PAPER

Title: Low cost airlines and international tourism demand. The se of the airport of Porto (Portugal).

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Abstract: It is widely argued that low-cost airlines (LCAs) 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 LCAs and international tourism demand, we analyse whether a causal relationship exists between the number of international LCA 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 LCApassengers on international tourism demand.

Despite the large diaspora (23.4 % of the foreign residents that visit Portugal using air transport are Portuguese nationals or their descendents), the share of VFR traffic at Porto´s airpot (20 %) and the (VFRs, second home owners and students)results show a positive effect of number of LCA passengers on the nights spent by international tourists in hotels and similar establishments in North Portugal. Due to the proximity of the Spanish region of Galicia, specifically its major city (Vigo), the LCAs international passengers arriving at porto's airport affect the number of nights spent by tourist in hotels and similar establishments in the neighbouring region of Galicia (Spain). The results show a positive effect of number of LCA passengers on the nights spent by international tourists in hotels and similar establishments. Our findings reveal the existence of a statistically significant bidirectional causality between international tourism flows and presence of LCAs.

1. **Introduction.**

Low cost airlines (LCA) have become one of the fastest growing players in the aviation market. In 2017, LCA transported one-in-four air passengers worldwide, and one-in-two intra-European passenger (Elfaa, 2018). The LCAs and their impact on tourism is an area of research that shows growing interest among scholars (Spasojevic et al., 2017). A large number of studies have described in detail the expansion of LCA (IATA, 2017; ICAO, 2016 ; Graham, 2013; Halpern and Graham, 2015), as well as its effects on the growth of domestic and international tourism demand (O'Connell and Williams, 2005; Graham and Shaw, 2008; Castillo Manzano and Marchena Gómez, 2010; Davidson and Ryley, 2010; Donzelli, 2010; Graham and Dennis, 2010; Aguiló et al., 2010; Chung and Whang, 2011; Hazledine and Collins, 2011; Rey et al., 2011; Dobruszkes and Mondou, 2013; Dobruszkes, 2013; Alsumairi and Tsui, 2017 and Tsui, 2017;Alvarez-Díaz et al., 2019).

On the contrary, the analysis of whether international tourism demand affects air services offered by LCA is still under-researched. This topic has not received the same consideration. Dobruszkes (2006) and Bieger and Wittmer (2006) and Farmaki and Papatheodorou (2015) pointed out that tourism demand was responsible for traffic demand of LCA's connections. Other authors found that different visiting friends and relatives (VFR) segments such as students and migrants as well as outbound tourism are driving forces of the increase in the number of routes and frequencies of LCA (Dobruszkes and Mondou 2013; Dobruszkes, 2013; Castillo Manzano and Marchena Gómez, 2010; O'Connell and Williams, 2005; Graham and Shaw, 2008; Davidson and Ryley, 2010; Burrrel 2011; Dobruszkes, 2009; Dwyer, a et al, 2014; Dobruzskez at al, 2019).

All in all, there is no conclusive evidence in the empirical literature that confirms the double relationship of causality between air connections and international tourism demand (Koo et al, 2017). Moreover, Dobruszkez et al., 2019 pointed out that despite the extensive literature on the relationship between LCC and tourism there is a gap in using econometric studies based on time series and appropriate statistics. In order to shed some light on this topic, the main goal of our research is to check from a statistical point of view whether or not there is a bi-directional relationship between LCA's connections and international tourism. To the author's knowledge, this is the first empirical study that analyses statistically circular causality. Specifically, the goal can be summarized in the empirical testing of the following hypotheses:

Hypothesis 1: the expansion of LCA's connections causes an increase in international tourism demand.

Hypothesis 2: the increase in international tourism demand causes an expansion in the LCA's connections.

