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Low-cost carrier entry at small European airports: Low-cost carrier effects on network connectivity and self-transfer potential

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1. Introduction

Airport connectivity is a way of measuring how accessible a region is in terms of its air transport links. High levels of connectivity have the potential to deliver significant economic and social benefits to both cities and regions (Goetz, 1992; Brueckner, 2003; Bel and Fageda, 2008; van de Vijver et al., 2014; Florida et al., 2015). When regions are disadvantaged by their location relative to major metropolitan and economic centres, frequent links to hubs that offer numerous onward destinations enhances connectivity (Suau-Sanchez and Burghouwt, 2012); this can improve the competitiveness of a region in attracting tourism and inward investment as it facilitates face-to-face interactions (Gaspar and Glaeser, 1998; Hall, 2009).

Connectivity depends on a diverse range of factors, such as, the types of airlines operating at an airport and the scale and geographic scope of their network. Connectivity offered by full service network carriers (FSNC), for example, can be quite different to that offered by a low-cost carrier (LCC). The former coordinates schedules at hub airports, offering seamless connections between regional, national, intra-continental and global markets. The latter, in contrast, limit themselves to serving short-haul markets only. Although some LCCs are evolving and offer connecting flights (Fageda et al., 2015), most LCCs, in order to maintain cost-competitiveness, focus on point-to-point services and do not facilitate connecting traffic. This enables them to schedule services competitively against incumbents without being subject to the complexities associated with a connecting wave-system (Fageda et al., 2015). Yet, in a context where low-cost carriers have rapidly become the dominant players in the short-haul markets (Dobruszkes, 2013), the substantial amount of flight frequencies at low-cost airport bases have created opportunities to transfer between those flights, even though flight connection services are not typically offered by the low-cost carriers themselves (Malighetti et al., 2008; Maertens et al., 2016). Passengers that do wish to connect between an LCC's flights must self-transfer, enduring the inconvenience of an additional check-in process at the LCC airport base, and facing the added risk of a missed connection. In spite of this, an increasing number of passengers self-transfer, especially among price-sensitive air travellers (O'Connell and Williams, 2005; OAG, 2016). In spite of that, only few airports in the world actively support self-connections. Examples include London Gatwick and Milano Malpensa airports, which have introduced the GatwickConnects and ViaMilano platforms, respectively. These allow passengers to book online their own flight transfer services between two flights not explicitly connected by the airline/s involved. In exchange for a fee (Gatwick) or for free (Milano), self-connecting passengers are offered a baggage transfer service and insurance against the risk of missing their onward flights.

Communities located in smaller regions have traditionally been able to access international destinations via connecting flights scheduled to their main national gateway usually operated by FSNCs or their regional affiliates (Suau-Sanchez et al., 2014). However, since the deregulation of the European air transport market, LCCs have launched services from many regional airports, growing traffic volumes and expanding the number of destinations served. FSNCs operating in regional markets have often had to reduce or even withdraw services as a result of LCC competition. Whilst it could argued that LCCs reduce the cost of travel for passengers (Fageda and Fernandez-Villadangos, 2009), the seamlessness and integration that FSNC networks provide between regional and international markets can disappear. However, Malighetti et al. (2008) highlights that two-thirds of the fastest indirect connections in Europe are not operated by FSNC, but by other carriers; this opportunity could be exploited to enable higher levels of connectivity.

Against this background, we contribute to the literature on the connectivity effects of LCC entry at small airports in two ways. Firstly, we analyse how intra-European connectivity has changed at small airports over the period 2002 to 2012 and what has been the effect, if any, of LCC expansion in these markets. Secondly, we evaluate how LCC entry has affected the quality of schedules for day-return trips, focusing on links between small airports and metropolitan centres. These connections are essential in facilitating face-to-face interaction and the continued sustainability of businesses located in non-metropolitan regions (Pagliari, 2003). The analysis also focuses on the role played by

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the remoteness of markets and the distance to main city centres, which result in the unevenness of connecting options across the Europe.

The reminder of the paper is structured as follows: in Section 2 we discuss the literature on airport connectivity at small airports. Section 3 presents the data sources, the airport grouping and methodology. Section 4 presents the results and Section 5 discusses the implications for both policy and practice.

2. Airport connectivity at small airports

2.1. The concept of airport connectivity and ways to measure it

Traditionally, measuring airport connectivity has been a way of quantifying how accessible a region is in terms of air transport links. Every passenger perceives their individual connection from origin to destination differently and choses the airline and route according to individual preferences (Castillo-Manzano and Marchena-Gomez, 2011; Nassiri and Rezaei, 2012). Intuitively, for a passenger, the most direct and fastest connection would be the most preferred. However other variables will also have an effect on how passengers select their travel itinerary. For instance, a lower ticked price or high brand loyalty to an airline may also influence the itinerary choice and for these reasons, passengers may be willing to endure the inconvenience of a transfer at an intermediate hub in preference to a direct service. However, as a general rule, the most preferred connection between two airports is when both the total travel time and the number of interim stops is minimised. Airlines will aim to facilitate point-to-point demand with direct flights. However, in low traffic density markets, direct flights may not be commercially feasible, so connecting flights via a hub will be scheduled to meet travel demand. For a small airport, direct services to and from a hub can significantly increase connectivity (Button, 2002; Redondi et al., 2013), since the increase in the number of airports served from the hub impacts exponentially on the number of city-pairs served (Doganis, 2010).

