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Low cost airlines and international tourism demand. The case of Porto's airport in the northwest of the Iberian Peninsula

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ABSTRACT

It is widely argued that low-cost carriers (LCCs) lead to an increase in tourism demand. However, there is no conclusive evidence when the airport is located in a region with large diaspora and outbound tourism. To gain insight into the relationship between LCCs and international tourism demand, we analyse whether a causal relationship exists between the number of international LCC passengers at the Porto airport and international tourism demand in the Galicia-North Portugal Euroregion using a vector autoregressive model. We evaluate the dynamics of the impacts of the LCC international passengers on international inbound tourism demand in a tourism demand model framework. The main findings are that the number of LCC international passengers has a positive influence on the number of nights spent by international guests in hotels and similar establishments and that the calculated monthly average injection of money into the economy is between 3 and 4.1 million € for North Portugal and between 1.4 and 2 million € for Galicia (Spain).

1. Introduction

The liberalization process of air transport is one of the main driving forces of low-cost carriers' (LCCs) passenger growth rate (IATA, 2017; ICAO, 2016). It is also considered the main cause of an increase in the number of routes, and of the reduction in ticket prices (Halpern and Graham, 2015). Consequently, whereas LCCs approximately transported 1 out of 5 passengers worldwide in 2007, that figure increased to more than 1 out of 4 passengers ten years later.[1] LCCs showed a higher market share in Europe with 1 out of 3 passengers in2017.[2]

Researchers agree on the fact that attraction of tourists relies on the existence of transportation at the right price (Martin-Cejas, 2010; Halpern and Graham, 2015; Lohmann et al., 2009; Hvass, 2014; Koo et al., 2017). This explains why authorities have designed policies such as the liberalization of air transport market (Dobruszkes and Mondou, 2013; Alsumairi and Tsui, 2017); subsidization of the development of airport transport facilities (ANA, 2000; ANA, 2007; Graham and Shaw, 2008); lower airport fees and marketing support (Graham and Dennis, 2010; ANA, 2013; Hvass, 2014; Farmaki and Papatheodorou, 2015) and/or direct subsidies to airlines (Francis et al., 2004; Castillo-Manzano et al., 2011; Duval, 2013; Ramos-Pérez, 2016). The aim of all these policy measures is to increase injections of money into the economy in the form of tourism spending.[3]

It is widely argued that LCCs lead to an increase in tourism demand and injections of money in traditional tourist destinations (Bieger and Wittmer, 2005; Aguiló et al., 2007; Vera-Rebollo and Ivars-Baidal, 2009; Donzelli, 2010; Graham and Dennis, 2010; Rey et al., 2011; Chung and Whang, 2011; Alsumairi and Tsui, 2017; Tsui, 2017).[4] However, some scholars pointed out that groups of LCCs passengers such as visiting friends and relatives (VFR), students and second home owners that use free private accommodations or second homes generate smaller injections of money into the circular flow of income than tourists staying in hotels and similar establishments (Seaton and Palmer, 1997; Briggs, 2002; Kotler et al., 2006; Farmaki and

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[1] https://blueswandaily.com/growing-lcc-market-passes-1-5-billion.

[2] https://www.anna.aero/2018/07/18/lcc-capacity-in-europe-set-for-half-a-billion-seats-in-2018/.

[3] Vera-Rebollo and Ivars-Baidal (2009) found that tourists travelling with LCCs show a lower average spending than visitors travelling with traditional airlines. Eugenio-Martin and Inchauste-Sintes (2016) reported one additional source of economic injections without increasing the number of air passengers. They noted that some visitors to the Canary Islands increased their expenditures at the destination as a consequence of the savings resulting from the cheaper fares offered by LCCs.

[4] For a more detailed literature review on the relationship between LCC and tourism, readers are referred to Alsumari and Tsui (2017); Tsui (2017). More extensive literature reviews on air transport and tourism were carried out by Spasojevic et al. (2018) and by Graham and Dobruszkes (2019).

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Papatheodorou, 2015). Furthermore, residents of the airport's area of influence visiting other destinations (outbound tourism) may also be among the LCC passengers and instead of serving as an injection of money, outbound tourism withdraws money from the circular flow of income. Specifically, Dobruszkes and Mondou (2013) and Hazledine and Collins (2011) analyse examples with large diasporas[5] and conclude that in such cases, injections are smaller (leakages larger) due to VFR.

In general, there is no conclusive evidence in the empirical literature about the effects of the increase in the number of LCC passengers on the injections into the circular flow of income if there is a large diaspora, a high share of VFR, second home owners and outbound tourism in the number of LCC passengers. Additionally, there is scarcity of research focus on the boost for tourism provided by LCCs and based on time series econometrics and appropriate statistics (Dobruszkes et al., 2019).

