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LOCAL LOW-TRAFFIC AIRPORTS IN SPAIN: PROBLEMS AND THE NECESSARY REORGANISATION OF THE TERRITORIAL NETWORK

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ABSTRACT

Throughout the last four decades in Spain, the network of airports with exterior connections has significantly expanded. In fact, the total number of airports has increased from 20 to just over 50. The airport-building process has been particularly vigorous in recent years, all within a framework of intensive construction of a transportation infrastructure as a basis for economic growth. In the case of airports, a desire to increase tourism stands out as a primary motivating factor for growth. Generous financial support from the European Union, cheap financing and a national decentralisation policy have also contributed to the airport-building phenomenon. Such politics, however, have given more priority to local interests than to the interests of the country as a whole. Furthermore, the liberalisation of the air traffic market, new organisational systems for air traffic and the rise of Low-Cost Carriers (LCCs) have all contributed to the airport boom. But the recent economic crisis has significantly reduced passenger traffic in the majority of the small local airports in Spain. This crisis situation calls for a thorough reorganisation of the Spanish airport system, with a particular focus on these small local airports. Ultimately, the airport system should better serve the territorial urban network and reflect a more open and competitive aviation market.

Key words: air transport, **small local airports (SLAs)**, airport system, reorganisation of the air transport network, Spain.

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RESUMEN

La consolidación de la red de aeropuertos en España y el fuerte aumento del tráfico aéreo es reciente, últimas cuatro décadas. Por ello, tanto los aeropuertos en servicio, como el volumen global del tráfico aéreo, convierten a España, por su tamaño, en uno de los principales mercados europeos. En los inicios de 1970 apenas había en España veinte aeropuertos con tráfico regular de pasajeros. Ahora son medio centenar. Eso ha supuesto inversiones cuantiosas. Se confirma el papel clave desempeñado por las compañías Low Cost. Han sido esenciales durante los últimos años de crecimiento del tráfico aéreo. En este trabajo se estudia el caso de los pequeños aeropuertos en España. Se aborda la evolución de su tráfico de pasajeros, su rápido aumento y su acusado descenso en años recientes, 2007-2012. A través del análisis de su localización espacial, de su estructura, organización y comportamiento, interesa comprender las causas de la fuerte reducción de su tráfico. Así mismo, se intenta indagar en sus consecuencias cara a la futura reorganización que, con toda probabilidad, se producirá en el sistema de la red española del tráfico aéreo. Todo eso, dentro del necesario cambio hacia un nuevo modelo productivo.

Palabras clave: transporte aéreo, aeropuertos de reducido tráfico, sistema aeroportuario, reordenación de la red de transporte aéreo, España.

I. INTRODUCTION AND APPROACH

Flows of traffic of people and goods are continuously increasing worldwide; such traffic is a feature of developed societies. In terms of air transport, although air traffic began in the early twentieth century, the massive development of commercial aviation has been more recent. Within the last two decades, air transport has undergone intense changes in terms of organisation and operation (Rodriguez *et al*., 2009). The process of liberalisation of the air traffic market has been a key element of these changes (Goetz and Graham, 2004; Bowen, 2009; Button, 2009). We have gone from a situation in which national companies dominated the market to a market in which low-cost carriers (LCCs) continue to expand their market share (Guillen and Lall, 2004).

At the same time, the spatial patterns for organising air traffic are also changing (Burghouwt, 2007). Initially, network links tend to begin with limited nodes of service (cities and areas with the greatest potential traffic). Soon, the hub and spoke model (HS) is often replaced (Wojahn, 2001), and direct links between cities at lower levels of the urban hierarchy are consolidated (point-to-point, PP) (Zook and Brunn, 2006). The emergence of new patterns of spatial organisation does not, however, imply the complete disappearance of the previously dominant models (Derudder, 2009). In fact, these different models coexist while competing with one another (Alderighi *et al*., 2005). In fact, the current trend is toward the coexistence and interdependence of new mixed models (Suau-Sánchez and Burghouwt, 2011).

Transport, transport accessibility and territorial organisation are essential aspects of human activity. Any profound transformation of the first causes affects how the country functions (Harvey, 1990). Air traffic is an essential in terms of human movement (Derud-

der, 2008), and no city or urban area wishes to be deprived of this means of transport (Bel and Fadega, 2007). Cities are almost always interested in offering new air links. At the same time, thanks to the growing role of air travel, airports today are of significant direct and indirect economic importance (Kasarda and Lindsay, 2011). Airports are therefore a priority in any territorial infrastructure policy (Garcia Lizana *et al*., 1996). For this reason, cities with smaller populations and less service and industry sector activities want to offer their own air transport services (Gámir and Ramos, 2002), and many cities in Spain have in fact achieved this. But there are of course limits to what is financially viable, and it is just not feasible for all Spanish cities to have their own airports.

II. DELIMITATIONS AND OBJECTIVES. DATA AND METHODS

This paper is a case study of the small local airports (SLAs) in Spain. We examine the evolution of passenger traffic in Spain, focusing on its rapid rise and sharp decline in recent years (2007-2012). Through an analysis of the spatial location of the Spanish SLAs and their structure, organisation and behaviour, we seek to understand the causes of the sharp reduction in traffic. We also try to evaluate the potential consequences of the likely future reorganisation of the Spanish air traffic network, as has happened in some neighbouring countries (Limtanakool *et al*., 2007). This study has been conducted in a context of change in which a new production model is clearly necessary.

SLAs are considered airports that account for less than 1.5 million passengers per year. The origin and purpose of these airports vary: they may be used largely for local or subregional services, for tourism or for other strategic purposes, such as insular development strategies, etc. The SLAs in Spain are thus heterogeneous and present diverse issues. Despite such differences, however, almost all of these airports are suffering from the economic crisis and reductions in traffic. Within the general context of Spanish air traffic, SLAs have recorded higher proportional declines with respect to the average. The hypothesis defended in this paper is that this process of decline in air traffic is not just a temporary situation for the causes are deep and complex. To a large extent, many of the Spanish SLAs can be seen as part of an economic model based on a vision of expansion and unlimited growth. This model has been supported by a few basic props related to tourism, leisure and free time, and construction, and has also benefitted from significant investments in new infrastructure (Serrano, 2002). At the same time, generous public subsidies have also helped increase traffic to and from Spanish airports. This economic model has boiled down to excessive funding for airports, especially in certain regions. Now, however, in a situation of deep economic crisis, numerous subsidies have disappeared and overall air traffic has declined, jeopardising the viability of many of the Spanish SLAs due to a lack of sufficient passengers.

