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CHAPTER 14

Low-cost carriers and airports: A complex relationship

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Abstract

In the last decades, low-cost carriers have generated several changes in the air market for both passengers and airports. Mainly for regional airports, low-cost carriers have represented an important opportunity to improve their connectivity levels and passenger traffic. Furthermore, many regional airports have become key factors to regenerate the local economy by improving accessibility and stimulating several markets, such as tourism. However, the relationship between low-cost carriers and airports is rather complex and the outcomes not always predictable. In order to analyse and understand better such relationship and its outcomes, this chapter discusses the main underlying factors identified in: relation with the regional air market (secondary/primary airports), balance of power (dominated/non-dominated airports) and industrial organisation (bases/non-bases). Starting from the proposed Relative Closeness Index, which combines yearly airport passengers and distance between airport pairs, a large sample of European airports is analysed. Then, a smaller sub-sample – which includes selected, significant case studies referring to mid-sized airports – is discussed in detail. Among the main findings, airports sharing their catchment area with others are in a very risky position, due to the potential mobility of LCCs, while geographically isolated airports in good catchment areas can better counterbalance the power of carriers.

Keywords: Low-cost carriers; regional airports; airport-airline relationship; Relative Closeness Index

JEL codes: C43; JEL: L93; JEL: R4

1. Introduction

Low-cost carriers have brought a crucial change to the air transport sector. In about ten years, they have been able to transform the concept of flying for both passengers and airports. Many secondary airports that were previously, at best, spokes in the hub-and-spoke systems of traditional airline companies or seasonal destinations, nowadays represent a dynamic part of the European airport industry. The success of the relationship between airlines and airports entails greater connectivity and mobility for an area, and generally affects local economies around airports.

The positive results of some European airports in the last decade promoted the idea that *any* airport could improve the accessibility and connectivity level of an area and regenerate the regional economy (by stimulating tourism, creating new jobs and providing connections with larger cities, among others) provided it is capable of attracting low-cost carriers (hereafter LCCs). Therefore, airport operators have implemented different schemes to encourage the presence of these carriers, and especially to have their aircraft based there.

Generally, the relative dependency between airlines and airports is ruled by certain factors, among which are the market potential of an area for the carrier (population, GDP, tourist attractions), airport technical aspects

(turnaround time, level of congestion, availability of slots, handling), possible incentives provided by the airport operators (airport charges, handling fees), and subsidies or financial guarantees from the airport/local authority. The combination of these elements shapes the level of dependency between the two parts and affects the stability of the relationship, including the actual market power of the airline and its capability to bargain for favourable agreements from the airport manager.

After a literature review on the LCC phenomenon, this chapter provides a taxonomy of the relationship between LCCs and airports by identifying three main themes: the relation with the regional air market (secondary/primary airports), the balance of power (dominated/non-dominated airports) and the industrial organisation (bases/non-bases). A large sample of airports is preliminarily analysed with respect to the relation to the regional air market. Then, a selection of case studies is discussed thoroughly according to all the themes above to better understand the relationship between airport and airline. The concluding section summarises the findings by discussing different forms of current relationships.

2. The low-cost carrier phenomenon in Europe: a short overview

One of the major results of the liberalisation of intra-European air services has been the development of low-cost ‘‘no-frills’’ airlines (Doganis, 2010) that have increasingly gained market shares across Europe, impacting traditional carriers on short-haul routes thanks to their extensive pan-European networks. Despite having introduced some changes to better meet the needs of passengers[1] by hybridizing the original model in the second wave of development, (Klophaus et al. 2012; Fageda et al. 2015), the peculiar elements of the LCC scheme can still be identified according to three aspects (Table 1): organizational, commercial and technical (Dobruszkes, 2006; Doganis, 2010; de Wit and Zuidberg, 2012; Lawton, 2002, Hunter, 2006).

Table 1 - Main features of the low-cost model

ORGANIZATIONAL	COMMERCIAL	TECHNICAL
Point-to-point connections on short/medium haul routes rather than hub & spoke schemes	High commercial ability to bargain with the airports for favourable conditions (airport charges, handling, etc)	Use of a single or restricted number of models of new aircraft
Non-integration into alliances and absence of frequent flyer programme	In-flight catering services (i.e. meals, drinks, etc.) available for a fee	Short turnaround time with high utilisation of aircraft and crew
Use of secondary non-congested airports with slots available at a relatively low price	High rate of advertising to promote the brand and increase the number of passengers	Single class cabin with a high-density configuration
Direct online selling, mainly ticketless	Heavy reliance on yield management to reach high load factors	Aircraft cleaning done by the cabin crew to reduce cost and turnaround times
More intensive use of labour and higher productivity	Strict policy on baggage and, in general, payment of surcharges outside basic services	

[1] In terms of product and service upgrades, such as the use of primary airports in addition to regional/secondary ones, the opening to the global distribution systems (GDSs) for ticket distribution, the introduction of customer-oriented features (longer seat pitch, apps for mobile phones, more flexible ticketing, fast-track) and services (for business travelers, groups, families).

Beyond the cost minimization and efficiency maximization approach of the low-cost/low fare model (Doganis, 2010), several other factors may explain the dramatic rise of low-cost services:

- The difficult situation of some full-service carriers already in critical condition and further affected by the global financial crisis, which forced them to downsize or cease services from some airports/routes, leaving space for LCCs (Dennis, 2005);
- The progressive enlargement of EU to new member states, which provided new markets (Dobruszkes, 2013);
- The presence of many secondary underused airports, often relatively close to big cities or located in districts with good catchment areas, whose potentialities have not been considered by full-service carriers;
- The incentives provided by airports and/or regional or local authorities (Laurino and Beria, 2014; Allroggen et al.,2013; Malina et al.,2011) that allowed LCCs to also provide services to low-density routes that, in many cases, have been dropped once the incentive ended (Wiltshire, 2013).

Between 2006 – 2014, the main European low-cost carriers, such as *Wizz Air*, *Norwegian Air*, *Air Berlin*, *EasyJet* and *Ryanair*, more than doubled the number of carried passengers (Table 2) from nearly 100 million in 2006 to more than 223 million in 2014. Dobruszkes (2013) shows how, also due to the higher impact of the financial crisis on full-service carriers, LCCs accounted for 70% of the 1995–2012 increase in the number of intra-European flights or seats and 64% of the number of seat-km. According to CAPA (2016), on average, LCCs currently provide 37% of intra-Europe seats, ranging from 60% of Hungary to 11% of Finland. In some cases, like in Italy, UK or Spain, they also play a major role in domestic routes.

Table 2 – Passengers in millions carried by a sample of low-cost carriers. *hereafter CAGR - Compound Annual Growth Rate represents the mean annual growth rate of traffic over a specified period of time.