In our paper, we estimate the effects of the number of international LCC passengers that arrive at Porto's airport on number of nights spent by international tourists in hotels and similar accommodations (excluding tourists that stay in free private accommodations or second homes such as second home owners or some VFR) within a tourism demand model framework and using cointegration. Better understanding of the impact of LCCs and tourism routes can be of great assistance in planning development strategies in the tourism industry and airport management, specifically the role of the LCCs not only in the north of Portugal and Galicia but also in other regions. Although the analysis of LCCs and their impact on tourism is an area that shows a growing interest among researchers (Spasojevic et al., 2018), to the author's knowledge, this is the first empirical study that analyses these effects in a region that is not a main tourist destination and is characterized by a large diaspora. Our study extends the quantification of the effects of the existence of LCCs in Porto (Portugal) on the international tourism demand in the neighbouring region of Galicia (Spain).

Regarding the case of the airport of Porto, first, public subsidies to the airport and promotion of routes have played a major role in the evolution of the number of passengers at the airport of Porto (ANA, 2000; ANA, 2007; ANA, 2013) that went up from less than 3 million people in 2005 to over 9.4 million in 2016. LCCs passenger traffic started in 2005 and increased to over 6 million in 2016. Second, these public incentives have generated a social and academic debate concerning their efficiency in terms of promoting economic growth and, more specifically, generating tourism revenue. Third, the North of Portugal and Galicia have sizeable diaspora populations: approximately 1.7 million nationals from Portugal and 0.5 million from Galicia live abroad (Oliveira and Neves, 2017; IGE, 2019). Most of them live in Central and Northern Europe (Belgium, France, the Netherlands, Germany, Luxemburg, Switzerland and the UK), which are the major Iberian Peninsula international tourism source markets and LCC routes from Porto's airport. Fourth, Carballo-Cruz and Costa (2014) reported that approximately 20% of the traffic are VFR. Fifth, private free accommodations and second homes represent 50.3% of the accommodations used by international inbound tourists to Portugal (INE, 2017) and Portuguese nationals or their descendants living abroad represent 23.4% of foreign residents that visit Portugal using air transport (INE, 2017). Consequently, the injections of money into the circular flow of income could amount less than planned by the authorities when they decided to attract LCC passengers to the airport of Porto.

If our study found a causal relationship between the number of international passengers carried by LCCs and number of nights spent by international tourists in hotels and similar accommodations, it could suggest that the designed policies to increase the number of international LCC passengers have effectively raised international tourism demand that clearly generates injections of money into the economy. On the contrary, no causality between the number of international passengers carried by LCCs and international tourists would imply that LCC passengers arriving at the airport of Porto do not stay in hotels and similar accommodations. If this were the case, the existence of LCCs would be good for the people transported (outbound tourists, VFR, second home owners and students) but would not bring the expected benefits for the tourism industry by increasing tourism expenditure at the destination.

The remainder of this paper is organized as follows: next section summarises the traffic figures of the airport and the catchment areas of North-Portugal and Galicia; section 3 describes the data and techniques used to quantify the effects of LCC passengers on tourism demand; the results and discussion section presents the findings and the concluding remarks complete the paper.

2. The airport of porto and the border regions of North Portugal and Galicia

Market penetration of LCCs in the Iberian Peninsula is higher than the European average (TOURSPAIN, 2017; ANAC, 2016a). LCC passengers represented 52.2% of international arrivals to Spanish airports in 2017 (TOURSPAIN, 2017) and 54.4% of the total passengers (ANAC, 2016a) in the three continental Portuguese airports (Faro, Lisbon and Porto). The share of LCCs in the passenger traffic at the airport of Porto was 65.7% in 2016 (ANAC, 2016a).

The relatively short distances between some airports in Spain and Portugal may lead people to choose neighbouring countries' airports when they decide to travel. This happens in the case of the regions of Galicia (Spain) and North-Portugal. Fig. 1 depicts the location of the main cities and airports in the border regions of North Portugal and Galicia. It takes approximately 60 min to travel from Porto's airport to the Galician border. About 2.7 million inhabitants have three airports (Coruña, Santiago and Vigo) available in Galicia (EUROSTAT, 2019a). The airports have scheduled mostly domestic connections that transported about 4.5 million passengers in 2016. North Portugal has 3.6 million inhabitants (EUROSTAT, 2019a), and only one airport available in the city of Porto. The passenger traffic amounted to over 9.4 million in 2016, 81% were international passengers and 52% international low-cost passengers (EUROSTAT, 2019b; ANAC, 2016a). According to Carballo-Cruz and Costa (2014), around 4 million people live in the 90 min travel distance area of the airport. The major city of Galicia, Vigo, and the Portuguese cities of Vila Real, Coimbra, Viseu and Figueira Foz are included in this area. 1.76 million inhabitants of the metropolitan area of Porto live in less than 60 min travel distance to the airport. As shown in Fig. 1 other cities outside the Metropolitan area with less than 60 min travel time are Braga, Guimaraes, Aveiro and Viana do Castelo. The passengers coming from Galicia represent 12% of the total number of passengers in the Porto's airport. The LCCs passenger traffic in this airport started in 2005.

