Ryanair and Spain: Air connectivity and tourism from the perspective of complex networks

Ryanair en España: conectividad aérea y turismo desde la perspectiva de las redes complejas

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Abstract

This research presents an innovative exploratory study of connectivity in Spain through the analysis of the main low-cost air company in Europe, Ryanair, employing complex network theory techniques. Knowing the connectivity of each one of the airports that operate in Spain, we analyse the different characteristics of national and international tourist flows in the country. Our results show that the most important European tourist flow is from United Kingdom to the Spanish coast and that the diversification of flights at different airports in the country promotes the development of new tourist destinations which have thus experienced an increase in their number of visitors. We start a new line of research that can analyse different parameters of air connectivity and the implications for tourism.

Keywords: Connectivity, low-cost companies, tourism, Ryanair, Spain, complex networks.

Resumen

Esta investigación presenta un innovador estudio exploratorio de la conectividad en España a través del análisis de la principal aerolínea low cost de Europa, Ryanair, gracias a la técnica de redes complejas. Conociendo la conectividad de cada uno de los aeropuertos en los que opera la compañía en España, se pretenden analizar las diferentes características de los flujos turísticos nacionales e internacionales que se dan en el país. Así, algunos de los resultados obtenidos reflejan que el flujo turístico más importante de Europa es el procedente de Reino Unido con destino a la costa española, o que la diversificación de los vuelos en diferentes aeropuertos del país promueve al desarrollo de nuevos destinos turísticos que, de esta forma, han experimentado un aumento en su número de visitantes. Se inicia así una nueva línea de investigación en la que pueden analizarse los distintos parámetros de conectividad aérea y sus relevantes implicaciones para el turismo.

Palabras Clave: Conectividad, compañías de bajo coste, turismo, Ryanair, España, redes complejas.

1. Introduction

Tourism and transport is an inseparable coupling in which, especially in the case of international trips, the plane is the major means of mobility for people travelling both for leisure and recreational purposes (Seguí Pons & Martínez Reynés, 2010). Thus, transport infrastructure is considered one of the most important factors in the development of cities' tourism (Calvo-Mora, Berbel-Pineda, Periáñez, & Suárez, 2011). In the tourism sector, the development of low-cost carriers (LCCs) in Europe has represented an revolution in relation to tourist movements (Dobruszkes, 2009), especially since the liberalisation of air transport in the European Union and the new open-skies policy introduced in 1997 (Hernández, 2008; Ribeiro de Almeida, 2011). In Spain, according to the Instituto de Estudios Turísticos (IET, 2012), LCCs have achieved a market share superior to that of full-service network carriers (FSNCs), covering around 57% of international arrivals in Spanish airports in 2011 and having an annual growth twice that of traditional airlines (4.9% compared with 2.9% in 2011).

LCCs can reduce fares by minimising the costs that these enterprises consider superfluous to customers (Rodríguez Gamero, 2008). Apart from these characteristics, which explain the high popularity that LCCs have achieved among normal tourists (Alderighi, Cento, Nijkamp, & Rietveld, 2012), another aspect positively valued by customers is the direct connectivity between the origin and the destination, that is flights without stopovers (Castillo-Manzano, Lopez-Valpuesta, & Pedregal, 2012a, 2012b).

LCC use is not just another variable in tourist transport analysis. Owing to its current development compared with FSNCs, it is being studied by the scientific community as a determinant defining the profile of the tourists who tend to use them for their leisure trips (Martínez-García & Raya, 2008; Martínez-García & Royo-Vela, 2010). The characteristics of LCC travellers identified in several studies, in contrast to travellers using FSNCs, are as follows:

- Aged between 15 and 24 years old or older than 64
- Medium to low income level
- Travelling for leisure purposes
- Periods of stay and tourist expenses in the destination are lower than for FSNC travellers
- Chosen tourist products are both urban and sun and sand tourism
- Quite loyal to the destination, visiting several times
- Use the Internet to look for information and buy trips without tourist packages
- Come mainly from Germany, the United Kingdom (UK), Spain, France and Italy
- Principal destinations are the UK and Spain (IET, 2012; Martínez-García & Raya, 2008; Martínez-García & Royo-Vela, 2010; Raya-Vilchez & Martínez-García, 2011).

All these characteristics allow us to draw a relevant conclusion: the democratisation of international trips thanks to LCCs (Rodríguez Gamero, 2008) has made it possible for a great part of the population who previously could not travel abroad due to their socio-economic circumstances to do so. This increase in the volume of international tourist flows favours an increase in the social and economic benefits in the principal LCC destinations (Rey, Myro, & Galera, 2011), the growth of tourist

incomes in the area and the creation of new jobs associated with tourist activities (Donzelli, 2010).