Carrier	2006	2007	2008	2009	2010	2011	2012	2013	2014	CAGR* 06/14
Wizz Air	3	4,2	5,9	7,8	9,6	11	11,6	13,5	15,8	23%
Norwegian air shuttle	5,1	6,8	9,1	10,8	13,0	15,7	17,7	20,7	24,0	21%
Air Berlin	25,6	28,2	28,6	32,4	34,9	35,3	33,3	31,5	31,7	3%
Easyjet	33,7	38,2	44,6	46,1	49,7	55,5	59,2	61,3	65,3	9%
Ryanair	40,5	49,0	57,7	65,3	72,7	76,4	79,6	81,4	86,4	10%

Source: data from ELFAA - The European Low Fares Airline Association website)

3. Relationship between LCCs and airports

In the last decade, many studies have remarked on the positive relationship between LCCs and regional or secondary airports (see for example Lin et al., 2013; Jankiewicz & Huderek-Glapska S, 2016). Before discussing the nature of such a relationship, the definition of "secondary" airport needs some further clarification. There is no unique definition of "secondary" airports, although they are generally identified as under-utilized airports that complement a network of "primary" or major airports – which, in turn, are defined as commercial service airports enplaning at least 10,000 passengers per year or airports where at least 10 network carriers are operating (Mason & Morrison, 2008). Secondary airports can be located close to some primary airports (such as in the London airport system, where Heathrow is the primary airport) or far from the main city they serve (such as Malmø in Sweden). Some common features are spare capacity, closeness to attractive cities, location in remote regions and low turnaround times. Strickland (2015) discusses and describes the role and the challenges secondary airports will be facing in the next years by analysing many EU secondary airports.

In the EU, airports are classified depending on passengers (EC, 2005), namely *community* (more than 10 million passengers), *national* (5-10 million passengers) and *regional* (less than 5 million passengers). Recent data shows that EU "secondary" airports handle about 260 million passengers per year, thus making a great contribution to European mobility. In the following, secondary airports will be identified as regional airports according to the EU classification, unless a more specific definition is given depending on the context.

The relationship between LCCs and airports is often reciprocal, because both try to take advantage of alternative demand markets and regions. In the deregulated environment that characterizes both airlines and airports, financial gain is due to the ability to capture as much demand as possible in a given catchment area by reducing operating costs at the same time (Graham, 2013). Then, on one side, airports try to adapt to LCC operating models by providing the basic facilities and services they require. On the other side, LCCs try to satisfy latent and unsatisfied travel demand by operating in areas characterized by poor alternative transport supply (mainly surface transport modes) and tourist attractiveness (Rey et al., 2011). Although addressing common goals, LCCs and airports may have balanced or imbalanced relationships depending on the compromises they are able to realize and the strength of their attachment (Lin et al., 2013). Furthermore, the strength of this relationship is also measured by the choice of the airport as a base for the LCC. Such a choice represents a better integration between LCC, the airport – the main consequences are technical requests and maintenance for aircraft – and the host country – for example, crew overnight accommodations in the nearest city (Fuhr and Beckers 2006), although it depends on the LCC's decision to maintain steady air services in the foreign country (Klein et al., 2015).

In this framework, the relationship between LCCs and airports is described based on three main themes:

- the role of the airport for the catchment area (secondary/primary airports);
- the industrial organisation of the airline in the airport (bases/non-bases);
- the balance of power between airport and airline (dominated/non-dominated airports).

3.1 Role of the airport in the catchment area

The role of the airport in the catchment area is extremely relevant in defining the behaviour of the carriers, since it determines the number and the characteristics of the options available to the airline to serve that particular demand. Three main cases of secondary airports are identified: airports in remote regions, airports competing with major airports for the same catchment area and exclusive airports serving secondary catchment areas.

Airports serving remote regions such as small islands can count on small catchment areas, but travellers have no real alternatives; neither inter-modal nor intra-modal. In this case, the limitedness of the market may leave space for only few and monopolistic routes, typically towards the hub or the main base of the operating carrier. This situation may differ during holiday periods, when additional supplies provide services to tourists (by either charter or seasonal low-costs carriers).

Secondary airports, totally or partially competing with major airports, lay on the other side of the range of the market structure spectrum. They may have a marginal role unless some conditions appear, such as congestion problems at the main airport (Bendinelli et al., 2016) or if they allow airlines to serve the captive market without bearing the higher costs of primary airports (as Rome Ciampino/Fiumicino, Girona/Barcelona El Prat, London Luton or Stansted/Heathrow). Many air markets have expanded towards secondary airports to search for extra capacity, given congestion and delay problems that affect major airports all over the world, particularly in Europe, where increasing traffic and lack of both airport development/expansion and strong regulatory policies have worsened the problem (Madas & Zografos, 2008). Even more frequently, low-cost carriers have used secondary airports to serve the otherwise impenetrable markets of former flag carriers, which resulted in enlarged, overlapping and more heterogeneous catchment areas (Pantazis & Liefner, 2006).

However, in the medium-long term, regional airports experiencing the highest traffic increase at the beginning are those that register the largest reductions during volatile periods (Halpern et al., 2016).

Without congestion at main airports or in the absence of relevant and unserved catchment areas, secondary airports do not develop or develop much less than the primary ones, typically specialising in niche markets (general aviation, charter, cargo). The main cause for such congestion is that air travellers prefer accessing larger airports to take advantage of lower fares and several airline services (Lian & Rønnevik, 2011), rather than having limited and expensive direct flights from the local airport. This phenomenon is also referred to as *traffic leakage* (Fuellhart, 2007; Fu & Kim, 2016). In these uncongested single-airport areas, there is often a one-to-one relationship between the catchment area and the airport. In this case, the relation of power in favour of one or the other depends mainly on the dimension of both the market (if large, more than one airline may exist) and the airline.

3.2 Airline organisation

The way airlines are organised is another factor making a difference in the relationship between airlines and airports. A primary difference is between hub & spokes (H&S) carriers and point-to-point ones, which refers to the organisation of their networks (Zanin and Lillo, 2013). Low-cost carriers almost everywhere adopt a point-to point-scheme, although the adjustments of the full carrier business models to maintain their market share have forced many LCCs to change their strategies and adopt hybrid network configurations (Klophaus et al., 2012). The impact of point-to-point LCC services on the airport organisation depends on the airport's role in its catchment area and the number and type of air carriers operating there. For airports where H&S services are established, LCCs may fill the slots between hub waves[2] and spread air demand over uncongested (or less congested) time spans. Alternatively, LCCs settle in airports without H&S carriers, where they can assume a dominant role. However, incumbent airlines controlling most slots at their hub airports represent an important entry barrier for LCCs at full-carrier-established hub airports (Kappes and Merkert, 2013), while the rise of the LCC phenomenon has made the dimension of their supply far from marginal in many airports (Pyrialakou et al., 2012; Carballo-Cruz, & Costa, 2014). In addition, where market conditions were favourable, LCCs have left their original secondary airports in favour of primary ones (de Wit and Zuideberg, 2012), where they compete for capacity with other traditional airlines.

The LCC organisational model may interfere with that of traditional airlines. Firstly, LCCs tend to be very demanding in terms of reliability, turnaround time and delays (Choo and Oum, 2013). Traditional H&S carriers plan very rigid timetables to coordinate the numerous flights arriving and departing from the hub (waves), but foresee broad buffers and leave spare capacity at the airport (Dennis, 2001). LCCs use the airport's capacity longer and more constantly, but timetables are tighter and allow no delays. Secondly, LCCs are organised in bases, where aircrafts and crews end the working day and where they usually come back after every return flight. Having aircrafts based there is a crucial element for an airport since, as suggested by Malighetti et al. (2016), it reduces the probability of suffering from downsizing due to the presence of switching costs.

3.3 Power relations

Airline organisation and catchment areas are among the factors influencing the power relations between airports and airlines. Airports have developed several forms of relationships with airlines, depending on mutual interests and revenue features. In some cases, they prefer to establish long-term relationships, which results in the development of H&S services and, generally, a dominant power of airlines in regards to airports (Fu et al., 2011). Under these conditions, almost all supply is provided by one airline and the airport is completely dependent on the airline's strategy and conditions (price, operational conditions).