EU Member States that are in the Schengen area countries represent nearly 80% of the origin/destination passenger traffic, EU Member States that are not in the Schengen area comprises approximately 9% (mainly UK) and members of the Schengen area that are not EU member States (mainly Switzerland) amount 10% (ANAC, 2016b).

Both border regions of Galicia and North-Portugal show an income per capita below the EU average (EUROSTAT, 2019c; EUROSTAT, 2019d) and an unemployment rate above the EU average (EUROSTAT, 2019e). International tourism demand is seen as a driving force to enhance GDP growth and to create new jobs. Due to the long distances to most of the tourist source markets, mainly in Central and Northern Europe, international tourism demand benefited from reduced cost of travel and an increased number of routes. Along with the growth in the number of LCC international passengers, North Portugal doubled its number of international tourists from 2005 to 2016 (Fig. 2). Moreover, the share of international tourism increased from one-third in 2005 to

[5] Dobruzskes at al., 2019 conducted a literature review on the interplay between migration, air transport and tourism.

Fig. 1. Travel distance to Porto's airport from main cities in Galicia (Spain) and Portugal.

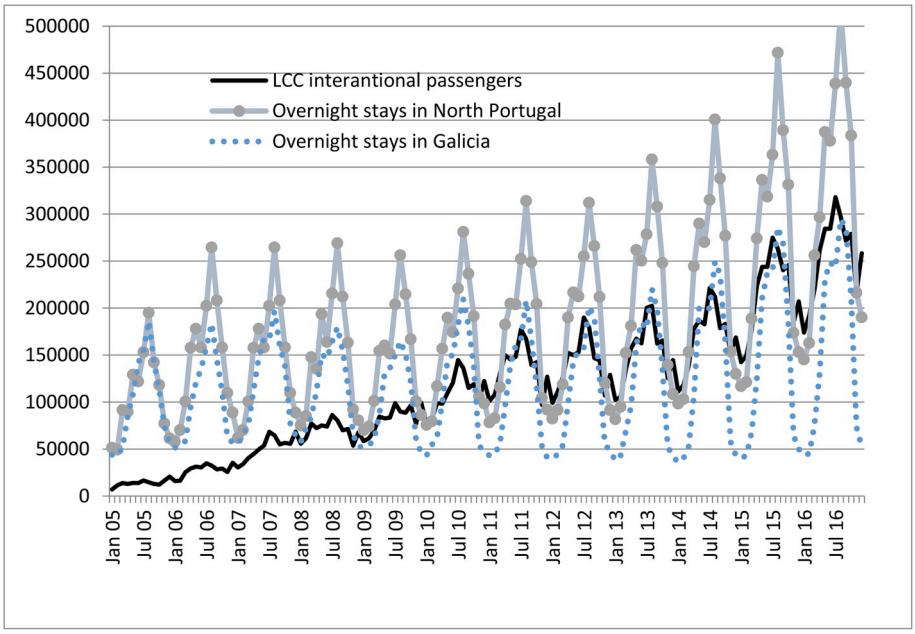

Fig. 2. Evolution of LCC international passengers at the airport of Porto and overnight stays in Hotels and similar accommodations in North Portugal and Galicia.

more than half in 2016 in North Portugal. The neighbouring Spanish region of Galicia experienced a 16% increase in the same period.

3. Materials and methods

3.1. Materials

Various variables describe the temporal evolution of international tourism demand, such as international tourism revenues, number of tourist arrivals and overnight stays. No time series is available for monthly tourism revenue. Aguiló et al. (2007) and Halpern and Graham (2015), among other authors, reported a decrease in the length of stay simultaneously with an increase in the number of arrivals and market share of LCCs. Considering that the number of arrivals would overvalue the increase in tourism demand, overnight stays takes into account the duration of the stay (Garin-Muñoz, 2009) and can be considered a better proxy for tourism demand in our study.

