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Abstract

The exploitation of existing commercial opportunities is increasing the share of concession revenues in total revenues at airports. Hence, the dependence of concession revenues is also increasing and the airport managers are interested in understanding how to improve their financial results exploring the determinants of this new revenue source. Using a dataset from a survey of passenger consumption at 30 Brazilian airports, this paper develops an econometric model of the main determinants of concession revenues at airports. Moreover, it aims to test the impact of low-cost carrier (LCC) passengers on concession revenues combined with others determinants to understanding the behavior of this type of passengers. There is a lack of consensus about the impact of LCC passengers on concession revenues and this work shows a different perspective about the variable. Thus, understanding the determinants of concession revenues contributes to airport manager's strategy on investments to increase others sources of revenue and understanding the behavior of LCC passengers contributes to increase the consumption per passenger at airport. Results suggest a statistically significant negative impact that LCC passengers have on concession revenue, but analyzing the LCC passengers that are traveling for leisure, the impact is statistically significant positive.

Keywords: concession revenue, airport management, passenger expenditure, LCC passengers.

Introduction

This work aims to contribute to airport management, through analysis the determinants of concession revenues using passenger consumption data in Brazilian airports. The move of airport governance from public to more private sector participation gave freedom, experience and

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motivation for the exploitation of existing commercial opportunities (Graham, 2009; Gillen, 2014). There are a growing number of airports fully or partially privatized, increasing revenues from concession services in the past two decades and, in some cases, even exceed the aviation revenues. Thus, there is a transformation on the role of airports and the perception by travelers and consumers. Indeed, such factors as the expansion of low-cost carriers (LCC), raising competition between airlines, strong interrelationships between tourism and shopping, privatization of infrastructure and increasing ease in purchasing tickets that justifies the interest in the determinants of concession revenues at airports (Guens et al, 2004; Graham, 2009; Fuerst et al, 2011; Czerny, 2013). The airport managers are concerned about the financial sustainability of the business, delivering both aeronautical services and concession services, in other words, the search for revenues maximization has gradually shifted its focus from aeronautical service to concession sources (Gillen, 2014; Fasone et al, 2016). Moreover, Graham (2009) states that especially at privatized airports, the result of increasing government economic regulation has been pressure on aeronautical revenues and the airports has increased its dependence on concession revenues. According to Czerny (2013), with airport privatization, the existence of concession revenues may exert downward pressure on private aeronautical charges.

The concession revenues, also called commercial revenues, non-aeronautical or non-fare are arising from rents, sales of food, drinks, parking, advertising, etc. That is, everything that is not the core business of airport. Therefore, understanding the determinants of concession revenues is essential because the airport managers are searching through such increase revenue, improve financial results and optimize passenger options to spend time and money at airports. Thus, this work aims to analyze what are the determining factors for the airport concession revenues increase.

The factors that influence concession revenues remain under investigation. The literature shows that only a limited number of works have used regression models to analyze the determinants of concession revenues providing important indications to managers (Geuens et al., 2004; Castillo-Manzano, 2010; Fasone et al, 2016). This work test a quasi-panel data model and one of the strengths of this work is the number of surveys in database and the possibility to test the impact of LCC passengers combined with others determinants. However, it has a problem about lack of important data as airport size, number of passengers and dwell time that was not possible to test.

The next section show the literature finds about determinants of concession revenues at airports, with a literature review of the main determinants and showing what variables are without consensus.

Moreover, shows the determinants of concession revenues at airports framework and the hypothesis to be tested. The following section is about the empirical model development, containing the informations about Brazilian airports, the way that the data was obtained, an explanation about empirical model and the address used in estimation strategy. Finally, the third section is about the results obtained with the econometric model and the robustness checks.

1. Theoretical framework

According to Czerny and Lindsey (2014), concession services at airports involve parking, car rentals, duty-free shopping, exchange houses and F&B[1], but the most important is that the consumption of these services are in a complementary way to the main airport service, in other words, increase the supply and reduce the price of flight tickets , increases the demand for concession services. In the same way, Fasone *et al* (2016) show that beyond concession services has become a key issue, the airports have increased their dependence on non-aviation revenue. Graham (2009) states that commercial revenues represent on average 50% of total revenue of the airports and the recent developments of airports, in line with privatization created exploration opportunities such revenue. In addition, both the increasing regulation on aeronautical charges and the pressure exerted by increased competitiveness in airline cost savings also make the airports more dependents on concession revenues. In the same way, Edwards (2005) and Morrison (2009) state that the search for revenues maximization has gradually shifted its focus from traditional core aeronautical service to non-aviation or commercial sources. However, when only analyzed the Caribbean and Latin America the commercial revenues only represented 29% of all revenues, so there is an opportunity to increase the share of this revenue in total revenues. According to Czerny (2013) given the increasing importance of concession services at airports, concession revenue could press down private aviation charges. Similarly, Gillen and Mantin (2014) show that some airports might consider press down private aviation charges that turns in more flights and more congested, but such delay can induce passengers to spend more on concessions services. Thus, with the increase of airport demand and the commercial revenues, it is very important to observe the determinants of concessions revenues.

The purpose of the article is contribute to airport management and it analyzes the determinants of concession revenues through the profile data of passengers who use the airport. Thus, it is possible

[1] Food and Beverage.

that the airport managers can trace its strategy of increasing concession revenue by prioritizing investments that have positive and significant impact on concession revenues. According Graham (2009), the growing demand of LCC passengers need dedicated facilities because of the lack of free in-flight catering. Echevarne (2008) and Entwistle (2007), through a survey found that passengers are arriving earlier and earlier to make purchases, only 5% find it an inconvenience to shop, while more than 60% plan to use shops and cafes. In addition, 85% would like to facilities to make their purchases.

