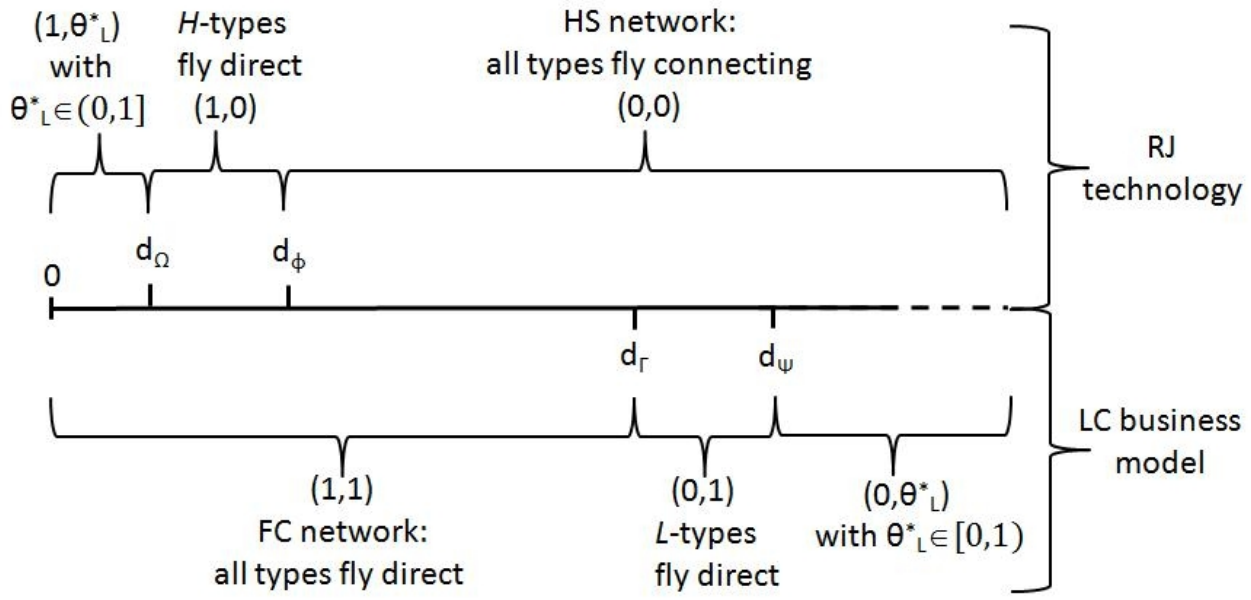
Therefore, the result in the corollary above states that, for sufficiently long distances, the network airline would send all H-types and a certain number of L-types connecting, adopting a HS network structure. Quite naturally, as distance increases, direct flights become less profitable.

3.4 Discussion

Considering an environment in which both a RJ technology may be available and a LC business model can be adopted by network airlines on thin routes, we can contemplate a numerical example where the previous results arise (since the solutions are complex). Given the stylized nature of the model, parameter choices are necessarily arbitrary and the analysis is not exhaustive. However, it reveals some interesting insights which are in line with the empirical evidence. Let $z_L = 5$, $\gamma_L = 0.1$, $\mu_L = 2.7$, $z_H = 15$, $\gamma_H = 2$ and $\mu_H = 8.8$, so that income, schedule-delay and connection disutilities are much higher for the H-types. Let $\delta = 0.5$, so that AB passengers are composed by both H and L-types in equal parts. However $\lambda = 0.45$ indicates that H-types are relatively scarce among local passengers (remember that a sufficient condition for strict convexity of $\pi(\theta_H, \theta_L)$ with respect to θ_H is $\lambda < 1/2$). Let $N = 1.3$ (remember that $N > 1$ is assumed), indicating that local spoke-to-hub markets (i.e., markets AH and BH) are normally denser than spoke-to-spoke markets (i.e., market AB). The marginal cost per departure is $\omega = 4$, which is larger than the marginal cost per passenger on hub-to-spoke routes, which is given by $\tau^c = 3$. Logically, the condition $\tau^d_{LC} < \tau^c < \tau^d_{RJ}$ is observed, with $\tau^d_{LC} = 0.6$ and $\tau^d_{RJ} = 6$ (where subscripts denote the type of PP connection between endpoints A and B). Finally, the number of passengers per flight on routes AH and BH is given by $n^c = 5$, and the condition $n^d_{RJ} < n^c < n^d_{LC}$ is respected, with $n^d_{RJ} = 1.35$ and $n^d_{LC} = 6.5$, since RJ aircraft are smaller and the load factor is higher when a low cost business model is implemented. Given this parameter constellation, the optimal choice of θ_H and θ_L depends on the value of d, in a way made clear in Fig. 6 below

[16] Note that the condition $d > d_\Upsilon$ (which implies $-\frac{\partial \pi(1,1)}{\partial \theta_L} > 0$) is no longer needed with $d > d_\Sigma$ (which implies $\pi(1, \theta_L) < \pi(0, \theta_L)$ for $\theta_L \in [0, 1]$).

Fig. 6: Optimal network choice



The critical values of d that determine the different relevant regions are $d_\Omega = 1.96$, $d_\Phi = 2.12$, $d_\Gamma = 6.01$ and $d_\Psi = 7.48$ (Appendix B explains why these are the critical values of d), and the equilibrium in network structure depends crucially on the type of PP connection adopted on route AB (either RJ or LC). With the parameter values chosen above, we can compute the profit obtained by the airline for different values of θ_H and θ_L. More precisely, we will consider the cases $\theta_H, \theta_L = \{0, 1\}$, i.e., assuming that the airline has to send all passengers of the same type through the same routing. This is not a strong assumption since, looking at Fig. 6 above, one can observe that the optimal values of θ_H and θ_L are either 0 or 1 in all cases except in the following two regions. First, the region $d < d_\Omega$ when a RJ model is adopted and $(\theta_H^*, \theta_L^*) = (1, \theta_L^*)$ with $\theta_L^* \in (0, 1]$, with $\theta_L^* \to 0$ as d decreases, so that a FC network arises for a sufficiently small distance between A and B. Second, the region $d > d_\Psi$ when a LC model is adopted and $(\theta_H^*, \theta_L^*) = (0, \theta_L^*)$ with $\theta_L^* \in [0, 1)$, with $\theta_L^* \to 0$ as d increases, so that a HS network arises for a sufficiently long distance between A and B. Table 1 presents the value of $\pi(0,0)$, $\pi(1,0)$, $\pi(0,1)$ and $\pi(1,1)$ for some particular values of d in the different regions shown in Fig. 6. The values in Table 1 confirm the results shown in Fig. 6 above.[17]

[17]Note that when a RJ model is adopted in the region $d < d_\Omega$, then $\pi(1,0) > \pi(1,1)$ is possible for values of d close to d_Ω (the optimal result is $(\theta_H^*, \theta_L^*) = (1, \theta_L^*)$ with $\theta_L^* \in (0, 1]$). In addition, when a LC model is

As we can see, the choice of θ_H and θ_L gives rise to a certain network structure, where shorter distances between endpoints A and B support FC structures and higher levels of d favor HS network configurations. Interestingly, for $d \in (d_\Phi, d_\Gamma)$, the HS network is the outcome when a RJ technology is available and the FC network is the outcome when airlines implement a LC business model. As a consequence, we can conclude that adopting either a RJ model or a LC model on certain PP routes can significantly affect airlines' network structure.

Additionally, focusing on the cases in which there is passenger segmentation (i.e., $(\theta_H^*, \theta_L^*) = (1, 0)$ when a RJ model is adopted, and $(\theta_H^*, \theta_L^*) = (0, 1)$ when a LC model is adopted), we observe that $(1, 0)$ arises for shorter distances than $(0, 1)$. This result is also confirmed by the empirical evidence, as will be shown in the next section.

4 An empirical application

In this section, we conduct an empirical application of the issues developed in the theoretical model. We use data of selected American and European network carriers in 2009. Our goal is not to make a comparison between the US and the EU markets, but to examine the choices of network carriers in terms of type of aircraft and business model.

First, we explain the criterion for the selection of the sample of routes and describe the variables used in the empirical analysis. Then, we examine data and estimate equations to identify how route features (distance, demand, proportion of business and leisure travelers) influence aircraft technology and business models.

4.1 Data

Data on airline supply on each route both for the US and the EU (frequencies, type of aircraft and total number of seats) have been obtained from RDC aviation (capstats statistics) and data on distance of the route are from the Official Airlines Guide (OAG) and the webflyer web site.[18]

Our sample includes all routes with direct flights served within continental US by the six major American network carriers (American Airlines, Continental, Delta, Northwest, United Airlines and US Airways) and their subsidiaries, and all routes with direct flights served within the EU (EU of 27 countries + Switzerland and Norway) by the four major network airlines

adopted in the region $d > d_\Psi$, then $\pi(0,0) < \pi(0,1)$ is possible for values of d close to d_Ψ (the optimal result is $(\theta_H^*, \theta_L^*) = (0, \theta_L^*)$ with $\theta_L^* \in [0, 1)$).

[18] See *http://webflyer.com.*

(Air France, British Airways, Iberia and Lufthansa) and their subsidiaries. Altogether, at the airline-route level, we have 5031 observations for US carriers, and 1033 for EU airlines.[19]

The theoretical analysis focuses on the distribution of traffic of network airlines and their subsidiaries between spoke-to-spoke routes (i.e., PP routes) and hub-to-spoke routes. Hence, to illustrate empirically the ideas set in the theoretical model, we need to select a group of network airlines. Within the carriers that have regional and/or low-cost subsidiaries, we have considered the ones with the most extensive network of routes in the considered markets.

We account for routes with different market structures, including monopoly and oligopoly routes. Monopoly routes represent 54% of observations for US carriers, and 53% of observations for EU airlines, where monopoly routes are defined as those routes where the dominant airline has a market share larger than 90% in terms of total annual seats.[20]

Note that we do not treat airlines' services in different directions on a given route as separate observations because this would miss the fact that airline supply must be exactly or nearly identical in both directions of the route. So we consider the link that has the origin in the largest airport. For example, on the route Saint Louis-Akron-Saint Louis, we consider the link Saint Louis-Akron but not the link Akron-Saint Louis.

Regarding the type of aircraft, the most used turboprops in our sample are the following: ATR 42/72, British Aerospace ATP, De Havilland DHC-8, Embraer 120, Fairchild Dornier 328, Fokker 50, Saab 340/2000. The most used regional jets (RJs) are: Avro RJ 70/85/100, Bae 146, Canadian Regional Jet, Embraer RJ 135/140/145/270/175/190/195, Fokker 70/100. Finally, the most used mainline jets in our sample are the following: Airbus 318/319/320/321, Boeing 717/737/757, and MD 80/90.

Note that network airlines can provide regional services either directly or by means of a subsidiary or partner airline.[21] On routes where regional aircraft are dominant, we cannot

[19] Since data for some explanatory variables are not available for the American carriers, the sample used in the regressions is reduced to 4895 observations. The Delta-Northwest merger was not completed until early 2010. Hence, we prefer to treat Delta and Northwest as separate airlines regarding their choice of aircraft. Note that the merger between Lufthansa and Austrian was not completed until 2010, while the merger between Iberia and Vueling was completed in 2009.

[20] We exclude data for airlines that offer fewer than 52 frequencies per year on a particular route: operations with less than one flight per week should not be considered as scheduled.

[21] Decisions of this type are beyond the scope of this paper. Forbes and Lederman (2009) examine the conditions in which the major airlines in the US prefer to provide regional air services either using vertically integrated carriers or through contracts with independent regional carriers. They find that major airlines are likely to rely on trusted regional subsidiaries on those routes where schedule disruptions are costly and likely to occur.

determine whether the provision of air services is undertaken by a regional carrier that is a subsidiary of the network airline, or by an independent regional carrier that has signed a contract with the network airline. This occurs because our dataset always allocates these regional flights to the network carrier.

In addition to the type of aircraft being used, we are also interested in the business model implemented by the airline: either full-service or low-cost (LC) service. This analysis focuses on European airlines because the American network carriers did not have any LC subsidiaries in 2009.[22] Among the European airlines, we have Transavia (LC subsidiary of Air France), Vueling (LC subsidiary of Iberia), and Germanwings and Bmi Baby (LC subsidiaries of Lufthansa). There are at least three reasons for this important difference between the US and the EU. First, the national interests of the former flag carriers in Europe make them operate in non-hub national airports to prevent competition in their home markets. Second, Europe has a higher number of airports specialized in leisure traffic. Finally, it could be argued that LC carriers in the US have experienced a certain upmarket movement that bring them closer to network carriers. In this context, setting up a subsidiary LC carrier can be inadvisable for American network carriers.[23]

Regarding the US airline aircraft choice, 6% of the observations refer to turboprops, 52% to RJs and 42% to mainline jets. Among European airlines, 10% of the observations refer to turboprops, 35% to RJs, 24% to mainline jets with LC subsidiaries and 31% to mainline jets with the main brand.

We consider the following hub airports for US carriers: Dallas (DFW), New York (JFK), Miami (MIA) and Chicago (ORD) for American Airlines; Cleveland (CLE), Houston (IAH) and New York (EWR) for Continental; Atlanta (ATL), Cincinnatti (CVG), New York (JFK) and Salt Lake City (SLC) for Delta; Detroit (DTW), Memphis (MEM) and Minneapolis (MSP) for Northwest; Chicago (ORD), Denver (DEN), Los Angeles (LAX), San Francisco (SFO) and Washington Dulles (IAD) for United Airlines; and Charlotte (CLT), Philadephia (PHX) and Phoenix (PHX) for US Airways. We consider the following hubs for European airlines: Amsterdam (AMS) and Paris (CDG and ORY) for Air France; London (LHR) for British

[22] Ted was a LC subsidiary of United but it was diluted into the mainline brand in the beginning of 2009. Another LC subsidiary, Song, was folded into the Delta mainline brand in 2006.

[23] Graham and Vowles (2006) and Morrell (2005) undertake a broad examination of the establishment of LC subsidiaries by network carriers, but fail to find indisputable evidence of the success of this strategy. In the US, it seems that the diffculties in effectively separating network operations from those of the LC subsidiary may lead to a cannibalization and dilution of the main brand. Furthermore, network carriers may find it difficult to differentiate the pay scales of employees due to union activism.

Airways; Madrid (MAD) for Iberia; and Frankfurt (FRA), Munich (MUC) and Zurich (ZRH) for Lufthansa. The observations of airlines operating in their hubs represent 41% for US carriers and 47% for European carriers.[24]

Data on population and Gross Domestic Product per Capita (GDPC) of American endpoints refer to the Metropolitan Statistical Area (MSA) and the information has been obtained from the US census. Some routes located in Micropolitan Statistical Areas are excluded from the empirical analysis because of the difficulties in obtaining sound comparable data. In the case of the EU, these data refer to the NUTS 3 level (the statistical unit used by Eurostat), provided by Cambridge Econometrics (European Regional Database publication). We are aware that MSAs in the US and NUTS 3, as defined by Eurostat, are not strictly comparable. Hence, it is difficult to make joint estimations using the whole sample of routes that include airlines from both the US and the EU.