Testing these hypotheses, as well as understanding these relationships, is of paramount importance and it can be helpful for public transport agencies, tourism entities and airport authorities to design more efficiently and implement better the operational and managerial strategies. The Hypothesis 1 is important given its political implications. On one hand, the acceptation of Hypothesis 1 would confirm the contribution of LCA to increase international inbound tourism. On the contrary, the inexistence of causality would suggest that the expansion of LCA has not been an effective means to increase international inbound tourism. Consequently, the local and regional policies designed to attract foreign visitors based on public subsidies and supports to enhance the expansion of low cost carriers would not have been effective.

In spite of being important, Hypothesis 2 is quite under-researched. Its acceptation would confirm the importance of tourism as a push factor influencing the expansion of low costs carriers. Conversely, if this hypothesis were not confirmed, then it would indicate that international inbound tourism would not be a determinant factor. Other factors suggested in literature, like visiting friends or relatives, would have more influence on the expansion of LCA.

In order to carry out our hypotheses testing, we use the Johansen Cointegration test (Johansen and Juselius, 1990) to detect the existence of a long-run relationship between international inbound tourism and the expansion of LCA connections. If such a relationship exists, then we apply the Granger's Representation Theorem (Granger, 1988) to test the direction of the relationship (i.e, testing the proposed hypotheses). We focus our analysis on the airport of Francisco Sá Carneiro, in Porto (Portugal). This airport is characterized by being located in a region with a large diaspora, the northern region of Portugal (Dobruszkes at al., 2019). Several scholars reported a positive impact of LCA on inbound tourism, but only if the airport is located in a main tourist destination region (Donzelli, 2010; Graham and Dennis, 2010; Aguiló et al., 2010; Rey

et al., 2011; Alsumairi and Tsui, 2017; Chung and Whang, 2011; and Tsui, 2017). Nevertheless, the role of LCA to draw tourists is uncertain when the airport is located in a region with a large diaspora, and is not a popular international tourism destination, as it happens in the case of the airport of Porto (ANA, 2012; Dobruszkes et al., 2019). This is an additional contribution of our study because if Hypothesis 1 were verified, then we would demonstrate that LCA has a positive effect on international inbound tourism even for airports that are not a popular international tourism destination and are located in a region with a large diaspora.

The remainder of this manuscript is organized as follows. Section 2 describes the data and the empirical analysis and finally, Section 3 concludes.

1.   Data and empirical analysis

2.1. Data

One of the most used indicators for international tourism inbounds is the number of overnight stays (Otero-Giraldez et al, 2012; Garin Muñoz, 2009). For that reasons, in our analysis, we use the variable TOURISM to measure the number of nights that international guests spent at hotels and similar accommodation establishments in the region of North Portugal. The data were obtained from the Portuguese Statistical Institute. We use the passengers flying with LCAs as proxy for the air services of LCAs at Porto's airport (Rey et al., 2010; Belobaba et al., 2009). This variable represents the demand side, i.e., the decisions made by travelers at a given price level of tickets. The available seats capacity of the LCAs has also been used to approximate the activity of the LCAs (Tsui, 2017). The number of seats reflects the decisions made by LCAs (scheduled routes, frequencies and capacities) i.e., the supply side. Figure 1 shows that available seats (supply side) only slightly differ from the demand side (tickets bought by travelers). Furthermore, the analysis of the correlation coefficient over the period of analysis 2005-2016 reveals that both are highly and positively correlated over the period 2000-2015 (0.993) indicating that both variables provide the same kind of information and approximates the same phenomenon, that is, the LCA activity in the airport of Porto.[1] The variables were seasonality adjusted using the Census X12 procedure to

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[1] The results obtained in the following sections using the international passengers transported by LCA (supply side) are the same the ones reported in the study and can be send under request.

control the seasonality of the data. The sample period spans from January 2005 to December 2016.