The paper is organised as follows: after defining the lines of introduction and approach to the subject in Section 1, in this section, Section 2, the data sources and research methodology are presented. Section 3 consists of an overview of the configuration process of the Spanish airport network and the period of significant increases in air traffic in Spain. The principal aim of this section is to describe the significance of passenger traffic in Spain. In Section 4 we analyse the Spanish SLAs. This section begins with a study of the type and location of

the SLAs followed by an analysis of the volume of air traffic in this sector. We then analyse the strong impact of the economic crisis on the SLAs in Spain, establishing differences in behaviour among airports and current responses. Furthermore, we also analyse the composition of SLA air traffic according to destination. Finally, we study the transformation of the flight system and the growing weight of LCCs and their link networks and connectivity. In Section 5 we discuss the different behaviour of the passenger traffic in the Spanish SLAs and recent adjustments made by the agency that oversees and coordinates the Spanish airport network. The analysis in Section 5 is based on a broad vision of the whole Spanish territory, thus defining the limited role of these small local airports. The paper ends with Section 6, the concluding remarks, which stress the main reasons why the future will be difficult for the Spanish SLAs. Challenges include reduced traffic, uneven geographical coverage and uncertain strategic significance. Furthermore, the heterogeneous nature of the SLAs in Spain calls for differentiated solutions.

Data. Most of the data used, detailed in each table, come from the Spanish Ministry of Public Works and Transport and the following agencies: AENA (Spanish Airports and Air Navigation) and Eurostat (European Union, 2013). Other demographics and complementary urban data have been taken from INE (National Statistics Institute of Spain) and the respective cities and autonomous regions where the airports studied are located.

Methods. The data are analysed successively combining interrelated elements. We followed a similar process to that carried out in other works in the current academic literature. This literature has provided us with secondary sources of information. For example, we have employed a formula used by other researchers in the field for calibrating the domestic and international connectivity coefficients. The cartography makes it easier to understand the distribution of the low-traffic airports at the territorial level.

III. CONSOLIDATION OF THE SPANISH AIRPORT NETWORK AND INCREASES IN AIR TRAFFIC

The consolidation of the Spanish airport network and the sharp increase in air traffic are recent developments, occurring within the last four decades. The number of airports in service in Spain and the overall volume of air traffic make the country one of the main European markets (Suau-Sánchez, 2013).

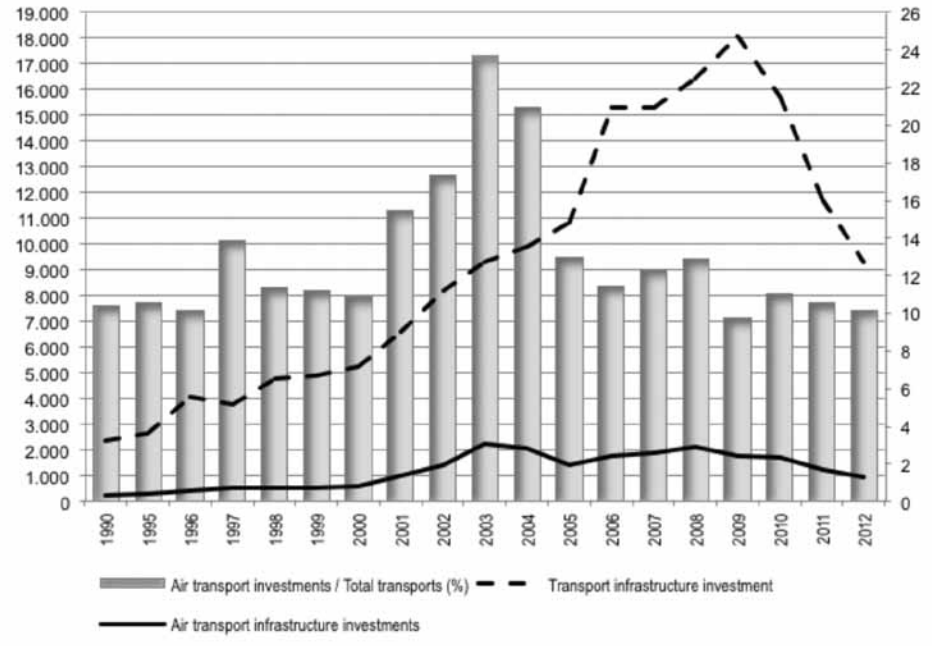
III.1. Airport network configuration

At the beginning of 1970, Spain had only 20 airports with scheduled passenger traffic. Now there are 50. This increase has involved substantial investment, detailed in Figure 1.

When Spain entered the European Economic Community (1986), the transport infrastructure was weak (Salmon, 1994). Years of continuous economic growth, however, have led to increased investment in the transport infrastructure in Spain, including financial support from the European Union. Air transport has not been the main destination for these funds, however. In fact, the largest sums have been invested in the road and railroad infrastructure (particularly for high speed trains). Nevertheless, air transport has received an average of more than ten percent of total investments, and in some years this proportion has been twice as high (2003 and 2004). Almost all existing airports

have been renovated, improved or expanded, and, in some cases, new airports have been built. Investments have been made in both main airports as well as in regional and local airports. Perhaps, however, the territorial distribution of these airports has not been balanced. Political pressures (regional and local) in a highly decentralised state have hindered rational decisions in all matters related to territory, as in other cases (Feldhoff, 2002). Furthermore, faith in an economic model based primarily on tourism has strongly influenced infrastructure investment.

Figure 1
AMOUNTS OF INVESTMENTS IN THE TRANSPORT INFRASTRUCTURE/AIR TRANSPORT IN SPAIN



Source: Authors, data from the Spanish Ministry of Public Works and Transport.

III.2. Significant increases in air traffic

The increase in air traffic at Spanish airports within the last several decades has been very intense, as can be seen in the passenger movement data in Table 1 below.