In the EU, all airports located in the following islands are considered as tourist destinations: the Balearic and Canary Islands (Spain), Sardinia and Sicily (Italy), Corsica (France), and many Greek islands,[25] and also the airports of Alicante (ALC), Faro (FAO), Malaga (AGP) and Nice (NCE). In the US, it is less clear which airports are located in pure tourist destinations. According to the data of the US Department of Commerce (2010), among the top 20 tourist destinations, only Orlando, Las Vegas and Gran Canyon have a high tourism intensity (i.e., the rate of international visitors per capita is higher than one). In fact, Brueckner and Pai (2009) consider as tourist destinations just Las Vegas, Orlando and two ski resorts. In this empirical application, we consider as tourist destinations the airports of Las Vegas (LAS), Orlando (MCO), Grand Canyon (FLG), Spokane (GEG), Vail (EGE), and some coastal cities of Florida and California, which are the two most popular states for tourism in the US. Some ski resorts airports (like Aspen) are not in our sample because they are located in Micropolitan Statistical Areas.

Finally, we built an airport access variable that measures the distance between the airport and the city center using Google Maps. In most cases, the identity of the relevant cities was self-evident. For airports located between cities, we calculated the distance from the airport to the closest city with more than $100,000$ inhabitants.

[24] Note that network carriers (and their regional subsidiaries) may exploit some connecting traffic in other airports that are not their main hubs. Hence, our analysis of PP routes may also include routes with a modest proportion of connecting passengers.

[25] Details available from the authors on request.

4.1.1 Descriptive data for the US

Table 2 shows data on the US network airlines considered in this analysis. As can be seen, there is a high diversity in their network of routes. Delta, Northwest and US Airways have an extensive network, offering services on a high number of monopoly routes and on many routes that do not have any of their hubs as endpoints. Interestingly, these airlines often choose RJs to serve city-pair routes. Continental and United focus their operations on their main hubs and their use of RJs is less intensive, although it is still the aircraft type most used by Continental. Finally, American Airlines mainly operates with mainline jets.

Table 3 shows some characteristics of the routes served by the major US network airlines in relation to the type of aircraft used. It can be seen that RJs are used on longer routes than turboprops but on shorter routes than mainline jets. Additionally, regional aircraft are used on thinner routes (with lower numbers of seats) than mainline jets. Overall, RJs are widely used by US network airlines.

4.1.2 Descriptive data for the EU

Table 4 shows data on European network airlines. As in the case of US airlines, we also see a high diversity in the route networks. British Airways provides services on a relatively low number of European routes, most of them in competition with other airlines. The vast majority of its routes are served with mainline jets and it does not have a LC subsidiary. Less than half of the routes have the hub as an endpoint. Air France and Lufthansa have a much more extensive network of routes in Europe and they quite often use either RJs or LC subsidiaries to offer services. However, Air France focuses its operations more on its hubs and also on monopoly routes. Finally, Iberia has similar characteristics to Lufthansa but provides services on a lower number of routes.

Table 5 shows some supply characteristics of the routes where the European network airlines considered offer services. Interestingly, the LC subsidiaries are used on the longest routes. Additionally, the use of mainline jets with the main brand seems to be focused particularly on dense routes. Overall, it can be seen that RJs and LC subsidiaries are widely used by European network airlines.

4.2 The emergence of a RJ technology

To examine airlines' aircraft choices, we estimate the following equation for the network airline i offering services on route k

$$Type\_of\_aircraft_{ik} = \alpha + \beta_1 Distance_k + \beta_2 Population_k + \beta_3 Population_k^2 + \beta_4 GDPC_k + \\ + \beta_5 D_k^{tourism} + \beta_6 Dist\_to\_city\_center_k + \beta_7 D_k^{monopoly} + \beta_8 D_{ik}^{hub} + \varepsilon_k. \tag{23}$$

Note that different types of aircraft may be used on the same route. Hence, we need to compute the market share of all aircraft used by airlines from the same category (turboprops, RJs or mainline jets) in terms of the total number of seats offered on the route. The dependent variable for the type of aircraft used is then constructed. This variable takes the value zero for routes where RJs have the largest market share (which will be the reference case); it takes the value one for routes where the turboprops have the largest market share, and it takes the value two for routes where mainline jets have the largest market share. Note that typically the market share of the category of aircraft that is dominant is well above 50%. We consider the following variables as exogenous explanatory variables of the type of aircraft used by airlines.

1. $Distance_k$: Number of kilometers in the case of European routes and number of miles in the case of American routes flown to link the endpoints of the route.

2. $Population_k$: Weighted average of population at the origin and destination regions of the route. We also include the square of the population as an explanatory variable because the effect of this variable is concentrated around the median values of its statistical distribution.[26]

3. $GDPC_k$: Weighted average of Gross Domestic Product per capita at the origin and destination regions of the route. Weights are based on population.

4. $D_k^{tourism}$: Dummy variable that takes the value one for routes in which at least one of the endpoints is a major tourist destination.

5. $Dist\_to\_city\_center_k$: The sum of the distances between the origin and the destination city-center and the respective airports.

6. $D_k^{monopoly}$: Dummy variable that takes the value one on routes where one airline has a market share larger than 90% in terms of total annual seats.

[26] The same could be argued for the distance variable, but the square of distance is highly insignificant when we include it in the regressions. As a consequence, this variable is not considered.

7. D_{ik}^{hub}: Dummy variable that takes the value one on routes in which at least one of the endpoints is a hub airport.

We include airline fixed effects in the regression. We consider the airline with the highest number of observations as the reference, i.e., Delta for the US sample and Air France/KLM for the EU sample.

The cost superiority of mainline jets in relation to RJs increases with distance, while on very short-haul routes turboprops are less costly than RJs. Thus, as route distance increases, we can expect RJs to be used less than mainline jets and more than turboprops. The longer range of RJs with respect to turboprops yields a clear prediction on the expected effect of the distance variable. However, the expected results for the rest of explanatory variables in the choice of RJs in relation to turboprops are not clear a priori.

Demand should be higher in more populated and richer endpoints. Additionally, monopoly routes should generally be thinner than routes where several airlines offer air services. As compared to mainline jets, we expect RJs to be used more on both monopoly routes and thinner routes, i.e., routes with less populated endpoints.

Note that the variable $GDPC_k$ may capture two different effects. On the one hand, demand should be higher in richer endpoints but, on the other hand, the proportion of business travelers may also be higher.

In this regard, our analysis also tries to identify routes with a higher proportion of leisure travelers. These routes are the ones with a tourist destination as endpoint and the ones with airports further away from the city center. The relatively higher frequency of RJs makes them particularly convenient for business travelers, so that we expect RJs (in relation to mainline jets) to be used less on tourist routes with a higher proportion of leisure travelers.

Finally the dummy variable for hub airports allows us to determine whether RJs are more likely to be used either to feed hubs or to provide services on PP routes. Recall that hub-to-spoke routes may be generally denser than spoke-to-spoke routes.

The estimation is made using a multinomial logit in which the use of RJs is the reference case. When we consider the move from RJs to another type of aircraft (i.e., either turboprops or mainline jets), note that a higher value of the corresponding explanatory variable would mean that the use of RJs will be more (less) likely if the sign of the coefficient associated to this variable is negative (positive).

Tables 6 and 7 show the results of the estimation of the aircraft choice for the main American and European network airlines. Table 6 shows the coefficients estimated and their respective standard errors. Table 7 shows the predicted change in the probability for an outcome to

take place (i.e., the use of RJs in relation either to turboprops or to mainline jets) as each independent variable changes from its minimum to its maximum value (i.e., from 0 to 1 for discrete variables) while all other independent variables are held constant at their mean values. The results in Table 6 report the statistical significance of the considered relationships, while the results in Table 7 report the quantitative impact of each explanatory variable.

First, we compare the use of RJs as compared to mainline jets. Looking at the effect of distance between endpoints, RJs are used more on shorter routes, as expected. The impact of the variable of distance is really important: the predicted increase in the probability of using mainline jets in relation to RJs as distance shifts from its minimum to its maximum value is about 95% in the case of American network airlines and 85% in the case of European network airlines.

Additionally, we find that RJs are more likely to be used on thinner routes than mainline jets. Our results show that mainline jets are used more than RJs on routes with more populated and richer endpoints (although the variable of GDP per capita is not statistically significant in the case of European airlines). In contrast, mainline jets are less used on monopoly routes. The predicted change in probabilities is quite high for all these variables and similar for US and EU network airlines. Only the effect of population on the predicted change in probabilities seems to be clearly higher in the case of European airlines.

Interestingly, RJs seem to be more used on routes with a higher proportion of business travelers. We make this conclusion in view of the fact that RJs are less used than mainline jets on tourist routes and on routes where airports are further from the city-center. The predicted change in probabilities is also high for both variables.

Finally, European network airlines use RJs more on spoke-to-spoke routes (i.e., PP routes) than on hub-to-spoke routes. Although we do not find statistical differences between hub-to-spoke routes and spoke-to-spoke routes considering US network airlines as a whole, this result can be qualified by analyzing each carrier independently and focusing on airline-specific effects. Results from regressions for each airline show that these differences are generally related with the magnitude of the effect but not with its direction or its statistical significance. An important exception is the result of the dummy variable for hub-to-spoke routes (i.e., D_{ik}^{hub}) for US network airlines. Table 8 explores this effect, showing the results of this variable for each American network airline.[27] The data in Table 8 suggest that several US network airlines use RJs more on spoke-to-spoke routes than on hub-to-spoke routes as is the case for European network airlines.

[27] The full report of the estimates of airline specific regressions is available upon request from the authors.

Shifting our attention to the analysis of the use of RJs with respect to turboprops, as expected, we can derive only one strong inference: turboprops are used more than RJs on shorter routes. The predicted decrease in the use turboprops with respect to RJs when distance shifts from its minimum to its maximum value is about 41% in the case of US network airlines and 60% in the case of European ones. Recall that the main advantage of RJs over turboprops is that they can be used on longer routes. As we have shown above, turboprops are used only on routes shorter than 300 miles, while RJs predominate on routes up to 900 miles in the US and on routes up to 600 miles in the EU. In the same vein, the mean distance of routes covered mainly by turboprops is between two and three times lower than the mean distance of routes covered mainly by RJs. From a statistical point of view, there are other variables that are significant, such as the dummies for monopoly routes and tourist endpoints. However, the impact of these variables in terms of the change in the predicted probabilities is very small (almost zero).

Looking at our previous theoretical results, we observe that the result $(\theta_H^*, \theta_L^*) = (1, 0)$, i.e., only business passengers travel direct, is confirmed empirically. Our empirical results show that RJs are mostly used by business travelers for intermediate-distance routes, and are mostly used on PP routes (for EU carriers and several US carriers). Consequently, new direct connections may be related to the advent of a RJ technology. In terms of Brueckner and Pai (2009), the "new route hypothesis" based on RJ direct connections seems plausible.

4.3 The emergence of a LC business model

Here we focus our attention on routes where mainline jets are used. Our interest here is to examine when a network airline is more likely to choose to operate the route with a LC subsidiary instead of the main brand. Recall that this analysis focuses only on European network airlines. We estimate the following equation for an airline i offering services on route k

$$\begin{aligned} D^{LC\_subsidiary} &= \alpha + \beta_1 Distance_k + \beta_2 Population_k + \beta_3 GDPC_k + \beta_4 D_k^{tourism} + \\ &+ \beta_5 Dist\_to\_city\_center_k + \beta_6 D_k^{monopoly} + \beta_7 D_{ik}^{hub} + \varepsilon_k, \end{aligned} \tag{24}$$

where the dependent variable is dichotomous and takes the value one on routes where network airlines offer services through a LC subsidiary. We use the same explanatory variables as in equation (23).[28]

[28] We exclude the observations of British Airways in the regression because this airline did not have a LC subsidiary in the period considered. Given the reduced number of observations in this regression, we consider

A priori, it is not clear whether the LC subsidiary is used more than the main brand either on longer or on shorter routes. However, following the theoretical analysis, the expected result is that the LC subsidiary may be widely used on thin PP routes with a high proportion of leisure travelers and relatively long distances. Thus, we expect LC subsidiaries to be used more on spoke-to-spoke routes (than on hub-to-spoke routes), on monopoly routes, on routes with poorer and less populated endpoints, and on routes with a high proportion of leisure travelers, i.e., routes from/to tourist destinations and routes with airports further away from the city center.

The estimation is made using the logit technique. A higher value of the coefficient associated to an explanatory variable means that the LC subsidiary is more (less) likely to be used if the sign of this coefficient is positive (negative). Table 9 shows the results of the estimation of equation (24).

The results above confirm our hypotheses. Indeed, all the coefficients are statistically significant and have the expected sign, except the one corresponding to the variable of the distance from the airport to the city center, which is not statistically significant. The impact in terms of change in the predicted probabilities is also high for all the significant variables.

Importantly, the coefficient associated to the variable of distance is positive and statistically significant, so we find evidence that the LC subsidiary is used more than the main brand on longer routes. For a network airline, the predicted increase in the probability of using a LC subsidiary instead of the main brain as route distance shifts from its minimum to its maximum value is about 72%.

Furthermore, the LC subsidiary is used more on spoke-to-spoke routes because the coefficient associated to the dummy variable for hub routes is negative and statistically significant. This result may be expected because network airlines concentrate connecting traffic in their hubs. The predicted decrease in the probability of using LC subsidiaries when routes have a hub as endpoint is about 76%.

The LC subsidiary is more likely to be used on monopoly routes and on routes with poorer and less populated endpoints. Therefore, we conclude that LC subsidiaries are used more on thinner routes. The predicted change in the probability of using LC subsidiaries is notable for all these variables.

Finally, it seems that the LC subsidiary is more likely to be used on routes with a high

---

that airline fixed effects are inappropriate. The low number of observations also advises against including the square of population as explanatory variable. In any case, this latter variable is highly insignificant when included in the regression.

proportion of leisure travelers because the coefficient associated to the dummy variable for tourist routes is positive and statistically significant. The predicted increase in the probability of using LC subsidiaries when routes have a tourist major destination as an endpoint is about 24%.

These results corroborate our theoretical results, and the optimal passenger division $(\theta_H^*, \theta_L^*) = (0, 1)$, i.e., only leisure passengers travel direct, is confirmed. Therefore, LC subsidiaries are mostly used to carry leisure travelers on relatively long and thin PP routes. Consequently, new direct connections may be related to the emergence of this new business model.

5 Concluding remarks

Network airlines may benefit from concentrating operations in their hub airports through the exploitation of density economies and a higher level of connectivity. However, adopting a HS network configuration may have negative consequences, such as congestion, lower competition due to airport dominance (by the *hubbing* airline), and lower service quality for citizens living in cities far from hub airports.

This paper shows that, under certain circumstances, network airlines may also have incentives to divert passengers away from the hub. Our main contribution is the analysis of the influence of two innovations, the RJ technology and the LC business model, in the provision of services on PP routes.

We find that the RJ technology and the LC business model are intensively used by network airlines on thin PP routes. More precisely, our main findings can be summarized as follows. On the one hand, a network airline finds it profitable to offer services on thin PP routes with RJs for sufficiently short distances (but longer distances than with turboprops). This direct connection is mostly addressed to business travelers, since the smaller size of RJ aircraft may allow network airlines to increase service quality (i.e., flight frequency) at higher fares. Naturally, sending passengers direct becomes less profitable on longer routes, and the airline will operate in a HS manner for sufficiently long distances. In the latter case, network carriers may use RJ aircraft to feed their hubs. On the other hand, a network carrier could be interested in serving a thin PP route by means of a subsidiary LC carrier for sufficiently long distances. This direct connection will be used mainly by leisure travelers who are more fare-sensitive. In this case, flight frequency is also lower.

The research question raised in this paper is especially relevant, because setting up new RJ or LC direct connections may have very different implications in terms of network structure,

fares and flight frequency. In addition, the regional impact of the different airline network configurations may also differ widely. Policy makers and airport operators should assess which type of airline networks they want to foster in their sphere of influence. If they wish to promote direct connections away from the hub, they should use tools such as airport charges (both the level and the relation with the weight of the aircraft), investment in capacities, and marketing of the cities where the airports are located.

