



## *Measuring the LCC effect on charter airlines in the Spanish airport system*

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### **Abstract:**

Using a robust transfer function model methodology, the present paper seeks to offer empirical evidence regarding the size and type of effects that low-cost carriers (LCCs) have had on traffic for charter carriers (CCs) in the Spanish airport system by geographic market. We show an unmistakable substitution relationship between CCs and LCCs in the latter's typical niche markets, national and European flights, while there is no reaction from the CCs in the segment of international flights outside the EU. Furthermore, substitution effects are smaller between CCs and LCCs on the domestic level than effects between LCCs and network carriers (NCs) and slightly larger on the European level. Lastly, CC traffic's different sensitivity to terrorist attacks, day of the week, air accidents and the economic crisis is also evident. CCs should therefore be considered an independent category that warrants individualized analyses.

**Keywords:** charter companies, low-cost carriers, market share, transfer function models, Spanish airport system.

**JEL codes:** Z3 Tourism Economics.



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### 1. Introduction.

Before liberalization, the airline market in Europe was divided in two. On the one hand, the scheduled network carriers (NCs) with approximately 75% intra-European market share and, on the other, the charter carriers (CC) with 25% market share (Binggeli and Pompeo, 2002). The advent, since the middle of the 1990s, of the low-cost phenomenon undermines the previous airline industry structure and has led to major changes in the other two airline company models' strategies and behavior, as well as in the tourism industry and tourist habits.

On the one hand, in the airline market the low-cost carriers (LCCs) and their management model have resulted in significant changes to the business model of the traditional airlines, the NCs (Dennis, 2007a; Wallace et al., 2006) and the CCs (Buck and Lei, 2004), often in an attempt by the two types of airline to resemble the LCCs; in airline-airport relations (Barrett, 2004; Francis et al., 2004; Gillen and Lall, 2004; Graham, 2013); in airport charges (Voltes-Dorta and Lei, 2013); in the role that hubs play (Alderighi et al., 2005; Bel and Fageda, 2010; Castillo-Manzano et al., 2012); and in the appearance of low-cost subsidiaries in both NCs (Fageda et al., 2011; Morrell, 2005) and in charter companies (Buck and Lei, 2004; Papatheodorou and Lei, 2006). In the tourism market the LCCs have transformed the way that tourists travel, for example, with an increase in short break holidays (Graham, 2006; Papatheodorou and Lei, 2006; Teichert et al., 2008) and a declining average stay (Barros et al., 2008); in many cases it has dictated the online purchase of airline tickets to the detriment of travel agencies (Castillo-Manzano and López-Valpuesta, 2010); and has seen the re-launch of new and existing destinations (Dobruszkes and Mondou, 2013; Graham and Dennis, 2010).

There is one stakeholder that is doubly involved in the airline market revolution and its repercussions on the tourism market: charter flights. Firstly, the tough competition from LCCs offering a wide choice of alternative destinations and greater flexibility in terms of flight frequency seems to have favored the substitution of charter flights for low cost



flights in the leisure market (see Dennis, 2007b in general; de Almeida, 2011 for the case of Portugal; and Dobruszkes and Mondou, 2013 for the case of Morocco), especially on shorter-medium distance routes (Bieger and Wittmer, 2006; Dobruszkes 2006; Dobruszkes and Mondou 2013; Williams, 2001). Secondly, the above-mentioned disintermediation process has led to computer-literate tourists (Williams, 2008) who are more experienced and sophisticated in their travel demands (Graham and Dennis, 2010) nowadays preferring to create their own holiday packages (Williams, 2001), including transport, transfers and accommodation, without delegating the task to tour operators (Buck and Lei, 2004; Rosselló and Riera, 2012). Finally, the ever more widespread short breaks holidays favored by the LCCs could be affecting the demand for traditional one- and two-week packages offered by charter operators (Buck and Lei, 2004). A priori, all these factors could be having a negative effect on CCs ability to achieve a very high load factor (Gil-Moltó and Piga, 2008), which could represent a cost disadvantage compared to their competitors (Buck and Lei, 2004).