Figure 1. Number of available seats and transported passengers by LCA at the airport of Porto and number of overnight stays of international inbound tourists in North Portugal.
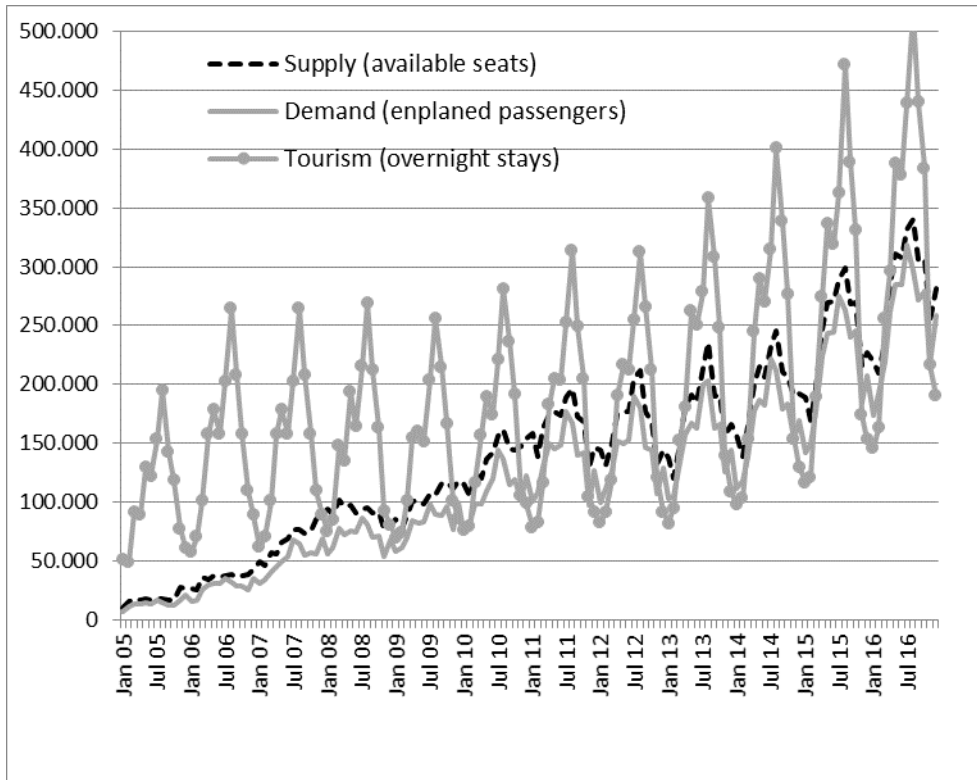
Source: Airport of Porto and Portuguese Statistical Institute

2.2.   Cointegration and causality analysis

The analysis of the existence of a statistical relationship between LCA at the airport of Porto and international inbound tourism in North Portugal (TOURISM) as well as the other way around is based on Johansen and Juselius (1990). The starting point is to check the stationarity of the time series. Table 1 displays the results of the Phillips and Perron (1988) and Dickey and Fuller (1981) unit root tests. Given that the time series are only stationary after the first differentiating, we can affirm that they are integrated of order one I(1). Given that both series are of the same order, it is possible to apply the proposed Johansen Cointegration test.

Table 1. Unit root tests

H0: variable has a unit root	Phillips and Perron (1)	Dickey and Fuller(2)
LCA	1.92 (1)	2.10 (1)
TOURISM	1.44 (7)	1.82 (3)
Δ LCA	-13.61* (4)	-13.63* (0)
Δ TOURISM	-23.28* (7)	-10.31* (2)

Note: Δ is the first difference operator. (1) Values in parenthesis specify the truncation lag for the Newey-West correction length used. (2)Values in parenthesis specify he lag length based on the Akaike Information. Critical values from Mackinnon (1996). *denotes significance at 5 per cent level.

Table 2 reports the results of the cointegration test. We use two likelihood ratio tests; namely, the trace and maximum eigenvalue statistics. Both tests rejects the null hypothesis of no cointegration at a level of significance of 0.05. Therefore, the expansion of LCA and international inbound tourism are cointegrated.

The fact that the variables are cointegrated indicates the existence of a bidirectional long-run relationship between the presence of LCA at Porto's airport and the number of overnight stays by non-residents in the region of North Portugal.