Table 1: Example of network choice when RJ and LC models are available on route AB

	$d = 0.5$ $(d < d_\Omega)$		$d = 2$ $(d \in (d_\Omega, d_\Phi))$		$d = 4$ $(d \in (d_\Phi, d_\Gamma))$		$d = 7$ $(d \in (d_\Gamma, d_\Psi))$		$d = 8$ $(d > d_\Psi)$	
	RJ	LC	RJ	LC	RJ	LC	RJ	LC	RJ	LC
$\pi(0,0)$	3.79	3.79	3.79	3.79	3.79	3.79	3.79	3.79	3.79	3.79
$\pi(1,0)$	6.19	-0.82	3.97	-1.28	1.01	-1.90	-3.44	-2.82	-4.92	-3.13
$\pi(0,1)$	3.07	5.84	0.85	5.38	-2.12	4.76	-6.56	3.84	-8.04	3.53
$\pi(1,1)$	6.37	7.54	1.93	6.61	-4.00	5.38	-12.89	3.54	-15.85	2.92

Note: d_Ω= 1.96, d_Φ= 2.12, d_Γ= 6.01 and d_Ψ= 7.48.

Table 2: Some data about US network airlines

Routes	American	Continental	Delta	Northwest	United	US Airways
All	823	276	1242	1122	567	1001
Monopoly	325	177	722	796	225	485
From hub	304	252	445	370	423	268
With RJs	182	127	799	739	221	538
With turboprops	11	57	14	79	74	66
With mainline jets	630	92	429	304	272	397

Table 3: Supply characteristics by type of aircraft used (US carriers)

	Turboprops	RJs	Mainline jets
Total observations	301	2606	2124
Mean distance (miles)	221	661	1299
Total seats	55742	81465	247077
Total departures	1186	1027	1778
Mean aircraft size	40.18	75.39	139.87

Table 4: Some data about EU network airlines

Routes	Lufthansa	Iberia	British Airways	Air France/KLM
All	382	217	87	347
Monopoly	184	108	22	237
From hub	161	78	40	206
With RJs	126	82	10	141
With turboprops	28	21	3	55
With mainline jets main brand	116	46	74	85
With mainline jets low-cost	112	68	0	66

Table 5: Supply characteristics by type of aircraft used (EU carriers)

	Turboprops	RJs	Mainline jets main brand	Mainline jets low-cost
Total observations	103	359	321	246
Mean distance (kms)	393	715	972	1209
Total seats	60306	85953	372842	103026
Total departures	951	1060	2573	700
Mean aircraft size	54.57	66.06	141.07	148.12

Table 6: Results of estimates of the aircraft choice (mlogit) - US sample

	US sample ($N = 4895$)		EU sample ($N = 1033$)	
	Dependent variable: RJ=0, turboprop=1	Dependent variable: RJ=0, mainline jet=2	Dependent variable: RJ=0, turboprop=1	Dependent variable: RJ=0, mainline jet=2
$Distance_k$	-0.0099 (0.0006)***	0.0025 (0.00009)***	-0.006 (0.0006)***	0.0015 (0.00017)***
$Population_k$	-3.35e-07 (9.30e-08)***	9.39e-08 (3.67e-08)***	0.00023 (0.00020)	0.00037 (0.00013)***
$Population_k^2$	2.05e14 (4.63e-15)***	-6.62e-15 (1.88e-15)***	-1.44e-08 (1.84e-08)	-2.63e-08 (1.09e-08)**
$GDPC_k$	0.000014 (0.00002)	0.000026 (0.00001)**	0.003 (0.005)	0.002 (0.002)
$D_k^{tourism}$	1.44 (0.30)***	1.35 (0.12)***	0.86 (0.37)**	0.92 (0.26)***
$Dist\_to\_city\_center_k$	-0.04 (0.017)**	0.009 (0.003)***	-0.011 (0011)	0.015 (0.005)***
$D_k^{monopoly}$	1.98 (0.30)***	-1.15 (0.08)***	0.91 (0.32)***	-0.81 (0.16)***
D_{ik}^{hub}	-0.31 (0.21)	0.14 (0.10)	-0.064 (0.37)	0.38 (0.18)**
$D_{American}$	1.37 (0.52)***	1.79 (0.12)***	–	–
$D_{Continental}$	3.02 (0.38)***	0.25 (0.19)	–	–
$D_{Northwest}$	1.65 (0.37)***	−0.17 (0.12)***	–	–
D_{United}	3.77 (0.42)***	0.23 (0.14)	–	–
$D_{US\ Airways}$	1.69 (0.37)***	0.03 (0.11)	–	–
$D_{British\ Airways}$	–	–	0.21 (0.96)	0.96 (0.40)**
$D_{Lufthansa}$	–	–	-0.35 (0.35)	0.78 (0.20)**
D_{Iberia}	–	–	-0.45 (0.38)	-0.12 (0.24)
$Constant$	-1.04 (0.80)	-3.63 (0.36)***	0.69 (0.97)	-2.84 (0.61)***
R^2	0.42		0.25	
$F(joint\ sig.)$	1725.65***		322.99***	

Note 1: Standard errors in parenthesis (robust to heteroscedasticity).

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

Table 7: Change in the predicted probabilities

	US sample ($N = 4895$)		EU sample ($N = 1033$)	
	Dependent variable: RJ=0, turboprop=1	Dependent variable: RJ=0, mainline jet=2	Dependent variable: RJ=0, turboprop=1	Dependent variable: RJ=0, mainline jet=2
$Distance_k$	-44.76%	95.94%	-60.52%	84.61%
$Population_k$	-0.045%	41.43%	0.26%	66.71%
$GDPC_k$	0.0010%	16.48%	0.32%	13.17%
$D_k^{tourism}$	0.007%	32.32%	0.23%	19.17%
$Dist\_to\_city\_center_k$	-0.019%	21.43%	1.73%	37.34%
$D_k^{monopoly}$	0.022%	-27.61%	1.15%	-19.38%
D_{ik}^{hub}	-0.0029%	3.47%	0.31%	9.04%

Table 8: Results from regressions for the variable D_{ik}^{hub} - US sample

	Dependent variable: RJ=0, mainline jet=2	
	Coefficient	Change in the predicted probabilities
Delta ($N = 1214$)	0.30 (0.17)*	6.67%
American ($N = 808$)	-0.15 (0.36)	-0.08%
Continental ($N = 268$)	1.41 (0.68)**	13.78%
Northwest ($N = 1085$)	0.89 (0.20)***	16.35%
United ($N = 528$)	-4.51 (0.85)***	-58.88%
US Airways ($N = 992$)	1.07 (0.24)***	25.57%

Note 1: Standard errors in parenthesis (robust to heteroscedasticity).
Note 2: Statistical significance at 1% (***), 5% (**), 10% (*).

Table 9: Results of estimates of the business model (logit) – EU routes with mainline jets ($N = 493$)

	Dependent variable: main brand=0, LC subsidiary=1	
	Coefficient	Change in the predicted probabilities
$Distance_k$	0.0013 (0.00029)***	72.67%
$Population_k$	-0.00017 (0.00005)***	43.71%
$GDPC_k$	-0.013 (0.0046)***	59.77%
$D_k^{tourism}$	1.001 (0.45)**	24.08%
$Dist\_to\_city\_center_k$	-0.005 (0.009)	-12.09%
$D_k^{monopoly}$	2.27 (0.37)***	51.08%
D_{ik}^{hub}	-4.02 (0.42)***	76.36%
$Constant$	2.40 (0.87)***	–
R^2	0.58	
$F(joint\ sig.)$	114.40***	

Note 1: Standard errors in parenthesis (robust to heteroscedasticity).
Note 2: Statistical significance at 1% (***), 5% (**), 10% (*).

References

[1] Barla, P., Constantatos, C., 2005, 'Strategic interactions and airline network morphology under demand uncertainty,' *European Economic Review*, 49, pp. 703-716.

[2] Basso, L.J., Jara-Díaz, S., 2006, 'Distinguishing multiproduct economies of scale from economies of density on a fixed-size transport network,' *Network and Spatial Economics*, 6, pp. 149-162.

[3] Basso, L.J., Jara-Díaz, S., 2005, 'Calculation of economies of spatial scope from transport cost functions with aggregate output (with an application to the airline industry),' *Journal of Transport Economics and Policy*, 39, pp. 25-52.

[4] Berry, S., Carnall, M., Spiller, P., 2006, 'Airline hubs: costs, markups and the implications of customer heterogeneity,' In: Lee, D. (Ed.), *Advances in Airline Economics*, vol. 1, Elsevier, Amsterdam, pp. 183-214.

[5] Bilotkach, V., 2009, 'A framework for modeling "real-life" airline networks,' *Review of Networks Economics*, 8 (3), article 3.

[6] Bilotkach, V., Fageda, X., Flores-Fillol, R., 2010, 'Scheduled service versus private transportation: the role of distance,' *Regional Science and Urban Economics*, 40, pp. 60-72.

[7] Bogulaski, C., Ito, H., Lee, D., 2004, 'Entry patterns in the Southwest Airlines route system,' *Review of Industrial Organization*, 25, pp. 317-350.

[8] Brueckner, J.K., 2004, 'Network structure and airline scheduling,' *Journal of Industrial Economics*, 52, pp. 291-312.

[9] Brueckner, J.K., Pai, V., 2009, 'Technological innovation in the airline industry: the impact of regional jets,' *International Journal of Industrial Organization*, 27, pp. 110-120.

[10] Brueckner, J.K., Spiller, P.T., 1994, 'Economies of traffic density in the deregulated airline industry,' *Journal of Law and Economics*, 37, pp. 379-415.

[11] Caves, D.W., Christensen, L.R., Tretheway, M.W., 1984, 'Economies of density versus economies of scale: why trunk and local service airline costs differ,' *RAND Journal of Economics*, 15, pp. 471-489.

[12] Dresner, M., Windle, R., Zhou, M., 2002, 'Regional jet services: supply and demand,' *Journal of Air Transport Management*, 8, pp. 267-273.

[13] Flores-Fillol, R., 2009, 'Airline competition and network structure,' *Transportation Research Part B*, 43, pp. 966-983.

[14] Flores-Fillol, R., 2010, 'Congested hubs,' *Transportation Research Part B*, 44, pp. 358-370.

[15] Forbes, S.J., Lederman, M., 2009, 'Adaptation and vertical integration in the airline industry,' *American Economic Review*, 99, pp. 1831-1849.

[16] Gil-Moltó, M.J., Piga, C., 2008, 'Entry and exit by European low cost and traditional carriers,' *Tourism Economics*, 14, pp. 577-598.

[17] Graham, B., Vowles, T.M., 2006, 'Carriers within carriers: a strategic response to low-cost airline competition,' *Transport Reviews*, 26, pp. 105-126.

[18] ICAO, 2004, 'Economic contribution of civil aviation,' circular 292-AT/124.

[19] Morrell, P., 2005, 'Airline within airlines: an analysis of US network airline responses to low cost carriers,' *Journal of Air Transport Management*, 11, pp. 303-312.

[20] Oum, T.H., Zhang, A., Zhang, Y., 1995, 'Airline network rivalry,' *Canadian Journal of Economics*, 28, pp. 836-857.

[21] Swan, W, Adler, N, 2006, 'Aircraft trip cost parameters: a function of stage length and seat capacity,' *Transportation Research Part E*, 42, pp. 105-115.

[22] US Department of Commerce, 2010, 'Overseas visitation estimates for U.S. states, cities, and census regions: 2009,' Office of Travel and Tourism Industries.

A Appendix: Proofs

Proof of Lemma 1.

From Eqs. (13), (14) and (15), we obtain the following threshold values for distance

$$d_\Omega = \frac{n^d}{\omega}\left[\mu_L + 2\tau^c - \tau^d + \frac{2\omega}{n^c} + n^d\frac{\gamma_H-\gamma_L}{\delta} - Nn^c\frac{2\widetilde{\gamma}-\gamma_L}{(N+1-\delta)^2}\right], \tag{A1}$$

$$d_\Phi = \frac{n^d}{\omega}\left[\mu_H + 2\tau^c - \tau^d + \frac{2\omega}{n^c} - n^d\frac{\gamma_H}{\delta} + n^c\frac{(1-\delta)(\gamma_H-\gamma_L)+N(\gamma_H-2\widetilde{\gamma})}{(1+N)(1+N-\delta)}\right], \tag{A2}$$

$$d_\Lambda = \frac{n^d}{\omega}\left[\mu_L + 2\tau^c - \tau^d + \frac{2\omega}{n^c} - n^c\frac{\delta(\gamma_H-\gamma_L)-N(2\widetilde{\gamma}-\gamma_L)}{(1+N)^2}\right], \tag{A3}$$

where $\Omega, \Lambda < 0$ imply $d > d_\Omega, d_\Lambda$, and $\Phi > 0$ implies $d < d_\Phi$. Therefore, $(\theta_H^*, \theta_L^*) = (1, 0)$ arises for $d \in (\max\{d_\Omega, d_\Lambda, 0\}, d_\Phi)$. We assume that this interval is non-empty, a condition that is guaranteed for a sufficiently small n^d relative to n^c (i.e., RJs need to be sufficiently small as compared to mainline jets).[29] Finally, since $\Phi < 0$ implies $d > d_\Phi$, then $(\theta_H^*, \theta_L^*) = (0, 0)$ arises for $d > d_\Phi$. ■

Proof of Corollary 1.

This corollary explains the requirements that must hold to sustain the optimal distribution of passengers $(\theta_H^*, \theta_L^*) = (1, \theta_L^*)$ with $\theta_L^* \in (0, 1]$. To have (at least) some L-types traveling direct, i.e., $\theta_L^* \in (0, 1]$, we need $\min\{d_\Omega, d_\Lambda\} > 0$ and $d \in (0, \min\{d_\Omega, d_\Lambda\})$. In addition, $d < d_\Phi$ ensures $\pi(1, 0) > \pi(0, 0)$, but it does not guarantee to observe $\theta_H^* = 1$ for any θ_L^*. At this point, let us define $\Sigma \equiv \pi(1, \theta_L) - \pi(0, \theta_L) > 0$, where

$$\Sigma \equiv \delta\left[\mu_H + 2\tau^c - \tau^d + \omega\left(\frac{2}{n^c} - \frac{d}{n^d}\right) - n^d\frac{\gamma_H-\gamma_L}{\delta+\theta_L(1-\delta)} + n^c\frac{(1-\delta)(1-\theta_L)(\gamma_H-\gamma_L)+N(\gamma_H-2\widetilde{\gamma})}{[N+(1-\delta)(1-\theta_L)][1+N-(1-\delta)\theta_L]}\right]. \tag{A4}$$

Therefore $d < d_\Sigma$ implies $\Sigma \equiv \pi(1, \theta_L) - \pi(0, \theta_L) > 0$ for any $\theta_L \in [0, 1]$, ensuring that all H-types still fly direct, where

$$d_\Sigma = \frac{n^d}{\omega}\left[\mu_H + 2\tau^c - \tau^d + \frac{2\omega}{n^c} - n^d\frac{\gamma_H-\gamma_L}{\delta+\theta_L(1-\delta)} + n^c\frac{(1-\delta)(1-\theta_L)(\gamma_H-\gamma_L)+N(\gamma_H-2\widetilde{\gamma})}{[N+(1-\delta)(1-\theta_L)][1+N-(1-\delta)\theta_L]}\right]. \tag{A5}$$

Finally, imposing $d < d_\Omega$ (which implies $\frac{\partial\pi(1,0)}{\partial\theta_L} > 0$) is sufficient to guarantee that the airline sends (at least) some L-type passengers direct (and the condition $d < d_\Lambda$ is not needed anymore). In conclusion, $d < \min\{d_\Omega, d_\Sigma\}$ sustains the optimal division of passengers $(\theta_H^*, \theta_L^*) = (1, \theta_L^*)$ with $\theta_L^* \in (0, 1]$. Note that $d_\Omega < d_\Sigma$ is satisfied for a sufficiently small n^d relative to n^c.