[2] It represents "a complex of incoming and outgoing flights, structured such that each incoming flight creates a bookable connection with every outgoing flight" (Danesi, 2006). These structure aims at maximizing the number of connections of an airline (historically a full carrier) available from the airport.

According to Lin et al. (2013), the relationships between airlines and airports could lead to several scenarios of power imbalance and mutual dependence. According to that study, the relationship between an LCC and an airport tends to be well-established as the airport capacity reaches saturation. In contrast, a negotiation approach is used more frequently when the airport capacity is under-utilized.

Another aspect of power balance relates to the presence of more airports in a shared catchment area; this is the case with multi-airport systems. Here, airlines, and then airports, compete according to their services and features; for example, when LCCs operating at secondary airports compete with full-service airlines operating at the primary airport (Pels, et al., 2009), or similar airports compete to attract demand for the same catchment area based on their management and air service features (Postorino and Praticò, 2012). Furthermore, negotiations of suitable contracts addressed to attract LCCs, which generally reduce aeronautical revenues, could have several impacts on the airport's financial management, thus suggesting a careful analysis when negotiating preferential contracts (Francis et al., 2003).

The existence of small and dominated airports is also very unpredictable: small markets are more prone to be left by a dominating airline as soon as market conditions change, for example in favour of another nearby airport offering better conditions. Single point-to-point routes can, in fact, be easily moved away, and this can make the difference in success or failure for a small airport. This dependence of the airport on the airline occurs also in the most common cases of partially dominated airports, like for LCC bases. Here, an airline which has a large share of traffic, peculiar conditions and local production factors (typically workforce) can enjoy large bargaining power under the threat of switching to another nearby airport to serve the same demand.

Even if the most obvious cases of airport abandonment are those of de-hubbing legacy carriers (for example, Milan Malpensa in 2008 as in Beria et al, 2012; Budapest in 2012 as in Bohl, 2013; or more in general in Redondi et al., 2012), this airline activity has also occurred in many smaller airports dominated by LCCs[3] as clearly discussed in Malighetti et al. (2016). For example, Ryanair often threatens to relocate and/or withdraw routes in response to national normative changes[4] or to influence charges and conditions in the airport, as it did in Strasbourg, Altenburg, Frankfurt Hahn or Belfast (Olischer and Dörrenbächer, 2013).

4. Degree of airport/airline dependency

The three aspects discussed in the previous section contribute to the degree of airport/airline dependency and power relations. In general, it is possible to identify circumstances that can affect the role and potential power of the airport. In particular, whenever traffic is scarce, alternative airports exist in the area or the largest market share belongs to one carrier only, the secondary airport may have a weak role. In contrast, the presence of stable and well-functioning airline hubs and/or bases, the presence of a large captive traffic (especially business) attractive to airlines, the absence of a dominant airline, and the lack of alternative airports as good substitutes[5] could favour an airport increasing its market power.

However, airline market power is not the only determinant of the relationship between airlines and airports, since incentives can also play a role in tightening or weakening this relationship. Typically, the efficacy of

[3] Olischer (2016) identifies 30 cases of threats of relocations/withdrawals within EU done by Ryanair (27), EasyJet (2), Germanwings (1) together with the reasons: taxes (33%), subsidies (23%), airport fees (20%), n° of passengers (17%) and infrastructure (7%). Among them, 18 relocations/withdrawals have been completely executed, 10 partially and only 2 have been not executed.

[4] This is the case in Italy, where the carrier has publically threatened to close two bases (Pescara and Alghero) as a result of a 40% increase in passenger departure taxes in 2016. Similarly, in Norway, the carrier announced the closure of its Oslo Rygge base following the introduction of an environmental tax for flights originating in Norway.

[5] This is more likely in the case of short-haul traffic. Long-haul routes tend to concentrate more on hubs, and potentially important catchment areas may not be served by any resident airline (Milan, Barcelona, Manchester).

incentives and subsidies in developing a market depend on how they are designed; in particular, they should promote a stable and constructive airport/airline relationship fostering sustainable and financially viable business plans, rather than stimulating short-term predatory practices by airlines that can only translate to a waste of public resources.

The liberalization of airline transport services and the rise of LCCs coupled with the presence of many formerly military airports in different areas of Europe (with a sufficiently attractive catchment area or not), resulted in the design and implementation of many programmes by airports operators and/or local/regional governments to foster traffic supply. Different supporting typologies have been implemented in the last two decades, ranging from simple discounts on airport fees to more complex agreements defining many aspects of the relationship between airports and airlines. Four categories can summarize the most used schemes (Laurino and Beria, 2014; Allroggen et al., 2013; Castillo-Manzano et al., 2011; Copenhagen Economics, 2012; Fichert & Klophaus 2011; Graham, 2013; Malina et al., 2011):

1. Discount on airport charges: rebates or reductions over a relatively short period of time;
2. Direct subsidies from the airport or the local authority for starting new routes by fixing the minimum number of flights to be provided;
3. Revenues guarantees: under a threshold agreed with the airline, the airport directly covers the missing revenue of the airline;
4. Co-marketing agreement: the airline agrees to promote the area where the airport is located through marketing and advertising activities in exchange for money.

By analysing a sample of 200 airports in the EU in 2010, Malina et al. (2011) found that two thirds of incentives were granted on the basis of officially disclosed incentive programs; the remainder were bilateral agreements between airlines and airports (foreseeing discounts on certain fees, bonus payments or joint marketing initiatives for a limited period to airlines). While large airports rely mainly on published incentive programs, small and medium-sized airports use both mechanisms. Bilateral agreements are used in particular where airports aim at becoming a base for an airline. However, this is a two-sided decision. On the one hand, the airport could increase its traffic volume, but on the other, should it have no alternative airlines, it could turn the based airline into the dominant customer with a lot of bargaining power.

The new Guidelines on State aid to airports and airlines (EC, 2014a) try to take into account the new scenario resulting from the liberalization process as well as the numerous cases of potential discriminatory behaviour of some airports in providing subsidies to airlines, suggesting a growth-oriented approach in the evaluation of state aid.

In particular, on one side the Guidelines acknowledge the potential role of regional airports for local development and for the accessibility of certain regions. On the other side, these guidelines highlight how, in the last decades, public funding to airport infrastructure often resulted in a proliferation of unprofitable airports, in many cases in the same catchment area, ghost airports or overcapacities while leaving congestion problems in the main airports (EC, 2014a). The new rules require that, in case an airport is located in the same catchment of another one with spare capacity, its business plan must identify the impact in terms of traffic variation on the existing one.