As can be deduced from the above, the advent of the LCCs and the important changes that this has caused has resulted in major changes not only to NCs but also to CCs (Graham, 2013). Notwithstanding, to date the academic literature has largely reflected the struggle between NCs and LCCs (Alderighi et al., 2012; Dennis, 2007a; Franke, 2004; Pearson et al., 2015) and ignored the charter market despite the competition that also exists between CCs and LCCs (Morandi et al., 2015; Wu et al., 2012). In fact, the few studies that analyze the clash between the three main airline business models (NCs, LCCs and CCs) focus on collateral aspects, such as the impact on aeronautical and non-aeronautical revenue in airports (Papatheodorou and Lei, 2006); their differences with respect to airport charges (Voltes-Dorta and Lei, 2013); and their strategies for competing in long-haul markets (Pels, 2008). On the other hand, the studies that have analyzed the possible substitution of charter flights for LCCs (Dennis 2007b; Williams, 2001; Wu and Hayashi, 2014) do not go so far as to quantify the traffic generated, or diverted between the two types of airline, with econometric methods, which is the objective of our study.



Using a robust methodology based on transfer function models, the present paper seeks to offer empirical evidence as to the size and typology of the effects that the development of LCCs has had on NCs and, in a wholly original way, CCs. This is done using a case study that is extremely relevant in international terms for the tourism sector as a whole, and for CCs in particular, which is the Spanish tourism market.

## 2. Data and Method.

The endogenous variables are monthly CC and NC air traffic from January 1999 to December 2014 in three geographical areas, namely i) domestic or national flights within Spain, ii) flights to EU destinations, iii) and flights to any other destinations. The data for the endogenous variables have been taken directly from the Spanish Public Authority for Airports and Aerial Navigation (AENA) website (<http://www.aena.es/csee/Satellite/HomeAena/en/>)<sup>1</sup>.

A separate model is built for each geographical area destination area and each type of company (6 models in total). This separation is justified by the fact that, a priori, according to Williams (2001), LCCs have represented a greater threat to charter companies in short haul markets for example, both for short breaks and long stay holidays. This distinction would also enable us to test whether the short- and medium-haul market is becoming saturated and the same passengers are being competed for while opportunities lie in long-haul flights.

A long list of exogenous variables have been tested in view of the factors that affect air traffic published in the literature. The effects of all these variables have been verified statistically and, as would be expected, their significance is model dependent. The list is as follows:

### A.1 Dummy variables:

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<sup>1</sup> Following AENA's recommendation, the criterion of considering CCs as non-regular traffic has been followed to separate traffic by airline, whilst the 2003-2013 list of companies considered to be low-cost proposed by the Spanish Tourism Institute (<http://estadisticas.tourspain.es/en-EN/Paginas/default.aspx>) has been used with slight adaptations to distinguish between LCCs and NCs. This list varies year on year to adapt to the evolving airline market. As our model's time series spans from 1999 to 2014, the list of LCCs for 2003 has been used for 1999-2002, while the list for 2013 has been used for 2014.



- A.2 EASTER: measures the effect of this moving festival, as some years it is celebrated completely in March, other years in April and some years bridges the two. The variable is defined in such a way that maximum weights are assigned to Wednesday, Thursday, Easter Sunday and Monday. Weights of zero are assigned to all other days in the week.
- A.3 TRADING: measures the different proportion between weekdays and weekend days to correct for trading. It is constructed as the number of business or trading days compared to weekend days and holidays in each individual month, i.e., the number of business or trading days minus the number of Saturdays and Sundays multiplied by 5/2. Any extra holidays in each month are subtracted from the business days.
- A.4 Eyjafjallajökull: this is related to the eruption of a volcano in Iceland that affected part of the air traffic in Europe during April 2010 (Castillo-Manzano et al., 2012).
- A.5 The negative effect on air traffic that resulted from the 9/11 terrorist attacks (Inglada and Rey, 2004) also had a significant effect on the Spanish airport system.
- A.6 Spanair accident of 20th August 2008: the possible negative effect of this accident is tested either as a permanent effect or as a transitory effect (Castillo-Manzano et al., 2012).
- A.7 Other variables that turned out not to be significant: i) other terrorist attacks: 11th March 2004 on public trains in Madrid, 7th July 2005 in London, ii) public works in Spain at hub airports, mainly the construction of terminals T4 at Adolfo Suárez Madrid-Barajas (inaugurated February 2006)) and terminal T2 at Barcelona-El Prat (inaugurated 20th February 2008), and the High Speed Train AVE connecting Madrid and Barcelona (came into operation end February 2008).
- B. Business Cycle: represented using the monthly Spanish Ministry of the Economy and Treasury Synthetic Economic Activity Index (SEAI, source:

<http://serviciosweb.meh.es/apps/dgpe/default.aspx>). It is often argued that the level of economic activity affects air traffic positively (Inglada and Rey, 2004).

C. The Low Cost Carriers effect (LCC) to measure the impact of the introduction of LCCs on charter operators in each geographical area.

The methodology is based on Transfer Function analysis (Box et al. 2016). The general model is:

$$\Delta^d \Delta_{12}^D y_t = \alpha + \sum_{i=1}^k \frac{b_i}{1 + a_i B} \Delta^d \Delta_{12}^D x_{it} + \sum_{j=1}^m w_j(B) \Delta^d \Delta_{12}^D z_{jt} + \frac{\theta_q(B) \Theta_Q(B^{12})}{\phi_p(B) \Phi_P(B^{12})} e_t$$

where  $y_t$  is any of the six endogenous variables (passengers on any carrier to any destination);  $x_{it}$  ( $i = 1, 2, \dots, k$ ) are dummy variables (EASTER, TRADING, Spanair, etc.);  $z_{jt}$  ( $j = 1, 2, \dots, m$ ) are exogenous variables (SEAI, LCC);  $e_t$  is white noise, i.e., a random Gaussian variable with zero mean, constant variance and independent;  $B$  is the lag operator, in such a way that  $B^l x_t = x_{t-l}$ ;  $\Delta = 1 - B$  is the difference operator;  $\Delta_{12} = 1 - B^{12}$  is the monthly seasonal difference operator;  $\alpha, b_i$  and  $a_i$  ( $i = 1, 2, \dots, k$ ) are constants to estimate;  $w_i(B)$  is the dynamic model that relates the exogenous variables to the endogenous variables, i.e.,  $w_i(B) = (w_0 + w_1 B + \dots + w_j B^j)$ ; the last term is an ARMA noise model with polynomials of different orders, i.e.,  $\phi_p(B) = (1 + \phi_1 B + \dots + \phi_p B^p)$ ,  $\theta_q(B) = (1 + \theta_1 B + \dots + \theta_q B^q)$ ,  $\Phi_P(B^{12}) = (1 + \Phi_1 B^{12} + \dots + \Phi_p B^{12P})$  and  $\Theta_Q(B^{12}) = (1 + \Theta_1 B^{12} + \dots + \Theta_Q B^{12Q})$ .

The ARMA process is assumed to be stationary and invertible.

All Transfer Functions of dummy variables are assumed to be of order 1. This parametrization is convenient because it allows for several possibilities when  $x_{it}$  is an impulse variable, namely, additive outliers ( $a_i = 0$ ), level shift ( $a_i = -1$ ), and transitory change ( $0 < a_i < 1$ ). When  $x_{it}$  is a more general dummy variable, such as EASTER,  $a_i$  is set to zero. Estimation is performed by Exact Maximum Likelihood using the ECOTOOL Matlab toolbox with an algorithm for automatic detection of outliers (Gómez and Maravall, 2000; Pedregal and Trapero, 2012).

### 3. Results.

Six models were estimated for both NCs and CCs and the three different destinations (domestic or national, EU and non-EU). Results are shown in Table 1.