Moreover, passengers will also have their welfare increased, because investing in concessions services will increase the passenger facilities options while spend time at the airport in addition to find the balance of commercial and aviation operations at an airport that would be socially desirable, reducing charges to compensate with increased concession revenue (Zhang and Zhang, 1997; Fasone et al, 2016). Although the theme is present in the literature at least since the late nineties, there are some differences regarding the determinants of concession revenues, in addition, there are no relevant studies with a broad database as used in this article. Therefore, this study aims to contribute to the discussion of the determinants of concession revenues presenting new research in order to improve the understanding of the subject.

1.1. Literature review

The main references in literature shows important points related to the determinants of concession revenues. The beginning of this discussion can be attributed to Zhang and Zhang (1997), who made a theoretical study showing that the balance of trade and aviation operations at an airport would be socially desirable, reducing charges and increasing passenger welfare. However, some determinants of concession revenues remain without a consensus as the impact of low-cost carriers (LCC) passengers.

Papatheodorou and Lei (2006) identified through econometric procedures by analyzing a sample of 21 UK airports over a period of eight years, the number of LCC passengers positively influence non-aeronautical revenues, both at small airports as large. As for charter and full-service impact was significant only in small airports. They used a Random Effects model for small airports and Fixed Effects for large airports. Lei and Papatheodorou (2010) again examined 21 UK airports over a period of nine years and found through panel data that, despite having significant impact on trading income of airports, LCC passengers contribute less than the other carrier's passengers do. The result was the same for models Fixed Effects, Random Effects and Pooled OLS.

In contrast, using a bivariate probit model at sample of over 20,000 passengers at seven different regional Spanish airports to analyze the factors that influence a passenger's decision to make a purchase, Carlos-Manzano (2010) note a lack of significance of the passenger using an LCC when determining the likelihood of making a purchase or consuming food/beverages. Moreover, LCC passengers spend seven percent less than traditional carrier passengers. Finally, the behavior and needs are very similar between LCC and other carrier's passengers.

In line with Castillo-Manzano (2010), Fasone et al (2016) analyzed 15 German airports over a period of four years and found both share and number of LCC passengers impact negatively on per passenger spending. Moreover, the share of other carriers had positive sign and number of passengers taking other traditional carriers is not likely to impact on per passenger spending. The model used a Ridge Regression (RR) and Partial Least Squares Regression (PLSR). The explanation according the authors is related to the perfect and inverse correlation between LCC and other carriers passengers, but the main contribution is that the mix of full-service and LCC can be crucial as the positive effect of traditional airlines passengers may occur if they increase proportionally to LCC.

As noted above, there is no consensus in literature about the impact of LCC passengers. In one side, the LCC passengers can have a positive impact because there is no free facilities on board and these passengers have to consume at airport. In the other side, considering that LCC passengers choose this kind of flight because the lower price, than they will purchase in another place cheapest out the airport.

It can observe that the three authors used different econometric models according to the specific database and the results about LCC passengers have no consensus. Moreover, the Table 1 resume the airport concession literature based on econometric modeling and shows that there are many determinants in the same lack of consensus as the impact of LCC passengers, in addition, there is only a limited number of works applied regression models in order to assess the determinants of concession revenues.

Thus, this work aims to test another empirical model of airport concession revenues, analyzing a broad database about Brazilian airports, with focusses on the behavior of LCC passengers related to airport concession consumption. Hence, the work offering another understanding about the variable, inasmuch as investigate the determinants of concession revenues.

1.2. Conceptual model

Many determinants influence the concessions revenues at airports. Some of them are passenger's characteristics as income, occupation, purpose of traveling, age, gender and nationality. Another group of determinants is structure of airport with size and traffic volume as main variables. Supply of retail shops and their positioning at the airport and contingent factors as flight delays, security checks and check-in may cause travellers to spend (Geuens et al, 2004; Torres et al, 2005; Graham, 2008; Castillo-Manzano, 2010; Fasone et al, 2016).

Other determinants remain without consensus, as the number of passengers. According Appold and Kasarda (2006) passenger traffic negatively affects the concession revenues per passenger because of the influence of congestion. Graham (2008 and 2009), Fuerst et al (2011) and Fasone et al (2016) reached the same conclusion. However, Czerny and Lindsey (2014), argue that the concession services are complementary to the main airport service, thus increasing supply or decreasing the price of the main service, will increase demand on the other.

The time it would have available for consumption, called Dwell Time positively affect passenger consumption according Torres et al. (2005) and Castillo-Manzano (2010), which suggests that airports reduce the passenger's time spent checking in, security checks and moves between. Echevarne (2008) and Entwistle (2007), through a survey found that passengers are arriving earlier to make purchases. Gillen and Mantin (2014) stated that airports should consider pressing the rates down to increase the number of flights, because the congestion from increasing flights induce passengers to consume more of concession services. However, according to Graham (2008 and 2009), motivational aspects such as delays from congestion can stress passengers, decreasing your chances of consuming the airport. Graham (2008 and 2009) stated that this type of passenger mainly consume food and drinks, as they are not served on board.

However, the impact of LCC passenger also remain without consensus, because Papatheodorou and Lei (2006 and 2010) states that the number of LCC passengers positively influence non-aeronautical revenues, while Carlos-Manzano (2010) note a lack of significance of the passenger using an LCC when determining the likelihood of making a purchase or consuming food/beverages. Finally, Fasone et al (2016) found both share and number of LCC passengers impact negatively on per passenger spending. Hence, the variable need more tests to determine what if the impact on concession revenues is positive, negative or no one and especially interacting with other determinants.

Table 1. Airport concession literature based on econometric modeling.