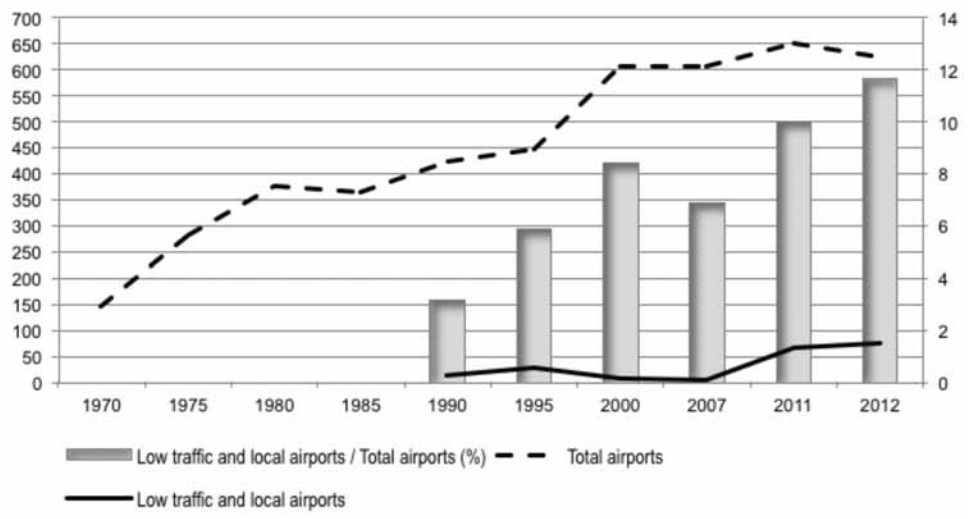
Between 1970 and 2012 there was a nearly 10-fold increase in air passenger traffic in Spain. Although the pace of the increase varied, it was nevertheless significant in each five-year period indicated. The amount of air passenger traffic in Spain is very high in the context of the European Union. Only in recent years has there been a significant reduction in air passenger traffic data. This reversal is in part due to the economic crisis, but is also a symptom of the exhaustion of a model. Meanwhile, the movement of goods has been far more modest (Figure 2).

Table 1
EVOLUTION AND STRUCTURE OF AIR PASSENGER TRANSPORT IN SPAIN

Years	Passengers (thousands)	Percentage, significance of increase, 1970=100	Increase (%) on previous temporary reference	% Domestic traffic/total	% International traffic/total	International traffic. Increase (%) on time reference
1970	21,415	100.0	-	46.2	53.7	-
1975	37,773	176,3	(1970-75) 76.3	48.6	51.4	(1970-75) 68.6
1980	45,560	212,7	20.6	54.3	45.6	7.2
1985	50,541	235,9	10.9	42.1	57.9	35.8
1990	73,369	342,5	45.1	48.0	52.0	35.0
1995	94,869	442,9	29.3	42.0	58.0	44.3
2000	138,690	647,5	46.4	41.6	58.4	47.5
2007	208,510	973,5	50.5	42.6	57.4	47.9
2011	203,291	949,1	-2.5	37.5	62.5	6.1
2012	193,178	902,0	-4.98	34.54	65.46	0.050

Source: Authors, data from the Spanish Ministry of Public Works and Transport and the Spanish Civil Aviation Authority (DGAC).

Figure 2
WEAKNESS OF AIR FREIGHT TRAFFIC



Source: Authors, data from the Spanish Ministry of Public Works and Transport and the Spanish Civil Aviation Authority (DGAC).

In total absolute value, air freight traffic volume, at 0.64 million tons, is low in Spain. Furthermore, the proportion of air freight traffic has grown by less than half of that of air passenger traffic. The amount of air freight traffic in Spain is minimal; most goods in the country are transported by road and sea (Seguí and Martínez, 2004). It is therefore easy to deduce a clear specialisation in air passenger traffic in Spain. Nevertheless, freight traffic from small airports has not ceased to increase, even in years in which passenger traffic has declined. In fact, air freight traffic from the SLAs rose by 11.67% in 2012. We should clarify, however, that this increase is due to a growing role played by the Zaragoza airport as a logistics centre rather than to a global specialisation among the SLAs.

III.3. Structure and typology of passenger traffic

Ever since air passenger traffic began to increase in Spain, figures have reflected the importance of international traffic (53.7% in 1970). The proportions in the following years confirm and reinforce this trend. In 2012, the percentage of international traffic exceeded 65.4%. The significance of international traffic is due to the consolidation of an economic model in Spain in which tourism plays a central role. For years, air passenger traffic in Spain has experienced continuous growth, albeit in different stages. The economic crisis has reduced the share of domestic traffic yet has benefitted international traffic. Tourism has resisted the crisis well in Spain.

IV. ANALYSIS OF THE NETWORK OF SMALL LOCAL AIRPORTS IN SPAIN. STRUCTURE AND PERFORMANCE

The analysis of the location, territorial behaviour and function of the SLAs in Spain is particularly interesting. The basic aim of this analysis was to calculate future perspectives. The importance of an airport lies especially in the amount of traffic it receives; its strategic value is another matter. Therefore, the basic criterion to consider when working with SLAs is annual movement, especially of passengers. Beyond a minimum threshold (1.5 million passengers per year), AENA considers that, under normal conditions, an airport requires little aid or compensation. Typically, around 20,000 flights are needed to reach this number of passengers. However, due to the small size of the planes that often serve these airports, because of low passenger volume, more flights are needed to obtain modest passenger numbers.

IV.1. Origins and spatial location.

The heterogeneity of the SLAs in Spain can be seen clearly when considering a number of criteria. In terms of airport origin, for example, several Spanish SLAs are former military airports that have been converted for civil aviation use: Albacete, Badajoz, Salamanca, Valladolid, León, Zaragoza, etc. Other Spanish SLAs are newly built: Granada, El Hierro, La Palma, Pamplona, etc. The demographic size of the principal city near each SLA in Spain as well as the potential area of influence of each airport also differ significantly. Such cities range in size from just over 20,000 residents to nearly 1.5 million. The morphology and

layout of the Spanish territory of course also contribute to differences between airports. The archipelago of the Canary Islands, for example, must have small island airports. To give another example, due to the narrow dimensions of the city of Ceuta, two heliports have been built (one in Ceuta itself and another in the nearby city of Algeciras).

Maps illustrating the spatial distribution of the Spanish SLAs (Figure 3) show a clear concentration in coastal areas: Vigo, La Coruña, Santander, San Sebastián, Reus, Murcia, Almería, etc. Many SLAs are also located in areas near the coast: Asturias, Vitoria, Granada, and Jerez. Nevertheless, there are several SLAs located within the Peninsula: Albacete, Badajoz, Córdoba, Salamanca, Valladolid, León, Zaragoza, and Pamplona. In these central areas, the population density is very low (AENA, 1996).