The variable TOURISMP measures the number of tourist nights that international guests spend in hotels and similar establishments in the North Portugal region, and TOURISMG represents the number of nights tourists spend in the Galicia region. In both cases, other tourists such as the VFR segment that use private accommodations and second home owners are not included. The data used were obtained from the Portuguese Statistical Institute and the Spanish Statistical Institute.

Previous research on tourism demand and economic theory considers price level and income the main explanatory variables in tourism demand (Song et al., 2009). Those variables were included as determinants of international tourism demand in several empirical studies, among others Daniel and Ramos (2002), Garín-Muñoz (2006), Chung and Whang (2011) and Alvarez-Diaz et al. (2015). Therefore, the variables PP and PG, which represent the price level (measured as Consumer Price Index-CPI) for North Portugal and Galicia, respectively, are included in the analysis. Both indices were also obtained from the correspondent Statistical Institutes. The variable IPI is a proxy of the levels of income in the main source markets of international tourism to North Portugal and Galicia (Industrial Production Index in the EU member States). Gross domestic product (GDP) or personal disposable income (PDI) are probably better indicators of income, but we could not use them because of the lack of these variables at a monthly frequency. Data were downloaded from the EU Statistical Office (Eurostat).

The other variable included in the analysis is the number of international air passengers flying with LCCs to the airport of Porto (PASSENGERS).[6] Porto's airport authority provided the data. Fig. 2 displays the evolution of the variables PASSENGERS, TOURISMP and TOURISMG. Table 1 shows main descriptive statistics. The variables TOURISMP, TOURISMG, IPI and PASSENGERS time series were seasonally adjusted, and all variables were log-transformed to interpret the estimated coefficients as elasticities. The sample period expand from January 2005 to December 2016.

3.2. Methods

To check for the existence of a statistical long-run relationship between the LCCs and international tourism demand, we model separately the international tourism demand for North Portugal (equation (1)) and for Galicia-Spain (equation (2)):

$$TOURISMP_t = \beta_0 + \beta_1 \cdot IPI_t + \beta_2 \cdot PP_t + \beta_3 \cdot PASSENGERS_t + \nu_t \quad (1)$$

$$TOURISMG_t = \alpha_0 + \alpha_1 \cdot IPI_t + \alpha_2 \cdot PG_t + \alpha_3 \cdot PASSENGERS_t + \nu_t \quad (2)$$

where ν_t is the disturbance term. We follow a four-step procedure to check the long-run equilibrium that allow us to quantify the impact of the explanatory variables on international inbound tourism demand. The procedure starts exploring the order of integration of the variables considered in the study. We use the ADF unit root test (Dickey and Fuller, 1981), which is usually applied to determine the order of integration of a time series (Hamilton, 1994). In the case that the time series were non-stationary, the estimation of a simple regression of equations (1) and (2) can lead to a spurious regression that shows a high degree of fit and statistically significant parameters (see Granger and Newbold, 1974).

In the second step we check if the variables included into the model are cointegrated. There are different approaches available that have been applied in different fields if the time series are integrated of the same order. Specifically, we use three complementary cointegration tests from three sets of authors: Engle and Granger (1987), Phillips and Ouliaris (1990), and Johansen and Juselius (1990).

In the third step, once the existence of a statistical long-run has been proved by those three alternative methods, we estimate equations (1) and (2). The estimation allows us to quantify the impact of the variables price, income and international LCCs passengers arriving at Porto's airport on inbound tourism demand. For completeness, we use bootstrap to estimate a confidence interval for each long-run parameters β_i and α_i in equations (1) and (2). The bootstrapping accounts for the estimated variability of the effects of the explanatory variables.

Finally, in the fourth step, we model the short-run relationship between international inbound tourism demand and its determinants based on Engle and Granger's (1987) work. Accordingly, the error correction model (ECM) associated with the long-run models (equation (1) and (2)) are represented in equation (3) for North Portugal and (4) for Galicia

$$\Delta TOURISMP_t = \gamma_0 + \sum_{i=1}^{p} \gamma_i \cdot \Delta TOURISMP_{t-i} + \sum_{i=1}^{p} \mu_j \cdot \Delta IPI_{t-j} + \sum_{i=1}^{p} \delta_j \cdot \Delta PP_{t-j} + \sum_{i=1}^{p} \lambda_j \cdot \Delta PASSENGERS_{t-j} + \alpha_1 CRISIS + \phi \cdot \hat{v}_{t-1} + \varepsilon_t \quad (3)$$