The development of LCCs is forcing quantitative and qualitative changes in tourist policies in the destinations that receive most of the LCC travellers. These changes will also affect the planning policies of the territory and tourist infrastructures (Vera-Rebollo & Ivars-Baidal, 2009). For example, in the Spanish case, there is increasing specialisation in real-state for tourism year on year on the Mediterranean coast (hotels, second homes, airports, etc.) as a result of the need to meet the transport and accommodation demands of the great number of foreign tourists (Vera-Rebollo & Ivars-Baidal, 2009).

For these reasons, it can be concluded that international tourism cannot currently be understood without taking into account the great development in LCCs, which is decisive in defining both the issuing markets and tourist destinations (Hosteltur, 2011). The influence of LCCs in international mobility is so important that several theorists are using LCCs as determining factors to understand migratory tendencies, such as the migratory network between Poland and the UK (Burrell, 2011). Similarly, we consider it necessary to study LCC connectivity in order to define the relationships between tourist issuing and host cities and their weight; this will enable us to determine quantitatively those cities which have a higher connectivity with other origins and destinations and what the connections are. Categorising and characterising the network provided by LCCs in Spain can facilitate a better comprehension of tourist mobility flows within the continent. This could be used as the basis for the development of national tourist policy and as a first attempt to research more geographically enclosed or focused phenomena such as migratory flows (Burrell, 2011). Thus, we propose a novel perspective on this subject by developing an analysis of Ryanair in Spain as a paradigmatic case study of LCCs by employing complex network theory (CNT) techniques.

Ryanair is an Irish air company created in Dublin in 1985, which operates following the aforementioned characteristics of LCCs (IET, 2012; Martínez-García & Raya, 2008; Martínez-García & Royo-Vela, 2010; Raya-Vilchez & Martínez-García, 2011). In January 2013, the airline was active in 185 cities of 28 countries (all European, except Morocco), carrying out more than 1,500 flights per day with more than 1,500 available routes. It has 50 bases of operations, works in 147 airports and has around 8,500 passengers every year (Ryanair, 2013), making it the most significant LCC in Europe (Hosteltur, 2011; Rodríguez Gamero, 2008). In this study, we consider that the analysis of the connectivity among European cities facilitated by Ryanair can be a key factor in understanding the international tourist flows in the continent, this being the most representative LCC and the one with the widest connectivity network.

Some studies have already analysed connectivity networks in Europe (Burghouwt, Hakfoort, & Ritsema van Eck, 2003), including the role played by LCCs in the development of these networks (Dobruszkes, 2006; Jimenez, Claro, & de Sousa 2012). However, there is still very little analysis of the implications of these networks for tourism by the international scientific community, an aspect to which we contribute with the results of our research. This study is also novel by analysing tourist flows using the CNT. We take Ryanair as a case study to analyse how its nodes (Spanish airports) interrelate (link), both among the Spanish nodes and with the other European airports, to determine the weight of each node in relation to the rest and the kind(s) of connectivity they have, analysing the implications for tourism.

2. Method

As mentioned in the introduction, to analyse the complex network of aerial transportation through LCCs in Spain, we have taken Ryanair as a case study and applied CNT. Regarding the method, CNT is grounded in the use of graphs, where the studied data are a set of connected nodes with several properties influencing other nodes (Arenas, Díaz-Guilera, Kurthsd, Moreno, & Zhou, 2008; Newman, 2003; Réka & Barabási, 2002; Strogatz, 2001; Watts, 1999). Complex systems have a set of characteristics defining their structure: they are composed of several parts which interact, every part has an internal structure and a specific aim, and what happens in one part affects the whole system in a non-linear manner.

A "graph" in this context is made up of "vertices" or "nodes" and lines called edges that connect them. In the context of network theory, a complex network is a graph (network) with non-trivial topological features and with patterns of connection between their elements that are neither purely regular nor purely random. The mathematical abstraction of a complex network is a graph G comprising a set of N nodes (or vertices) connected by a set of M links (or edges), k_i being the degree (number of links) of node i.

We call all nodes with a direct connection to another node neighbours, i.e. neighbours of V_i. In the first part of our study, we determine the structural properties of the complex network, that is, how the nodes are connected.

2.1 analysis of CNT in the case of Ryanair

First, an analysis of Ryanair's destinations was undertaken. As mentioned in the introduction, the company currently has 185 destinations in 28 countries. Figure 1 shows the existing connections among them in Spain and the rest of Europe.