Author	Sample and Model	Dependent Variable	Regressors
Papatheodorou and Lei (2006)	21 Uk airports, 8 years, FE and RE	Total NAR (log)	No. Passengers: LCC (+) all airports, Charter (+) and Full-service (+) just in small airports
Appold e Kasarda (2006)	75 US airports, 1 year, OLS	Sales (log)	No. Passengers (+), Mean logged flight distance (+), Total domestic commercial space (log) (+)
		Sales per pax (log)	No. Passengers (-), Mean logged flight distance (+), Total domestic commercial space (log) (+)
Lei e Papatheodorou (2010)	21 UK airports, 9 years, POLS, FE and RE	Real commercial revenue	No. LCC passengers (+), No. charter and full-service passengers (+)
Castillo-Manzano (2010)	7 Spanish airports, Bivariate Probit (log-lin)	Consume (log)	Age (-), Euro (+), Vacation (+), Group size (+), Children (+), Seen off (+), Hotel courtesy bus(-), Waiting time (+), Frequent flyer (+)
		Purchase (log)	Age (-), Non-Spanish (+), Homemaker (-), Student (-), Connecting flight (-), Eurozone international destination (+), Vacation (+), Children (+), Taxi (+), Hotel courtesy bus(+), Private car (+), Waiting time (+), Frequent flyer (+)
		Expenditure (log)	Non-Spanish (+), Student (-), LCC (-), Connecting flight (-), Eurozone international destination (+), Group size (+), Children (+), Seen off (+), Hotel courtesy bus (+), Waiting time (+)
Fuerst et al (2011)	41 European airports, 2SLS (log-log)	NAR pax (log)	No. passengers (-), Ratio of commercial to total revenue (+), GDP per capita (+)
	29 European airports, OLS (log-log)	NAR pax (log)	% Domestic passengers (+), Traffic movements (+)
	26 European airports, OLS (log-log)	NAR/sq. meter (log)	No. domestic passengers (+), % Business travelers (-), No. traffic movements (+), Retail space per PAX (-)
Fasone et al (2016)	15 German airports, 4 years, RR and PLSR	NAR pax (log)	No. passengers (-), % LCC passengers (-), Number LCC passengers (-), % passengers other than LCC (+), Number of international passengers (-), Number of movements (-), Overall surface of commercial activities (+), Surface of non-aviations activities (+), Number of retail shops (+) , Number of retail F&B (-)
		NAR/sq. meter (log)	No. passengers (-), % LCC passengers (-), % passengers other than LCC (+), Number of movements (-), Surface of non-aviations activities (-), Number of retail F&B (-)

Models acronyms are as follows. OLS: Ordinary Least Squares; FE: Fixed Effect; RE: Random Effect; 2SLS: two-stage least squares; POLS: Pooled OLS; RR: Ridge regression; PLSR: partial least squares regression.

Thus, the hypotheses is as follows:

H1. LCC passengers should have negative impact on concession revenues.

H2. LCC passengers with leisure purpose should have positive impact on concession revenues.

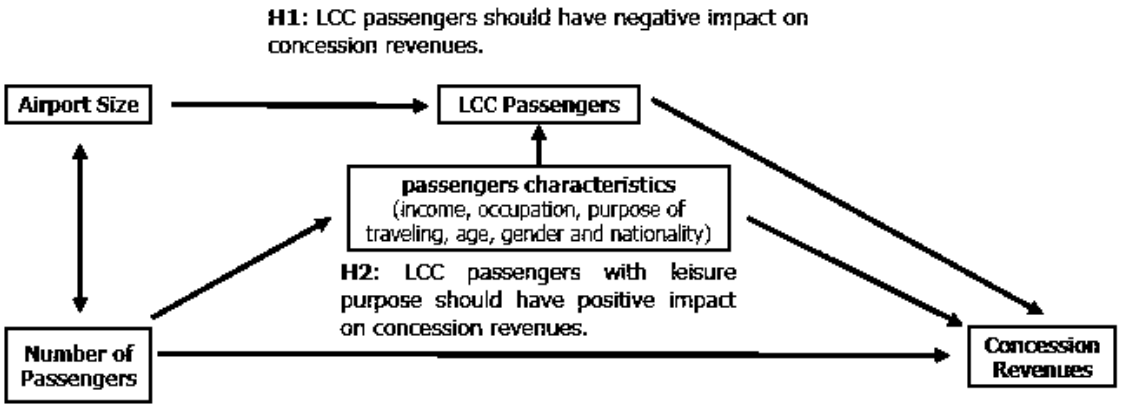

Fig. 1. Determinants of concession revenues at airports framework.

Figure 1 shows the framework about determinants of concession revenues at airports and the relationship with the work hypothesis. According literature review, there are many determinants that have a significant impact on concession revenues. According to Fasone et al (2016), airport size is highly correlated with many candidate explanatory variables of concession revenues, including the reliance of low-cost carriers with secondary and small airports. Thus, the number of passengers have a significant impact, but there is no clear evidence if it is a positive or negative impact as literature above. It can influence directly the concession revenues, because increasing the number of passengers can increase or decrease the consumption at airport according to its capacity. Moreover, number of passenger can affect passenger's characteristics.

The passenger characteristics have different ways to influence both LCC passengers and concession revenues. Geuens et al. (2004) identified travelers consume a typical airport features as multilingual communication and possibility to pay in different currencies, but also purchase per pulse, depending on the atmosphere of the airport. Thus, men are more cautious with their purchases, while women can be classified as "shopping lovers". Torres et al. (2005) showed that leisure passengers spend more than business passengers do, but the boarding time is less than 45 minutes the business passengers who consume more. Graham (2008 and 2009) showed that leisure passengers and young tend to buy more, while the LCC passengers are good food and beverage users. Connection passengers are not likely to buy, but foreigners are good buyers. The typical consumer would be a young woman on a chartered flight on holiday, while older men are averse to

shopping. Therefore, the hypothesis tests the impact of LCC passengers at concession revenues and the influence of LCC passengers that are travelling to leisure on concession revenues.

2. Empirical model development

2.1. Application

This work develop an empirical model of airport concession revenues based on the consumption behavior of passengers, in which a sum of determinants contributes to increase or decrease de concession revenues at airport. The concession revenues, also called commercial revenues, non-aeronautical or non-fare are the revenues that is not the core business of airport, like retail shops, sales of food, drinks, exchange houses, parking and advertising. According Graham (2009), some airports have more than 50% of revenues from concession revenues.