In terms of aid provided to the airlines, the new approach of the European Commission acknowledges that airlines are not willing, without adequate incentives, to start new routes from unknown and untested small airports (EC, 2014a) so, under specific conditions, airlines can receive start-up aid. In order to evaluate if aid (subsidies, co-marketing, tax rebates, etc) could be provided to an airport, the Market Economy Operator

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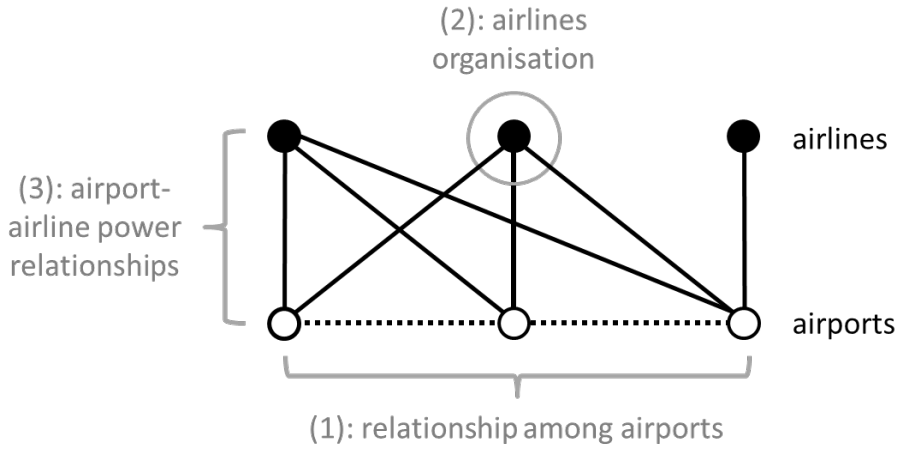
(MEO) test[6] should be applied. In this case, using the MEO test provides the Commission guidelines to assess whether the conditions offered to an airline at the airport would have been offered by a profit-driven airport operator (EC, 2014a). This requires demonstrating *ex ante* that the deal between the airline and the airport contributes to the profitability of the airport, and that it should be able to cover all costs deriving from the arrangement plus a reasonable profit margin. To take into account that smaller airports may need more time to adjust their strategies (for example, in terms of airport charges to airline, increasing the non-aviation revenues, attracting new airlines, etc.) the Guidelines foresee a ten-year transitional period.

5. Analysis

5.1 Methodology

As discussed in Section 3, we study the relationship between airports and LCCs, looking at three aspects: the relative power among airports (1), the organisation of the airline (2), and the relative power between airport and airline (3), sometimes ruled by incentives, some others only by market forces. Limiting this to LCCs, the second element considers only if the airport is a base or not. Figure 1 schematises the relationships.

Figure 1 – Scheme of aspects determining airlines – airports relationships.



According to this scheme, we start from a broad sample of 157 airports belonging to four European countries, and quantitatively analyse the relationship among airports (1) by means of a couple of indicators:

$$f(\mathrm{YCP_i}, \mathrm{RCI_i}(\mathrm{YCP_j}))$$

$\mathrm{YCP_i}$ indicates the dimension of the airport *i* in terms of yearly carried passengers while $\mathrm{RCI_i}$, called Relative Closeness Index, represents the weight of the airports surrounding airport *i* calculated as follows:

$$RCI_i = \sum_{j \neq i} \frac{YCP_j}{d_{ij}^2}$$

It divides the yearly carried passengers ($\mathrm{YCP_j}$) at all *j* airports around airport *i* with the squared distance ($\mathrm{d_{ij}}$) between *i* and *j*. The distance allows reducing the effect of far airports, in particular making negligible those

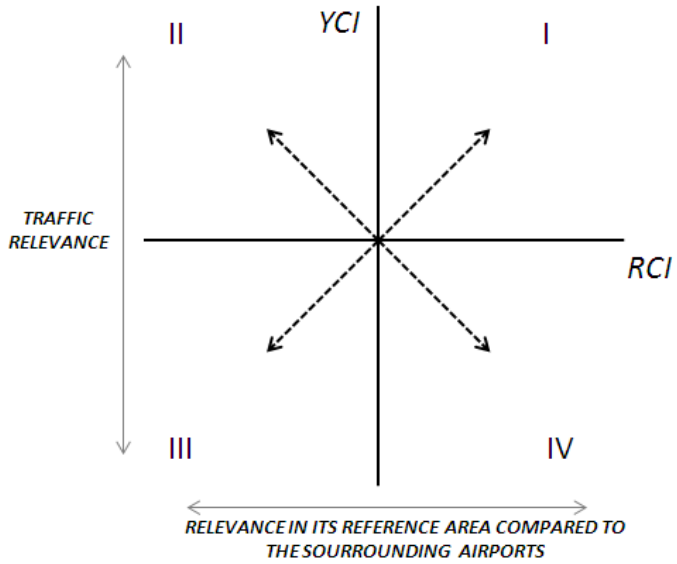
[6] There are two possible situations that can exclude the possibility of a state aid: "if (1) the price charged for the airport services corresponds to the market price; (2) the price charged for the airport services is shown, through an ex ante analysis, to lead to a reasonable return on capital for the airport manager" (EC, 2014a).

farther than 100-150 km. In practice, a low index means that the airport is isolated or is surrounded by very small airports. A high value suggests that one or more large airports are located near to *i*.

To discuss the role of LCCs, it is important to also look at the dynamics of the two indicators over a ten-year period. Figure 2 provides an overview of the possible outcomes deriving from the variation over time of RCI and YCP values. By excluding the opening of new airports, four main patterns can be identified:

I. the airport grows together with the surrounding ones, but it loses some relevance;
II. the airport grows and also gains relevance with respect to the close ones;
III. the airport decreases its traffic together with the surroundings ones, but gains some relevance;
IV. the airport decreases its traffic while the others grow and it loses some relevance in the area.

Figure 2 – Dynamics of the relationship between RCI and YCI



The analysis of the sample according to these two metrics, in section 5.2, will allow for selecting a more limited number of case studies, for which all three elements of the relationship will be discussed in 5.3.

5.2 Sample and case selection

This first analysis has been applied to four European countries (Italy, Germany, France and Spain) and their airports, in order to identify, also quantitatively, if there are common determinants underlying the relationship between LCCs and airports. Table 3 reports the main characteristics of the examined countries useful to understanding and analysing such a relationship.

Table 3 - Main features of the examined European countries. Source: www. worldometers.info for data on population and land area; airport data from ENAC (Italy), AENA (Spain), Direction Généralede l'Aviation civile (France), ADV, Destatis websites of the airports (Germany)