Table 2. Test of cointegration by Johansen and Juselius (1990)

VARIABLES	H0	H1	Trace	Max-Eigen
	$r = 0$	$r = 1$	27.73*	25.91*
TOURISM and LCA	$r \leq 1$	$r \geq 2$	1.82	1.82

Note: r is the number of vector of cointegration. P-value of MacKinnon *et al.* (1999). *denotes rejection of the hypothesis at the 0.05 level. The lag length is based on the Akaike information Criterion and uncorrelated residuals.

Granger (1988) demonstrated that if two variables are cointegrated, then there is a long-run causal relationship in at least one direction. The Granger's Representation Theorem (Granger, 1988) supports and validates the use of an Error Correction Model (ECM) to test if such a relationship runs from:

Hypothesis 1: International air passengers transported by low costs carriers at Porto's airport to the number of overnight stays by non-residents in North Portugal ($LCA \rightarrow TOURISM$):

$$\Delta TOURISM_t = \gamma_0 + \sum_{i=1}^{p} \gamma_{1i} \cdot \Delta TOURISM_{t-i} + \sum_{j=1}^{p} \cdot \gamma_{2j} \Delta LCA_{t-j} + \phi \cdot \hat{\mu}_{t-1} + \varepsilon_t \tag{1}$$

Hypothesis 2: Overnight stays by non-residents in North-Portugal to the number of number of international flight tickets offered by low cost carriers at the airport of Porto ($TOURISM \rightarrow LCA$):

$$\Delta LCA_t = \gamma_0 + \sum_{i=1}^{p} \gamma_{1i} \cdot \Delta LCA_{t-i} + \sum_{j=1}^{p} \cdot \gamma_{2j} \Delta TOURISM_{t-j} + \phi \cdot \hat{\mu}_{t-1} + \varepsilon_t \tag{2}$$

where Δ is the first difference operator, p is the number of lags. Since we are working with monthly data, the maximum number of lags is P= 12. The optimal number of lags is selected according to Akaike Information Criterion (Akaike, 1973). $\gamma's$ are the short term parameters, ε_t is assumed to be a white noise error term and $\hat{\mu}_{t-1}$ is the error correction term (ECT). The ECT captures the correction back towards long term equilibrium whenever there was any deviation from the long run equilibrium path. The presence of causality can be analyzed by testing the parameters associated to the ECT in equations (1) and (2) by analyzing the statistical significance by a t-test. Specifically, it is necessary to observe the statistical significance of the parameters associated to the ECT in order to conclude if there is a unique or bidirectional relationship between LCA

international passengers to overnights stays in hotels or similar establishments by non-residents.

Table 3 provides the estimated coefficient associated to the ECT of equations (1) and (2), and its corresponding t-statistics. Both parameters were found to be statistically significant and confirm the existence of long term bidirectional causality between the number of transported passengers by LCA at Porto's airport and number of overnight stays of international tourists in North Portugal.

Table 3. Results of the ECT based on the ECM

Dependent variable	ECT	t-Statistic
ΔTOURISM	0.04	2.70
Δ LCA	0.03	5.16

In parenthesis the equation of the ECM. The residuals are uncorrelated

The results show that hypothesis 1 was accepted. The findings are in line with literature that have found an increase in international tourism flows as a consequence of the expansion of LCA[2] (Donzelli, 2010; Graham and Dennis,2010; Aguiló et al., 2010; Rey et al., 2011);and Alsumairi and Tsui, 2017. Chung and Whang (2011) and Tsui (2017)) reported positive effects of increasing air services of LCAs on domestic inbound tourism in South Korea and New Zeland, respectively**.** Our additional contribution is that we found positive statistically significant effects of LCA on international inbound tourism in North Portugal, a region with a large diaspora and that is not a major tourism destination for international tourism **(**Dobruszkes, 2013;

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[2] It is important to note that different publications has described the wisely managed promotion of the region as tourist destination and the improvements in the tourism hospitality industry and points of tourist attraction (Costa *et al*., 2012; UNESCO, 2019; Costa and Almeida, 2018) that took place in Porto and the surrounding region simultaneously to the incentives that aimed to expand the capacity of the LCA at the airport of Porto.