In Brazil, since 1995 the federal government decreed the "Concession Law" to transfer the infrastructure to private management. This law also establishes that concession revenues can be used to low the rates, according with each bidding terms. Since 2000s, the demand for air transport in Brazil is growing substantially, particularly during the late 2000s. Thus, the authorities considered to make changes in the airport sector, initializing with privatization of some key airports that were under the management of Infraero, the state-owned airport infrastructure management company, which managed 67 Brazilian airports (Betini and Oliveira, 2016). In 2012, Infraero raise R$ 1,341 billion in concession revenues, mainly because of the increase of Food and Beverages surface and publicity[2]. The Figure 2 shows the share of concession revenues on total revenues at airports from all over the globe, using 2011 data, unless otherwise stated[3]. The average share is 39.6%, but some airports as Washington National in United States can reach more than 70.0%.

[2] Source: "14/3 - Infraero registra recorde de R$ 1,3 bilhão em receitas comerciais em 2012" (Infraero, March, 14, 2013).

[3] Source: Estudos de Viabilidade. (2015, June 17). Retrieved June 23, 2016, from http://www.aviacao.gov.br/assuntos/concessoes-de-aeroportos/novas-concessoes/pmi.

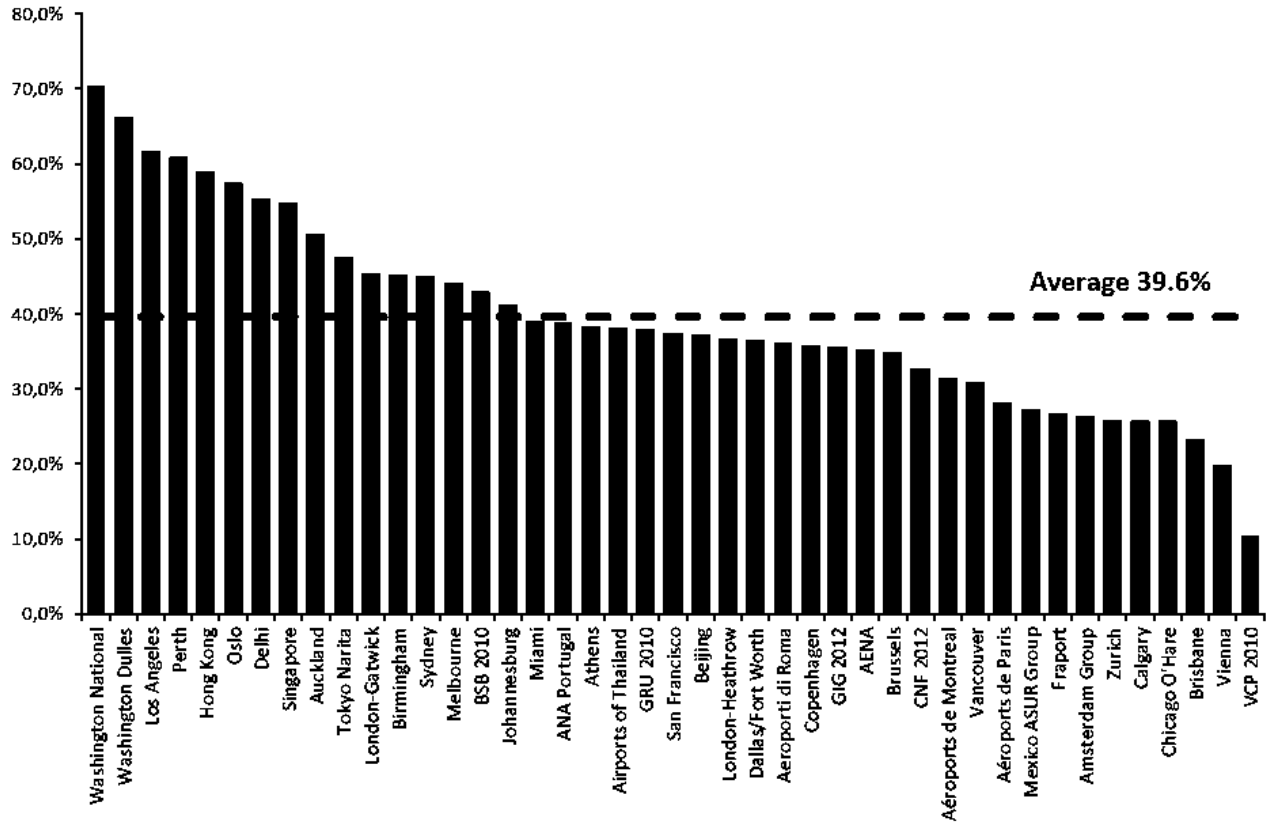

Fig. 2. Share of Concession Revenues.

There are two options to treat to concession revenues in terms of economic regulation, namely single till or dual till. The first consider all alternatives sources of revenue for reviewing economic and financial balance of the contract and consequently to the evolution of regulated tariffs values. The other option is not consider these sources of revenue in balance. Thus, with airport privatization, the existence of concession revenues may exert downward pressure on private aeronautical charges (Czerny, 2013).

Interrelationship between shopping and tourism, the increasing number of travellers, and the rising amount of shops and sales at the airport, with two-thirds of all airport revenue comes from nonairline sources. Thus, make concession revenues a key issue to airport managers that have to understanding the passenger consumption behavior to maximize this source of revenue. A 2013 study showed the importance of revenue from nonairline sources, and leasing out some of that space for retail is a

revenue opportunity with little downside for airport operators, because a vibrant shopping area can lessen the need to charge the airlines higher rents and landing fees[4].