Figure 3
NETWORK OF SMALL LOCAL AIRPORTS (SPAIN)

Source: Authors.

The combination of these different characteristics results in a complex spatial distribution. The spaces without an airport nearby are scarce. The morphology of the airport network in Spain, with its high density of nodes, confirms that it is difficult to find an area in the country that is more than 200 km from an airport. This distribution equates to an isochrone with no more than 100 minutes of travel time by land between any two points.

The lack of an overall plan for air transport in Spain, in addition to the fact that the airport infrastructure expanded as airport operators and airlines responded to local interests, explains the abundance of airports in Spain and the current imbalances throughout the country.

IV.2. Air traffic volume

Out of all the Spanish airports (including the two heliports), 30 are of local character and have low volumes of traffic. Due to this low level of traffic (less than 1.5 million passengers per year), the overall movement through these airports represents only a small proportion with respect to global traffic. Detailed data are provided in Table 2.

Table 2
TRAFFIC DEVELOPMENT AT SMALL AIRPORTS (SLAS)

Years	2000		2007		2012		Variation 2007-2012	
-	Total	SLAs	Total	SLAs	Total	SLAs	Total	SLAs
Global movement of passengers (thousands)	138,615	7,686	208,510	16,716	193,178	11,445	-15,332	-5,271
Significance of SLAs/Total (%)	-	5.5	-	8.0	-	5.9	-	-2.1
Total aircraft (thousands)	1,372.7	124.3	2,082.9	243.0	1,664.3	158.9	-418.6	-84.1
Significance of SLAs / Total (%)	-	9.0	-	11.6	-	9.5	-	-2.1
Transport of goods (Total: thousands MT; SLAs: MT)	424,7	13.5	607,5	4.1	671,7	73.1	64,2	69.0
Significance of SLAs / Total (%)	-	3.1	-	0.7	-	10.8	-	10.1

Source: Authors, data from the Spanish Ministry of Public Works and Transport.

To gain a broader perspective, we started with data from the year 2000. Between this year and 2007, there was a strong increase in traffic. However, the data of 2012 confirms a sharp decline. Analysis of these data makes it possible to draw the following conclusions:

i) The total air passenger traffic in the Spanish SLAs barely exceeded 8% of the overall total for Spain in 2007, the maximum proportion observed.
ii) Aircraft movement was also minimal, barely exceeding 11% of the overall total for Spain in 2007. This confirms the smaller size of the planes servicing the SLAs. In addition, the occupancy rate of these planes was slightly below average.
iii) In the Spanish SLAs, air freight transport is a sector of little significance, although it shows a different trend than passenger traffic. In 2000, the proportion of overall freight traffic in the SLAs was low (3.17% of the total). The proportion then decreased to 0.7% in 2007. However, in 2012, the amount of goods transported through the SLAs increased and the proportion (SLAs/total airports) reached 10.8%. Neverthe-

less, this substantial increase is due to a single airport, Zaragoza, which has carved out something of a niche for itself in the freight transport sector (Zaragoza airport accounts for 80% of all goods transported through the Spanish SLAs). The logistics centre set up in Zaragoza (Morales, 2010) has driven this increase in freight traffic.

IV.3. The strong impact of the global economic crisis on the Spanish SLAs

The global economic crisis has hit Spain hard, and the air traffic sector has clearly suffered the consequences. Overall passenger traffic has decreased, yet SLAs have been more strongly affected than the main airports, as can be seen in Tables 3 and 4.

Table 3
VARIATIONS IN PASSENGER TRAFFIC (LARGE AND SMALL AIRPORTS) BY DESTINATION: DOMESTIC AND INTERNATIONAL. ABSOLUTE VALUES AND PERCENTAGES

	2000-2007			2007-2012		
	Total	Main airports (MAs)	Small airports (SLAs)	Total	Main airports (MAs)	Small airports (SLAs)
Absolute values (thousands)	69,896	60,866	9,030	-15,332	-10,061	-5,271
Percentage (%)	5.4	46.5	117.5	-7.3	-5.2	-31.5

Source: Authors, data from the Spanish Ministry of Public Works and Transport.

During the years of growth in air traffic in Spain, the number of passengers who used SLAs sharply increased, from 7.68 million passengers in 2000 to 16.71 in 2007 (a total increase of 9.03 million passengers). In other words, SLA passenger traffic rose by 117.48% in this period, compared to the average increase in total air passenger traffic in Spain of 50.42%. During the same stretch of time, the passenger traffic in the Main Airports (MAs) increased by 46.45%. However, during the following years (2007-2012), global air passenger traffic in Spain showed a reverse trend. Overall traffic decreased by 15.3 million passengers, and out of this number, SLAs lost 5.27 million. In percentage terms, when comparing overall 2012 data with overall 2007 data, air passenger traffic in Spain decreased by 7.3%. Within this total, the MAs suffered a decrease in passenger traffic of 5.2% versus the 31.5% decrease in SLAs. These data confirm that SLAs have suffered the consequences of the economic crisis and airport adjustments to a greater extent than the MAs. These data also indicate an imbalance in the organisation of the airport network in Spain and a capacity that exceeds demand (Anton, 2008).

IV.4. The transformation of air carriers (LCCs) and the spatial patterns of air traffic organisation and the impact on SLAs

Today we can see that the traditional operating system for air traffic hindered growth (Brueckner and Pels, 2007). National monopolies and oligopolies, both internal and external,

were common. This impeded increases in the number of flights available and therefore also precluded decreases in plane fares (Vidal, 2008). In the last several decades, this system has undergone a long process of transition toward a more liberal market. In essence, this liberalisation of the air transport market includes four principal aspects: access to the market, control of capacity, tariffs and the issuance of operating licenses (Warnock-Smith and Potter, 2005). The first steps in this process were taken in the U.S. In the European Union, liberalisation of the aviation market began in 1987. The liberalisation process expanded in successive phases, in 1990 and 1993 (Button et al., 1998). Charter flights were favoured to develop tourism (Díaz, 2012), which was an important initial step, but further changes were needed. The liberalisation of air transport in Europe in April 1997 prompted many adjustments among airports in Spain, and airlines had to face the challenge of further adjustments in the market. One of the most outstanding features resulting from the liberalisation process was the increasing role of Low-Cost Carriers (LCCs) with respect to the Full Service Network Carriers (FSNCs) (Fageda and Hernández-Villadangos, 2009). In the last decade within the European Union, passenger traffic has only increased among the four major low-cost airlines (Ryanair, Easyjet, Air Berlin and Virgin Atlantic), rising from 45.39 million passengers in 2000 to more than 260 million in 2013. Some of these companies have multiplied their initial numbers twenty times (EUROPEAN UNION, 2013) and are thus among the market leaders of all existing airlines in the European Union. In a short period of time, these low-cost carriers have outpaced traditional companies with nearly a century of history and strong state support.