Dobruszkes and Mondou, 2013; Hazledine and Collins, 2011; O'Connell and Williams, 2005).

Regarding hypothesis 2, we found out a positive relationship running from number of overnight stays of international tourists in the region of North Portugal to the presence of the LCA in the airport of Porto is in line with previous literature. The fact that hypothesis 2 has been accepted confirms statistically what was previously noted by different authors: Dobruszkes (2006)[3] reported that that LCA follow the strategy of developing capacity in the airports located in tourist destinations. Bieger and Wittmer (2006) consider that tourism is an influencing factor on airports and LCAs in Europe take advantage of new developments in tourism such as theme parks, VFR or second home owners. Finally, the interplay between tourism destinations and LCA can be seen in their route maps (Easyjet, 2018; Flybe, 2018; Norwegian, 2018; Ryanair, 2018;Transavia, 2018; Elfaa, 2018).
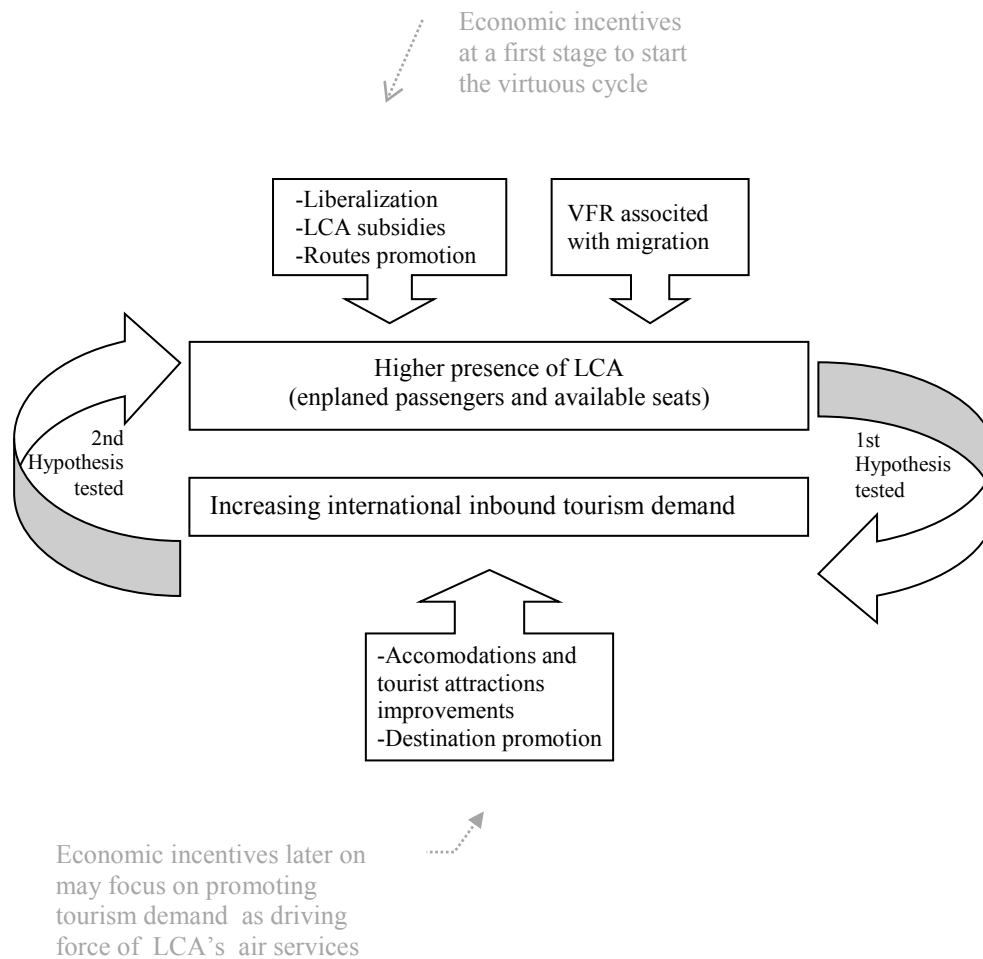

3. Conclusions and policy implications

LCA have become major players in many airports where they have increased their market share. The region of North Portugal, where the airport is located, was not a popular international tourism destination and there is a large diaspora that generates VFR tourism associated with migrant population. Under these circumstances, economic incentive to LCA for direct services that aim to increase the number of international tourists are uncertain.