Figure 1: Ryanair destinations

Source: Ryanair (2013).

Once all the nodes in the network had been identified, a database comprising every country was developed and a weight (number of flights per week) was assigned to the links among the nodes, thus creating the connections between the networks of all the 25 Spanish airports in which Ryanair operates, i.e. a matrix of adjacency was created for each airport. In the graphic of the network developed for Spain, each node represents an airport, with a line linking the route from an airport to another; the linking line grows thicker as the number of connections per week (weight) increases.

3. Results

This section presents the results of the analysis of the structural properties of the Spanish network in relation to the tourist sector. First the general features of this network are examined in order to provide a basis for then focusing on the properties of network centrality and betweenness. These properties provide a better understanding of the functioning of the Spanish complex network from the perspective of the airline Ryanair and thus the implications of different flows for tourism.

3.1. Characteristics of the Ryanair network in Spain

Spain is connected nationally and internationally to 118 destinations through Ryanair, Palma being the airport with the highest offer of 56 destinations and Tenerife North the least connected airport with only two destinations (see Table 1).

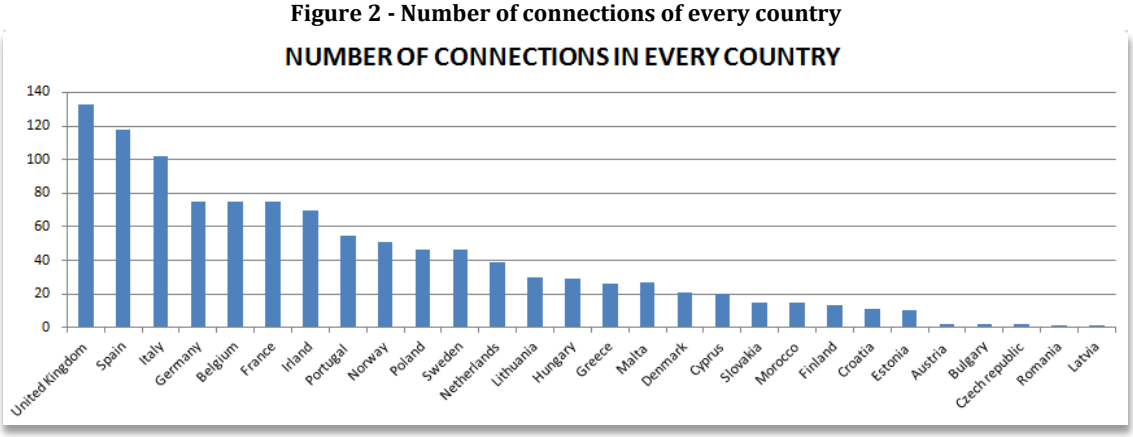
Table 1: Number of connections from Spain

Airport of origin	Number of destination airports
Alicante	40
Almeria	6
Asturias	4
Barcelona-El Prat	40
Bilbao	5
Fuerteventura	20
Gerona	54
Gran Canaria	28
Ibiza	28
Jerez	4
Lanzarote	21
Madrid	43
Málaga	50
Menorca	5
Murcia	10
Palma	56
Reus	16
Santander	17
Santiago	14
Sevilla	30
Tenerife North	2
Tenerife South	35
Valencia	36
Valladolid	5
Zaragoza	6
TOTAL	118

Source: Ryanair (2013) – elaborated by the authors.

Considering the number of connections between every European airport in which Ryanair operates (28 countries including Spain) and comparing the Spanish information with other European countries, we can see from Figure 2 that Spain is in second place regarding connectivity, only surpassed by the UK.

Figure 2 - Number of connections of every country



Source: Ryanair (2013) – elaborated by the authors.