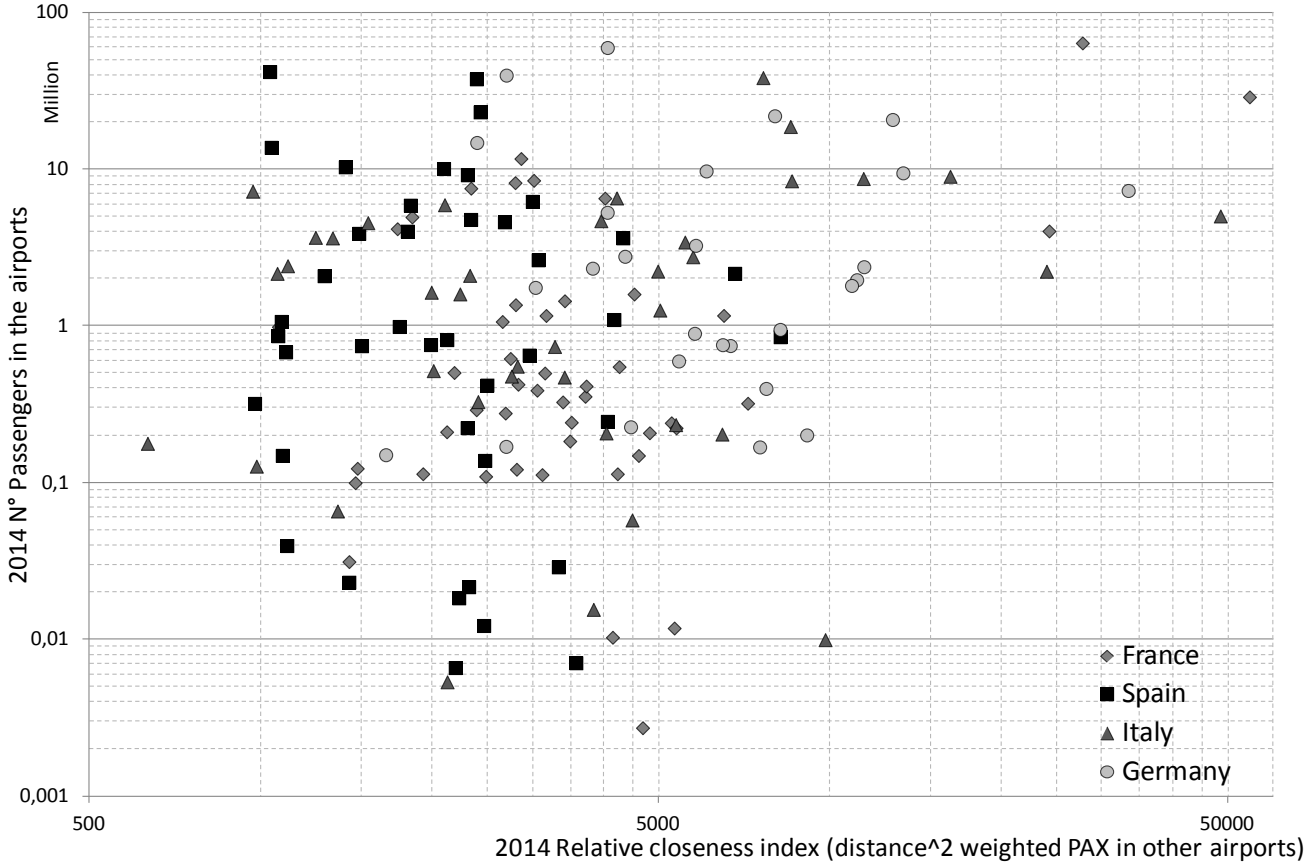
Country	*France*	*Germany*	*Italy*	*Spain*
Total land area [km²]	547.571	348.520	294.152	498.535
Population (2016)	64.668.129	80.682.351	59.801.004	46.064.604
Density (inh/Km²)	118	232	203	92
Urban Pop %	80,5	77,2	70,7	82
N° apts with scheduled services considered	47	27	40	43
N° apts with more than 1M pax in 2014	12	17	23	20
Passengers volume 2014	164.682.473	209.844.141	150.243.055	195.863.599

% passenger traffic in top 5 apts	73,39	74,61	55,28	64,62
% passenger traffic in top 10 apts	89,89	91,29	74,82	83,06
CAGR 04-14 [%]	2,79	2,8	3,45	1,66

Figure 3 depicts the 157 airports of the examined sample (reference year 2014) in a RCI-YCP diagram that allows for identifying some clusters. As a general comment, airports on the right side of the chart (whatever their dimension) have high RCI values, which is due to the presence of other airports in the same reference area (the closer they are, the higher the index). On the contrary, more isolated airports, such as those on small islands or in remote regions with poor surface transport supply, lie on the left part of the chart. As for the y-coordinate, airports characterized by good traffic volumes are on the top of the diagram, while airports with small traffic on a yearly basis are on the bottom. For a given airport *i*, its RCI value is a weighted combination of traffic volumes at surrounding airports and their distances from *i*. Then, the airport coordinates in the RCI-YCP diagram take into account both the size of the traffic volume at the airport itself and the presence of close airports, whose competing role depends on the amount of carried passengers. Small airports could be surrounded by large competitors and are consequently in the weakest position both in terms of demand (passengers are likely to opt for large airports due to the higher frequencies and destinations) and for the supply (carriers may concentrate on the main airports). Also among the mid-sized airports, the situation varies depending on the presence of large competitors nearby.

In this context, LCCs can modify the airport coordinates in the RCI-YCP diagram both directly and indirectly. The direct variation is due, for example, to the extra traffic due to the entry of a LCC, which moves up the position of the airport *i*. Instead, if LCCs bring extra traffic to neighbouring airports *j*, the point indirectly moves right, towards a relatively weaker position.

Figure 3 – RCI-YCP diagram for the airport sample in 2014 by using logarithmic scales (Source: our elaborations on traffic statistics from AENA-Spain, ENAC-Italy, ADV-Germany, Direction du Transport aérien - France)



Starting from these premises, four groups of airports have been identified. Group 1 encloses airports with YCP greater than 10 million, which also includes hubs; group 2 airports with YCP ranging between 1 and 10 million; group 3 airports with YCP ranging between 0.1 and 1 million, and group 4, the remaining airports. Mid-sized airports, belonging to groups 2 and 3, are historically more affected by LCCs than the other ones. In fact, airports belonging to group 1 have an established position and LCCs could add benefits (if operating at the airport itself) or satisfy latent demand (if operating at neighbouring airports), but not modify their position. On the other hand, airports from group 4 are generally small airports in remote or isolated areas, often benefitting from Public Service Obligation[7] (PSO) or seasonal LCC services.

Furthermore, the consistency among airports in the groups has been determined by considering the population density in the region where the airport is located, the presence of LCCs and their role for the airport development as well as their impact in the surrounding airports, the compound growth rate of passenger traffic in the time span considered, the value of RCI and the airport specificity, if that is the case.

Based on these considerations, two significant cases within groups 2 and 3 for each country (16 cases on the whole) have been considered (Table 4) for further discussion. Airports in group 2 have been chosen by considering two different values of RCI, which correspond to low and high levels. Airports in group 3 have been selected based mainly on their location and the weight of LCCs.

Table 4 - The examined airports of groups 2 and 3

[7] PSO refers to subsidies provided by governments (paid to airports, airlines or both) in order to guarantee a minimum level of air services to small or rural communities that, for example, may lack transport alternatives to reach main economic centers.

Country	Airport	Group	RCI	Main features of airports
IT	Napoli (NAP)	2	Low	Important role in the area, good presence of LCCs
IT	Verona (VRN)	2	High	High population density, presence of alternative airports, tourism attractions
FR	Lione (LYS)	2	High	Good population density and important role in the area
FR	Nantes (NTE)	2	Low	Important role in the coastal area, good presence of LCCs
ES	Sevilla (SVQ)	2	Low	Role in the area and high presence of LCCs
ES	Girona (GRO)	2	High	Close to a large airport (BCN), tourism location and strong dependency on LCCs
DE	Hannover (HAJ)	2	High	Good population density and important role in the area
DE	Weeze (NRN)	2	Low	High presence of LCCs, strong population density
IT	Reggio Calabria (REG)	3	Low	Isolated airport and marginal role of LCCs
IT	Parma (PMF)	3	High	Presence of other airports in the same catchment area and strong dependency on LCCs
FR	Grenoble (GNB)	3	High	Close to a large regional airport (LYS) and good population density in the surrounding areas
FR	Pau-Pyrénées (PUF)	3	Low	Low population density, closeness to a similar airport (Lourdes) relative presence of LCCs
ES	Santander (SDR)	3	Low	Relatively isolated airport, but important role for the surrounding areas, high dependence on LCCs
ES	Valladolid (VLL)	3	Low	Central, not coastal, location; low population density and high dependence on LCCs
DE	Lubeck (LBC)	3	High	Relatively isolated airport, but important role for the surrounding areas and strong LCC role
DE	Karlsruhe (FKB)	3	High	High population density and strong LCC role