Note that, from the expression for $\Sigma \equiv \pi(1, \theta_L) - \pi(0, \theta_L)$ above, we cannot recover $\Phi \equiv$

[29] Computations available from the autors on request.

$\pi(1,0) - \pi(0,0)$ by setting $\theta_L = 0$ (observe the element that multiplies n^d in the expressions for Φ and Σ). The reason is that there is a discontinuity in $\pi(0,\theta_L)$ between $\theta_L = 0$ and $\theta_L > 0$ because $\theta_L = 0$ implies dismantling the direct route between cities A and B and sending all passengers through the hub (i.e., adopting a HS network). ■

Proof of Lemma 2.

From Eqs. (20), (21) and (22), we obtain the following threshold values for distance

$$d_\Psi = \frac{n^d}{\omega}\left[\mu_L + 2\tau^c - \tau^d + \frac{2\omega}{n^c} - n^c \frac{\delta(\gamma_H - \gamma_L) + N(2\widetilde{\gamma} - \gamma_L)}{(N+\delta)^2}\right], \tag{A6}$$

$$d_\Gamma = \frac{n^d}{\omega}\left[\mu_H + 2\tau^c - \tau^d + \frac{2\omega}{n^c} - n^d(\gamma_H - \gamma_L) + n^c \frac{\gamma_H - 2\widetilde{\gamma}}{N+\delta}\right], \tag{A7}$$

$$d_\Upsilon = \frac{n^d}{\omega}\left[\mu_L + 2\tau^c - \tau^d + \frac{2\omega}{n^c} + \delta n^d(\gamma_H - \gamma_L) - n^c \frac{2\widetilde{\gamma} - \gamma_L}{N}\right], \tag{A8}$$

where $\Psi, \Upsilon < 0$ imply $d < d_\Psi, d_\Upsilon$, and $\Gamma < 0$ implies $d > d_\Gamma$. Therefore, $(\theta_H^*, \theta_L^*) = (0,1)$ for $d \in (d_\Gamma, \min\{d_\Psi, d_\Upsilon\})$. We assume that this interval is non-empty, a condition that is guaranteed for a sufficiently large n^d relative to n^c (i.e., the load factor in the low-cost flights on route AB is sufficiently high as compared to the load factor in regular flights on routes AH and BH).[30] Finally, when $\Gamma > 0$ then $d < d_\Gamma$ and $(\theta_H^*, \theta_L^*) = (1,1)$. ■

Proof of Corollary 2.

This corollary explains the requirements that must hold to sustain the optimal distribution of passengers $(\theta_H^*, \theta_L^*) = (0, \theta_L^*)$ with $\theta_L^* \in [0,1)$. To have (at least) some L-types traveling connecting, i.e., $\theta_L^* \in [0,1)$, we need $d > \max\{d_\Psi, d_\Upsilon\}$. However, this condition does not guarantee that all H-types still fly connecting (i.e., $\theta_H^* = 0$), which requires $\Sigma < 0$ or, equivalently, $d > d_\Sigma$ (the expressions for Σ and d_Σ are given in the proof of Corollary 1). Therefore, $d > \max\{d_\Psi, d_\Sigma\}$ sustains the optimal division of passengers $(\theta_H^*, \theta_L^*) = (0, \theta_L^*)$ with $\theta_L^* \in [0,1)$. Note that $d_\Psi > d_\Sigma$ for a sufficiently large n^d relative to n^c. ■

B Appendix: Details on the numerical analysis

These are the values for all the critical values of distance: $d_\Lambda = 1.90$, $d_\Omega = 1.96$, $d_\Phi = 2.12$, $d_\Gamma = 6.01$, $d_\Psi = 7.48$ and $d_\Upsilon = 14.48$. Finally let us denote d_Σ^{RJ} and d_Σ^{LC} the values of d_Σ, depending on the type of PP connection between endpoints A and B. Note that d_Σ^{RJ} and d_Σ^{LC} are functions of θ_L. On the one hand, d_Σ^{RJ} is a concave function that takes values between

[30] Computations available from the autors on request.

2.21 (when $\theta_L = 0$) and 2.74 (when $\theta_L = 0.85$). On the other hand, d_Σ^{LC} is an increasing and concave function that takes values between -12.37 (when $\theta_L = 0$) and 6.01 (when $\theta_L = 1$). There are a number of restrictions that must hold to carry out this numerical analysis. Lemma 1 states that $(\theta_H^*, \theta_L^*) = (1, 0)$ arises for $d \in (\max\{d_\Omega, d_\Lambda, 0\}, d_\Phi)$ and, since $d_\Omega > d_\Lambda$, the relevant value is d_Ω. Looking at Lemma 2, $(\theta_H^*, \theta_L^*) = (0, 1)$ arises for $d \in (d_\Gamma, \min\{d_\Psi, d_\Upsilon\})$ and, since $d_\Psi < d_\Upsilon$, the relevant value is d_Ψ. Following Corollary 1, $(\theta_H^*, \theta_L^*) = (1, \theta_L^*)$ with $\theta_L^* \in (0, 1]$ is observed when $d_\Omega > 0$ and $d \in \left(0, \min\left\{d_\Omega, d_\Sigma^{RJ}\right\}\right)$ and, since $d_\Omega < d_\Sigma^{RJ}$ holds for any $\theta_L \in [0, 1]$, the relevant value is d_Ω. Finally, looking at Corollary 2, $(\theta_H^*, \theta_L^*) = (0, \theta_L^*)$ with $\theta_L^* \in [0, 1)$ occurs when $d > \max\left\{d_\Psi, d_\Sigma^{LC}\right\}$ and, since $d_\Psi > d_\Sigma^{LC}$ holds for any $\theta_L \in [0, 1]$, the relevant value is d_Ψ. ■

FUNDACIÓN DE LAS CAJAS DE AHORROS

DOCUMENTOS DE TRABAJO

Últimos números publicados

159/2000 Participación privada en la construcción y explotación de carreteras de peaje
Ginés de Rus, Manuel Romero y Lourdes Trujillo

160/2000 Errores y posibles soluciones en la aplicación del *Value at Risk*
Mariano González Sánchez

161/2000 Tax neutrality on saving assets. The spahish case before and after the tax reform
Cristina Ruza y de Paz-Curbera

162/2000 Private rates of return to human capital in Spain: new evidence
F. Barceinas, J. Oliver-Alonso, J.L. Raymond y J.L. Roig-Sabaté

163/2000 El control interno del riesgo. Una propuesta de sistema de límites
riesgo neutral
Mariano González Sánchez

164/2001 La evolución de las políticas de gasto de las Administraciones Públicas en los años 90
Alfonso Utrilla de la Hoz y Carmen Pérez Esparrells

165/2001 Bank cost efficiency and output specification
Emili Tortosa-Ausina

166/2001 Recent trends in Spanish income distribution: A robust picture of falling income inequality
Josep Oliver-Alonso, Xavier Ramos y José Luis Raymond-Bara

167/2001 Efectos redistributivos y sobre el bienestar social del tratamiento de las cargas familiares en el nuevo IRPF
Nuria Badenes Plá, Julio López Laborda, Jorge Onrubia Fernández

168/2001 The Effects of Bank Debt on Financial Structure of Small and Medium Firms in some European Countries
Mónica Melle-Hernández

169/2001 La política de cohesión de la UE ampliada: la perspectiva de España
Ismael Sanz Labrador

170/2002 Riesgo de liquidez de Mercado
Mariano González Sánchez

171/2002 Los costes de administración para el afiliado en los sistemas de pensiones basados en cuentas de capitalización individual: medida y comparación internacional.
José Enrique Devesa Carpio, Rosa Rodríguez Barrera, Carlos Vidal Meliá

172/2002 La encuesta continua de presupuestos familiares (1985-1996): descripción, representatividad y propuestas de metodología para la explotación de la información de los ingresos y el gasto.
Llorenc Pou, Joaquín Alegre

173/2002 Modelos paramétricos y no paramétricos en problemas de concesión de tarjetas de credito.
Rosa Puertas, María Bonilla, Ignacio Olmeda

174/2002 Mercado único, comercio intra-industrial y costes de ajuste en las manufacturas españolas.
José Vicente Blanes Cristóbal

175/2003 La Administración tributaria en España. Un análisis de la gestión a través de los ingresos y de los gastos.
Juan de Dios Jiménez Aguilera, Pedro Enrique Barrilao González

176/2003 The Falling Share of Cash Payments in Spain.
Santiago Carbó Valverde, Rafael López del Paso, David B. Humphrey
Publicado en "Moneda y Crédito" nº 217, pags. 167-189.

177/2003 Effects of ATMs and Electronic Payments on Banking Costs: The Spanish Case.
Santiago Carbó Valverde, Rafael López del Paso, David B. Humphrey

178/2003 Factors explaining the interest margin in the banking sectors of the European Union.
Joaquín Maudos y Juan Fernández Guevara

179/2003 Los planes de stock options para directivos y consejeros y su valoración por el mercado de valores en España.
Mónica Melle Hernández

180/2003 Ownership and Performance in Europe and US Banking – A comparison of Commercial, Co-operative & Savings Banks.
Yener Altunbas, Santiago Carbó y Phil Molyneux

181/2003 The Euro effect on the integration of the European stock markets.
Mónica Melle Hernández

182/2004 In search of complementarity in the innovation strategy: international R&D and external knowledge acquisition.
Bruno Cassiman, Reinhilde Veugelers

183/2004 Fijación de precios en el sector público: una aplicación para el servicio municipal de suministro de agua.
Mª Ángeles García Valiñas

184/2004 Estimación de la economía sumergida es España: un modelo estructural de variables latentes.
Ángel Alañón Pardo, Miguel Gómez de Antonio

185/2004 Causas políticas y consecuencias sociales de la corrupción.
Joan Oriol Prats Cabrera

186/2004 Loan bankers' decisions and sensitivity to the audit report using the belief revision model.
Andrés Guiral Contreras and José A. Gonzalo Angulo

187/2004 El modelo de Black, Derman y Toy en la práctica. Aplicación al mercado español.
Marta Tolentino García-Abadillo y Antonio Díaz Pérez

188/2004 Does market competition make banks perform well?.
Mónica Melle

189/2004 Efficiency differences among banks: external, technical, internal, and managerial
Santiago Carbó Valverde, David B. Humphrey y Rafael López del Paso

190/2004 Una aproximación al análisis de los costes de la esquizofrenia en españa: los modelos jerárquicos bayesianos
F. J. Vázquez-Polo, M. A. Negrín, J. M. Cavasés, E. Sánchez y grupo RIRAG

191/2004 Environmental proactivity and business performance: an empirical analysis
Javier González-Benito y Óscar González-Benito

192/2004 Economic risk to beneficiaries in notional defined contribution accounts (NDCs)
Carlos Vidal-Meliá, Inmaculada Domínguez-Fabian y José Enrique Devesa-Carpio

193/2004 Sources of efficiency gains in port reform: non parametric malmquist decomposition tfp index for Mexico
Antonio Estache, Beatriz Tovar de la Fé y Lourdes Trujillo

194/2004 Persistencia de resultados en los fondos de inversión españoles
Alfredo Ciriaco Fernández y Rafael Santamaría Aquilué

195/2005 El modelo de revisión de creencias como aproximación psicológica a la formación del juicio del auditor sobre la gestión continuada
Andrés Guiral Contreras y Francisco Esteso Sánchez

196/2005 La nueva financiación sanitaria en España: descentralización y prospectiva
David Cantarero Prieto

197/2005 A cointegration analysis of the Long-Run supply response of Spanish agriculture to the common agricultural policy
José A. Mendez, Ricardo Mora y Carlos San Juan

198/2005 ¿Refleja la estructura temporal de los tipos de interés del mercado español preferencia por la liquidez?
Magdalena Massot Perelló y Juan M. Nave

199/2005 Análisis de impacto de los Fondos Estructurales Europeos recibidos por una economía regional: Un enfoque a través de Matrices de Contabilidad Social
M. Carmen Lima y M. Alejandro Cardenete

200/2005 Does the development of non-cash payments affect monetary policy transmission?
Santiago Carbó Valverde y Rafael López del Paso

201/2005 Firm and time varying technical and allocative efficiency: an application for port cargo handling firms
Ana Rodríguez-Álvarez, Beatriz Tovar de la Fe y Lourdes Trujillo

202/2005 Contractual complexity in strategic alliances
Jeffrey J. Reuer y Africa Ariño

203/2005 Factores determinantes de la evolución del empleo en las empresas adquiridas por opa
Nuria Alcalde Fradejas y Inés Pérez-Soba Aguilar

204/2005 Nonlinear Forecasting in Economics: a comparison between Comprehension Approach versus Learning Approach. An Application to Spanish Time Series
Elena Olmedo, Juan M. Valderas, Ricardo Gimeno and Lorenzo Escot

205/2005 Precio de la tierra con presión urbana: un modelo para España
Esther Decimavilla, Carlos San Juan y Stefan Sperlich

206/2005 Interregional migration in Spain: a semiparametric analysis
Adolfo Maza y José Villaverde

207/2005 Productivity growth in European banking
Carmen Murillo-Melchor, José Manuel Pastor y Emili Tortosa-Ausina

208/2005 Explaining Bank Cost Efficiency in Europe: Environmental and Productivity Influences.
Santiago Carbó Valverde, David B. Humphrey y Rafael López del Paso

209/2005 La elasticidad de sustitución intertemporal con preferencias no separables intratemporalmente: los casos de Alemania, España y Francia.
Elena Márquez de la Cruz, Ana R. Martínez Cañete y Inés Pérez-Soba Aguilar

210/2005 Contribución de los efectos tamaño, book-to-market y momentum a la valoración de activos: el caso español.
Begoña Font-Belaire y Alfredo Juan Grau-Grau

211/2005 Permanent income, convergence and inequality among countries
José M. Pastor and Lorenzo Serrano

212/2005 The Latin Model of Welfare: Do 'Insertion Contracts' Reduce Long-Term Dependence?
Luis Ayala and Magdalena Rodríguez

213/2005 The effect of geographic expansion on the productivity of Spanish savings banks
Manuel Illueca, José M. Pastor and Emili Tortosa-Ausina

214/2005 Dynamic network interconnection under consumer switching costs
Ángel Luis López Rodríguez

215/2005 La influencia del entorno socioeconómico en la realización de estudios universitarios: una aproximación al caso español en la década de los noventa
Marta Rahona López

216/2005 The valuation of spanish ipos: efficiency analysis
Susana Álvarez Otero

217/2005 On the generation of a regular multi-input multi-output technology using parametric output distance functions
Sergio Perelman and Daniel Santin

218/2005 La gobernanza de los procesos parlamentarios: la organización industrial del congreso de los diputados en España
Gonzalo Caballero Miguez

219/2005 Determinants of bank market structure: Efficiency and political economy variables
Francisco González

220/2005 Agresividad de las órdenes introducidas en el mercado español: estrategias, determinantes y medidas de performance
David Abad Díaz

221/2005 Tendencia post-anuncio de resultados contables: evidencia para el mercado español
Carlos Forner Rodríguez, Joaquín Marhuenda Fructuoso y Sonia Sanabria García

222/2005 Human capital accumulation and geography: empirical evidence in the European Union
Jesús López-Rodríguez, J. Andrés Faíña y Jose Lopez Rodríguez

223/2005 Auditors' Forecasting in Going Concern Decisions: Framing, Confidence and Information Processing
Waymond Rodgers and Andrés Guiral

224/2005 The effect of Structural Fund spending on the Galician region: an assessment of the 1994-1999 and 2000-2006 Galician CSFs
José Ramón Cancelo de la Torre, J. Andrés Faíña and Jesús López-Rodríguez

225/2005 The effects of ownership structure and board composition on the audit committee activity: Spanish evidence
Carlos Fernández Méndez and Rubén Arrondo García

226/2005 Cross-country determinants of bank income smoothing by managing loan loss provisions
Ana Rosa Fonseca and Francisco González

227/2005 Incumplimiento fiscal en el irpf (1993-2000): un análisis de sus factores determinantes
Alejandro Estellér Moré

228/2005 Region versus Industry effects: volatility transmission
Pilar Soriano Felipe and Francisco J. Climent Diranzo

229/2005 Concurrent Engineering: The Moderating Effect Of Uncertainty On New Product Development Success
Daniel Vázquez-Bustelo and Sandra Valle

230/2005 On zero lower bound traps: a framework for the analysis of monetary policy in the 'age' of central banks
Alfonso Palacio-Vera

231/2005 Reconciling Sustainability and Discounting in Cost Benefit Analysis: a methodological proposal
M. Carmen Almansa Sáez and Javier Calatrava Requena

232/2005 Can The Excess Of Liquidity Affect The Effectiveness Of The European Monetary Policy?
Santiago Carbó Valverde and Rafael López del Paso

233/2005 Inheritance Taxes In The Eu Fiscal Systems: The Present Situation And Future Perspectives.
Miguel Angel Barberán Lahuerta

234/2006 Bank Ownership And Informativeness Of Earnings.
Víctor M. González

235/2006 Developing A Predictive Method: A Comparative Study Of The Partial Least Squares Vs Maximum Likelihood Techniques.
Waymond Rodgers, Paul Pavlou and Andres Guiral.