Table 2 - Most significant Ryanair connections between European airports

COUNTRY	AIRPORTS WITH THE MOST CONNECTIONS	MOST CONNECTIONS WITH AIRPORTS OF OTHER COUNTRIES	TOTAL NUMBER OF DESTINATIONS OFFERED IN THE COUNTRY
Germany	Dusseldorf Weeze	Malaga and Palma de Mallorca	75
Austria	Salzburg	London Stansted	2
Belgium	Brussels	–	75
Bulgaria	Plovdiv	–	2
Cyprus	Pafos	–	20
Croatia	Zadar	Frankfurt Hahn, Brussels Charleroi, London Stansted, Oslo Rygge and Stockholm Skavsta	11
Denmark	Billund	Gerona, Palma de Mallorca, Malaga and London Stansted	21
Slovakia	Bratislava	–	15
Spain	Palma	London Stansted	118
Estonia	Tallinn	–	10
Finland	Tampere	Milan Bergamo	13
France	Paris Beauvais	London Stansted	75
Hungary	Budapest	–	29
Ireland	Dublin	London Stansted	70
Italy	Milan Bergamo	Brussels Charleroi and London Stansted	102
Latvia	Riga	–	1
Lithuania	Kaunas	London Luton, London Stansted, Dublin and Oslo Rygge	30
Malta	Malta	–	27
Morocco	Marrakech	Brussels Charleroi and Marseille	15
Norway	Oslo Rygge	Alicante, Malaga, Palma de Mallorca, London Stansted	51
Netherlands	Eindhoven	Palma de Mallorca and Milan Bergamo	39
Poland	Krakow	London Stansted and Dublin	46
Portugal	Oporto	Baden Baden, Bremen, Dortmund, Dusseldorf, Frankfurt, Memmingen, Brussels, Liverpool. London Stansted, Dublin, Eindhoven, Maastricht, Madrid and Paris Beauvais	55
United Kingdom	London Stansted	Dublin and Tenerife South	133
Czech Republic	Brno	–	2
Romania	Constanta	–	1
Sweden	Stockholm Skavsta	Gerona	46

Note: empty cells (–) denote that no differences were found between the numbers of connections in the airports of that country.

Source: Ryanair (2013) – elaborated by the authors.

Regarding the general characteristics of the network, Table 2 displays the main connections between European airports (the airports can be either originating or destination airports).

Looking at Table 2, we can see that several European countries have an important index of connectivity with Spanish airports. For example, the airports of Malaga and Palma de Mallorca are the main origins or destinations for Ryanair flights in Germany, Denmark, Norway and the Netherlands. On the other hand, Gerona has important connections with Denmark and Sweden, Alicante with Norway, and Madrid with Portugal.

3.2. Centrality

The centralisation rate refers to the special condition in which an airport plays a main role because it is connected to all the nodes (destinations) of the network. Thus, 100% denotes a connection to all the airports (i.e. a star network) and 0% denotes a mesh network. In our research, this analysis determines whether the Ryanair airports in Spain have an important network of connections without a central point or whether one main airport issues and receives most flights in the country. It is calculated as follows:

$$C = N^{-1}\sum_{i=1}^{n} C_i = N^{-1}\sum_{i=1}^{n}\frac{n_i}{k_i(k_i-1)/2}$$

In this formula, n_i is the number of connections between nodes closer to node i and k_i is the degree. Table 3 presents the degree of centrality for each country.

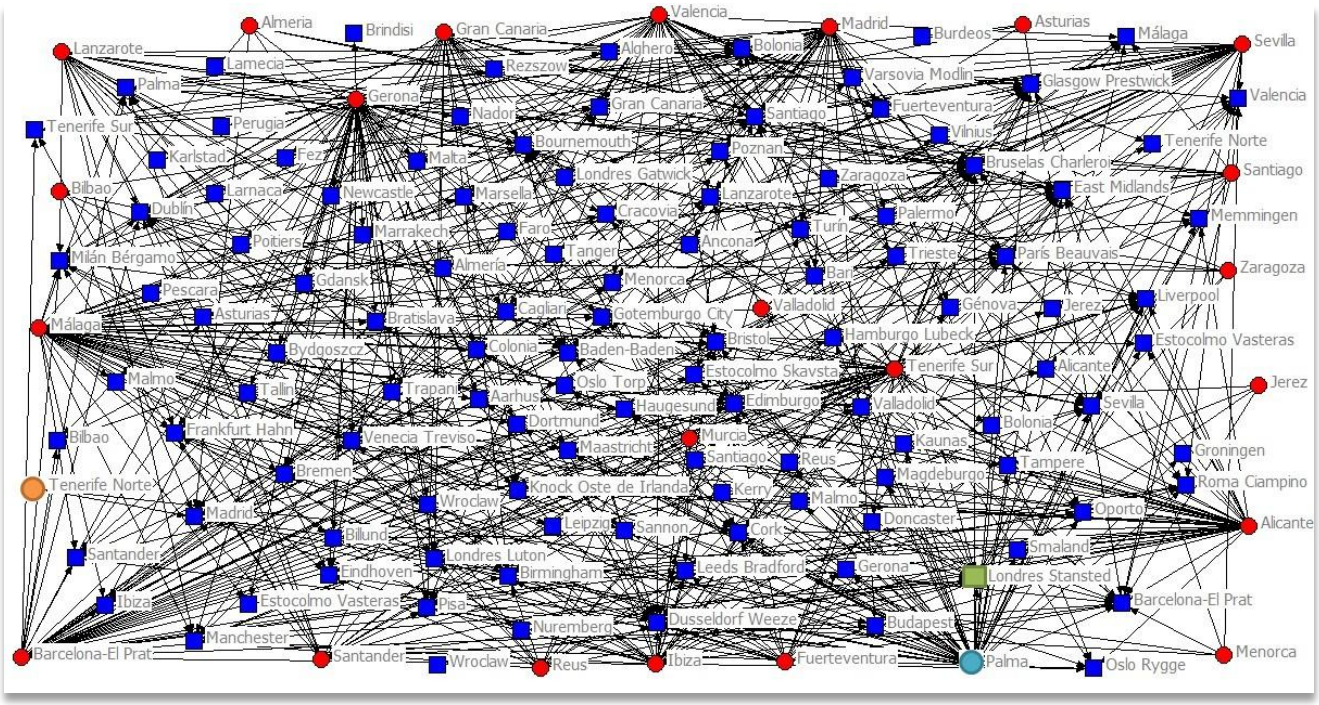
Table 3 - Degree of centrality of country networks