$$\Delta TOURISMG_t = \gamma_0 + \sum_{i=1}^{p} \gamma_i \cdot \Delta TOURISMG_{t-i} + \sum_{i=1}^{p} \mu_j \cdot \Delta IPI_{t-j} + \sum_{i=1}^{p} \delta_j \cdot \Delta PG_{t-j} + \sum_{i=1}^{p} \lambda_j \cdot \Delta PASSENGERS_{t-j} + \alpha_1 CRISIS + \phi \cdot \hat{v}_{t-1} + \varepsilon_t \quad (4)$$

where ε_t is assumed to be a white-noise error term, $\hat{v}_{t-1}$ is the error correction term (ECT).[7] Based on the information given in European Commission (2017), we construct the dummy variable CRISIS that takes a value of 1 for the period 2008:1–2013:12 during the financial global crisis and the debt crisis in EU member states and 0 the rest of the months. The rest of the variables were defined in subsection 3.1.

Table 1
Descriptive statistics.

	TOURISMP	TOURISMG	IPI	PG	PP	PASSENGERS
Mean	186,319.5	119,141	101.4	101.3	101.6	118,836.8
Median	162,961.5	112,623	101.7	101.5	101.1	108,754
Maximum	516,823	294,556	119.2	103.5	104.9	318,010
Minimum	49,200	35,909	79.2	98.1	98.7	7027
Std. dev.	97,746.5	66,598.6	7.7	1.07	1.68	75,329.5

[6] Fuel prices has been included in previous studies as explanatory variable, e.g. Alsumairi and Tsui (2017). However, in our case the inclusion of this variable was not possible because it is highly correlated with the number of passengers.

[7] The coefficient of ECT describes the speed of the adjustment back from any deviation from the long-term equilibrium. This coefficient must be statistically significant to corroborate the existence of cointegration.

Table 2
Dickey and Fuller test for unit root.

Ho: variable has a unit root	t-statistic
TOURISMG	1.40 (2)
TOURISMP	2.65(2)
PASSENGERS	3.99(0)
IPI	0.04 (3)
PG	−0.84(12)
PP	−0.85(12)
Δ TOURISMG	−11.04* (1)
Δ TOURISMP	−13.28*(1)
Δ PASSENGERS	−2.70*(4)
Δ IPI	−3.97*(2)
Δ PG	−2.91*(11)
Δ PP	−1.87**(11)

Note: Δ is the first difference operator. Values in parenthesis specify the lag length based on Schwarz Information Criterion.* indicates significance at 5% level. **indicates significance at 10% level. Critical values are based on MacKinnon (1996).

4. Results and discussion

4.1. First step: unit root test

The analysis of the existence of a statistical long-run relationship between the variables included in the demand functions (1) and (2) begins checking the time series' cointegration property. Table 2 shows the results of the Dickey and Fuller (1981) test. All six time series are non-stationary in levels, but they are stationary after the first differentiation, i.e. integration of order one. Therefore, in the second step, it is possible to apply multiple cointegration tests: the Johansen Cointegration test to determine the number of cointegration vectors (Johansen and Juselius, 1990), the Phillips-Ouliaris Test (Phillips and Ouliaris, 1990) and the Engle and Granger Test (Engle and Granger, 1987).

4.2. Second step: cointegration analysis

Table 3 shows the results of the three cointegration tests used in our study. All the tests reject the null hypothesis of no cointegration at the level of significance of 5%. This result confirms the presence of a long-run relationship between international tourism to North Portugal and the explanatory variables considered in equation (1) as well as international tourism to Galicia and the explanatory variables included in equation (2).

The results are in line with literature that showed an increase in tourism flows as a consequence of the increase in the number of LCC passengers (Donzelli, 2010; Graham and Dennis, 2010; Aguiló et al., 2007; Rey et al., 2011; Alsumairi and Tsui, 2017; Chung and Whang, 2011; Tsui, 2017). However, those previous empirical studies focused on airports in major tourism destinations rather than airports in regions that are not major tourism destination and show a high share of migrant population among their passenger traffic (Dobruszkes, 2013; Dobruszkes and Mondou, 2013; Hazledine and Collins, 2011; O'Connell and Williams, 2005). Furthermore, our study also extends the analysis to examine the effects of international passengers on international inbound tourism to Galicia, a region of the neighbouring country of Spain. The results show a positive effect of LCCs at the Porto airport (Portugal) that goes beyond the country's borders. It positively affects the number of nights spent by international tourists in hotels and similar accommodations in the neighbouring Spanish region of Galicia with a large number of airports per capita but only a few international flights scheduled during the period of study.