The importance of the low-cost carrier phenomenon has drawn the attention of multiple disciplines: economics, geography, managerial sciences, etc. (Staniland, 2003). The complexity and dimensions of the trend are surprising. These low-cost companies represent a challenge to the traditional way flights have been organised. It is not just a question of reducing costs and providing more flight options by stimulating demand. There hava also been significant changes in the organisation of the flight system. As opposed to the previously predominant hub-and-spoke (HS) network system, flight organisation today tends more towards the point-to-point (PP) system. At present, there is a level of coexistence between the two systems for the spatial organisation of flights (Castillo-Manzano *et al*., 2012). The LCC phenomenon thus constitutes an interesting example: changes in business organisation and management in addition to other changes of a legal nature have had an important influence on the growth of economic activity in air transport. The consequences of the increasing participation of LCCs in Spain, especially in some cases, are appreciable (Bel, 2009). The data in table 4 confirm this statement.

Table 4
PASSENGERS ARRIVING IN SPAIN ACCORDING TO THE AIRLINE USED

	2003		**2007**		**2011**	
Low-Cost	10,471,480	**23.4%**	23,906,824	**39.9%**	36,104,440	**56.9%**
Traditional	34,269,170	76.6%	35,940,533	60.1%	27,395,247	43.1%
Total	44,740,650	100.0%	59,847,357	100.0%	63,499,687	100.0%

Source: Authors, data from AENA (Spanish Airports and Air Navigation).

During the course of the years shown in the table, the number of passengers carried by LCCs in Spain multiplied 3.6 times. The proportional increase has also been very steep. In 2003 LCC passengers accounted for less than a quarter of total passengers arriving in Spain, yet by 2011 this percentage had more than doubled. In the initial years of significant growth, LCCs managed to strongly increase demand. To do this, LCCs have offered lower fares while at the same time providing more direct destinations. In addition, other causes have favoured the rise of LCCs. The development of tourism in Spanish coastal areas, for example, has played a key role in attracting new customers (Saladié *et al*., 2014). The Spanish islands, leading tourist centres, have also helped propel the LCCs (Rendeiro, 2010). Furthermore, through the LCCs, several nodes of the Spanish urban network with regional and local airports have obtained flights with direct links that were either limited or nonexistent just a few years ago. The data in Table 5 provide a fuller picture of the above-mentioned trends. The busiest airports by passenger traffic have been selected.

Table 5
*THE «LOW-COST» CITY/AIRPORT SHARE DURING THE LAST YEAR OF THE SAMPLE, 2011**

	Total	National	E.U.	Non E.U.
Almería	44.35	25.00	80.82	0.00
Asturias	26.08	21.97	56.66	58.94
Jerez de la Frontera	47.64	39.13	63.93	0.00
Granada	44.01	37.23	98.53	25.84
Coruña	27.57	20.00	93.00	0.00
La Palma	13.52	0.16	60.48	99.90
Murcia-San Javier	91.75	36.19	96.83	96.33
Pamplona	11.10	91.28	97.15	0.00
Reus	87.24	93.93	85.42	96.25
San Sebastián	71.24	86.42	88.41	0.00
Santander	69.99	53.95	99.55	0.00
Valladolid	52.04	22.66	86.57	0.71
Vigo	13.39	12.85	19.11	0.00
Zaragoza	67.58	32.10	92.58	3.02

Source: Data from AENA. * For each of the geographical areas considered, namely National territory, the European Union (E.U.) and outside the European Union (Non E.U.).

The differences are varied. At some airports, the passenger arrivals in LCCs represent nearly the totality of passenger traffic, with values above or close to 90% (Murcia-San Javier, Reus). At other airports, however, LCC passengers only account for 13% of the total (Vigo). This variation is due to different performance models. The featured airports largely serve tourists. The proportion of LCC passengers is lower at airports in cities that have larger populations and that function as subregional and local centres (such as Zaragoza, Valladolid and Santander). LCC traffic is also minimal at airports located in cit-

ies that, even with a significant population, do not play a significant role at the regional or local level (Vigo), or in cities that have competition from other nearby airports.

Similar differences in proportions can be found in domestic flight data due to a variety of factors. For example, national companies have traditionally covered certain routes and continue to do so today (La Palma, Granada, etc).

The proportion of low-cost flights within the European Union is the highest. With few exceptions, the number always exceeds 50%. These numbers confirm the success of the diverse range of flights offered under the PP model for flight organisation, which is used primarily by the LCCs. International flights beyond the E.U. are almost completely nonexistent in the SLAs.

The key role played by LCCs in the Spanish SLAs is clear. These companies have been essential in maintaining the SLAs during the years of increases in traffic (Martínez-García and Royo-Vela, 2010). LCCs have transformed the market, increasing available flights, increasing demand and changing the organisation and performance of flights. Nevertheless, looking to the future, this high level of dependence between SLAs and LCCs also entails elements of servitude, particularly due to the fact that the expansion of the LCCs has been based on subsidies, which have mainly come from public sources (essentially regional and local subsidies).

IV.5. The global structure of passenger traffic in the Spanish SLAs according to destination: domestic and international.

The passenger traffic in the Spanish SLAs is mainly domestic. In fact, the proportion of domestic traffic in the SLAs is superior to the average in overall Spanish air traffic statistics. The dominance of domestic traffic in the SLAs is principally due to the overall size of Spain, the spatial distribution of the airport network and the predominant purpose of the SLAs, because the population base in the SLA areas of influence is weak. Table 6 shows the data for this phenomenon.