COUNTRY	%	COUNTRY	%	COUNTRY	%	COUNTRY	%
Germany	80.91	Slovakia	100	Ireland	91.6	Netherlands	78.29
Austria	38.1	Spain	34.25	Italy	58.03	Poland	50.26
Belgium	100	Estonia	100	Latvia	100	Portugal	63.99
Bulgaria	100	Finland	83.25	Lithuania	54.62	United Kingdom	71.78
Cyprus	74.29	France	39.82	Malta	100	Czech Republic	100
Croatia	69.23	Greece	36.9	Morocco	54.74	Romania	100
Denmark	88.74	Hungary	100	Norway	83.67	Sweden	77.71

Source: Ryanair (2013) – elaborated by the authors.

Spain, like other countries such as Austria, France and Greece, has a low centralization rate (34.2%) and thus has a mesh network as displayed in Figure 3.

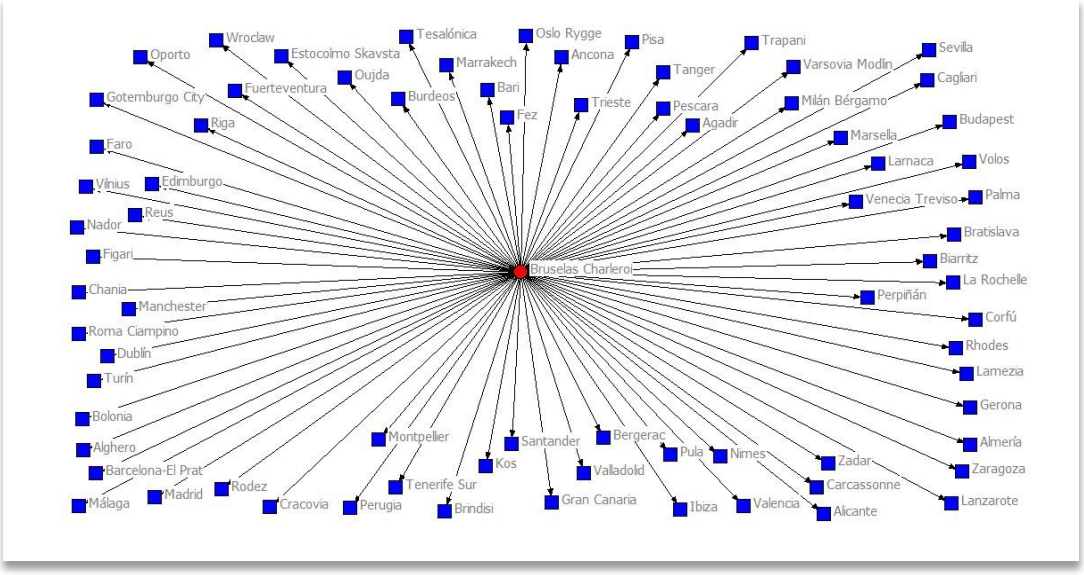
Figure 3 - The Spanish network



Source: Ryanair (2013) – elaborated by the authors.

Mesh networks, where there is no central airport, are very different from networks with a high centralization, as the case of Belgium for example. Belgium has a star network, i.e. connectivity is focused in just one node (airport), as displayed in Figure 4, which shows that Brussels airport is the origin or destination of all the Ryanair flights of the country.

Figure 4 - The Belgian network



Source: Ryanair (2013) – elaborated by the authors.