4.3. Third step: estimation of long-run impacts of the explanatory variables

Table 4 shows that all the estimates in the long run have the expected signs and are statistically significant. According to these findings, we can confirm that if the number of LCC passengers carried to the airport of Porto increases by 1%, the overnight stays in hotels and similar accommodations will increase by 0.24% and 0.13% in North Portugal and Galicia, respectively. The bootstrap confidence intervals are (0.19, 0.29) for North Portugal and (0.12, 0.16) for Galicia. Income elasticity is approximately 2.33% in North Portugal (bootstrap confidence intervals: (1.54, 3.11)) and 1.69% in Galicia (bootstrap confidence interval: (1.36, 2.0)). These values imply high income elasticities, which are in line with previous elasticity estimates for international tourism demand to Spain (Rey et al., 2011; Alvarez-Diaz at al., 2015) and international tourism demand to Portugal (Daniel and Ramos, 2002).

The price elasticity indicates that a 1% price increase in north Portugal or Galicia reduces tourism demand by 7.49% and 5.33%, respectively, which can be considered high and reflect the strong influence of price on demand in both regions. The bootstrap confidence intervals are (−10.8, −4.1) for North Portugal and (−6.9, −3.8) for Galicia. Crouch (1995) reported higher price elasticities when the length of stay is taken as a measure of demand as is the case when we consider the number of arrivals (number of tourists). Moreover, Crouch (1995) also found that price elasticity of travel to Northern Europe is significantly lower than that for Southern Europe/Mediterranean destinations, i.e. southern destinations are more price sensitive. Government agencies, the industry and the airport authorities should be aware of these competitive factors. High price elasticity has been reported in previous studies for Spain (Garín-Muñoz, 2006; Garín-Muñoz and Montero-Martín, 2007) and Portugal (Daniel and Ramos, 2002). For instance, in the 1990s, demand fell strongly in Portugal as a consequence of price increases (Smith and Jennifer, 1998). The bootstrap confidence interval of price elasticity and bootstrap confidence interval of income elasticity for the Galicia region overlap each confidence interval for North Portugal. These results confirm our expectations that income elasticity and price elasticity are not statistically different for

Table 3
Results of the different cointegration test.

Cointegration Test	Statistic(Galicia)	Statistic(Portugal)
Engle and Granger (1987)	Tau = −5.39* Z = −48.15*	Tau = −4.86* Z = −49.65*
Phillips and Ouliaris (1990)	Tau = −5.39* Z = −47.69*	Tau = −9.07* Z = −120.47*
Johansen and Juselius (1990)	r = 0; Trace = 63.87* r = 1; Trace = 42.91 r = 0; Eigenvalue = 61.68* r = 1; Eigenvalue = 20.29	r = 0; Trace = 72.71* r = 1; Trace = 30.07 r = 0; Eigenvalue = 42.64* r = 1; Eigenvalue = 17.19

Note: P-values from MacKinnon (1996) and Mackinnon-Haug-Michelis(1999).(*) denotes rejection of the hypothesis of "no cointegration" at the 0.05 level.

Table 4
Long and short run estimation.

North Portugal				Galicia			
Long-run equation							
Variable	Coefficient	p-value	Bootstrap interval estimation	Coefficient	p-value		Bootstrap interval estimation
Intercept	33.17	0.00		26.9	0.00		
PASSENGERS	0.24	0.00	(0.19, 0.29)	0.13	0.00		(0.12, 0.16)
IPI	2.33	0.00	(1.54, 3.11)	1.69	0.00		(1.36, 2.0)
PP	−7.49	0.00	(-10.8, −4.1)	–	–		–
PG	–	–		−5.33	0.00		(-6.9, −3.8)
Short-run equation							
Variable	Coefficient	p-value		Coefficient	p-value		
Intercept	0.02	0.02		0.01	0.06		
ECT	−0.13	0.02		−0.25	0.00		
D(PASSENGERS)	0.31	0.00		0.19	0.01		
D(TOURISMP(-1))	−0.39	0.00		–	–		
D(TOURISMP(-12))	−0.11	0.09		–	–		
D(TOURISMG(-1))	–	–		−0.18	0.02		
D(TOURISMG(-7))	–	–		−0.16	0.02		
Crisis	−0.03	0.03		−0.02	0.01		
Diagnosis tests							
		p-value		p-value			
Autocorrelation	Ljung-Box-Test Q(1) Q(12)	0.28 0.27		0.73 0.17			
Heteroskedasticity	White test	0.79		0.17			
Misspecification	RESET test	0.12		0.10			

Galicia and North Portugal because both regions attract similar tourists. On the other hand, most of the tourist attractions (towns; cities; and other historical, cultural and natural sites) of North Portugal are closer to Porto's airport than tourist attractions of Galicia. It implies that confidence intervals of LCC international passengers demand elasticities for both regions do not overlap each other. Consequently, the effects of international passengers arriving at Porto's airport on international tourism are nearly the double in North Portugal than in Galicia.