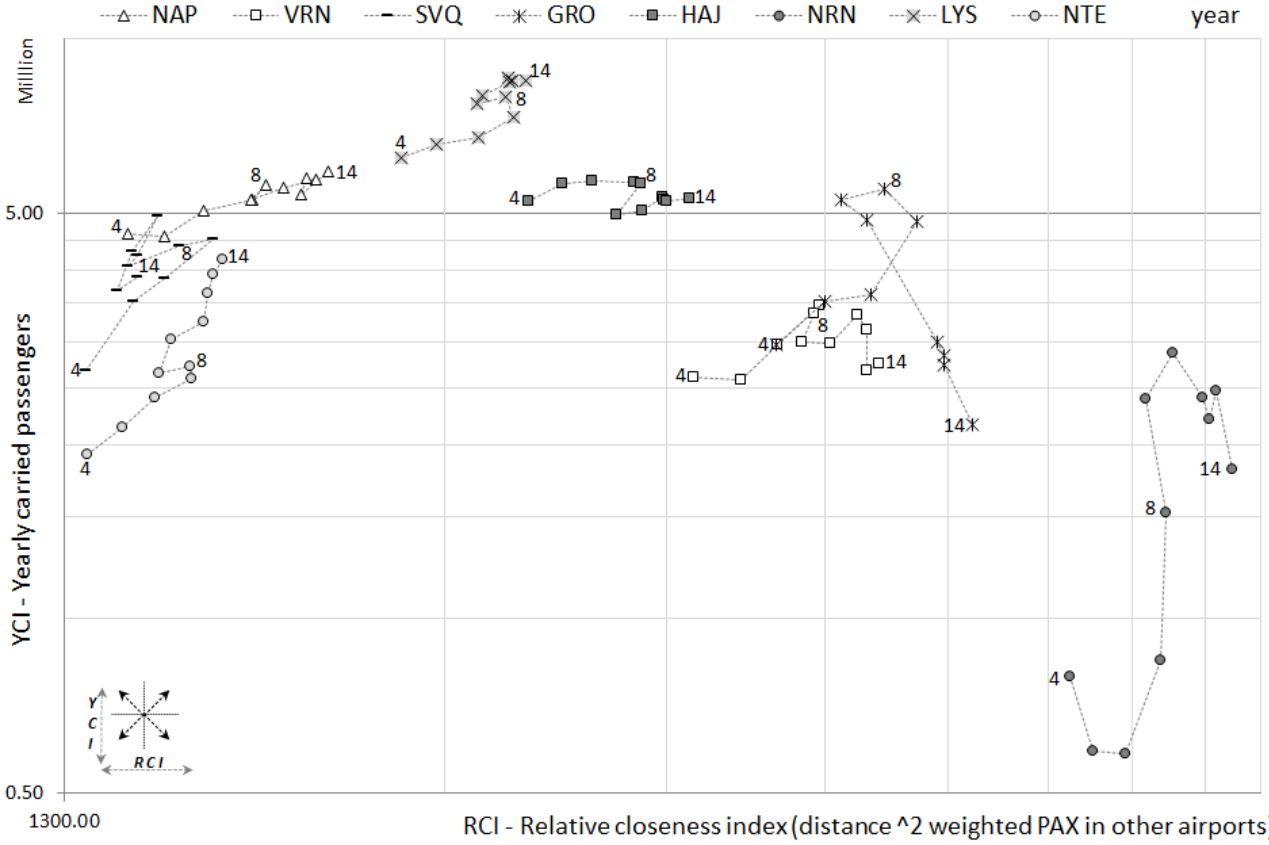
The next section discusses these airports and their histories, looking both at their relative power and at the dynamics of the positioning due to LCC entrances, exits and actions.

5.3 Discussion of the case studies

As discussed above, RCI and YCP provide an indication of the role played by airports with respect to the potential competitors serving the same catchment area. Figure 4 provides a comparison among airports in group 2, namely those with YCP ranging between 1 and 10 million,[8] while Table 5 shows the evolution of the compound annual growth rate between 2004 and 2014 for the RCI and YCP indexes.

[8] With the exception of Lyon, in the time span considered, the airports in this group had, on average, 5 Million passengers a year; thus they can be classified as regional airports according to the EU definition provided in paragraph 3.

Figure 4 - Evolution of RCI between 2004 and 2014 for the airports in group 2 (Source: our elaboration on official statistics for the airports). Note: the numbers refer to years, thus 4 stands for 2004, 8 for 2008 and 14 for 2014.



The airport of Naples (NAP) in Italy evolved in the chart toward the right side. According to RCI, since in the same period there is no variation in d_{ij} – i.e. no new airports in the neighbourhood – NAP evolution identifies an increase in YCP of neighbouring airports. However, there was a general increase in the carried passengers also at NAP, where, during the same period, the percentage of LCC services increased significantly with the opening of an easyJet base in 2014. This aspect, together with the position in the territory and the absence of strong competing airports (FCO being about 200 km away), contributed to strengthening the locally dominant position of NAP. The other Italian airport in group 3, Verona (VRN), registered an increase in its RCI due to the presence, in a 150km radius, of several competing airports that experienced relevant traffic growth in the time span analysed (in terms of CAGR Bologna had 8,58%; Venezia 3,72%; Treviso 9,67%, Bergamo 10,13% and Linate 0,4%[9]). At the same time, there was also an evolution of the LCC services, with a good presence in 2011-2012 (about 34%) due to the increasing role of Ryanair which, in summer 2012, accounted for 13% of flights and almost 19% of seat capacity, just behind Meridiana[10]. In 2013, the presence of LCCs declined (from 34% to about 17%) due to the failure of WindJet and the withdrawal of Ryanair following the decision of VRN to cease the agreement, which foresaw financially unsustainable incentives paid to the carrier. Despite this critical situation, the airport is trying to slowly recover its traffic values thanks to carriers that were substituted for Ryanair, thus demonstrating the presence of a significant local demand and the role played by tourism attractions (VRN ranks second in terms of charter services nationwide).

Lyon Airport (LYS) is France's fourth busiest airport and is located in Rhône-Alpes, one of the most economically dynamic European regions. During the ten years analysed, traffic has steadily increased mainly

[9] In terms of Compound Annual Growth Rate. In the case of Linate, the growth path has been limited by law, reducing the number of hourly movements allowed following the opening of Malpensa in 1998.

[10] http://www.anna.aero

on international routes that, also due to the increasing presence of LCC passing from 2.6% to 26.4% market shares, grew at a higher rate (52%) than domestic ones (23%). Despite this growth, the airport has lost some points in terms of RCI because of the presence of both Genève, located 150 km north-east, which registered a 6% CAGR, and Marseille airports, in the south, which had a 4% CAGR. The other French airport in the group, Nantes (NTE), has a low RCI and locally important results. In fact, it is isolated on France's Atlantic coast and its closest competing airports (Rennes, La Rochelle, Tours, Poitiers) have a marginal role carrying, on average, less than 0.3M passengers a year. The number of carried passengers at NTE has a positive trend in the examined period, with the percentage of LCC shares constantly increasing (from 0.2% in 2005 to 38.6% in 2014) despite the relevant presence of Air France and of its regional partner HOP!.