We used Johansen cointegration test and Granger's Representation Theorem, widely used in the literature to assess the link between variables that are integrated of order one (I(1)). Specifically, we tested whether the variable presence of LCA affects international inbound tourism to Porto and the surrounding region and vice versa. The empirical results show the existence of a bidirectional causality between LCA and international inbound tourism. This finding suggests the presence of a virtuous cycle between LCA's air services and international inbound tourism at Porto's airport represented in Figure 2.

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[3] The biggest LCAs were developing North-South networks from countries where charter airlines were already successful and well established, such as UK, Germany, Sweden, Norway and Belgium Specifically Farmaki and Papatheodorou (2015) found that LCA to Cyprus replaced charter flights.

Figure 2. Virtuous cycle of the realtionship LCA-international inbound tourism

Economic incentives
at a first stage to start
the virtuous cycle

-Liberalization
-LCA subsidies
-Routes promotion

VFR associed
with migration

Higher presence of LCA
(enplaned passengers and available seats)

2nd
Hypothesis
tested

Increasing international inbound tourism demand

1st
Hypothesis
tested

-Accomodations and
tourist attractions
improvements
-Destination promotion

Economic incentives later on
may focus on promoting
tourism demand as driving
force of LCA's air services

According to it, the higher presence of LCA has been proved to be effective to increase international inbound tourism in a region with a large diaspora and not a popular international tourism destination that may has benefited from the air traffic demand of migrant population. Our study validates statistically that the entry of LCA transporting more passengers for direct international connections at Porto's airport stimulates additional international inbound tourism. Consequently, it suggest that in a first stage the existence of economic incentives from the public sector to LCA for developing international air connections may be appropriate. Additionally, the statistically significant impact of LCA on popular international tourism destinations reported in previous studies has been proved to be valid for the airport of Porto, located in a region with a large diaspora and that was not a popular international tourist destination.

We also found statistical evidence that a positive evolution in the number of international tourists has contributed to the expansion of LCA's air services. Results show that the increasing number of international inbound tourists seems to rise the interest of LCA to provide air connections. It is remarkable that the increasing importance of Porto and the surrounding region as international tourist destination turns out to be a driving force of the presence of LCA at the airport of Porto. It suggests that once there is sufficient international inbound tourism demand the LCA are interested in supplying the international air services without economic incentives from the public sector. At his stage policy makers and tourism industry should be aware of making sure the attractiveness of the tourism destination.

Thus, economic incentives may better be used to promote the tourist destination and to improve accommodations, points of tourist attraction etc. that are the driving force of LCA services. Therefore , it may be worthwhile to offer better insight into the different routes. When data availability makes it possible, improvements that could be made to this study is the analysis of air traffic flows and routes to the airport of Porto. These examination can find eligible routes for improvement in inbound tourists attractions or accommodations, e.g., based on higher cooperation among destination's stakeholders with potential airlines (Hvass, 2014).

Other airports that face similar challenges of increasing the number of tourists based on LCA without being a popular destination and/have a large diaspora could take advantage of the learning process of the airport of Porto. Moreover, regions with a large diaspora may take advantage of nationals living abroad. A number of previous studies (ANA, 2012; Dobruszkes et al., 2019), indicate that the VFR segment of migrants has importance for the presence of international LCA connections that indirectly help to meet tourism demand objectives. When data availability makes it possible, further research should be focused on time series econometric analysis of the potentially positive effects of the migrant population on the passenger traffic expansion of LCAs at the airport of Porto,

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