	CCs Domestic	CCs EU destinations	CCs All other destinations	NCs Domestic	NCs EU destinations	NCs All other destinations
<b>LCCt</b>	-0.044**	-0.041**	0.045	-0.262**	-0.098***	0.951***
<b>LCCt-1</b>		-0.034**	0.019	-0.397***		
<b>EASTER</b>	0.049***	0.112***	0.036***		0.157***	0.047***
<b>TRADING</b>		-0.014***	-0.002***	0.004**	-0.009***	-0.002***
<b>Eyjafjallajökull</b>		-0.121**			-0.287***	
<b>9/11t</b>				-0.277**	-0.168*	-0.053**
<b>9/11t-1</b>						-0.113***
<b>9/11 <math>\alpha_i</math></b>				-1 (fixed)	-1 (fixed)	-0.516**
<b>Spanair</b>				-0.332***		
<b>Spanair <math>\alpha_i</math></b>				-0.734***		
<b>SEAI</b>		0.043***		0.123***	0.049***	
<b>Differencing</b>	12	1, 12	12	1, 12	1, 12	1, 12
<b>AR(1)</b>	-0.545***		-0.765***			
<b>MA(1)</b>		-0.252***		-0.180**		
<b>MA(12)</b>			-0.264***	-0.384***	-0.592***	-0.455***
<b>Q(1)</b>	2.021	0.337	1.619	0.001	1.433	0.164
<b>Q(12)</b>	11.986	13.335	15.445	8.401	15.330	10.862
<b>Q(24)</b>	20.824	32.750	19.488	29.283	26.301	27.265
<b>KSL</b>	0.057 (0.164)	0.036 (0.621)	0.033 (0.657)	0.034 (0.648)	0.059 (0.155)	0.054 (0.222)
<b>H</b>	0.906 (0.712)	0.869 (0.604)	0.888 (0.658)	0.925 (0.769)	0.764 (0.310)	0.832 (0.486)

Table 1. Estimation results. One, two and three asterisks indicate statistical significance at 10%, 5% and 1% levels, respectively. Differencing indicates whether the degree of differencing is regular alone or regular and seasonal. AR(1), MA(1), and MA(12) stand for the ARMA orders for the model noise. Q(p) is the Lung-Box autocorrelation portmanteau test for p lags under the null hypothesis of Independence. KSL is the Kolmogorov-Smirnov-Lilliefors gaussianity test under the null of gaussianity (p-value in brackets). H is a variance ratio test between the first third of the samples with respect to the final third under the null of homoscedasticity (p-value in brackets).



The most important results are:

- The emergence of LCCs has different effects depending on the endogenous variable considered. There are negative effects on domestic and EU destinations both for CCs and NCs, non-significant effects on all remaining destinations for CCs, and a powerful positive effect on all other destinations for NCs. Obviously it is not possible to talk of unidirectional causality from one type of airline -LCCs- on the other two, but rather of a correlation-substitution relationship between the airline categories that were studied.

If we observe the figures for NCs in Table 1, it can be said that for every thousand passengers that the LCCs gain, the NCs lose 262 passengers from domestic flights per month and 397 in the following month, 98 from EU destinations, and the NCs gain 951 passengers to non-EU destinations. The effects on charter flights are more moderate than in the case of the NCs, as a thousand passengers gained on domestic flights by the LCCs reduce charter passengers by 44 per month. For EU destinations the reduction is 41 per month and 34 per month thereafter. Since the parameters are not significant in the case of charter flights for the remaining destinations, the effect should be considered null.

If we focus on the domestic flight market and combine the LCCs' effects on both the NCs and charter airlines *grosso modo*, it could be said that approximately 70% of LCC traffic comes from the other two types of airline, whilst the remaining 30% is new demand generated by the LCCs themselves. This ratio is completely different in the case of the EU market, where only slightly over 17% of LCC traffic comes from the other types of airline and, as a result, the remaining 83% is new demand. To summarize, these results recognize the integrating role that LCCs are playing in the European area.

The figures for passengers lost during the entire period due to these effects are 7.78 million for domestic CCs, 43.41 million for CCs to EU destinations, 137.09 million for domestic NCs and 57.09 million for CCs to EU destinations.