Table 6
THE EVOLUTION OF PASSENGER TRAFFIC (TOTAL AIRPORTS, MAS AND SLAS) BY DESTINATION: DOMESTIC AND INTERNATIONAL. PERCENTAGE VALUES

	2000			**2007**			**2012**		
	Total	MAs	SLAs	Total	MAs	SLAs	Total	MAs	SLAs
Domestic traffic	41.63	39.55	73.77	42.58	40.85	62.51	34.55	33.69	67.18
International traffic	58.37	60.44	26.23	57.42	59.15	37.49	65.45	66.31	32.82

Source: Authors, data from the Spanish Ministry of Public Works and Transport.

As can be seen, various changes occurred between 2000 and 2012. The following changes stand out:

i) In 2000, the percentage of domestic traffic in the SLAs was substantially higher than the overall average, by 32.1 points. This was almost twice the percentage recorded in MAs. The dominant role of the SLAs was therefore to provide links with the major national hubs and with other regional airports or for tourism purposes in Spain.

ii) The 2007 data show a clear change in SLA passenger traffic with respect to the year 2000: the proportion of passengers on domestic flights decreased and the proportion of passengers on international flights increased, involving a transfer of more than 11 points. In the same timeframe, the composition of flights leaving from MAs barely changed. These changes can be attributed to the fact that the expansion of low-cost flights created more direct links (point-to-point) with popular cities outside of Spain, mainly in the European territory.

iii) In 2012, despite the sharp drop in passenger traffic recorded in the Spanish SLAs with respect to 2007 (-31.54%), the proportions of the destinations barely changed. International flights only fell by 4.67%, which we believe is due to two principal causes:

- In some SLAs, such as Murcia, Reus, and Almeria (with the highest passenger movement), passenger traffic was highly dependent on tourist flights (Saínz-González et al., 2011). In these cases, the predominance of LCCs was maintained.
- At the same time, other SLAs located in mid-sized cities and in more populated areas of influence (Oviedo, Santander, Vigo, and Zaragoza) generated a certain level of demand for travel abroad, confirmed by data, which was covered by LCCs. We can therefore deduce that LCCs have played a significant role in increasing traffic in the Spanish SLAs.

IV.6. Flight networks, links and connectivity in the Spanish SLAs

The increase in passenger traffic has increased the number of connections between the Spanish SLAs and other cities. The new flight networks are denser. Table 7 shows these results in detail. We have broken down results into the following three categories: total, national and international links. In addition, we have developed the following two synthetic indicators: national and international coefficients of connectivity.

In 2011, the total number of connections amounted to 212 in SLAs. This value is close to twice that recorded a decade earlier, when the LCC boom had not yet begun. In recent years, international links have grown to a greater extent than domestic links. But for now, there is a near balance between the two destinations (domestic and international). Nevertheless, the differences are substantial between airports. Only 10 SLAs exceed 10 destinations, with a maximum of close to 20 destinations in the best connected airports. The rest have few connections. The differences between SLAs are more pronounced in terms of international passenger traffic than in domestic transport. Only 4 SLAs exceed 10 international links (Reus, Murcia-San Javier, Almeria and Jerez de la Frontera). These airports largely specialise in the tourism sector. However, modest figures across the board among the Spanish SLAs confirm the weakness of international connectivity. The national and international connectivity coefficients (CC) have been calculated for all Spanish airports. This procedure, used in other scientific papers (Córdoba and Gago, 2010), is expressed as follows:

$$\boldsymbol{CC}\ vi = \frac{\sum_{i=1}^{Nj-1} ai}{Nj} \cdot 100 \quad \text{For} \quad ai = \begin{bmatrix} 1\ if\ \partial branch & (vi, vj) \\ 0\ if\ \nexists branch & (vi, vj) \end{bmatrix}$$

Table 7
NETWORK SMALL AIRPORTS IN SPAIN, LINKS OR CONNECTIONS WITH OTHER AIRPORTS. NATIONAL CONNECTIVITY COEFFICIENT (CCN) AND INTERNATIONAL (CCI)

SLAs	Total links	National links	International links	CCN	CCI
Albacete	2	2	0	5.41	0.00
Almería	17	7	10	18.92	3.66
Asturias	16	12	4	31.58	1.47
Badajoz	4	4	0	10.26	0.00
Burgos	3	3	0	9.38	0.00
Jerez de la Frontera	21	5	16	13.51	5.86
El Hierro	2	2	0	5.00	0.00
Granada	7	6	1	16.22	0.37
Huesca-Pirineos	1	1	0	2.78	0.00
La Coruña	6	3	3	7.89	1.10
La Gomera	2	2	0	5.00	0.00
La Palma	11	5	6	12.50	2.20
León	5	5	0	13.51	0.00
Lleida	3	3	0	8.57	0.00
Logroño	3	3	0	8.82	0.00
Melilla	7	7	0	17.50	0.00
Murcia-San Javier	18	1	17	2.86	6.23
Pamplona	4	4	0	11.76	0.00
Reus	20	2	18	5.56	6.59
Salamanca	2	2	0	5.41	0.00
San Sebastián	3	3	0	8.82	0.00
Santander	19	11	8	31.43	2.93
Valladolid	11	8	3	22.22	1.10
Vigo	10	8	2	21.05	0.73
Vitoria	2	2	0	5.88	0.00
Zaragoza	13	7	6	19.44	2.20
Total links or Average connectivity	**212**	**118**	**94**	**12.36**	**1.32**

Source: Authors; data from AENA.

Where:

CC = Connectivity Coefficient
vi = node *i*
ai = relationships (arcs) of node *i*
Nj = all nodes in the system
100 = multiplier to obtain data in percent

The average connectivity in SLAs is very low in terms of domestic flights and almost negligible on the international level. However, among the various airports, there are small differences in rates of connectivity. Nevertheless, the weak significance of rates inside the set of Spanish airports as a whole confirms the compromised future of these airports. If connections are not extended, it will be difficult to increase the flow of air traffic. Yet in the present market situation, and in the context of global economic cuts in the current crisis, it will be difficult to increase connections.

V. DECREASES IN PASSENGER TRAFFIC. READJUSTMENTS IN SPANISH AIRPORTS AT THE BEGINNING OF A NEW CYCLE

We noted earlier (Table 3) that there has been a 7.34% decrease in passengers in all Spanish airports during the recent years of economic crisis with respect to the highest figure recorded in 2007. This decline has mostly affected SLAs, which have experienced a decrease in passenger traffic of 31.54%, compared to only 5.25% among the rest of the Spanish airports. In this context, it is of interest to analyse in more detail the behaviour of the Spanish SLAs, with the intention of establishing models in order to clearly see the different situations among the airports. Data are specified in Table 8.