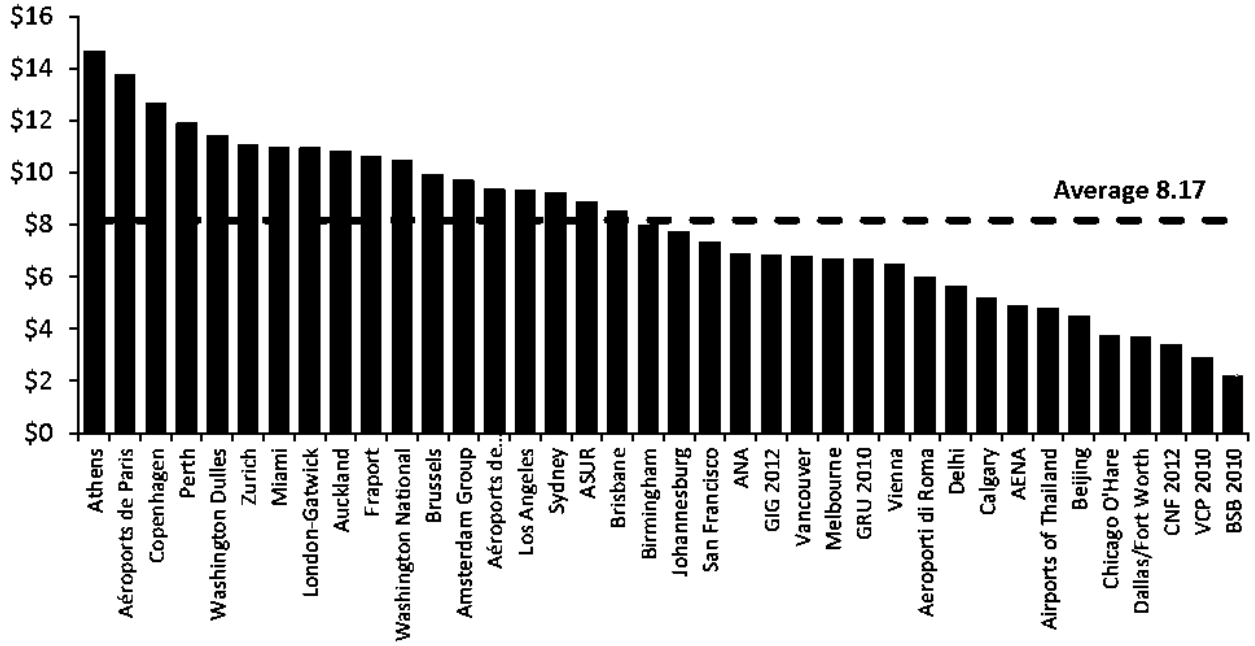

Fig. 3. Concession Revenues per Passenger (USD)

Figure 3 shows Concession Revenues per passenger in USD currency using 2011 data, unless otherwise stated. The average is $8.17, but some airports as Athens can reach more than $14 per passenger[5].

2.2. Data

Econometric data obtained from the survey ordered by Brazilian Development Bank (BNDES) called Characterization and Dimensioning Matrix Source Air Transport Destination in Brazil held in 2009 by Institute of Economic Research (Fipe). The survey was applied in 30 Brazilian airports, considering the airports with the highest passenger flow in 2008 and the main airports of each Federative Unit as showed in Table 2, totalizing 47 588 surveys that guaranteed a maximum error of about 5%, at a confidence level 95%. The survey, through direct interviews to passengers in boarding areas before travel was sufficient to fill the structured questionnaires. The research

[4] Source: "*Airport Has Plan For More Retailers; BWI Adding Space With an Expansion And New Terminal*" (The Washington Post, May, 16, 2005), "*Mall-Type Shops Help Airport Revenue Fly*" (The Washington Post, October, 2, 2007), "*Airport Projects Delayed or Canceled*" (The New York Times, June, 23, 2009), "*U.S. Airports Are Better, but Not Best*" (The New York Times, May, 7, 2015).

[5] Source: Estudos de Viabilidade. (2015, June 17). Retrieved June 23, 2016, from http://www.aviacao.gov.br/assuntos/concessoes-de-aeroportos/novas-concessoes/pmi.

included 24-hour shifts research and 7 days a week ensuring coverage of all flights from airports surveyed. The team FIPE, in meetings and work seminars with Mckinsey's technical staff, Anac, Ministry of Defense, Infraero and industry experts, composed the form of research, in order to meet the desired objectives for the research (FIPE, 2009).

Table 2. Passenger flow at the 30 main Brazilian airports in 2008.

Airport	City – Federative Unit	Passenger flow (boarding and disembarking passenger)
Guarulhos - Governador André Franco Montoro	São Paulo - SP	20.400.304
Congonhas	São Paulo - SP	13.672.301
Galeão - Antônio Carlos Jobim	Rio de Janeiro - RJ	10.754.689
Pres. Juscelino Kubitschek	Brasília - DF	10.443.393
Deputado Luís Eduardo Magalhães	Salvador - BA	6.042.307
Tancredo Neves	Belo Horizonte - MG	5.189.528
Salgado Filho	Porto Alegre - RS	4.931.464
Guararapes - Gilberto Freyre	Recife - PE	4.679.457
Afonso Pena	Curitiba - PR	4.281.354
Santos Dumont	Rio de Janeiro - RJ	3.628.766
Pinto Martins	Fortaleza - CE	3.465.791
Val de Cans	Belém - PA	2.153.508
Hercílio Luz	Florianópolis - SC	2.080.342
Eduardo Gomes	Manaus - AM	2.021.668
Eurico de Aguiar Salles	Vitória - ES	1.988.447
Augusto Severo	Natal - RN	1.643.369
Santa Genoveva	Goiânia - GO	1.554.000
Marechal Rondon	Cuiabá -MT	1.396.164
Viracopos	Campinas - SP	1.083.878
Zumbi dos Palmares	Maceió - AL	957.744
Marechal Cunha Machado	São Luís - MA	870.784
Campo Grande	Campo Grande - MS	835.034
Santa Maria	Aracaju - SE	870.784
Pampulha - Carlos Drummond de Andrade	Belo Horizonte - MG	835.034
Macapá	Macapá - AP	669.777
Senador Petrônio Portella	Teresina - PI	561.189
Pres. Castro Pinto	João Pessoa - PB	493.999
Governador Jorge Teixeira de Oliveira	Porto Velho - RO	466.034
Presidente Médici	Rio Branco - AC	448.444
Brigadeiro Lysias Rodrigues	Palmas - TO	426.470
Boa Vista	Boa Vista - RR	302.551
Porto Seguro	Porto Seguro - BA	259.362

FIPE (2009)

The structured questionnaires provide important information that transformed into our variables in the empirical model. Thus, Table 3 give an initial presentation about the sample.