The study of this property is relevant as it indicates the degree of the dependency of a country on just one airport, implying that if that main node fails, the damage in the whole network is greater, affecting its whole connectivity. In contrast, in countries with a mesh network, where there is no central airport, not only is that possible damage minimised but also domestic tourism is favoured as there is greater connectivity among the cities of the country.

3.3. Betweenness

Mediation is one of the centrality indicators most used in the physics literature. This represents the number of short routes between any pair of nodes in the network. The concept is related to the frequency of an airport being on the shortest route between two other airports, i.e. the geodesic path. In our study, this index allows us to discover which Spanish airport serves as the main mediator among the other connected

airports. Although this normally coincides with the airport or node with the greatest number of Ryanair flights in the country, on some occasions the mediator airport may not belong to that country. For example, in Austria, the airport with the highest degree of betweenness among its nodes is London Stansted. The formula that describes this property is as follows:

$$CB(v) = \sum \frac{\sigma st(v)}{\sigma st}$$

In this formula, v is the studied node, σst(v) is the number of paths from s to t going through v and σst is the number of paths from s to t.

Table 4 shows the mediator airports in all 28 European countries in which Ryanair operates. In the case of Spain, the airport of Gerona airport has the highest betweenness rate, so we can assume that it is the most connected city of the country.

Table 4 - Mediator airports by country

COUNTRY	MEDIATOR AIRPORT	COUNTRY	MEDIATOR AIRPORT	COUNTRY	MEDIATOR AIRPORT	COUNTRY	MEDIATOR AIRPORT
Germany	Dusseldorf Weeze	Slovakia	Bratislava	Ireland	Dublin	Netherlands	Eindhoven
Austria	London Stansted	Spain	Gerona	Italy	Milan Bergamo	Poland	Krakow
Belgium	Brussels Charleroi	Estonia	Tallinn	Latvia	Riga	Portugal	Oporto
Bulgaria	Plovdiv	Finland	Tampere	Lithuania	Kaunas	United Kingdom	London Stansted
Cyprus	Pafos	France	Paris Beauvais	Malta	Malta	Czech Republic	Breno
Croatia	Zadar	Greece	Chania	Morocco	Marrakech	Romania	Constanta
Denmark	Billund	Hungary	Budapest	Norway	Oslo Rygge	Sweden	Stockholm Skavsta

Source: Ryanair (2013) – elaborated by the authors.

4. Discussion

The purpose of this paper was to open up a new line of research linking tourist flows with airport connectivity based on complex network analysis, focusing in this case on LCCs and Ryanair specifically. Its eminently exploratory and broad nature means that the conclusions are general and therefore we cannot focus attention on particular cases except as examples to show the aforementioned phenomena. Based on the foregoing, we can draw a number of conclusions.

In Europe, generally, centralisation rates are high. In most cases, one airport plays the main role in every country. We find the lowest centralisation rates in countries with many destinations, such as Italy, Spain and the United Kingdom, where the most important originating and destination airports are diversified; thus, these countries have a great variety of tourist flows. On the other hand, in places where centralisation is high, such as Belgium, tourist flows have only one airport as the principal originating and destination hub.

Betweenness determines the airport that has the shortest path between any pair of nodes. This information can be very useful for tourists as the mediator airport offers the shortest routes to their destinations. Thus, for example, if Spanish tourists wish to visit any city in the UK, the shortest route to their destination may be offered by the airport of Gerona (which has the highest mediation index in Spain; see Table 3). This means a benefit for those cities with a high mediation index that are not consolidated international tourist destinations, such as Gerona, Reus and Alicante. These cities are favoured as connection points among origins and destinations. This not only provides recognition to those cities that otherwise would be unknown to international tourists, but also generates tourist incomes by virtue of their role as a stopover for many international trips. Thus, new destinations are created, which are also the origins of new routes where "there are more people arriving by plane than by train" (Hosteltur, 2011, p. 15). Therefore, while FSNCs tend to prioritise activity in major cities, the increase in LCCs has meant great benefits for other cities where the possibilities of travelling have been increased, mainly internationally, without depending on making stops in many cases.

At this point, we can contemplate the following question: Does LCC connectivity determine the current tourist flows in Europe? Previous studies have analysed the networks of worldwide airports (Guimerà, Mossa, Turtschi, & Amaral, 2005), or particular countries (Bagler, 2004; Li & Cai, 2004). However, until now no research has focused on LCCs, which have completely changed air passenger transport. Therefore, the analysis of Ryanair as a complex network and its implications for tourism is pioneering in international research and can make a significant contribution in explaining European tourist flows, especially in the case of transnational flows due to airport connectivity, as the most prevalent LCC determines the features of many cities as issuers and receivers of tourism. With regard to this, the tourist flows between countries in northern Europe and Mediterranean destinations are confirmed. This can be illustrated by the example of the high connectivity between Germany and Palma de Mallorca (Spain), with 40% of the Germans who travel to Spain visiting the Balearic Islands (Hosteltur, 2011; IET, 2011a, 2012).