Table 8
EVOLUTION OF THE PASSENGER TRAFFIC IN THE SPANISH SLAS

	Passengers (thousands)			
	2001	**2007**	**2012**	**Difference, 2007-12 (2007: 100%)**
Albacete	-	18	3	-83.34
Algeciras	-	-	9	-
Almería	882	1,199	729	-49.20
Asturias	800	1,553	1,305	-15.93
Badajoz	28	87	63	-27.59
Burgos	-	-	16	-
Ceuta	-	23	18	-21.74
Ciudad Real	-	-	-	-
Córdoba	1	2	2	0
Jerez de la Frontera	651	1,530	830	-45.76
El Hierro	120	182	152	-16.49
Granada	488	1,447	725	-50.92
Huesca-Pirineos	-	-	1	-
La Coruña	581	1,252	835	-33.31
La Gomera	-	40	19	-52.50
La Palma	850	1,145	946	-17.38

León	19	161	51	-68.33
Logroño	-	52	14	-77.08
Madrid-Torrejón	-	33	25	-24.25
Melilla	259	328	308	-6.10
Murcia-San Javier	141	1,994	1,176	-41.03
Pamplona	339	492	184	-62.61
Reus	686	1,294	922	-28.75
Salamanca	41	64	22	-65.63
San Sebastián	278	460	254	-44.79
Santander	259	761	1,098	+44.28
Valladolid	179	510	319	-37.46
Vigo	721	1,406	829	-41.04
Vitoria	119	172	24	-86.05
Zaragoza	244	511	548	+7.24
Total (A)	7,686	16,716	11,445	-31.54
Total airports (B)	138,614	208,510	193,178	-
A/B (%)	5.54	8.01	5,92	**-**

Source: Authors, data from the Spanish Ministry of Public Works and Transport.

Of the 30 airports included, it was not possible to compare the number of passengers recorded between 2007 and 2011 in four cases. These four airports have either suspended their services (Ciudad Real) or lacked traffic at the beginning of the temporary reference (Huesca, Burgos and the Algeciras heliport). Another airport (Córdoba) has maintained the same small number of passengers. The remaining 25 airports show different balances (Figure 4). It is interesting to cluster and classify the airports according to results. Doing so, the four following groups can be established:

i) Six airports (Vitoria, Albacete, Logroño, León, Salamanca and Pamplona) recorded decreases in passengers of 62% or higher (twice the average losses in total SLAs). All of these airports are located in average sized cities (of between 150,000 and 240,000 residents). The CCI index is zero, and the CCN index low (lower than or close to 10). Foreign tourism is not a priority activity in these six cities. Furthermore, these airports must compete with other larger airports nearby (within two hours by road) with more connections.

ii) Nine SLAs recorded passenger losses of between 30% and 60%. The composition of these airports is more complex than in the first group above according to the different criteria of analysis. In the case of several of these airports, residents in the area of influence provide the greatest number of passengers, nearing or exceeding one million (Jerez, Granada, Murcia, La Coruña, Valladolid, San Sebastian and Vigo). It is interesting to note the variation among figures. La Gomera and Vigo are two extreme

cases, which confirm the inadequacy of this criterion. Several airports have been more influenced by tourism, such as Almeria, Murcia-San Javier, San Sebastian and Granada. This has resulted in the presence of some international links. These airports also recorded higher values in their CCN indexes. All of these trends confirm the breadth and generality of the current economic crisis, which has affected different airports in terms of their nature, demographic dimension and structure of services. The numerous structural changes previously mentioned in this paper threaten the viability of several of these airports.

iii) Eight airports experienced decreases in passenger traffic of less than 30% (the average loss in all Spanish SLAs between 2007 and 2012). Four of these airports can be considered strategic airports due to their insular character (La Palma and El Hierro) and/or location outside the peninsula (Melilla and Ceuta). Others are based in cities with very different situations: two are regional centres with a significant population in their area of influence (Oviedo-Asturias and Badajoz-Extremadura); another, Reus, has reduced LCC operations; and finally, Madrid-Torrejón, which does not have a clear role due to its proximity to Madrid's main airport, Barajas. All of the above reasons help to explain why these eight airports have shown better performance relatively speaking with respect to the sharp declines in air traffic suffered by other SLAs.

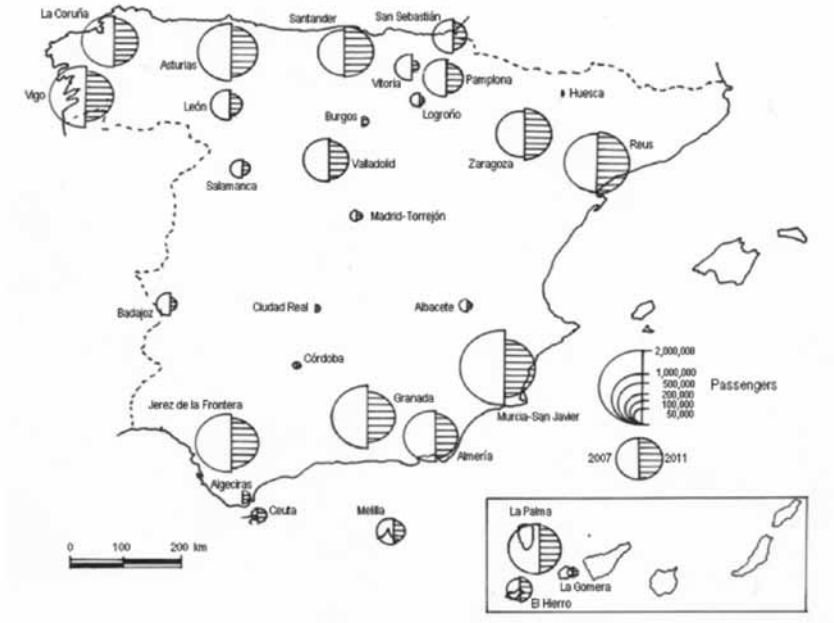
iv) There are only two airports that have experienced increases in passenger traffic: Santander and Zaragoza. Both of these airports are seeking to consolidate their role as regional centres, although there is a significant difference in the demographic size of the two cities. The smaller population of Santander is compensated for (or offset) by its greater isolation and poorer communication with the vital economic and functional areas in Spain. In its favour, the proximity of Santander to the urban agglomeration of Bilbao allows it to attract customers via the low-cost services offered at the airport. Zaragoza has a larger population and area of influence and thus has the capacity to generate more demand. In both Santander and Zaragoza, the overall participation of SLAs is high (69.99% and 67.58%, respectively). If such progress continues, these airports could adjust well to the reorganisation of the Spanish airport network that is likely to occur in the coming years. This reorganisation is likely to be comprehensive and complex.