236/2006 Using Compromise Programming for Macroeconomic Policy Making in a General Equilibrium Framework: Theory and Application to the Spanish Economy.
Francisco J. André, M. Alejandro Cardenete y Carlos Romero.

237/2006 Bank Market Power And Sme Financing Constraints.
Santiago Carbó-Valverde, Francisco Rodríguez-Fernández y Gregory F. Udell.

238/2006 Trade Effects Of Monetary Agreements: Evidence For Oecd Countries.
Salvador Gil-Pareja, Rafael Llorca-Vivero y José Antonio Martínez-Serrano.

239/2006 The Quality Of Institutions: A Genetic Programming Approach.
Marcos Álvarez-Díaz y Gonzalo Caballero Miguez.

240/2006 La interacción entre el éxito competitivo y las condiciones del mercado doméstico como determinantes de la decisión de exportación en las Pymes.
Francisco García Pérez.

241/2006 Una estimación de la depreciación del capital humano por sectores, por ocupación y en el tiempo.
Inés P. Murillo.

242/2006 Consumption And Leisure Externalities, Economic Growth And Equilibrium Efficiency.
Manuel A. Gómez.

243/2006 Measuring efficiency in education: an analysis of different approaches for incorporating non-discretionary inputs.
Jose Manuel Cordero-Ferrera, Francisco Pedraja-Chaparro y Javier Salinas-Jiménez

244/2006 Did The European Exchange-Rate Mechanism Contribute To The Integration Of Peripheral Countries?.
Salvador Gil-Pareja, Rafael Llorca-Vivero y José Antonio Martínez-Serrano

245/2006 Intergenerational Health Mobility: An Empirical Approach Based On The Echp.
Marta Pascual and David Cantarero

246/2006 Measurement and analysis of the Spanish Stock Exchange using the Lyapunov exponent with digital technology.
Salvador Rojí Ferrari and Ana Gonzalez Marcos

247/2006 Testing For Structural Breaks In Variance Withadditive Outliers And Measurement Errors.
Paulo M.M. Rodrigues and Antonio Rubia

248/2006 The Cost Of Market Power In Banking: Social Welfare Loss Vs. Cost Inefficiency.
Joaquín Maudos and Juan Fernández de Guevara

249/2006 Elasticidades de largo plazo de la demanda de vivienda: evidencia para España (1885-2000).
Desiderio Romero Jordán, José Félix Sanz Sanz y César Pérez López

250/2006 Regional Income Disparities in Europe: What role for location?.
Jesús López-Rodríguez and J. Andrés Faíña

251/2006 Funciones abreviadas de bienestar social: Una forma sencilla de simultanear la medición de la eficiencia y la equidad de las políticas de gasto público.
Nuria Badenes Plá y Daniel Santín González

252/2006 "The momentum effect in the Spanish stock market: Omitted risk factors or investor behaviour?".
Luis Muga and Rafael Santamaría

253/2006 Dinámica de precios en el mercado español de gasolina: un equilibrio de colusión tácita.
Jordi Perdiguero García

254/2006 Desigualdad regional en España: renta permanente versus renta corriente.
José M.Pastor, Empar Pons y Lorenzo Serrano

255/2006 Environmental implications of organic food preferences: an application of the impure public goods model.
Ana Maria Aldanondo-Ochoa y Carmen Almansa-Sáez

256/2006 Family tax credits versus family allowances when labour supply matters: Evidence for Spain.
José Felix Sanz-Sanz, Desiderio Romero-Jordán y Santiago Álvarez-García

257/2006 La internacionalización de la empresa manufacturera española: efectos del capital humano genérico y específico.
José López Rodríguez

258/2006 Evaluación de las migraciones interregionales en España, 1996-2004.
María Martínez Torres

259/2006 Efficiency and market power in Spanish banking.
Rolf Färe, Shawna Grosskopf y Emili Tortosa-Ausina.

260/2006 Asimetrías en volatilidad, beta y contagios entre las empresas grandes y pequeñas cotizadas en la bolsa española.
Helena Chuliá y Hipòlit Torró.

261/2006 Birth Replacement Ratios: New Measures of Period Population Replacement.
José Antonio Ortega.

262/2006 Accidentes de tráfico, víctimas mortales y consumo de alcohol.
José Mª Arranz y Ana I. Gil.

263/2006 Análisis de la Presencia de la Mujer en los Consejos de Administración de las Mil Mayores Empresas Españolas.
Ruth Mateos de Cabo, Lorenzo Escot Mangas y Ricardo Gimeno Nogués.

264/2006 Crisis y Reforma del Pacto de Estabilidad y Crecimiento. Las Limitaciones de la Política Económica en Europa.
Ignacio Álvarez Peralta.

265/2006 Have Child Tax Allowances Affected Family Size? A Microdata Study For Spain (1996-2000).
Jaime Vallés-Giménez y Anabel Zárate-Marco.

266/2006 Health Human Capital And The Shift From Foraging To Farming.
Paolo Rungo.

267/2006 Financiación Autonómica y Política de la Competencia: El Mercado de Gasolina en Canarias.
Juan Luis Jiménez y Jordi Perdiguero.

268/2006 El cumplimiento del Protocolo de Kyoto para los hogares españoles: el papel de la imposición sobre la energía.
Desiderio Romero-Jordán y José Félix Sanz-Sanz.

269/2006 Banking competition, financial dependence and economic growth
Joaquín Maudos y Juan Fernández de Guevara

270/2006 Efficiency, subsidies and environmental adaptation of animal farming under CAP
Werner Kleinhanß, Carmen Murillo, Carlos San Juan y Stefan Sperlich

271/2006 Interest Groups, Incentives to Cooperation and Decision-Making Process in the European Union
A. Garcia-Lorenzo y Jesús López-Rodríguez

272/2006 Riesgo asimétrico y estrategias de momentum en el mercado de valores español
Luis Muga y Rafael Santamaría

273/2006 Valoración de capital-riesgo en proyectos de base tecnológica e innovadora a través de la teoría de opciones reales
Gracia Rubio Martín

274/2006 Capital stock and unemployment: searching for the missing link
Ana Rosa Martínez-Cañete, Elena Márquez de la Cruz, Alfonso Palacio-Vera and Inés Pérez-Soba Aguilar

275/2006 Study of the influence of the voters' political culture on vote decision through the simulation of a political competition problem in Spain
Sagrario Lantarón, Isabel Lillo, Mª Dolores López and Javier Rodrigo

276/2006 Investment and growth in Europe during the Golden Age
Antonio Cubel and Mª Teresa Sanchis

277/2006 Efectos de vincular la pensión pública a la inversión en cantidad y calidad de hijos en un modelo de equilibrio general
Robert Meneu Gaya

278/2006 El consumo y la valoración de activos
Elena Márquez y Belén Nieto

279/2006 Economic growth and currency crisis: A real exchange rate entropic approach
David Matesanz Gómez y Guillermo J. Ortega

280/2006 Three measures of returns to education: An illustration for the case of Spain
María Arrazola y José de Hevia

281/2006 Composition of Firms versus Composition of Jobs
Antoni Cunyat

282/2006 La vocación internacional de un holding tranviario belga: la Compagnie Mutuelle de Tram-ways, 1895-1918
Alberte Martínez López

283/2006 Una visión panorámica de las entidades de crédito en España en la última década.
Constantino García Ramos

284/2006 Foreign Capital and Business Strategies: a comparative analysis of urban transport in Madrid and Barcelona, 1871-1925
Alberte Martínez López

285/2006 Los intereses belgas en la red ferroviaria catalana, 1890-1936
Alberte Martínez López

286/2006 The Governance of Quality: The Case of the Agrifood Brand Names
Marta Fernández Barcala, Manuel González-Díaz y Emmanuel Raynaud

287/2006 Modelling the role of health status in the transition out of malthusian equilibrium
Paolo Rungo, Luis Currais and Berta Rivera

288/2006 Industrial Effects of Climate Change Policies through the EU Emissions Trading Scheme
Xavier Labandeira and Miguel Rodríguez

289/2006 Globalisation and the Composition of Government Spending: An analysis for OECD countries
Norman Gemmell, Richard Kneller and Ismael Sanz

290/2006 La producción de energía eléctrica en España: Análisis económico de la actividad tras la liberalización del Sector Eléctrico
Fernando Hernández Martínez

291/2006 Further considerations on the link between adjustment costs and the productivity of R&D investment: evidence for Spain
Desiderio Romero-Jordán, José Félix Sanz-Sanz and Inmaculada Álvarez-Ayuso

292/2006 Una teoría sobre la contribución de la función de compras al rendimiento empresarial
Javier González Benito

293/2006 Agility drivers, enablers and outcomes: empirical test of an integrated agile manufacturing model
Daniel Vázquez-Bustelo, Lucía Avella and Esteban Fernández

294/2006 Testing the parametric vs the semiparametric generalized mixed effects models
María José Lombardía and Stefan Sperlich

295/2006 Nonlinear dynamics in energy futures
Mariano Matilla-García

296/2006 Estimating Spatial Models By Generalized Maximum Entropy Or How To Get Rid Of W
Esteban Fernández Vázquez, Matías Mayor Fernández and Jorge Rodriguez-Valez

297/2006 Optimización fiscal en las transmisiones lucrativas: análisis metodológico
Félix Domínguez Barrero

298/2006 La situación actual de la banca online en España
Francisco José Climent Diranzo y Alexandre Momparler Pechuán

299/2006 Estrategia competitiva y rendimiento del negocio: el papel mediador de la estrategia y las capacidades productivas
Javier González Benito y Isabel Suárez González

300/2006 A Parametric Model to Estimate Risk in a Fixed Income Portfolio
Pilar Abad and Sonia Benito

301/2007 Análisis Empírico de las Preferencias Sociales Respecto del Gasto en Obra Social de las Cajas de Ahorros
Alejandro Esteller-Moré, Jonathan Jorba Jiménez y Albert Solé-Ollé

302/2007 Assessing the enlargement and deepening of regional trading blocs: The European Union case
Salvador Gil-Pareja, Rafael Llorca-Vivero y José Antonio Martínez-Serrano

303/2007 ¿Es la Franquicia un Medio de Financiación?: Evidencia para el Caso Español
Vanesa Solís Rodríguez y Manuel González Díaz

304/2007 On the Finite-Sample Biases in Nonparametric Testing for Variance Constancy
Paulo M.M. Rodrigues and Antonio Rubia

305/2007 Spain is Different: Relative Wages 1989-98
José Antonio Carrasco Gallego

306/2007 Poverty reduction and SAM multipliers: An evaluation of public policies in a regional framework
Francisco Javier De Miguel-Vélez y Jesús Pérez-Mayo

307/2007 La Eficiencia en la Gestión del Riesgo de Crédito en las Cajas de Ahorro
Marcelino Martínez Cabrera

308/2007 Optimal environmental policy in transport: unintended effects on consumers' generalized price
M. Pilar Socorro and Ofelia Betancor

309/2007 Agricultural Productivity in the European Regions: Trends and Explanatory Factors
Roberto Ezcurra, Belen Iráizoz, Pedro Pascual and Manuel Rapún

310/2007 Long-run Regional Population Divergence and Modern Economic Growth in Europe: a Case Study of Spain
María Isabel Ayuda, Fernando Collantes and Vicente Pinilla

311/2007 Financial Information effects on the measurement of Commercial Banks' Efficiency
Borja Amor, María T. Tascón and José L. Fanjul

312/2007 Neutralidad e incentivos de las inversiones financieras en el nuevo IRPF
Félix Domínguez Barrero

313/2007 The Effects of Corporate Social Responsibility Perceptions on The Valuation of Common Stock
Waymond Rodgers , Helen Choy and Andres Guiral-Contreras

314/2007 Country Creditor Rights, Information Sharing and Commercial Banks' Profitability Persistence across the world
Borja Amor, María T. Tascón and José L. Fanjul

315/2007 ¿Es Relevante el Déficit Corriente en una Unión Monetaria? El Caso Español
Javier Blanco González y Ignacio del Rosal Fernández

316/2007 The Impact of Credit Rating Announcements on Spanish Corporate Fixed Income Performance: Returns, Yields and Liquidity
Pilar Abad, Antonio Díaz and M. Dolores Robles

317/2007 Indicadores de Lealtad al Establecimiento y Formato Comercial Basados en la Distribución del Presupuesto
Cesar Augusto Bustos Reyes y Óscar González Benito

318/2007 Migrants and Market Potential in Spain over The XXth Century: A Test Of The New Economic Geography
Daniel A. Tirado, Jordi Pons, Elisenda Paluzie and Javier Silvestre

319/2007 El Impacto del Coste de Oportunidad de la Actividad Emprendedora en la Intención de los Ciudadanos Europeos de Crear Empresas
Luis Miguel Zapico Aldeano

320/2007 Los belgas y los ferrocarriles de vía estrecha en España, 1887-1936
Alberte Martínez López

321/2007 Competición política bipartidista. Estudio geométrico del equilibrio en un caso ponderado
Isabel Lillo, Mª Dolores López y Javier Rodrigo

322/2007 Human resource management and environment management systems: an empirical study
Mª Concepción López Fernández, Ana Mª Serrano Bedia and Gema García Piqueres

323/2007 Wood and industrialization. evidence and hypotheses from the case of Spain, 1860-1935.
Iñaki Iriarte-Goñi and María Isabel Ayuda Bosque

324/2007 New evidence on long-run monetary neutrality.
J. Cunado, L.A. Gil-Alana and F. Perez de Gracia