Table 3. Descriptive statistics of continuous variables.

Variable	Label	Obs	Mean	Std. Dev.	Min	Max
Passengers expenditure	airpcons	41663	10.55193	27.86877	0	800
Price of the airplane ticket	price	25800	383.499	234.2027	.5	4000
Distance for each route, miles	miles	42750	674.6469	448.0518	40.81427	2592.748
Number of days before flight that the passengers bought the ticket	bookdays	40255	15.53857	24.0093	0	365
Number of stops until this airport	nstops	42750	.2703392	.4979241	0	2
Passenger age	age	42609	39.4158	12.58573	12	99
Woman	female	42750	.3613099	.4803857	0	1
Foreigner passenger	nation_for	42750	.0124444	.1108597	0	1
The time spending to access the airport, hours	acctime	42214	1.316451	2.642299	0	72
Income below 2 minimum wages	inc00_02	42750	.0386901	.1928575	0	1
Income from 2 to 5 minimum wages	inc02_05	42750	.1111111	.3142734	0	1
Income from 5 to 10 minimum wages	inc05_10	42750	.1869942	.3899114	0	1
Income from 10 to 15 minimum wages	inc10_15	42750	.1667602	.372766	0	1
Income from 15 to 20 minimum wages	inc15_20	42750	.1316023	.3380619	0	1
Income from 20 to 30 minimum wages	inc20_30	42750	.1368655	.3437093	0	1
Income above 30 minimum wages	inc30_hi	42750	.176	.3808246	0	1
Business owner	occup_busown	42750	.1162339	.320509	0	1
Autonomous	occup_autono	42750	.1720468	.3774255	0	1
Public worker	occup_public	42750	.1524211	.3594327	0	1
Retiree	occup_retire	42750	.0447018	.2066507	0	1
Home worker	occup_homewk	42750	.0126082	.1115774	0	1
Student	occup_studen	42750	.053848	.2257201	0	1
Unemployed	occup_unempl	42750	.0085848	.0922567	0	1
Leisure travel purpose	trpurp_lei	42750	.1875088	.390324	0	1
Visit friends or relatives travel purpose	trpurp_vrf	42750	.1731462	.378378	0	1
Study travel purpose	trpurp_edu	42750	.030924	.1731138	0	1
Passenger payed the travel	whopay_self	42750	.3231111	.4676702	0	1
Relatives or friends payed the travel	whopay_frre	42750	.0800234	.2713326	0	1
Low-cost carrier passenger	lcc	42750	.3995088	.4898031	0	1
LCC carrier passenger with leisure purpose	lcc_lei	42750	.0769123	.2664553	0	1
LCC combined with miles	lcc_miles	42750	262.3881	422.1422	0	2592.748
LCC combined with access time	lcc_acctime	42214	.5471747	1.863242	0	72
Stated airline preference	stat_airline	42750	.0187836	.1357617	0	1
Stated airport preference	stat_airport	42750	.4450526	.4969774	0	1

°

This descriptive statistics of continuous variables figures some important informations. The mean passenger expenditure is $ 10.55 with the minimal $0.00 and the maximum of $ 800.00. The mean ticket price is $383.49 with the minimal $0.50 and the maximum of $ 4000.00. Another important information is that almost 40% are LCC passengers[6].

The mean age is 39 years, only 36% of passengers are female and the share of foreigners is little more than 1%. The data about income figures that majority passengers have 5 to 10 minimal wages as income and the majority occupation is autonomous (17%). In relation to the purpose of the travel,

[6] We considered passengers flying by Gol as low-cost carrier passengers.

the majority is to leisure (18%) and the passengers with purpose to travel to leisure using LCC are 7%. In addition, the mean access time is 1.31 hour.

2.3. Empirical model

Equation below presents the empirical model of airport concession revenues using Brazilian data:

- $\ln airpcons = \beta_0 + \beta_1 \ln price + \beta_2\, miles + \beta_3 bookdays + \beta_4\, nstops + \beta_5\, age + \beta_6\, female + \beta_7\, nation\_for + \beta_8\, acctime$
- $+\beta_9 inc00\_02 + \beta_{10} inc02\_05 + \beta_{11} inc05\_10 + \beta_{12} inc10\_15 + \beta_{13} inc15\_20 + \beta_{14} inc20\_30 + \beta_{15} inc30\_hi$
- $+\beta_{16} occup\_busown + \beta_{17} occup\_autono + \beta_{18} occup\_public + \beta_{19}\text{occup\_retire} + \beta_{20} occup\_homewk + \beta_{21} occup\_studen + \beta_{22}\text{occup\_unempl}$
- $+\beta_{23} trpurp\_lei + \beta_{24} trpurp\_vrf + \beta_{25} trpurp\_edu$
- $+\beta_{26} whopay\_self + \beta_{27} whopay\_frre$
- $+\beta_{28} lcc + \beta_{29} lcc\_lei + \beta_{30} lcc\_miles + \beta_{31} lcc\_acctime$
- $+\beta_{32} stat\_airline + \beta_{33} stat\_airport + u$

Where:

- $airpcons$ is airport consumption, the total of money spending by passengers at airport;
- $price$ is the price of the airplane ticket;
- $miles$ is the distance of each route in miles;
- $bookdays$ is the number of days before flight that the passengers bought the ticket;
- $nstops$ is the number of stops until this airport;
- age is how old the passenger is;
- $female$ is if the passenger was a woman;
- $nation\_for$ is if the passenger is foreigner;
- $acctime$ is the time spending to arrive at airport;