We can confirm an increase in the number of nights that international tourists stay in hotels and similar establishments in the north of Portugal and Galicia caused by the rise in the number of international passengers carried by LCC to the airport of Porto. This increase implies an injection of money into the circular flow of income in both regions.

4.4. Fourth step: estimation of the short-run impact of the explanatory variables

The next step is to estimate the ECM (equations (3) and (4)) associated with the models represented in equations (1) and (2) for North Portugal and Galicia, respectively. It allows us to quantify the impact of each of the variables included in the ECM.

As we can see in Table 4, the estimated coefficient associated with the ECT is in both cases statistically significant and corroborates the existence of cointegration between our variables.

Table 4 also provides the estimated coefficient of the ECM. The LCCs' impact also turns out to be positive and significant in the short term with an elasticity of 0.31 for North Portugal and 0.19 for Galicia. The coefficients associated to ECTs (ϕ) in equations (3) and (4) meet the requirement of being statistically significant. It illustrates that the speed of adjustment back from the long-term equilibrium is faster in Galicia (0.25) than in Portugal (0.13), which can be interpreted as a higher correction of the deviation from the long-term equilibrium caused by an external shock. The years of financial global and sovereign debt crisis in EU member states had a negative and statistically significant impact in the short-run on overnight stays in hotels and similar establishments.

To easily appreciate the injections of money into the economy, Table 5 shows the international tourism expenditure increase in both regions caused by each additional international passenger carried by LCC from Porto's airport. We take mean values of the period of analysis. According to the computed confidence intervals, a 1% rise in the number of international LCC passengers (1188 passengers *per* month) will lead to an increase of between 394 and 540 in the number of nights spent by international tourists in North Portugal and between 143 and 191 in Galicia.

We consider these figures to obtain the expenditure increase at the destination caused by the LCC passenger traffic to Porto's airport. It is a measure of the injection of money into the economy that can be used in a Cost-Benefit-Analysis (CBA). As shown in Table 5, the number of LCC arriving passengers at the airport of Porto needed for one additional night spent in hotels and similar establishments is between 2.2 and 3.0 in North Portugal and between 6.2 and 8.3 in Galicia. According to the National Statistical Offices of Portugal (INE, 2017) and Spain (INE, 2018), the daily average international tourist expenditure in 2016 was 76.5 € in Portugal and 103 € in Galicia, which means that, on average, each international LCC passenger flying to Porto's airport increases the international tourist expenditure by between 25.5 € and 34.8 € in North Portugal and between 12.4 € and 16.6 € in Galicia. The average monthly injections of money into the circular flow of income caused by international passengers carried by LCCs to Porto's airport are between 3 and 4.1 million euro for North Portugal and between 1.4 and 2 million for the neighbouring region of Galicia.

5. Conclusions

Increasing market share of LCCs is a fact for many airports and particularly for the airport of Porto, where LCCs have played a key role in the increase in the number of passengers. Nowadays LCCs transport approximately two thirds of the international passengers that amount

Table 5
Summary of the estimated effects of international LCC passengers (based on the mean values of the series).

North Portugal	Galicia
A: *1% international LCC passenger increase at Porto's airport* = 1188* passengers	
B_1: *0.19%, 0.29%*** *nights increase caused by the 1% international LCC passenger growth* = between 394 and 540 nights	***B_2:*** *0.12%, 0.16%*** *nights increase caused by the 1% international LCC passenger growth* = between 143 and 191 nights
Additional LCC international passengers *needed to get one additional night booked*	
$\mathbf{C_1}$=A/B_1= between 2.2 and 3 passengers	$\mathbf{C_2}$=A/B_2=between 6.2 and 8.3 passengers
International tourism expenditure per day (night)	
$\mathbf{D_1}$= 76.5€†	$\mathbf{D_2}$= 103€††
International tourism expenditure increase per additional international LCC passenger	
=$\mathbf{D_1/C_1}$ =between 25.5 € and 34.8 €	=$\mathbf{D_2/C_2}$ =between 12.4 € and 16.6 €
Total average injection of money per month	
3 million €-4.1 million €	1.4 million €-2 million €

Note: *mean value (Table 1); **computed bootstrap confidence intervals (Table 4); †Portuguese Statistical Office (INE, 2017); ††Spanish Statistical Office (INE, 2018).

more than half of the passengers traffic of the airport. Previous literature has questioned the expected positive impact of LCCs when there is a large diaspora and/or VFR tourism (Dobruszkes, 2013; Dobruszkes and Mondou, 2013; Hazledine and Collins, 2011; O'Connell and Williams, 2005). It raises doubts about the uncertain effects of subsidizing LCCs and airport facilities to increase the number of international tourists in a region (North Portugal) that was not a traditional tourism destination and is characterized by a large diaspora.