325/2007 Monetary policy and structural changes in the volatility of us interest rates.
Juncal Cuñado, Javier Gomez Biscarri and Fernando Perez de Gracia

326/2007 The productivity effects of intrafirm diffusion.
Lucio Fuentelsaz, Jaime Gómez and Sergio Palomas

327/2007 Unemployment duration, layoffs and competing risks.
J.M. Arranz, C. García-Serrano and L. Toharia

328/2007 El grado de cobertura del gasto público en España respecto a la UE-15
Nuria Rueda, Begoña Barruso, Carmen Calderón y Mª del Mar Herrador

329/2007 The Impact of Direct Subsidies in Spain before and after the CAP'92 Reform
Carmen Murillo, Carlos San Juan and Stefan Sperlich

330/2007 Determinants of post-privatisation performance of Spanish divested firms
Laura Cabeza García and Silvia Gómez Ansón

331/2007 ¿Por qué deciden diversificar las empresas españolas? Razones oportunistas versus razones económicas
Almudena Martínez Campillo

332/2007 Dynamical Hierarchical Tree in Currency Markets
Juan Gabriel Brida, David Matesanz Gómez and Wiston Adrián Risso

333/2007 Los determinantes sociodemográficos del gasto sanitario. Análisis con microdatos individuales
Ana María Angulo, Ramón Barberán, Pilar Egea y Jesús Mur

334/2007 Why do companies go private? The Spanish case
Inés Pérez-Soba Aguilar

335/2007 The use of gis to study transport for disabled people
Verónica Cañal Fernández

336/2007 The long run consequences of M&A: An empirical application
Cristina Bernad, Lucio Fuentelsaz and Jaime Gómez

337/2007 Las clasificaciones de materias en economía: principios para el desarrollo de una nueva clasificación
Valentín Edo Hernández

338/2007 Reforming Taxes and Improving Health: A Revenue-Neutral Tax Reform to Eliminate Medical and Pharmaceutical VAT
Santiago Álvarez-García, Carlos Pestana Barros y Juan Prieto-Rodriguez

339/2007 Impacts of an iron and steel plant on residential property values
Celia Bilbao-Terol

340/2007 Firm size and capital structure: Evidence using dynamic panel data
Víctor M. González and Francisco González

341/2007 ¿Cómo organizar una cadena hotelera? La elección de la forma de gobierno
Marta Fernández Barcala y Manuel González Díaz

342/2007 Análisis de los efectos de la decisión de diversificar: un contraste del marco teórico "Agencia-Stewardship"
Almudena Martínez Campillo y Roberto Fernández Gago

343/2007 Selecting portfolios given multiple eurostoxx-based uncertainty scenarios: a stochastic goal programming approach from fuzzy betas
Enrique Ballestero, Blanca Pérez-Gladish, Mar Arenas-Parra and Amelia Bilbao-Terol

344/2007 "El bienestar de los inmigrantes y los factores implicados en la decisión de emigrar"
Anastasia Hernández Alemán y Carmelo J. León

345/2007 Governance Decisions in the R&D Process: An Integrative Framework Based on TCT and Knowledge View of The Firm.
Andrea Martínez-Noya and Esteban García-Canal

346/2007 Diferencias salariales entre empresas públicas y privadas. El caso español
Begoña Cueto y Nuria Sánchez- Sánchez

347/2007 Effects of Fiscal Treatments of Second Home Ownership on Renting Supply
Celia Bilbao Terol and Juan Prieto Rodríguez

348/2007 Auditors' ethical dilemmas in the going concern evaluation
Andres Guiral, Waymond Rodgers, Emiliano Ruiz and Jose A. Gonzalo

349/2007 Convergencia en capital humano en España. Un análisis regional para el periodo 1970-2004
Susana Morales Sequera y Carmen Pérez Esparrells

350/2007 Socially responsible investment: mutual funds portfolio selection using fuzzy multiobjective programming
Blanca Mª Pérez-Gladish, Mar Arenas-Parra , Amelia Bilbao-Terol and Mª Victoria Rodríguez-Uría

351/2007 Persistencia del resultado contable y sus componentes: implicaciones de la medida de ajustes por devengo
Raúl Iñiguez Sánchez y Francisco Poveda Fuentes

352/2007 Wage Inequality and Globalisation: What can we Learn from the Past? A General Equilibrium Approach
Concha Betrán, Javier Ferri and Maria A. Pons

353/2007 Eficacia de los incentivos fiscales a la inversión en I+D en España en los años noventa
Desiderio Romero Jordán y José Félix Sanz Sanz

354/2007 Convergencia regional en renta y bienestar en España
Robert Meneu Gaya

355/2007 Tributación ambiental: Estado de la Cuestión y Experiencia en España
Ana Carrera Poncela

356/2007 Salient features of dependence in daily us stock market indices
Luis A. Gil-Alana, Juncal Cuñado and Fernando Pérez de Gracia

357/2007 La educación superior: ¿un gasto o una inversión rentable para el sector público?
Inés P. Murillo y Francisco Pedraja

358/2007 Effects of a reduction of working hours on a model with job creation and job destruction
Emilio Domínguez, Miren Ullibarri y Idoya Zabaleta

359/2007 Stock split size, signaling and earnings management: Evidence from the Spanish market
José Yagüe, J. Carlos Gómez-Sala and Francisco Poveda-Fuentes

360/2007 Modelización de las expectativas y estrategias de inversión en mercados de derivados
Begoña Font-Belaire

361/2008 Trade in capital goods during the golden age, 1953-1973
Mª Teresa Sanchis and Antonio Cubel

362/2008 El capital económico por riesgo operacional: una aplicación del modelo de distribución de pérdidas
Enrique José Jiménez Rodríguez y José Manuel Feria Domínguez

363/2008 The drivers of effectiveness in competition policy
Joan-Ramon Borrell and Juan-Luis Jiménez

364/2008 Corporate governance structure and board of directors remuneration policies: evidence from Spain
Carlos Fernández Méndez, Rubén Arrondo García and Enrique Fernández Rodríguez

365/2008 Beyond the disciplinary role of governance: how boards and donors add value to Spanish foundations
Pablo De Andrés Alonso, Valentín Azofra Palenzuela y M. Elena Romero Merino

366/2008 Complejidad y perfeccionamiento contractual para la contención del oportunismo en los acuerdos de franquicia
Vanesa Solís Rodríguez y Manuel González Díaz

367/2008 Inestabilidad y convergencia entre las regiones europeas
Jesús Mur, Fernando López y Ana Angulo

368/2008 Análisis espacial del cierre de explotaciones agrarias
Ana Aldanondo Ochoa, Carmen Almansa Sáez y Valero Casanovas Oliva

369/2008 Cross-Country Efficiency Comparison between Italian and Spanish Public Universities in the period 2000-2005
Tommaso Agasisti and Carmen Pérez Esparrells

370/2008 El desarrollo de la sociedad de la información en España: un análisis por comunidades autónomas
María Concepción García Jiménez y José Luis Gómez Barroso

371/2008 El medioambiente y los objetivos de fabricación: un análisis de los modelos estratégicos para su consecución
Lucía Avella Camarero, Esteban Fernández Sánchez y Daniel Vázquez-Bustelo

372/2008 Influence of bank concentration and institutions on capital structure: New international evidence
Víctor M. González and Francisco González

373/2008 Generalización del concepto de equilibrio en juegos de competición política
Mª Dolores López González y Javier Rodrigo Hitos

374/2008 Smooth Transition from Fixed Effects to Mixed Effects Models in Multi-level regression Models
María José Lombardía and Stefan Sperlich

375/2008 A Revenue-Neutral Tax Reform to Increase Demand for Public Transport Services
Carlos Pestana Barros and Juan Prieto-Rodriguez

376/2008 Measurement of intra-distribution dynamics: An application of different approaches to the European regions
Adolfo Maza, María Hierro and José Villaverde

377/2008 Migración interna de extranjeros y ¿nueva fase en la convergencia?
María Hierro y Adolfo Maza

378/2008 Efectos de la Reforma del Sector Eléctrico: Modelización Teórica y Experiencia Internacional
Ciro Eduardo Bazán Navarro

379/2008 A Non-Parametric Independence Test Using Permutation Entropy
Mariano Matilla-García and Manuel Ruiz Marín

380/2008 Testing for the General Fractional Unit Root Hypothesis in the Time Domain
Uwe Hassler, Paulo M.M. Rodrigues and Antonio Rubia

381/2008 Multivariate gram-charlier densities
Esther B. Del Brio, Trino-Manuel Ñíguez and Javier Perote

382/2008 Analyzing Semiparametrically the Trends in the Gender Pay Gap - The Example of Spain
Ignacio Moral-Arce, Stefan Sperlich, Ana I. Fernández-Saínz and Maria J. Roca

383/2008 A Cost-Benefit Analysis of a Two-Sided Card Market
Santiago Carbó Valverde, David B. Humphrey, José Manuel Liñares Zegarra and Francisco Rodriguez Fernandez

384/2008 A Fuzzy Bicriteria Approach for Journal Deselection in a Hospital Library
M. L. López-Avello, M. V. Rodríguez-Uría, B. Pérez-Gladish, A. Bilbao-Terol, M. Arenas-Parra

385/2008 Valoración de las grandes corporaciones farmaceúticas, a través del análisis de sus principales intangibles, con el método de opciones reales
Gracia Rubio Martín y Prosper Lamothe Fernández

386/2008 El marketing interno como impulsor de las habilidades comerciales de las pyme españolas: efectos en los resultados empresariales
Mª Leticia Santos Vijande, Mª José Sanzo Pérez, Nuria García Rodríguez y Juan A. Trespalacios Gutiérrez

387/2008 Understanding Warrants Pricing: A case study of the financial market in Spain
David Abad y Belén Nieto

388/2008 Aglomeración espacial, Potencial de Mercado y Geografía Económica: Una revisión de la literatura
Jesús López-Rodríguez y J. Andrés Faíña

389/2008 An empirical assessment of the impact of switching costs and first mover advantages on firm performance
Jaime Gómez, Juan Pablo Maícas

390/2008 Tender offers in Spain: testing the wave
Ana R. Martínez-Cañete y Inés Pérez-Soba Aguilar

391/2008 La integración del mercado español a finales del siglo XIX: los precios del trigo entre 1891 y 1905
Mariano Matilla García, Pedro Pérez Pascual y Basilio Sanz Carnero

392/2008 Cuando el tamaño importa: estudio sobre la influencia de los sujetos políticos en la balanza de bienes y servicios
Alfonso Echazarra de Gregorio

393/2008 Una visión cooperativa de las medidas ante el posible daño ambiental de la desalación
Borja Montaño Sanz

394/2008 Efectos externos del endeudamiento sobre la calificación crediticia de las Comunidades Autónomas
Andrés Leal Marcos y Julio López Laborda

395/2008 Technical efficiency and productivity changes in Spanish airports: A parametric distance functions approach
Beatriz Tovar & Roberto Rendeiro Martín-Cejas

396/2008 Network analysis of exchange data: Interdependence drives crisis contagion
David Matesanz Gómez & Guillermo J. Ortega

397/2008 Explaining the performance of Spanish privatised firms: a panel data approach
Laura Cabeza Garcia and Silvia Gomez Anson

398/2008 Technological capabilities and the decision to outsource R&D services
Andrea Martínez-Noya and Esteban García-Canal

399/2008 Hybrid Risk Adjustment for Pharmaceutical Benefits
Manuel García-Goñi, Pere Ibern & José María Inoriza

400/2008 The Team Consensus–Performance Relationship and the Moderating Role of Team Diversity
José Henrique Dieguez, Javier González-Benito and Jesús Galende

401/2008 The institutional determinants of CO_2 emissions: A computational modelling approach using Artificial Neural Networks and Genetic Programming
Marcos Álvarez-Díaz , Gonzalo Caballero Miguez and Mario Soliño

402/2008 Alternative Approaches to Include Exogenous Variables in DEA Measures: A Comparison Using Monte Carlo
José Manuel Cordero-Ferrera, Francisco Pedraja-Chaparro and Daniel Santín-González

403/2008 Efecto diferencial del capital humano en el crecimiento económico andaluz entre 1985 y 2004: comparación con el resto de España
Mª del Pópulo Pablo-Romero Gil-Delgado y Mª de la Palma Gómez-Calero Valdés

404/2008 Análisis de fusiones, variaciones conjeturales y la falacia del estimador en diferencias
Juan Luis Jiménez y Jordi Perdiguero

405/2008 Política fiscal en la uem: ¿basta con los estabilizadores automáticos?
Jorge Uxó González y Mª Jesús Arroyo Fernández

406/2008 Papel de la orientación emprendedora y la orientación al mercado en el éxito de las empresas
Óscar González-Benito, Javier González-Benito y Pablo A. Muñoz-Gallego

407/2008 La presión fiscal por impuesto sobre sociedades en la unión europea
Elena Fernández Rodríguez, Antonio Martínez Arias y Santiago Álvarez García

408/2008 The environment as a determinant factor of the purchasing and supply strategy: an empirical analysis
Dr. Javier González-Benito y MS Duilio Reis da Rocha

409/2008 Cooperation for innovation: the impact on innovatory effort
Gloria Sánchez González and Liliana Herrera

410/2008 Spanish post-earnings announcement drift and behavioral finance models
Carlos Forner and Sonia Sanabria

411/2008 Decision taking with external pressure: evidence on football manager dismissals in argentina and their consequences
Ramón Flores, David Forrest and Juan de Dios Tena

412/2008 Comercio agrario latinoamericano, 1963-2000: aplicación de la ecuación gravitacional para flujos desagregados de comercio
Raúl Serrano y Vicente Pinilla

413/2008 Voter heuristics in Spain: a descriptive approach elector decision
José Luís Sáez Lozano and Antonio M. Jaime Castillo

414/2008 Análisis del efecto área de salud de residencia sobre la utilización y acceso a los servicios sanitarios en la Comunidad Autónoma Canaria
Ignacio Abásolo Alessón, Lidia García Pérez, Raquel Aguiar Ibáñez y Asier Amador Robayna

415/2008 Impact on competitive balance from allowing foreign players in a sports league: an analytical model and an empirical test
Ramón Flores, David Forrest & Juan de Dios Tena

416/2008 Organizational innovation and productivity growth: Assessing the impact of outsourcing on firm performance
Alberto López

417/2008 Value Efficiency Analysis of Health Systems
Eduardo González, Ana Cárcaba & Juan Ventura

418/2008 Equidad en la utilización de servicios sanitarios públicos por comunidades autónomas en España: un análisis multinivel
Ignacio Abásolo, Jaime Pinilla, Miguel Negrín, Raquel Aguiar y Lidia García

419/2008 Piedras en el camino hacia Bolonia: efectos de la implantación del EEES sobre los resultados académicos
Carmen Florido, Juan Luis Jiménez e Isabel Santana

420/2008 The welfare effects of the allocation of airlines to different terminals
M. Pilar Socorro and Ofelia Betancor

421/2008 How bank capital buffers vary across countries. The influence of cost of deposits, market power and bank regulation
Ana Rosa Fonseca and Francisco González

422/2008 Analysing health limitations in spain: an empirical approach based on the european community household panel
Marta Pascual and David Cantarero

423/2008 Regional productivity variation and the impact of public capital stock: an analysis with spatial interaction, with reference to Spain
Miguel Gómez-Antonio and Bernard Fingleton

424/2008 Average effect of training programs on the time needed to find a job. The case of the training schools program in the south of Spain (Seville, 1997-1999).
José Manuel Cansino Muñoz-Repiso and Antonio Sánchez Braza