Thus, if we use Spain as an example of tourist receivers, in 2012 the IET reported that the UK was its most important country of origin regarding international tourism, with almost 14 million arrivals, 83% of them by LCCs (IET, 2012). This concurs with the results of our study as the two countries with the highest number of Ryanair destinations in Europe are the UK with 133 destinations and Spain with 108 and the most connected cities are London and Tenerife in the first case and Palma de Mallorca and London in the second case. This validates the significant connection between both countries and reflects the most important tourist flows across the continent. In the case of Italy, the IET (2011a) reported that 66% of tourists who travelled to Spain did so by LCC, with a constant annual increase of around 8%, which makes Italy another important country of origin for Spain thanks to these airlines. Something similar is happening with Belgium, which is also becoming an important issuing market for Spain (IET, 2011a).

The results of this analysis also demonstrate the contribution of LCCs to the consolidation of emerging tourist destinations. In the case of Spain, the great diversification of its connectivity with a low centralisation rate (34.25%, see Table 3) but without a central point for tourist flows gives a clear indication of the considerable influence of Ryanair in the increase in foreign tourists. Approximately 30% of foreign tourists went to cities that are not traditional international tourism destinations, such as Zaragoza, Gerona, Jaen and Murcia, where the arrival of tourists using LCCs constitutes between 80% and 95% of the total number (IET, 2011b). In this group, as previously mentioned, those cities that are not completely consolidated

destinations internationally but that have a high mediation index, such as Gerona, benefit from being a linking point between issuing and receiving points (IET, 2011b). Thus, LCCs establish connections between airports branded as "second level", giving visibility to those cities where these airlines are invigorating elements for their connectivity and their economy (Seguí Pons & Martínez Reynés, 2010).

Apart from the aforementioned results, we can also find implications for tourism management. First, this information could be very useful to airlines already operating in the countries considered in this study and for those thinking of opening new markets and working in new countries; studies such as this are good sources of information for the analysis of competence in the air passenger transport sector. Second, it is important to consider that the failure of one or several nodes can affect the development and connectivity of the whole system (Arenas *et al*., 2008). As previously shown, in some countries, such as Belgium, most connections depend on just one airport, which increases the risk for the whole network in the case of climate problems, for example, or the closure of the airport due to a terrorist threat, which is more common in the airports of major cities. Thus, the closure of one airport supposes the cancellation of flights to and from those airports that depend on it in the same country and even international connections, increasing the damage. Therefore, network analysis also allows us to identify the most important node of every country and whether the centralisation rate is too high, which could be helpful in avoiding potential problems.

Without a deeper analysis of every aspect considered in this study, we can still confirm that the development of LCCs influences international tourist flows, not only in the democratisation of international travel as other studies have confirmed (Rodríguez Gamero, 2008), but also in every aspect of tourist mobility (Dobruszkes, 2009; IET, 2011b; Hosteltur, 2011; Seguí Pons & Martínez Reynés, 2010) and non-tourist mobility (Burrell, 2011). For these reasons, this novel exploratory study of Ryanair in Spain as a paradigmatic example of LCCs from the perspective of the CNT opens up a new line of research for the analysis of the different parameters of airport connectivity. It also offers implications for tourism, with the aim of having real applicability in the management and configuration of destinations and tourist flows in Europe in general and Spain in particular.

References

Alderighi, M., Cento, A., Nijkamp, P. & Rietveld, P. (2012). Competition in the European aviation market: The entry of low-cost airlines. *Journal of Transport Geography, 24*, 223–233.

Arenas, A., Díaz-Guilera, A., Kurthsd, J., Moreno, Y. & Zhou, C. (2008). Synchronization in complex networks. *Physics Reports, 469*(3), 93–153.

Bagler, G. (2004). Analysis of airport network of India as a complex weighted network. *Physica A*, *387*(12), 2972–2980.

Burghouwt, G., Hakfoort, J. & Ritsema van Eck, J. (2003). The spatial configuration of airline networks in Europe. *Journal of Air Transport Management, 9*(5), 309–323.

Burrell, K. (2011). Going steerage on Ryanair: Cultures of migrant air travel between Poland and the UK. *Journal of Transport Geography, 19*(5), 1023–1030.

Calvo-Mora, A., Berbel-Pineda, J. M., Periáñez, R. & Suárez, E. M. (2011). Determining factors of a city's tourism attractiveness. *Tourism & Management Studies*, *7*, 9–23.