- A positive Easter effect was found for most of the series. Trading effects were negative for EU and non-EU destinations, meaning that these flights are more





related to weekends, while it is positive for NC domestic flights and non-existent for charter flights. This latter point means that domestic NC flights are used more intensely for business purposes, as was to be anticipated.

- The effect of the Eyjafjallajökull volcano eruptions had only a local impact in space and time, as it was clearly felt by both CCs and NCs during a single month and only for EU destinations. This is easily explained by the geographical distribution of the volcano's effects.
- The 9/11 terrorist attack did not affect any of the CC destinations, but doubtlessly had an effect on NC passengers to all destinations. In the case of domestic flights and EU destinations it was fixed as a level shift. For all other destinations the effect is milder, resulting in a transitory effect that lasted for only 8 months.
- The Spanair accident only affected NC flights to domestic destinations. It had a rapid decay that lasted for only one year.
- Economic activity appears to have a positive effect on the number of passengers on NC flights to EU destinations and domestic flights. All other cases seem to be unaffected by the economic cycle.
- All models were estimated with a constant  $\alpha$  that was not significant. All are statistically correct, as no autocorrelation remains in the residuals and they are Gaussian and homoscedastic.

#### 4. Conclusions.

This paper provides a full empirical analysis of the effects that LCCs have on other types of airline. The paper's main originality lies in the fact that it not only addresses the relationship between LCCs and NCs, but, perhaps for the very first time, accurate data are also offered on the substitution relationships with charter flights that were produced after the advent of the LCCs. For this a case study -Spain- is used that is extremely relevant both because of the importance of the country's airport system, which had almost 196 million passengers in 2014, and also due to its importance as the third ranked country in the world for international tourist arrivals, with 65 million tourists in 2014 (UNWTO, 2015).



One of the conclusions of this paper is the analysis of the substitution relationships between LCCs and the other airlines. Major similarities and interesting differences can be observed between the NCs and the CCs. One of the similarities is the clear empirical evidence that these relationships have occurred and are significant in the two segments where most LCC operations are concentrated, i.e., domestic flights within the Spanish airport system and flights between Spain and the rest of Europe. Another fact that attracts attention is that there is also a certain similarity in the overall impact of LCC substitution effects on European flights. Specifically, for every 1000 passengers that LCCs gain in said market, NCs lose 98 passengers and CCs 85. However, this is not so immediate in the latter case, as it occurs over two periods.

There is, on the other hand, a major difference in the scale of the LCCs' substitution effects in the domestic air market. It is possible to talk of a clear retreat by the NCs in the face of the LCC advance, whereas the impact of the latter on the CCs is on a much smaller scale. This could also be explained by reasons linked to the Spanish tourist market. For example, a significant number of domestic charter flights are closely linked to the IMSERSO (Institute of Social Services and the Elderly) Tourist Program, which favors tourism by the elderly through State subsidies and reduces seasonality in the country's tourism sector. This program provides for over a million trips, i.e., some two million seats on air routes, essentially on charter flights.

As far as international flights outside Europe are concerned, however, there is absolutely no similarity in the behavior displayed by the NCs and the CCs in the face of the push made by the LCCs. The NCs appear to have found a good market niche in this respect, where they can expand without the LCCs hot on their heels, as the latter only have flights to destinations around the periphery of Europe, such as Morocco, Tunisia and Russia (medium-haul). For their part the CCs, which can be seen as pioneering low-cost long-haul services (Francis et al., 2007; Pels, 2008) have not experienced any type of reaction to LCCs in this market. As such, the CCs continue to be the most common option for people who wish to travel outside Europe to places such as the Caribbean, due to the competitiveness of the price of a 'package holiday', and the lack of an LCC alternative (Castillo-Manzano and López-Valpuesta, 2015).



All of the characteristics inherent in the evolution of charter flights demonstrate that charter airlines should clearly be considered an independent category that justifies individualized analyses, such as that conducted in this paper. Such studies should put an end to the feeling that the charter business remains largely understudied (Dobruszkes and Mondou, 2012).

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