425/2008 Medición de la eficiencia y cambio en la productividad de las empresas distribuidoras de electricidad en Perú después de las reformas
Raúl Pérez-Reyes y Beatriz Tovar

426/2008 Acercando posturas sobre el descuento ambiental: sondeo Delphi a expertos en el ámbito internacional
Carmen Almansa Sáez y José Miguel Martínez Paz

427/2008 Determinants of abnormal liquidity after rating actions in the Corporate Debt Market
Pilar Abad, Antonio Díaz and M. Dolores Robles

428/2008 Export led-growth and balance of payments constrained. New formalization applied to Cuban commercial regimes since 1960
David Matesanz Gómez, Guadalupe Fugarolas Álvarez-Ude and Isis Mañalich Gálvez

429/2008 La deuda implícita y el desequilibrio financiero-actuarial de un sistema de pensiones. El caso del régimen general de la seguridad social en España
José Enrique Devesa Carpio y Mar Devesa Carpio

430/2008 Efectos de la descentralización fiscal sobre el precio de los carburantes en España
Desiderio Romero Jordán, Marta Jorge García-Inés y Santiago Álvarez García

431/2008 Euro, firm size and export behavior
Silviano Esteve-Pérez, Salvador Gil-Pareja, Rafael Llorca-Vivero and José Antonio Martínez-Serrano

432/2008 Does social spending increase support for free trade in advanced democracies?
Ismael Sanz, Ferran Martínez i Coma and Federico Steinberg

433/2008 Potencial de Mercado y Estructura Espacial de Salarios: El Caso de Colombia
Jesús López-Rodríguez y Maria Cecilia Acevedo

434/2008 Persistence in Some Energy Futures Markets
Juncal Cunado, Luis A. Gil-Alana and Fernando Pérez de Gracia

435/2008 La inserción financiera externa de la economía francesa: inversores institucionales y nueva gestión empresarial
Ignacio Álvarez Peralta

436/2008 ¿Flexibilidad o rigidez salarial en España?: un análisis a escala regional
Ignacio Moral Arce y Adolfo Maza Fernández

437/2009 Intangible relationship-specific investments and the performance of r&d outsourcing agreements
Andrea Martínez-Noya, Esteban García-Canal & Mauro F. Guillén

438/2009 Friendly or Controlling Boards?
Pablo de Andrés Alonso & Juan Antonio Rodríguez Sanz

439/2009 La sociedad Trenor y Cía. (1838-1926): un modelo de negocio industrial en la España del siglo XIX
Amparo Ruiz Llopis

440/2009 Continental bias in trade
Salvador Gil-Pareja, Rafael Llorca-Vivero & José Antonio Martínez Serrano

441/2009 Determining operational capital at risk: an empirical application to the retail banking
Enrique José Jiménez-Rodríguez, José Manuel Feria-Domínguez & José Luis Martín-Marín

442/2009 Costes de mitigación y escenarios post-kyoto en España: un análisis de equilibro general para España
Mikel González Ruiz de Eguino

443/2009 Las revistas españolas de economía en las bibliotecas universitarias: ranking, valoración del indicador y del sistema
Valentín Edo Hernández

444/2009 Convergencia económica en España y coordinación de políticas económicas. un estudio basado en la estructura productiva de las CC.AA.
Ana Cristina Mingorance Arnáiz

445/2009 Instrumentos de mercado para reducir emisiones de co2: un análisis de equilibrio general para España
Mikel González Ruiz de Eguino

446/2009 El comercio intra e inter-regional del sector Turismo en España
Carlos Llano y Tamara de la Mata

447/2009 Efectos del incremento del precio del petróleo en la economía española: Análisis de cointegración y de la política monetaria mediante reglas de Taylor
Fernando Hernández Martínez

448/2009 Bologna Process and Expenditure on Higher Education: A Convergence Analysis of the EU-15
T. Agasisti, C. Pérez Esparrells, G. Catalano & S. Morales

449/2009 Global Economy Dynamics? Panel Data Approach to Spillover Effects
Gregory Daco, Fernando Hernández Martínez & Li-Wu Hsu

450/2009 Pricing levered warrants with dilution using observable variables
Isabel Abínzano & Javier F. Navas

451/2009 Information technologies and financial prformance: The effect of technology diffusion among competitors
Lucio Fuentelsaz, Jaime Gómez & Sergio Palomas

452/2009 A Detailed Comparison of Value at Risk in International Stock Exchanges
Pilar Abad & Sonia Benito

453/2009 Understanding offshoring: has Spain been an offshoring location in the nineties?
Belén González-Díaz & Rosario Gandoy

454/2009 Outsourcing decision, product innovation and the spatial dimension: Evidence from the Spanish footwear industry
José Antonio Belso-Martínez

455/2009 Does playing several competitions influence a team's league performance? Evidence from Spanish professional football
Andrés J. Picazo-Tadeo & Francisco González-Gómez

456/2009 Does accessibility affect retail prices and competition? An empirical application
Juan Luis Jiménez and Jordi Perdiguero

457/2009 Cash conversion cycle in smes
Sonia Baños-Caballero, Pedro J. García-Teruel and Pedro Martínez-Solano

458/2009 Un estudio sobre el perfil de hogares endeudados y sobreendeudados: el caso de los hogares vascos
Alazne Mujika Alberdi, Iñaki García Arrizabalaga y Juan José Gibaja Martíns

459/2009 Imposing monotonicity on outputs in parametric distance function estimations: with an application to the spanish educational production
Sergio Perelman and Daniel Santin

460/2009 Key issues when using tax data for concentration analysis: an application to the Spanish wealth tax
José Mª Durán-Cabré and Alejandro Esteller-Moré

461/2009 ¿Se está rompiendo el mercado español? Una aplicación del enfoque de feldstein –horioka
Saúl De Vicente Queijeiro□, José Luis Pérez Rivero□ y María Rosalía Vicente Cuervo□

462/2009 Financial condition, cost efficiency and the quality of local public services
Manuel A. Muñiz□ & José L. Zafra□□

463/2009 Including non-cognitive outputs in a multidimensional evaluation of education production: an international comparison
Marián García Valiñas & Manuel Antonio Muñiz Pérez

464/2009 A political look into budget deficits.The role of minority governments and oppositions
Albert Falcó-Gimeno & Ignacio Jurado

465/2009 La simulación del cuadro de mando integral. Una herramienta de aprendizaje en la materia de contabilidad de gestión
Elena Urquía Grande, Clara Isabel Muñoz Colomina y Elisa Isabel Cano Montero

466/2009 Análisis histórico de la importancia de la industria de la desalinización en España
Borja Montaño Sanz

467/2009 The dynamics of trade and innovation: a joint approach
Silviano Esteve-Pérez & Diego Rodríguez

468/2009 Measuring international reference-cycles
Sonia de Lucas Santos, Inmaculada Álvarez Ayuso & Mª Jesús Delgado Rodríguez

469/2009 Measuring quality of life in Spanish municipalities
Eduardo González Fidalgo, Ana Cárcaba García, Juan Ventura Victoria & Jesús García García

470/2009 ¿Cómo se valoran las acciones españolas: en el mercado de capitales doméstico o en el europeo?
Begoña Font Belaire y Alfredo Juan Grau Grau

471/2009 Patterns of e-commerce adoption and intensity. evidence for the european union-27
María Rosalía Vicente & Ana Jesús López

472/2009 On measuring the effect of demand uncertainty on costs: an application to port terminals
Ana Rodríguez-Álvarez, Beatriz Tovar & Alan Wall

473/2009 Order of market entry, market and technological evolution and firm competitive performance
Jaime Gomez, Gianvito Lanzolla & Juan Pablo Maicas

474/2009 La Unión Económica y Monetaria Europea en el proceso exportador de Castilla y León (1993-2007): un análisis de datos de panel
Almudena Martínez Campillo y Mª del Pilar Sierra Fernández

475/2009 Do process innovations boost SMEs productivity growth?
Juan A. Mañez, María E. Rochina Barrachina, Amparo Sanchis Llopis & Juan A. Sanchis Llopis

476/2009 Incertidumbre externa y elección del modo de entrada en el marco de la inversión directa en el exterior
Cristina López Duarte y Marta Mª Vidal Suárez

477/2009 Testing for structural breaks in factor loadings: an application to international business cycle
José Luis Cendejas Bueno, Sonia de Lucas Santos, Inmaculada Álvarez Ayuso & Mª Jesús Delgado Rodríguez

478/2009 ¿Esconde la rigidez de precios la existencia de colusión? El caso del mercado de carburantes en las Islas Canarias
Juan Luis Jiménez y Jordi Perdiguero

479/2009 The poni test with structural breaks
Antonio Aznar & María-Isabel Ayuda

480/2009 Accuracy and reliability of Spanish regional accounts (CRE-95)
Verónica Cañal Fernández

481/2009 Estimating regional variations of R&D effects on productivity growth by entropy econometrics
Esteban Fernández-Vázquez y Fernando Rubiera-Morollón

482/2009 Why do local governments privatize the provision of water services? Empirical evidence from Spain
Francisco González-Gómez, Andrés J. Picazo-Tadeo & Jorge Guardiola

483/2009 Assessing the regional digital divide across the European Union-27
María Rosalía Vicente & Ana Jesús López

484/2009 Measuring educational efficiency and its determinants in Spain with parametric distance functions
José Manuel Cordero Ferrera, Eva Crespo Cebada & Daniel Santín González

485/2009 Spatial analysis of public employment services in the Spanish provinces
Patricia Suárez Cano & Matías Mayor Fernández

486/2009 Trade effects of continental and intercontinental preferential trade agreements
Salvador Gil-Pareja, Rafael Llorca-Vivero & José Antonio Martínez-Serrano

487/2009 Testing the accuracy of DEA for measuring efficiency in education under endogeneity
Salvador Gil-Pareja, Rafael Llorca-Vivero & José Antonio Martínez-Serrano

488/2009 Measuring efficiency in primary health care: the effect of exogenous variables on results
José Manuel Cordero Ferrera, Eva Crespo Cebada & Luis R. Murillo Zamorano

489/2009 Capital structure determinants in growth firms accessing venture funding
Marina Balboa, José Martí & Álvaro Tresierra

490/2009 Determinants of debt maturity structure across firm size
Víctor M. González

491/2009 Análisis del efecto de la aplicación de las NIIF en la valoración de las salidas a bolsa
Susana Álvarez Otero y Eduardo Rodríguez Enríquez

492/2009 An analysis of urban size and territorial location effects on employment probabilities: the spanish case
Ana Viñuela-Jiménez, Fernando Rubiera-Morollón & Begoña Cueto

493/2010 Determinantes de la estructura de los consejos de administración en España
Isabel Acero Fraile y Nuria Alcalde Fradejas

494/2010 Performance and completeness in repeated inter-firm relationships: the case of franchising
Vanesa Solis-Rodriguez & Manuel Gonzalez-Diaz

495/2010 A Revenue-Based Frontier Measure of Banking Competition
Santiago Carbó, David Humphrey & Francisco Rodríguez

496/2010 Categorical segregation in social networks
Antoni Rubí-Barceló

497/2010 Beneficios ambientales no comerciales de la directiva marco del agua en condiciones de escasez: análisis económico para el Guadalquivir
Julia Martin-Ortega, Giacomo Giannoccaro y Julio Berbel Vecino

498/2010 Monetary integration and risk diversification in eu-15 sovereign debt markets
Juncal Cuñado & Marta Gómez-Puig

499/2010 The Marshall Plan and the Spanish autarky: A welfare loss analysis
José Antonio Carrasco Gallego

500/2010 The role of learning in firm R&D persistence
Juan A. Mañez, María E. Rochina-Barrachina, Amparo Sanchis-Llopis & Juan A. Sanchis-Llopis

501/2010 Is venture capital more than just money?
Marina Balboa, José Martí & Nina Zieling

502/2010 On the effects of supply strategy on business performance: do the relationships among generic competitive objectives matter?
Javier González-Benito

503/2010 Corporate cash holding and firm value
Cristina Martínez-Sola, Pedro J. García-Teruel & Pedro Martínez-Solano

504/2010 El impuesto de flujos de caja de sociedades: una propuesta de base imponible y su aproximación contable en España
Lourdes Jerez Barroso y Joaquín Texeira Quirós

505/2010 The effect of technological, commercial and human resources on the use of new technology
Jaime Gómez & Pilar Vargas

506/2010 ¿Cómo ha afectado la fiscalidad a la rentabilidad de la inversión en vivienda en España? Un análisis para el periodo 1996 y 2007
Jorge Onrubia Fernández y María del Carmen Rodado Ruiz

507/2010 Modelización de flujos en el análisis input-output a partir de la teoría de redes
Ana Salomé García Muñiz

508/2010 Export-led-growth hypothesis revisited. a balance of payments approach for Argentina, Brazil, Chile and Mexico
David Matesanz Gómez & Guadalupe Fugarolas Álvarez-Ude

509/2010 Realised hedge ratio properties, performance and implications for risk management: evidence from the spanish ibex 35 spot and futures markets
David G McMillan & Raquel Quiroga García

510/2010 Do we sack the manager... or is it better not to? Evidence from Spanish professional football
Francisco González-Gómez, Andrés J. Picazo-Tadeo & Miguel Á. García-Rubio

511/2010 Have Spanish port sector reforms during the last two decades been successful? A cost frontier approach
Ana Rodríguez-Álvarez & Beatriz Tovar

512/2010 Size & Regional Distribution of Financial Behavior Patterns in Spain
Juan Antonio Maroto Acín, Pablo García Estévez & Salvador Roji Ferrari

513/2010 The impact of public reforms on the productivity of the Spanish ports: a parametric distance function approach
Ramón Núñez-Sánchez & Pablo Coto-Millán

514/2010 Trade policy versus institutional trade barriers: an application using "good old" ols
Laura Márquez-Ramos, Inmaculada Martínez-Zarzoso & Celestino Suárez-Burguet

515/2010 The "Double Market" approach in venture capital and private equity activity: the case of Europe
Marina Balboa & José Martí

516/2010 International accounting differences and earnings smoothing in the banking industry
Marina Balboa, Germán López-Espinosa & Antonio Rubia

517/2010 Convergence in car prices among European countries
Simón Sosvilla-Rivero & Salvador Gil-Pareja

518/2010 Effects of process and product-oriented innovations on employee downsizing
José David Vicente-Lorente & José Ángel Zúñiga-Vicente

519/2010 Inequality, the politics of redistribution and the tax-mix
Jenny De Freitas

520/2010 Efectos del desajuste educativo sobre el rendimiento privado de la educación: un análisis para el caso español (1995-2006)
Inés P. Murillo, Marta Rahona y Mª del Mar Salinas

521/2010 Sructural breaks and real convergence in opec countries
Juncal Cuñado

522/2010 Human Capital, Geographical location and Policy Implications: The case of Romania
Jesús López-Rodríguez, Andres Faiña y Bolea Cosmin-Gabriel

523/2010 Organizational unlearning context fostering learning for customer capital through time: lessons from SMEs in the telecommunications industry
Anthony K. P. Wensley, Antonio Leal-Millán, Gabriel Cepeda-Carrión & Juan Gabriel Cegarra-Navarro

524/2010 The governance threshold in international trade flows
Marta Felis-Rota

525/2010 The intensive and extensive margins of trade decomposing exports growth differences across Spanish regions
Asier Minondo Uribe-Etxeberria & Francisco Requena Silvente

526/2010 Why do firms locate r&d outsourcing agreeements offshore? the role of ownership, location, and externalization advantages
Andrea Martínez-Noya, Esteban Gárcía-Canal & Mauro f. Guillén