The Spanish airport system is managed in an integrated centralised way by AENA (Spanish Airports and Air Navigation), a publicly owned organisation that depends on the Ministry of Development and has full control over Spain's airports. AENA manages in an integrated manner all airports that handle commercial traffic in Spain in addition to a host of related facilities.

AENA's managerial objectives are to protect the public interest in air transport services, maintain travel security measures, introduce technological innovations, and ensure quality services to customers within a system of efficient and economical operations (Costas-Centivani, 1999).

In its role as airport manager, AENA assigns slots to airlines and oversees airports. This centralised system has been justified with arguments of territorial redistribution, i.e., it is claimed that the profits generated by the major airports can be used to compensate for the

Figure 4
VARIATION IN PASSENGER TRAFFIC (2007-2011)



Source: Authors, data from the Spanish Ministry of Public Works and Transport.

losses of the smaller, less profitable airports, effectively subsidising services to remote areas and to destinations that would not otherwise have enough market potential to attract private operators (Tapiador et al., 2008). Through its compensation system, AENA has made it possible for many SLAs, at least up until now, to cope with significant losses. Declines in air traffic, however, have had a major impact on the balance sheets of these airports. Prompted by this situation, in June 2012, AENA announced its first adjustments (Table 9). The opening hours were reduced at the airports that had both recorded losses and been used by a small number of passengers. Such airports are examples of the excess air infrastructure in Spain.

Some airports have essentially closed; others remain open symbolically. This first adjustment of services was necessary yet will entail more extensive interventions in the future. Ideally actions taken should involve the entire existing airport network in Spain, including the SLAs. This new set of actions could be carried out within the current integrated management system for all Spanish airports, either by making modifications or by taking a different path altogether. In fact, the Spanish government has recently intervened, announcing that AENA will be restructured in two ways. Regional governments will participate in the management of airports located within their territories, and private companies will also take part.

Some argue that the airports should be ceded entirely to Spain's autonomous regional governments, which would mean the disappearance of AENA. The government's intention seems to be for AENA to retain day-to-day management operations and for regional officials

Table 9
SPANISH AIRPORTS WITH REDUCED HOURS OF OPERATION, JUNE 2012

	Losses in € million, net income in 2011	Weekly hours of operation in the past	Weekly hours of operation today
Albacete	2,5	112	12
Badajoz	2,7	94,5	43,5
Algeciras	1,2	80,5	71,3
Burgos	4,7	91	12
Ceuta	1,7	82,3	74,5
Córdoba	3,9	91	0
Huesca	4,5	78,8	2
León	6,6	119	51
Logroño	5,3	101,5	13
Madrid-Torrejón	5,3	126	0
Melilla	9,1	88,6	88,6
Pamplona	7,8	121,3	108,5
Salamanca	4,5	168	11,5
San Sebastián	5,0	98	98
Valladolid	5,3	108,5	78,8
Vitoria	10,2	168	60

Source: Data from the Spanish Ministry of Public Works and Transport.

to participate in key planning decisions, such as commercial space allocation, infrastructure investment, and so on. Furthermore, the government seems to want to allow private companies to buy up to 49% of the shares of AENA, so the airports are essentially kept under public control (Tovar and Rendeiro, 2010). Nevertheless, new more liberalised approaches could also be taken, stressing private over public management.

VI. CONCLUDING REMARKS

The latest restrictions adopted confirm the desire to streamline services and reduce losses. Nevertheless, the problem is more serious and will require further action. Ultimately, it is necessary to determine if there is an excess of air infrastructure in Spain, and, if so, how to solve the problem. Ideally, a general plan for the reorganisation of the Spanish airport system should be adopted. This plan, in turn, must be related to the aimed-for production model for the Spanish economy. Thus far, the tourism industry and other complementary activities have been essential in Spain. This sector has had an open growth horizon and has certainly contributed significantly to the economy. In the future, however, this may not continue to be true, and diversification will be needed.

The model provided by LCCs, and favoured by generous subsidies, has helped boost air passenger traffic in Spain in recent years. In particular, this model has boosted SLA growth. The profound consequences of the economic crisis, however, are revealing the weaknesses of the current LCC model. The effects have been most intense at the SLA level. The SLAs with acute declines in traffic cannot continue to operate. Furthermore, they cannot be maintained, nor is it profitable to do so, through local and regional subsidies that allow several LCCs to continue to operate. It is infeasible to continue promoting LCC air links, especially in SLAs, due to the sharp fall in demand.

In the near future, the reorganisation of the airport network in Spain, especially of the SLAs, will have to ensure that airports are better adapted to the basic network of urban nodes. The dense network of roads and highways and numerous stretches of high speed rail in Spain have reduced travel times by land and have thus brought many cities closer together. This has reduced passenger traffic in SLAs in favour of the bigger airports, which have better connections in terms of both domestic and international flights. This same process has been noted in other parts of Europe as well (Dobruszkes, 2006; Lian and Ronnevik, 2011). The viability of several SLAs located less than an hour from other regional airports with more traffic, better connections and better prospects seems questionable. For many SLAs, the new system of direct air links (PP) is insufficient to remain in operation. The reorganisation of the Spanish airport network will therefore deeply affect the SLAs, as has happened in other European countries (Reynolds-Feighan, 2007). The future of several SLAs that have been promoted through a local or subregional perspective is in serious jeopardy. The cities in which these airports are located had high expectations for the growth potential of such services, but these expectations have not been met. Some of the Spanish SLAs, due to their strategic nature, will require special treatment. A few of the SLAs in Spain may have a brighter future if they manage to increase air traffic. Ultimately, however, some SLAs will have to be closed if no other alternatives or solutions are found.

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