Table 5 – Evolution of the Compound Annual Growth Rate (CAGR) between 2004 and 2014 for the Relative Closeness Index (RCI) and Yearly Carried Passengers (YCP)

Group 2	IATA	CAGR - YCI 04/14	CAGR - RCI 04/14
Napoli	NAP	2,53%	3,72%
Verona	VRN	0,53%	3,44%
Siviglia	SVQ	4,00%	0,93%
Girona	GRO	-1,96%	3,63%
Hannover	HAJ	0,08%	2,96%
Weeze	NRN	8,53%	3,00%
Lione	LYS	3,12%	2,31%
Nantes	NTE	7,93%	2,49%

Looking at the Spanish airports, Sevilla has constantly increased the percentage of LCCs from less than 8% in 2004 to 85% in 2014, and traffic volumes registered a CAGR of 4% in the same period. Interestingly, the airport does not have a dominant carrier; two thirds of the passengers are shared between Ryanair and Vueling, and the rest are carried by other airlines. In terms of RCI, despite the relative closeness of Malaga (4th in terms of traffic in Spain), the value has not significantly changed in the considered time span by evidencing a specific role for SVQ in the area that is confirmed by the data on population density, which is concentrated around Sevilla. Differently, the Girona airport, fully dominated by Ryanair, has experienced higher instability with two evident phases. In the first one, the traffic increased in an apparently successful way, thanks to the Ryanair base, but its neighbours also increased, resulting in a growing RCI. Between 2010 – 2014, Girona started losing traffic in favour of the near airport of Barcelona El Prat, where the dramatic expansion of Vueling, Ryanair and EasyJet determined traffic increase, together with the recovering of lost volumes due to the failure of Spainair in 2012 (CAPA, 2015). In these years the YCP of Girona has fallen while its RCI has grown, putting it into a difficult position[11].

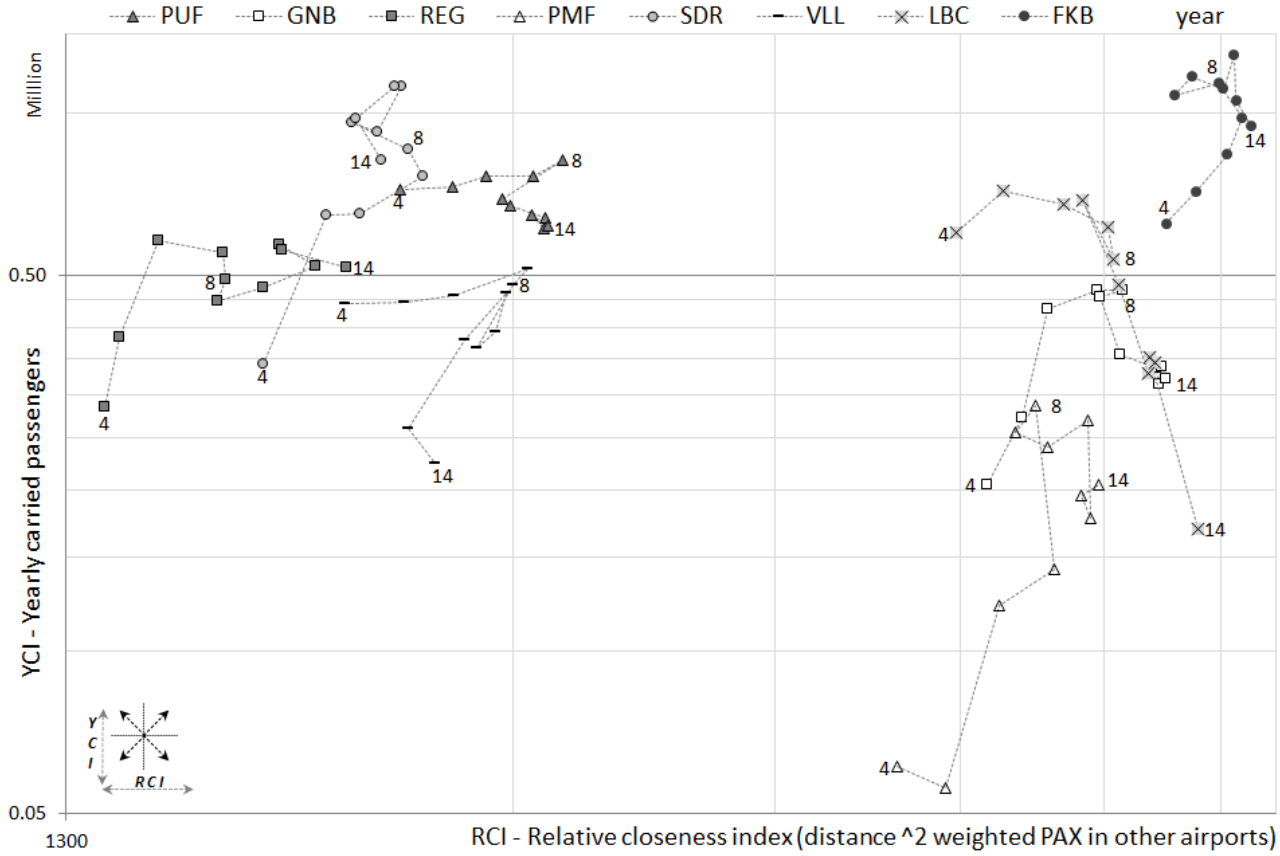
In Germany, the airport of Weeze (NRN) has increased its YCP, slowing down only in the last four years in part due to the financial crisis and in part to the introduction of an aviation tax, which resulted in Ryanair reducing its network. At the same time, the RCI has constantly grown due to the presence of many airports in the area both bigger, like Dusseldorf (75km south) or Cologne (130km south), and similar in traffic terms, such as Dortmund (130 km east) and Eindhoven (80 km west). The other German airport in group 2, Hannover, despite not being dominated by LCCs, has played an important role in its catchment area. Pantazis and Liefner (2006), demonstrate the impact of LCCs on traffic increase as well as on expansion of the Hannover catchment area, following the entrance of the low-cost carrier Hapag Lloyd Express, which exploited the free capacity resulting from the expansion of the airport before the start of the EXPO2000. The increase in RCI results from

[11] In 2010 Ryanair launched its base in El Prat and it is now progressively downsizing its presence in Girona.

the traffic growth registered in the two closest airports of Bremen (CAGR 6%) and Hamburg (CAGR 4%), while in contrast, traffic figures for Hannover have only slightly changed in the ten years analysed.

Figure 5 provides a comparison among the airports in group 3, i.e. ranging from 0.1 to 1 million passengers, while Table 6 shows the evolution of the compound annual growth rate between 2004 and 2014 for the RCI and YCP indexes.

Figure 5 - Evolution of RCI between 2004 and 2014 for the airports in group 3 (Source: our elaboration on official statistics for the airports). Note: the numbers refer to years, thus 4 stands for 2004, 8 for 2008 and 14 for 2014.



In Italy, Reggio Calabria (REG) and Parma (PMF) have similar vertical evolutions and a general increase of their YCP at the end of the examined period. However, in both cases traffic volumes declined during the last years – more significantly for PMF than REG. By looking at the LCC presence, its role has been very marginal and inconsistent for REG (only for three years in the time span considered). On the contrary, the LCC presence at PMF has been constantly increasing, reaching the considerable value of 94% in 2014 (91.3% during the ten-year period). However, this relevant presence has not led to a constant traffic growth. These results should be combined with the RCI values for both airports. REG has small values, while the opposite happens for PMF. In the latter case, there is a significant presence of competing airports in the neighbourhood, in particular the Bologna and Milan airport systems, which reduce the potential role of PMF. In contrast,, REG has just one real competitor (Lamezia Terme, SUF, about 130 km away) and the presence of LCCs during three years did not produce significant positive or negative changes.