527/2010 Corporate Taxation and the Productivity and Investment Performance of Heterogeneous Firms: Evidence from OECD Firm-Level Data
Norman Gemmell, Richard Kneller, Ismael Sanz & José Félix Sanz-Sanz

528/2010 Modelling Personal Income Taxation in Spain: Revenue Elasticities and Regional Comparisons
John Creedy & José Félix Sanz-Sanz

529/2010 Mind the Remoteness!. Income disparities across Japanese Prefectures
Jesús López-Rodríguez□, Daisuke Nakamura

530/2010 El nuevo sistema de financiación autonómica: descripción, estimación empírica y evaluación
Antoni Zabalza y Julio López Laborda

531/2010 Markups, bargaining power and offshoring: an empirical assessment
Lourdes Moreno & Diego Rodríguez

532/2010 The snp-dcc model: a new methodology for risk management and forecasting
Esther B. Del Brio, Trino-Manuel Ñíguez & Javier Perote

533/2010 El uso del cuadro de mando integral y del presupuesto en la gestión estratégica de los hospitales públicos
David Naranjo Gil

534/2010 Análisis de la efectividad de las prácticas de trabajo de alta implicación en las fábricas españolas
Daniel Vázquez-Bustelo□□ y Lucía Avella Camarero

535/2010 Energía, innovación y transporte: la electrificación de los tranvías en España, 1896-1935
Alberte Martínez López

536/2010 La ciudad como negocio: gas y empresa en una región española, Galicia 1850-1936
Alberte Martínez López y Jesús Mirás Araujo

537/2010 To anticipate or not to anticipate? A comparative analysis of opportunistic early elections and incumbents' economic performance
Pedro Riera Sagrera

538/2010 The impact of oil shocks on the Spanish economy
Ana Gómez-Loscos, Antonio Montañés & María Dolores Gadea

539/2010 The efficiency of public and publicly-subsidiz ed high schools in Spain. evidence from pisa-2006
María Jesús Mancebón, Jorge Calero, Álvaro Choi & Domingo P. Ximénez-de-Embún

540/2010 Regulation as a way to force innovation: the biodiesel case
Jordi Perdiguero & Juan Luis Jiménez

541/2010 Pricing strategies of Spanish network carrier
Xavier Fageda, Juan Luis Jiménez & Jordi Perdiguero

542/2010 Papel del posicionamiento del distribuidor en la relación entre la marca de distribuidor y lealtad al establecimiento comercial
Oscar González-Benito y Mercedes Martos-Partal

543/2010 How Bank Market Concentration, Regulation, and Institutions Shape the Real Effects of Banking Crises
Ana I. Fernández, Francisco González & Nuria Suárez

544/2010 Una estimación del comercio interregional trimestral de bienes en España mediante técnicas de interpolación temporal
Nuria Gallego López, Carlos Llano Verduras y Julián Pérez García

545/2010 Puerto, empresas y ciudad: una aproximación histórica al caso de Las Palmas de Gran Canaria
Miguel Suárez, Juan Luis Jiménez y Daniel Castillo

546/2010 Multinationals in the motor vehicles industry: a general equilibrium analysis for a transition economy
Concepción Latorre & Antonio G. Gómez-Plana

547/2010 Core/periphery scientific collaboration networks among very similar researchers
Antoni Rubí-Barceló

548/2010 Basic R&D in vertical markets
Miguel González-Maestre & Luis M. Granero

549/2010 Factores condicionantes de la presión fiscal de las entidades de crédito españolas, ¿existen diferencias entre bancos y cajas de ahorros?
Ana Rosa Fonseca Díaz, Elena Fernández Rodríguez y Antonio Martínez Arias

550/2010 Analyzing an absorptive capacity: Unlearning context and Information System Capabilities as catalysts for innovativeness
Gabriel Cepeda-Carrión, Juan Gabriel Cegarra-Navarro & Daniel Jimenez-Jimenez

551/2010 The resolution of banking crises and market discipline: international evidence
Elena Cubillas, Ana Rosa Fonseca & Francisco González

552/2010 A strategic approach to network value in information markets
Lucio Fuentelsaz, Elisabet Garrido & Juan Pablo Maicas

553/2010 Accounting for the time pattern of remittances in the Spanish context
Alfonso Echazarra

554/2010 How to design franchise contracts: the role of contractual hazards and experience
Vanesa Solis-Rodriguez & Manuel Gonzalez-Diaz

555/2010 Una teoría integradora de la función de producción al rendimiento empresarial
Javier González Benito

556/2010 Height and economic development in Spain, 1850-1958
Ramón María-Dolores & José Miguel Martínez-Carrión

557/2010 Why do entrepreneurs use franchising as a financial tool? An agency explanation
Manuel González-Díaz & Vanesa Solís-Rodríguez

558/2010 Explanatory Factors of Urban Water Leakage Rates in Southern Spain
Francisco González-Gómez, Roberto Martínez-Espiñeira, Maria A. García-Valiñas & Miguel Á. García Rubio

559/2010 Los rankings internacionales de las instituciones de educación superior y las clasificaciones universitarias en España: visión panorámica y prospectiva de futuro.
Carmen Pérez-Esparrells y José Mª Gómez-Sancho.

560/2010 Análisis de los determinantes de la transparencia fiscal: Evidencia empírica para los municipios catalanes
Alejandro Esteller Moré y José Polo Otero

561/2010 Diversidad lingüística e inversión exterior: el papel de las barreras lingüísticas en los procesos de adquisición internacional
Cristina López Duarte y Marta Mª Vidal Suárez

562/2010 Costes y beneficios de la competencia fiscal en la Unión Europea y en la España de las autonomías
José Mª Cantos, Agustín García Rico, Mª Gabriela Lagos Rodríguez y Raquel Álamo Cerrillo

563/2010 Customer base management and profitability in information technology industries
Juan Pablo Maicas y Francisco Javier Sese

564/2010 Expansión internacional y distancia cultural: distintas aproximaciones —hofstede, schwartz, globe
Cristina López Duarte y Marta Mª Vidal Suárez

565/2010 Economies of scale and scope in service firms with demand uncertainty: An application to a Spanish port
Beatriz Tovar & Alan Wall

566/2010 Fiscalidad y elección entre renta vitalicia y capital único por los inversores en planes de pensiones: el caso de España
Félix Domínguez Barrero y Julio López Laborda

567/2010 Did the cooperative start life as a joint-stock company? Business law and cooperatives in Spain, 1869–1931
Timothy W. Guinnan & Susana Martínez-Rodríguez

568/2010 Predicting bankruptcy using neural networks in the current financial crisis: a study for US commercial banks
Félix J. López-Iturriaga, Óscar López-de-Foronda & Iván Pastor Sanz

569/2010 Financiación de los cuidados de larga duración en España
Raúl del Pozo Rubio y Francisco Escribano Sotos

570/2010 Is the Border Effect an Artefact of Geographic Aggregation?
Carlos Llano-Verduras, Asier Minondo-Uribe & Francisco Requena-Silvente

571/2010 Notes on using the hidden asset or the contribution asset to compile the actuarial balance for pay-as-you-go pension systems
Carlos Vidal-Meliá & María del Carmen Boado-Penas

572/2010 The Real Effects of Banking Crises: Finance or Asset Allocation Effects? Some International Evidence
Ana I. Fernández, Francisco González & Nuria Suárez Carlos

573/2010 Endogenous mergers of complements with mixed bundling
Ricardo Flores-Fillol & Rafael Moner-Colonques

574/2010 Redistributive Conflicts and Preferences for Tax Schemes in Europe
Antonio M. Jaime-Castillo & Jose L. Saez-Lozano

575/2010 Spanish emigration and the setting-up of a great company in Mexico: bimbo, 1903-2008
Javier Moreno Lázaro

576/2010 Mantenimiento temporal de la equidad horizontal en el sistema de financiación autonómica
Julio López Laborda y Antoni Zabalza

577/2010 Sobreeducación, Educación no formal y Salarios: Evidencia para España
Sandra Nieto y Raúl Ramos

578/2010 Dependencia y empleo: un análisis empírico con la encuesta de discapacidades y atención a la dependencia (edad) 2008.
David Cantarero-Prieto y Patricia Moreno-Mencía

579/2011 Environment and happiness: new evidence for Spain
Juncal Cuñado & Fernando Pérez de Gracia

580/2011 Aanalysis of emerging barriers for e-learning models. a case of study
Nuria Calvo & Paolo Rungo

581/2011 Unemployment, cycle and gender
Amado Peiró, Jorge Belaire-Franch, & Maria Teresa Gonzalo

582/2011 An Analytical Regions Proposal for the Study of Labour Markets: An Evaluation for the Spanish Territory
Ana Viñuela Jiménez & Fernando Rubiera Morollón

583/2011 The Efficiency of Performance-based-fee Funds
Ana C. Díaz-Mendoza, Germán López-Espinosa & Miguel A. Martínez-Sedano

584/2011 Green and good?. The investment performance of US environmental mutual funds
Francisco J. Climent-Diranzo & Pilar Soriano-Felipe

585/2011 El fracaso de Copenhague desde la teoría de juegos.
Yolanda Fernández Fernández, Mª Ángeles Fernández López y Blanca Olmedillas Blanco

586/2011 Tie me up, tie me down! the interplay of the unemployment compensation system, fixed-term contracts and rehirings
José M. Arranz & Carlos García-Serrano

587/2011 Corporate social performance, innovation intensity and their impacts on financial performance: evidence from lending decisions
Andrés Guiral

588/2011 Assessment of the programme of measures for coastal lagoon environmental restoration using cost-benefit analysis.
José Miguel Martínez Paz & Ángel Perni Llorente

589/2011 Illicit drug use and labour force participation: a simultaneous equations approach
Berta Rivera, Bruno Casal, Luis Currais & Paolo Rungo

590/2011 Influencia de la propiedad y el control en la puesta en práctica de la rsc en las grandes empresas españolas
José-Luis Godos-Díez, Roberto Fernández-Gago y Laura Cabeza-García

591/2011 Ownership, incentives and hospitals
Xavier Fageda & Eva Fiz

592/2011 La liberalización del ferrocarril de mercancías en europa: ¿éxito o fracaso?
Daniel Albalate del Sol, Maria Lluïsa Sort García y Universitat de Barcelona

593/2011 Do nonreciprocal preference regimes increase exports?
Salvador Gil-Pareja, Rafael Llorca-Vivero & José Antonio Martínez-Serrano

594/2011 Towards a dynamic analysis of multiple-store shopping: evidence from Spanish panel data
Noemí Martínez-Caraballo, Manuel Salvador, Carmen Berné & Pilar Gargallo

595/2011 Base imponible y neutralidad del impuesto de sociedades: alternativas y experiencias
Lourdes Jerez Barroso

596/2011 Cambio técnico y modelo de negocio: las compañías de transporte urbano en España, 1871-1989
Alberte Martínez López

597/2011 A modified dickey-fuller procedure to test for stationarity
Antonio Aznar, María-Isabel Ayuda

598/2011 Entorno institucional, estructura de propiedad e inversión en I+D: Un análisis internacional
Félix J. López Iturriaga y Emilio J. López Millán

599/2011 Factores competitivos y oferta potencial del sector lechero en Navarra
Valero L. Casasnovas Oliva y Ana M. Aldanondo Ochoa

600/2011 Política aeroportuaria y su impacto sobre la calidad percibida de los aeropuertos
Juan Luis Jiménez y Ancor Suárez

601/2011 Regímenes de tipo de cambio y crecimiento económico en países en desarrollo
Elena Lasarte Navamuel y José Luis Pérez Rivero

602/2011 La supervivencia en las empresas de alta tecnología españolas: análisis del sector investigación y desarrollo
Evangelina Baltar Salgado, Sara Fernández López, Isabel Neira Gómez y Milagros Vivel Búa

603/2011 Análisis económico y de rentabilidad del sistema financiero español, por tipo de entidades y tamaño, después de cuatro años de crisis y ante los retos de la reestructuración financiera
Salvador Climent Serrano

604/2011 Does competition affect the price of water services? Evidence from Spain
Germà Bel, Francisco González-Gómez & Andrés J Picazo-Tadeo

605/2011 The Effects of Remoteness in Japanese Educational Levels
Jesús López-Rodríguez & Daisuke Nakamura

606/2011 The money market under information asymmetries and imperfectly competitive loan and deposit markets
Aday Hernández

607/2011 The effects of airline and high speed train integration
M. Pilar Socorro & M. Fernanda Viecens

608/2011 Consecuencias de la imbricación de los clientes en la dirección medioambiental: un análisis empírico
Jesús Ángel del Brío González, Esteban Fernández Sánchez y Beatriz Junquera Cimadevilla

609/2011 Revenue autonomy and regional growth: an analysis for the 25 year-process of fiscal decentralisation in Spain
Ramiro Gil-Serrate, Julio López-Laborda & Jesús Mur

610/2011 The accessibility to employment offices in the Spanish labor market: Implications in terms of registered unemployment
Patricia Suárez, Matías Mayor & Begoña Cueto

611/2011 Time-varying integration in European government bond markets
Pilar Abad, Helena Chuliá & Marta Gómez-Puig

612/2011 Production networks and EU enlargement: is there room for everyone in the automotive industry?
Leticia Blázquez, Carmen Díaz-Mora & Rosario Gandoy

613/2011 Los factores pronóstico económico, estructura productiva y capacidad de innovar en la valoración de activos españoles
Mª Begoña Font Belaire y Alfredo Juan Grau Grau

614/2011 Capital structure adjustment process in firms accessing venture funding
Marina Balboa, José Martí & Álvaro Tresierra

615/2011 Flexibilidad Contable en la Valoración de Instrumentos Financieros Híbridos
Jacinto Marabel-Romo, Andrés Guiral-Contreras & José Luis Crespo-Espert

616/2011 Why are (or were) Spanish banks so profitable?
Antonio Trujillo-Ponce

617/2011 Extreme value theory versus traditional garch approaches applied to financial data: a comparative evaluation
Dolores Furió & Francisco J. Climent

618/2011 La restricción de balanza de pagos en la España del euro. Un enfoque comparativo.
David Matesanz Gómez, Guadalupe Fugarolas Álvarez-Ude y Roberto Bande Ramudo

619/2011 Is inefficiency under control in the justice administration?
Marta Espasa & Alejandro Esteller-Moré

620/2011 The evolving patterns of competition after deregulation
Jaime Gómez Villascuerna, Raquel Orcos Sánchez & Sergio Palomas Doña

621/2011 Análisis pre y post-fusiones del sector compuesto por las cajas de ahorros españolas: el tamaño importa
Antonio A. Golpe, Jesús Iglesias y Juan Manuel Martín

622/2011 Evaluating three proposals for testing independence in non linear spatial processes
Fernando A. López-Hernández, M. Luz Maté-Sánchez-Val & Andrés Artal-Tur

623/2011 Valoración del Mercado de los Activos Éticos en España: una Aplicación del Método de los Precios Hedónicos
Celia Bilbao-Terol y Verónica Cañal-Fernández

624/2011 Happiness beyond Material Needs: The Case of the Mayan People
Jorge Guardiola, Francisco González-Gómez & Miguel A. García-Rubio

625/2011 Stock characteristics, investor type and market myopia
Cristina Del Rio-Solano & Rafael Santamaria-Aquilué

626/2011 Is mistrust under control in the justice administration?
Alejandro Esteller-Moré

627/2011 Working capital management, corporate performance, and financial constraints
Sonia Baños-Caballero, Pedro J. García-Teruel & Pedro Martínez-Solano

628/2011 On the optimal distribution of traffic of network ailines
Xavier Fageda & Ricardo Flores-Fillol