The original contributions of this study compared to Dobruszkes and Mondou (2013) and Hazledine and Collins (2011) that also consider regions with large diaspora are: first, we carry out an econometric time series analysis in within a demand model framework; second, we focus on the effects of LCC international passengers on nights spent by international tourists in hotels and similar establishments, i.e., tourists that clearly generate injections of money into the economy of the region that they visit; third, we check the order of integration of the time series included in the analysis and use a vector autoregressive model; fourth, the estimated elasticities allow us to calculate the injection of money into the economy in monetary terms.

Despite the large diaspora (23.4% of the foreign residents using air transport are Portuguese nationals or their descendents), the share of VFR traffic at Porto's airport (20%) and the tourists arriving by air that use free private accommodations and second homes, the results show a positive stastitically significant effect of number of LCC passengers on the nights spent by international tourists in hotels and similar establishments in North Portugal. The calculated elasticities and injection of money into the economy may be useful for airport and/or destination managers, especially with regards to set up incentive schemes that increase LCC traffic.

These results could be included in a Cost-Benefit-Analysis (CBA) in order to determine if the benefits generated by the existence of the airport of Porto outweigh the investment costs, operating cost and costs of promotion of LCC routes (Carballo-Cruz and Costa, 2014). However, the calculated injections of money into the economy obtained in this study are only a part of the benefits necessary to carry out a comprehensible CBA. The estimation of other tangible and intangible benefits is outside the objective of this paper.

Due to the proximity of the Spanish region of Galicia, specifically its major city (Vigo), the analysis of the effects of LCCs international passengers arriving at porto's airport on the number of nights spent by tourist in hotels and similar establishments has been extended to the neighbouring region of Galicia (Spain). The results also show a positive effect of the number of LCC passengers on the nights spent by international tourists in hotels and similar establishments.

Moreover, the empirical analysis confirms that the estimations of international tourism demand for North Portugal and Galicia show similar results for both regions: Income elasticities suggest a rise in the number of nights spent in expansion periods and a drop in tourism demand as a response to lower economic growth rates in the EU member states that are the main source markets for both regions. Tourism demand is very sensitive to price changes in both regions. Southern European countries usually show higher international tourism price elasticities than Northern European countries, which is a warning to the tourism sector and airport management. The computed bootstrap confidence interval for price elasticity and income elasticity in both regions overlap and show that the elasticities are statistically non-different in both regions, i.e. both regions attract international tourists that react similarly to income and price changes.

On the contrary, the fact that bootstrap confidence intervals for the reaction of international tourism on international passengers carried by LCCs from Porto's airport do not overlap each other confirm the expected statistically different effects in North Portugal and Galicia. The increase in the number of nights spent by international tourists in hotels and similar establishments in North Portugal (0.24) caused by LCC passengers at Porto's airport turns out to be the double as in Galicia (0.13). It is in line with the fact that more tourist attractions in North Portugal are closer to the airport of Porto. Based on those estimated elasticities both, the daily and monthly average expenditures increase for additional LCC international passengers at Porto's airport were calculated. Each additional LCC international passenger causes a daily expenditure increase between 25.5 and 34.8 € in North Portugal and 12.4 and 16.6 € in Galicia. Considering the average number of LCC international passengers, the monthly injection of money into the circular flow of income accounts for 3 and 4.1 million € for North Portugal and between 1.4 and 2 million € for the neighbouring region of Galicia.

The segment of migrants (ANA, 2012; Carballo-Cruz and Costa, 2014) is included in the LCC international arrivals at the airport of Porto that cause a positive statistically significant impact in the long-run on tourism expenditure at the destinations (North Portugal and Galicia). However, we cannot explicitly confirm nor denied the

contribution of the LCC international VFR passenger traffic at the airport of Porto and particularly the traffic associated with the Diaspora in the estimated long-run impact on tourism expenditure. Thus, this is one of the main limitations of our study. When data availability makes it possible, further research should be focused on the specific time series econometric analysis of the effect of migration and/or other VFR segments on tourism expenditure. Additionally, given the role that migrants have played in the launch of new LCC international routes at the airport of Porto (ANA, 2012), it may be worthwhile to offer better insight into this complementary contribution of the Diaspora on the passenger traffic expansion of LCCs and their positive impact on tourism expenditure at the destinations.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jairtraman.2019.101689.

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