Castillo-Manzano, J. I., Lopez-Valpuesta, L. & Pedregal, D. J. (2012a). How can the effects of the introduction of a new airline on a national airline network be measured? *Journal of Transport Economics and Policy, 46*(2), 263–279.

Castillo-Manzano, J. I., Lopez-Valpuesta, L. & Pedregal, D. J. (2012b). What role will hubs play in the LCC point-to-point connections era? The Spanish experience. *Journal of Transport Geography, 24*, 262–270.

Dobruszkes, F. (2006). An analysis of European low-cost airlines and their networks. *Journal of Transport Geography, 14*(4), 249–264.

Dobruszkes, F. (2009). New Europe, new low-cost air services. *Journal of Transport Geography, 17*(6), 423–432.

Donzelli, M. (2010). The effect of low-cost air transportation on the local economy evidence from Southern Italy. *Journal of Air Transport Management, 16*(3), 121–126.

Guimerà, R., Mossa, S., Turtschi, A. & Amaral, L. A. N. (2005). The worldwide air transportation network: Anomalous centrality, community structure, and cities' global roles. *Proceedings of the Natural Academy of Sciences of the United States of America, 102*(22), 7794–7799.

Hernández, J. A. (2008). *El turismo de masas. Evolución y perspectivas.* Síntesis: Editorial Síntesis.

Hosteltur (2011). El efecto de Ryanair sobre los destinos españoles. *Hosteltur,* n. 204, 1–15.

IET (2011a). *Movimientos Turísticos Entre Fronteras (FRONTUR). Encuesta de Gasto Turístico (EGATUR*). Madrid: Instituto de Estudios Turísticos.

IET (2011b). *Informe anual de CBC*. Madrid: Instituto de Estudios Turísticos.

IET (2012). *Turismo, Tráfico Aéreo y Compañías Aéreas de Bajo Coste en el Año 2011*. Madrid: Instituto de Estudios Turísticos.

Jimenez, E., Claro, J. & de Sousa, J. P. (2012). Spatial and commercial evolution of aviation networks: A case study in mainland Portugal. *Journal of Transport Geography, 24*, 383–395.

Li, W. & Cai, X. (2004). Statistical analysis of airport network of China. *Physical Review E*, *69*(4). DOI: 10.1103/PhysRevE.69.046106.

Martínez-García, E. & Raya, J. M. (2008). Length of stay for low-cost tourism. *Tourism Management, 29*(6), 1064–1075.

Martínez-García, E. & Royo-Vela, M. (2010). Segmentation of low-cost flights users at secondary airports. *Journal of Air Transport Management, 16*(4), 234–237.

Newman, M. E. J. (2003). The structure and function of complex networks. *SIAM Reviews*, *45*(2), 167–256.

Raya-Vilchez, J. M. & Martínez-García, E. (2011). Nationality and low-cost trip duration. A microeconometric analysis. *Journal of Air Transport Management, 17*(3), 168–174.

Réka, A. & Barabási, A. (2002). Statistical mechanics of complex networks. *Reviews of Modern Physics*, *74*(1), 47–97.

Rey, B., Myro, R. L. & Galera, A. (2011). Effect of low-cost airlines on tourism in Spain. A dynamic panel data model. *Journal of Air Transport Management, 17*(3), 163–167.

Ribeiro de Almeida, C. (2011). The new challenges of tourism airports – The case of Faro airport. *Tourism & Management Studies, 7*, 109–120.

Rodríguez Gamero, M. I. (2008). Compañías de Bajo Coste y Democratización de los Cielos. El caso de Ryanair en Europa y Península. *Estudios Turísticos,* N.º 175–176, 81–87.

Ryanair (2013). *Map of routes*. Retrieved from http://www.ryanair.com/es/destinos-economicos

Seguí Pons, J. M. & Martínez Reynés, M. R. (2010). Movilidad y Sostenibilidad en el Transporte Aéreo: Las Compañías de Bajo Coste en los Destinos Turísticos de España y Baleares. *Revista Transporte y Territorio,* n.º 2, 68–98.

Strogatz, S. H. (2001). Exploring complex networks. *Nature*, *410*(6825), 268–276.

Vera-Rebollo, J. F. & Ivars-Baidal, J. A. (2009). Spread of low-cost carriers: Tourism and regional policy effects in Spain. *Regional Studies, 43*(4), 559–570.

Watts, D. J. (1999). Networks, dynamics, and the small world phenomenon. *American Journal of Sociology*, *105*(2), 493–527.

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