There are diverse ways to measure airport connectivity. Burghouwt and Redondi (2013) and Suau-Sanchez et al. (2015) provide a thorough review of the different approaches and studies on airport connectivity.

On the one hand, supply-based studies, i.e., analyses using airline supply data, such as flight schedules, use accessibility and centrality measures. The former provides information on potential connectivity by measuring the maximum number of potential connections available to each arriving flight, the latter, calculates the centrality of each airport based on the topology of the network (centrality models). The main supply-based accessibility measures are, among others, the Danesi measure (Danesi, 2006), the Reynolds-Feyham and McLay accessibility approach (Reynolds-Feighan and McLay, 2006), the Netscan model (Veldhuis, 1997; Matsumoto et al., 2008; Suau-Sanchez and Burghouwt, 2012), the Weighted Indirect Connections (Burghouwt and de Wit, 2005; Burghouwt, 2007), and the Accessibility index (Redondi et al., 2013). The main supply-based centrality measures are degree centrality (Bowen, 2000; Burghouwt and Hakfoort, 2001), betweenness centrality (Guimerà et al., 2005; Guida and Maria, 2007; Malighetti et al., 2008; Paleari et al., 2010), closeness centrality (Sapre and Parekh, 2011), essential betweenness centrality (Malighetti et al., 2008), weighted betweeness (Rodríguez-Déniz, 2012), and average quickest travel time (Niesse and Grimme, 2013). Since these studies are based on the analysis of published airline schedules, their results can be interpreted in terms of potential "flight connectivity" rather than actual "passenger connectivity". An important limitation of this approach is that not all flight connectivity has the same value for the airports and airlines involved. Potential connections in large city-pair routes will be more valuable than in city-pair routes where no passenger traffic is recorded.

Addressing this limitation requires the use of data on passenger bookings that have explicit indication on the actual city-pair market that is being connected and the actual full passenger itinerary (e.g, MIDT and PaxIS are two of the most well-known databases). These demand-based studies use centrality measures and provide information on the actual topology of the network. The main measures are hub intensity (Derudder et al., 2010), degree and betweeness centrality (Wang et al., 2011; Zeng et al., 2011; Jia and Jiang, 2012), closeness centrality (Wang et al., 2011), connecting passengers (Adikariwattage et al., 2012) and flow centrality (Rodríguez-Déniz et al., 2013; Suau-Sanchez et al., 2015, 2016a).

2.2. Uneven connectivity at small airports

Studies on small and remoter airports have generally been focused on the provision of air services and their economic impact, the different subvention mechanisms and infrastructure requirements (see, for example, Williams and Bråthen, 2010). But research on accessibility and connectivity of remoter airports has been limited. Recent contributions share the view that there is an uneven distribution of connectivity among smaller airports. Halpern and Bråthen (2011), with reference to Norway, highlight that frequency levels are higher to domestic destinations compared to international. Similarly, Suau-Sanchez and Burghouwt (2012), in analysing the Spanish market, demonstrate that only the smaller airports connected to the main national hub could achieve significant connectivity values to international destinations. At the European level, Suau-Sanchez et al. (2016a) shows that only a limited number of European airports benefited significantly from deregulation and LCC traffic development. Furthermore, those airports that benefitted from connectivity improvements were usually dependent on a small number of airlines, in most cases, Ryanair. Similar observations were made by Lian and Rønnevik (2011) who showed that LCC entry in Norway also led to a loss of traffic at smaller regional airports. The results of the studies mentioned above are confirmed by a Europe-wide analysis (Lieshout et al., 2016) which highlights that in large parts of Scandinavia, France and Spain, airline and airport competition is considerably limited and affects connectivity opportunities. These areas are often served only by a handful of airports and/or airlines, limiting airline choice and therefore competition. In addition, the small size of airports and the limited traffic and connectivity also impacts on their efficiency. In this regard, Merkert and Mangia (2014) show that regional and small airports with low levels of competition also deliver lower efficiency levels.

Whilst most of the literature focuses on historical dimensions, Redondi et al. (2013) considers the effects of future scenarios on connectivity by simulating effects caused by the closure of airports handling < 2 million passengers a year. The study found relatively limited country-level effects, with the exception of the Scandinavian states, and significant variation between regions. For example, some regions in France, Spain and Italy experienced increases in average travel times of up to 40%.

Furthermore, the phenomenon of self-connectivity that was firstly defined by Burghouwt (2007) as "self-help hubbing" and was later analysed by Malighetti et al. (2008) for smaller airports. They highlight the opportunities this offers in connectivity terms, they results show that two-thirds of the fastest indirect connections in the intra-European market are not operated by carriers aligned to alliance networks. Other studies have scoped the market potential of self-connectivity (Fichert and Klophaus, 2016; Maertens et al., 2016; Suau-Sanchez et al., 2016b), but with less emphasis on the potential benefits for smaller airports.

3. Data and methodology

3.1. The sample of airports

We obtain our data from the OAG (Official Airline Guide) dataset, which provides supply information on a diverse number of variables for each scheduled flight, including origin and destination airport, time of departure and arrival, number of seats supplied, aircraft type, and day