- $inc00\_02$ is the variable to passenger with income below 2 minimum wages;
- $inc02\_05$ is the variable to passenger with income between 2 and 5 minimum wages;
- $inc05\_10$ is the variable to passenger with income between 5 and 10 minimum wages;
- $inc10\_20$ is the variable to passenger with income between 10 and 20 minimum wages;
- $inc20\_30$ is the variable to passenger with income between 20 and 30 minimum wages;
- $inc30\_hi$ is the variable to passenger with income higher than 30 minimum wages;
- $occup\_busown$ is the variable to passenger that have your own business;
- $occup\_autono$ is the variable to passenger that is autonomous;
- $occup\_public$ is the variable to passenger that work in a public sector;
- $occup\_retire$ is the variable to passenger that is retiree;
- $occup\_homewk$ is the variable to passenger that work at home;
- $occup\_studen$ is the variable to passenger that is studying;
- $occup\_unempl$ is the variable to passenger that is unemployed;
- $trpurp\_lei$ is the variable to leisure traveler purpose;
- $trpurp\_vrf$ is the variable to traveler visiting relatives or friends;
- $trpurp\_edu$ is the variable to traveler with education purpose;
- $whopay\_self$ is the variable to passenger that paid itself the ticket;
- $whopay\_frre$ is the variable to passenger that friends or relatives who pays the ticket;
- lcc is the variable to passenger traveling with low-cost carrier;
- lcc_lei is the intercation between LCC passenger and leisure purpose of travel;
- lcc_miles is the interaction between LCC passenger and the distance of the route;

- $lcc\_acctime$ is the interaction between LCC passenger and the time spending to arrive at airport;
- $stat\_airline$ is the variable to passenger that state preference to that airline company;
- $stat\_airport$ is the variable to passenger that state preference to that airport;
- u is the disturbances term.

This econometric model is consistent with the literature models adding other variables and principally, interacting the LCC variable with leisure traveler purpose. Thus, the H1 test uses the variable lcc and the H2 test uses the variable lcc_lei, accordind determinants of concession revenues at airports framework.

2.4. Estimation strategy

2.4.2. Multicolinearity, heteroskedasticity

To determine the severity of the multicolinearity, we calculate the variance inflation factor (VIF), because a higher variance means a less precise estimator and it translates into higher confidence intervals and hypotheses tests less accurate, in other words, the VIF test calculate the variance inflation in each variable caused by multicolinearity. The mean VIF was 82.46 and indicates multicolinearity, which means that results may be analyzed with caution, principally the significance statistical test.

To test heteroskedasticity in the residuals, we implemented the Pagan-Hall, White/Koenker and Breusch-Pagan/Godfrey/Cook-Weisberg heteroskedasticity tests using alternative specifications of levels, squares, cross products of regressors and fitted values of the regressand. The tests suggested presence of heteroskedasticity in the disturbances and we use Huber/White/Sandwich adjustment to correct this bias, preserving the OLS results and just correcting the standard errors.

2.4.4. Estimator

The estimation method employed is the ordinary least squares (OLS) with statistics robust to arbitrary heteroskedasticity.

3. Results

Table 4 presents the estimation results of the empirical model of concession revenues in Brazil.

Table 4 - Estimation results (OLS)[7]

	(1) OLS	(2) OLS	(3) OLS	(4) OLS	(5) OLS	(6) OLS
ln price	0.0654***	0.0732***	0.0652***	0.0644***	0.0642***	0.0653***
miles	0.0001		0.0001	0.0001	0.0001	0.0001
n days bef flight	0.0013***	0.0014***	0.0013***	0.0013***	0.0014***	0.0013***
n of stops	-0.0517*	-0.0335	-0.0520*	-0.0516*	-0.0521*	-0.0523*
age	-0.0023**	-0.0022**	-0.0022**	-0.0017*	-0.0017*	-0.0023**
female	0.0943***	0.0948***	0.0943***	0.0973***	0.0979***	0.0946***
foreigner	-0.0450	-0.0460				-0.0457
access time	0.0171**	0.0178**	0.0170**	0.0170**	0.0168**	0.0169**
income below 2 mw	-0.2132**	-0.2126**	-0.2115**	-0.2100**	-0.2111**	-0.2147**
income 2 to 5 mw	-0.0192	-0.0178	-0.0181	-0.0206	-0.0206	-0.0194
income 5 to 10 mw	0.0578	0.0588	0.0590	0.0560	0.0553	0.0571
income 10 to 15 mw	0.1162*	0.1164*	0.1174*	0.1135*	0.1127*	0.1154*
income 15 to 20 mw	0.1777***	0.1773***	0.1788***	0.1751***	0.1740***	0.1766***
income 20 to 30 mw	0.2297***	0.2309***	0.2310***	0.2252***	0.2246***	0.2291***
income above 30 mw	0.2488***	0.2491***	0.2498***	0.2440***	0.2427***	0.2476***
occupation bus owner	0.2184***	0.2187***	0.2187***	0.2105***	0.2097***	0.2181***
occupation autnomous	0.0620**	0.0621**	0.0616**	0.0526*	0.0510*	0.0607**
occupation public wk	0.0595*	0.0594*	0.0595*	0.0501	0.0495	0.0590*
occupation retiree	0.0940	0.0948	0.0936			0.0939
occupation home wk	0.0217	0.0192	0.0207			0.0252
occupation student	-0.1122**	-0.1111**	-0.1135**	-0.1182**	-0.1191**	-0.1131**
occupation unemployd	-0.0087	-0.0110	-0.0091			-0.0076
purpose leisure	0.0345	0.0418	0.0347	0.0360		
purpose vrf	-0.0006	0.0011	-0.0006	0.0022		
purpose study	-0.0124	-0.0112	-0.0124	-0.0108		
payed self	-0.0533*	-0.0508*	-0.0537*	-0.0500*	-0.0447*	-0.0491*
payed friends-relats	-0.1435***	-0.1413***	-0.1436***	-0.1361***	-0.1303***	-0.1393***
lcc carrier	-0.0893**	-0.1129***	-0.0896**	-0.0898**	-0.0924**	-0.0920**
lcc x leisure purp	0.0922*	0.0848	0.0917*	0.0915*	0.1237***	0.1245***
lcc_miles	0.0001	0.0001**	0.0001	0.0001	0.0001	0.0001
lcc_acctime	-0.0165**	-0.0173**	-0.0165**	-0.0165**	-0.0164**	-0.0164**
stated airline pref	0.0154	0.0174	0.0158	0.0155	0.0148	0.0148
stated airport pref	0.0674***	0.0666***	0.0673***	0.0663***	0.0659***	0.0670***
Adj_R2	0.0571	0.0570	0.0571	0.0572	0.0574	0.0573
RMSE	10.228	10.228	10.228	10.227	10.226	10.227
F	6.7e+10	2.2e+09	3.7e+08	5.7e+09	4.6e+08	2.8e+09
N_Obs	10769	10769	10769	10769	10769	10769