As for the French cases, GNB, located near to the Western Alps region, has experienced variable traffic trends, with ski tourists from abroad representing its main customers (98%). Despite the relevant role of seasonal charter services, regular flights have also increased thanks to the presence of LCCs, which on average have 43% of GNB's market share. However, the extremely seasonal character of passenger flows together with the closeness of similar alternative airports (Chambéry – Savoie) or bigger ones (Lyon and Geneve) translated to

a constant increase in the RCI index by reducing the role of GNB in the area. Similarly, to GNB, the airport of Pau - Pyrénées (PUF) is located in a mountainous area and is less than 50 km away from the airport of Tarbes Lourdes Pyrénées (LDE), whose traffic is related to religious tourism and pilgrimages to Lourdes (Bernier, 2010). Traffic has been mainly domestic due to the strong presence of Air France on routes to both Paris airports[12]. Passengers in PUF grew until 2008, when LCCs reached their peak (20%); nonetheless, in 2009 PUF lost 15% of passengers while LDE grew by 53% without any LCCs. The presence of LDE together with the relative closeness of Toulouse (7th airport in France) and the withdrawal of Ryanair service in 2011[13] determined declining YCI and constantly increasing RCI values, which indicate a minor role for the airport.

Table 6 - Evolution of the Compound Annual Growth Rate (CAGR) between 2004 and 2014 for the Relative Closeness Index (RCI) and the Yearly Carried Passengers (YCP)

Group 3	IATA	CAGR - YCI 04/14	CAGR - RCI 04/14
Reggio Calabria	REG	6,17%	3,82%
Parma	PMF	12,75%	3,19%
Santander	SDR	9,63%	1,86%
Valladolid	VLL	-6,86%	1,41%
Lubecca	LBC	-11,90%	3,81%
Karlsruhe	FKB	4,28%	1,32%
Grenoble	GNB	4,62%	2,82%
Pau-Pyrénées	PUF	-1,48%	2,31%

In Spain, the airport of Santander shows an increase in YCP, which follows the LCC's growing presence, while its RCI is substantially stable in the time period analysed. As pointed out by Martinez and Marin (2015), the relatively small population of the city is offset by its isolation and the poor transport alternatives to the functional areas in Spain, which give Santander a role as a sub-regional centre that is also attractive to the potential low-cost customers from the near agglomeration of Bilbao. In contrast, the Valladolid airport has changed its RCI in both directions. In the first years of the analysis, RCI has slightly grown, as has the LCC percentage. However, in the last four years RCI decreased together with its YCI, probably due to traffic reduction in the biggest and closest airport of Madrid. There, the economic crisis, Iberia's restructuring process, the impact of high-speed train services on domestic routes and an increase in airport charges, which caused the cut of Ryanair's capacity and the closure of the EasyJet base, produced a drop in traffic figures.

As for the German cases, the Lubeck airport shows a particular trend, since its traffic grew until 2009 mainly due to LCCs. However, since 2010, the values have started to decrease, partly due to the financial crisis, while the nearby Hamburg airport (5th in traffic terms) kept growing, thanks to EasyJet, Germanwings and Condor establishing their bases at the airport. This translated to a constant RCI increase, which highlights a marginal role for Lubeck in favour of Hamburg, located only 60km away, whose higher number of frequencies and destinations proved more attractive for passengers. The airport of Karlsruhe (FKB) has experienced a growing trend since 2003, when Ryanair started initial operations to London Stansted. In the same year, the carrier relocated its Strasbourg routes (25km south of Karlsruhe) to FKB following a court judgment that imposed the repayment of subsidies received at the Strasbourg airport by the carrier (Olischer and Dörrenbächer, 2013). During the years, RCI moved towards the right side mainly due to the growth of the two bigger airports of Stuttgart (110km east) and Frankfurt (160 km north). Moreover, in the last two years the airport has flat-lined, despite Ryanair launching its base in 2012.

[12] http://www.anna.aero

[13] The European Commission found that airport service agreements and marketing arrangements concluded between the Chambre de Commerce et d'Industrie de Pau-Béarn and Ryanair/AMS between 2003 and 2011, as well as a contract signed with Transavia in 2006, gave these companies an undue economic advantage over their competitors (EC, 2014b).

6. Conclusions and main findings

Following the liberalization process, the presence of low-cost carriers proved to be fundamental for the success of many airports in Europe. Nonetheless, quite often this presence represents only a necessary condition that needs other elements (such as the catchment area or the incoming market for tourist reasons) to guarantee long-term growth and sustainability. As a result, totally different outcomes may result from the interaction between airports and LCCs, which in turn influence the role of the airport in the catchment area.

This chapter provides an analysis of the two main aspects shaping the airport-LCC relationship: the role of the airport in the area and the balance of power between the LCC and the airport. These aspects have been analysed starting from a sample of 157 airports in Europe, with a focus on a sub-sample of 16 representative airports in a 10-year time span. These airports have also been discussed narratively, commenting on the presence, the role and the organisation of LCCs.

The analysis allows us to draw some common patterns:

- If several LCCs operate in an airport, the airport is less likely to be dominated by one carrier, in particular if there are no good substitutes in the region. This is the case of Sevilla or Nantes, where good population density and the relatively far distance of alternative airports results in a low RCI;
- In a context with a good catchment area and two airports, LCCs may opt for the secondary one instead of the primary airport due to its lower charges and entry barriers. As soon as the carrier decides to also serve the primary airport where it could also get business passengers, RCI increases. This is, for example, the case when Girona downsized in favour of Barcelona El Prat;
- Similarly, where there are many primary airports in the same catchment area, the airport hosting one LCC has a relatively low impact and is dominated by the carrier. This happened in Parma, Lubeck or Karlsruhe, all suffering from Ryanair's decisions. Only in the presence of a peculiar catchment area and where the airport manager favours a mix between low-cost and full-service carriers can the airport regain a role, as with the case of Verona;
- Tourism may be important for the success of an airport such as Verona, Girona or Sevilla, however where seasonality plays a part and similar airports compete to attract tourists, as in the case of Grenoble (with Chambery) or Pau – Pyrénées (with Lourdes Pyrénées), the outcomes can differ;
- Where the airport is rather isolated, due to poor surface transport services and relatively distant neighbouring airports, the type of airline does not significantly modify its YCP, as the airport only serves its captive demand in the primary catchment area. This is the case of Reggio Calabria;
- Finally, good catchment areas and a good mix of traffic (business, leisure, charter) allows more stable relationships between airports and airlines, preventing the dominance of one over the other (Naples, Lyon).

In conclusion, the relationship between LCCs and airports is not simply dual, but also heavily dependent on the role of the airport in its catchment area. It is not the sole presence of an LCC, even when growing for many years, that guarantees growth or even lasting traffic figures for any airport. Airports sharing the catchment area with others are in a very risky position, due to the mobility of the LCCs, even if the area they serve is very dynamic and guarantees a large demand. This aspect pushes airports to be extremely efficient and able to adapt to the changes in LCCs' business models, in order to continue to play a role in the catchment area. Differently, geographically isolated airports in good catchment areas can better counterbalance the power of carriers.

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