The results figures some significant variables are according the finds in literature, as the income (only 2 to 5 and 5 to 10 minimum wages were insignificant), occupation (only retiree, home worker and unemployed were insignificant) age and gender (Geuens et al, 2004; Torres et al, 2005; Graham,

[7] Results produced by the ordinary least square estimator (OLS); statistics robust and efficient to arbitrary heteroskedasticity; P-value representations: ***p<0.01, ** p<0.05, * p<0.10.

2008; Castillo-Manzano, 2010; Fasone et al, 2016). In contrast to literature review, foreigners and leisure travelers passengers are not significant in the present model.

Income variables are the main determinants for airport consumption and the higher the income, higher the consumption. Therefore, in the first model, an increase of 1 passenger with income between 5 and 10 minimum wages, ceteris paribus, the passenger consumption will raise 11.62% and if the income is higher than 30 minimum wages, will raise 24.88%.

In the six models, the variable about LCC passengers is negative at least at 95% significance level and this means that H1 was not rejected, following the same line Fasone et al (2016), and unlike Papatheodorou and Lei (2006 and 2010) that stated that the number of LCC passengers positively influence non-aeronautical revenues. The effect of LCC passengers is that an increase of 1 low-cost carrier passenger, ceteris paribus, will decrease 8.93% the passenger consumption in the model 1.

However, is interesting to see that the interaction variable between LCC passengers with the purpose of traveling for leisure influences positively at 95% significance level the passenger expenditure. Therefore, there are no evidences to reject H2 too, showing that despite the insignificance of the isolate variable leisure purpose and the significant impact of LCC passengers on consumption, when analyzed together, the influence is positively significant. The effect of LCC passengers with leisure purpose in the first model is that an increase of 1 LCC leisure passenger, ceteris paribus, will raise 9.22% the passenger expenditure.

The work showed that the results are in line with the expected and gave another source of information to airport managers to construct the airport strategy. The LCC passengers despite have a statistically significant negative impact on expenditure, when combined with the leisure purpose turns the impact from negative to positive. Thus, rescuing the contribution of Fasone et al (2016), that the mix of full-service and LCC can be crucial as the positive effect of traditional airlines passengers may occur if they increase proportionally to LCC, in addition, is not only increase the mix proportionally, but also try to increase the participation of travelers for leisure on the low-cost carriers.

4. Robustness checks and limitations

On table 4 the model contemplate all variables. The column 2 eliminates the miles variable, showing that, even statistically insignificant, when it dropped the model got worst. Another important information is that the interaction variable between LCC and miles becomes statistically significant, meaning that without miles others variables may be underestimated, as the literature states miles as generation variable. The column 3 dropped the foreigner variable, and unlike the literature, it does not cause variations. One of the reasons is that in table 3 shows that just 1.24% of the surveys are foreigners, so there is no statistical significance.

Column 4 and 5 dropped some occupations variables and purpose of travel variables respectively, but it has not caused significant impact, just improved a little the R2 and raise de impact of LCC x Leisure Purpose passengers to the consumption. The last column just omitted travel purposes variables. The result is almost the same in each column and are a little evidence to prove the hypotheses tested of LCC passengers.

Conclusion

This work tried to build an empirical model of airport concession revenues, analyzing their determinants at passenger consumption level, using a higher number of variables, but with focusses on LCC passenger's behavior. The use of ordinary least squares (OLS) estimator with statistics robust to arbitrary heteroskedasticity minimized the squared residuals.

The literature review shows that there are several key determinants, but the hypotheses tested were based on LCC passenger that do not have a consensus as to its impact on the concession revenues. For this, we used data from 30 Brazilian airports in 2009 and found a statistically significant negative impact that LCC passengers have on concession revenue, but analyzing the LCC passengers that are traveling for leisure, the impact is statistically significant positive. One of the strengths of this work is the number of surveys in database and the possibility to test the impact of LCC passengers combined with others determinants.

The limitations of the work is that the OLS estimator do not correct endogeneity and this may cause bias on the estimation, because some regressors can be not orthogonal to the error, in other words, some regressors can be correlated to the error and it turns the properties about OLS estimator invalid. Therefore, to avoid this bias is necessary employee an instrumental variables estimator.

Furthermore, it has a problem about lack of important data as airport size, number of passengers and dwell time that was not possible to test.

But even so, there are an opportunity to airport managers to increase concession revenues not only maintaining the proportionally between the mix of LCC and full-service passengers, according Fasone et al (2016), but also increasing the share of travelers for leisure in low-cost carriers. Therefore, airport managers should make investments to attract travelers for leisure using the fact that low-cost carriers do not have inflight services free, and it is a way to improve the expenditure of travelers for leisure at airport offering products that LCC do not have.

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