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Abstract

This paper examines the airline network construction of Azul, a Brazilian airline, investigating which and how factors affect Azul's entry decision in a domestic route. Another subject of study is how the Azul merger with Trip, a regional airline, has affected its entry model. To do so, an econometric model of airline entry is developed, analyzing the entry determinants through the following group of characteristics: route distance, demand, city-pair and competition. Results show that Azul's business model is based on connecting new destination, not served by other airlines yet, with one of its hubs, and consistently avoiding direct competition with dominant airlines at the route and airport level. Regarding the effect of the merger, the results suggest that Azul's entry model has shifted away from its original model based on JetBlue's towards a regional based model, increasingly entering shorter routes and regional airports through time.

Keywords: entry; merger; business model; determinants; regional; LCC; econometrics.

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1. Introduction

The objective of this project is to analyze the route entry determinants of Azul Airlines in the Brazilian domestic market, and check if there was any underlying change in its entry behavior after the merger with Trip Regional Airline. This paper also compares Azul's entry determinants with JetBlue's, the airline Azul was based on its foundation.

Since the US deregulation, the growth of low-cost carriers has been attracting attention from several parties in the industry. This can be explained by the impact these types of airlines have been doing in the expansion of the aviation industry. In 2015, low-cost carriers carried more than 980 million passengers, which represent 28% of the world total schedules passengers[1]. And this number can be further increased; as eight of the world's ten fastest growing airlines now are low-cost carriers[2].

These marks are accomplished by the low-cost low-fare model, in which airlines offer limited passenger services ("no-frill"), among other characteristics, to reduce its operation costs and lower its ticket prices. By applying this business model Southwest Airlines, one of the biggest low-cost carriers of the world and a global benchmark in the low-cost market, is solely responsible for US$9.1 billion domestic consumer fare saving per year, which translates as an average reduction of $45 on fares when Southwest serves a market than when it does not. This value represents a fare reduction of 15% comparing to other airlines and it corresponds to a traffic increase of 30% in the airline market (Beckenstein & Campbell, 2017). With this strategy, airlines are able to serve price sensitive passengers, who would otherwise use another mean of transport or not travel at all, expanding the air travel industry[3][4].

In order to re-attract the price sensitive passengers, many network carriers (also known as traditional carriers, or full service carriers) are establishing their own low-cost division, called "airlines-within-airlines" that apply some, if not all, of the elements of the low-cost business model (Homsombat, Lei & Fu, 2014), or even buying a low-cost airline, as recently Cathay Pacific, one of the biggest network carriers of the world, bought Honk Kong Express, to enter this budget airline market[5]. This acquisition

[1] "Low Cost Carriers (LCCs)" (ICAO, 2019)

[2] "Biggest, fastest, oldest - 15 unbelievable statistics about air travel" (The Telegraph, November, 19, 2018)

[3] "How low-cost airlines alter the economics of flying" (The New York Times, September, 1, 2017)

[4] "The low-cost airline changing the way we fly" (BBC, February, 14, 2018)

[5] "Cathay buys HK Express, will operate it as low-cost carrier" (Washington Post, March, 26, 2019)

can be seen as strategic movement by Cathay Pacific, taking advantage of the increasing Asian-Pacific low-cost market[6].

While the Asian-Pacific air travel market is increasing in the last years, on the other hand the US and Europe is reaching saturation in the low-cost market, forcing low-cost carriers to adopt different strategies to continue its operations (Dobruszkes, Givoni & Vowles, 2017). One of the new strategies adopted by American and European LCCs was to fly on long-haul markets, going against the "Southwest pattern" of choosing a route to operate. This paradigm shift on the entry pattern has been decreasing the long-haul fares, adding a new layer of complexity on the airline market competition[7].

This paper considers the case of Azul Airlines in the Brazilian domestic air transport industry. Azul Airlines is a low-cost carrier founded in 2008 by David Neeleman, founder of JetBlue and WestJet, an American and Canadian LCC respectively. In 2012, Azul has merged with Trip, a Brazilian Regional Airline, creating the Brazil's third largest airline. This has further increased its presence in the Brazilian domestic airline market[8], especially in the north region of the country at the time[9]. But the current configuration of the route network of Azul shows a visible change since its merger with Trip. Although the number of routes operated by Azul hasn't changed by much, its route configuration shows that Azul has left some of the north region airports and has been focusing its operations in the Southeast and South regions of Brazil[10]. This research will examine the entry determinants of Azul Airlines and check if there was any paradigm shift in entry decisions through the years.

To do so, this research develops an econometric model to explain the market entry decision by Azul Airlines in domestic flights in Brazil. A Probit model will be used to examine the patterns of entry in city-pairs by Azul Airlines from 2008 to 2018 and check if there was any change in its entry behavior through the years.

This paper aims to extend the literature on the low cost carriers' entry determinants. It was noted in the early 2000s that US LCCs were changing its entry behavior, dissociating from the classic LCC market target, i.e. dense and short-haul markets and operating from secondary and/or regional airports

[6] "Asian budget airlines ride growth in long-haul flights" (Nikkei Asian Review, March, 6, 2018)
[7] "Why ticket prices on long-haul flights have plummeted" (The Economist, December, 8, 2018)
[8] "Azul and Trip merge to create Brazil's third largest airline" (Valor International, May, 28, 2012)
[9] "Azul and Trip Route Map" (Azul, 2012)
[10] "Azul Route Map" (Azul, 2019)

(Ito & Lee, 2003; Boguslaski, Ito & Lee, 2004). Several studies after also confirmed this entry behavior change in other parts of the world, showing that what was observed in the US in the 2000s wasn't a localized characteristics of the LCCs (Gil-Moltó & Piga, 2008; de Wit & Zuidberg, 2012; Dobruszkes, Givoni & Vowles, 2017).

Besides comparing the Brazilian LCC Azul's entry behavior with other LCCs' already studied in previous researches, this paper also aims to analyze how a LCC merger can impact on entry behaviors, a subject not well explored in the literature yet. This paper will take this event into account and compare Azul's entry behavior before and after the merger and look for evidences of entry pattern changes.

The next sessions of this research is divided as follows: Section 2 presents the discussion of the literature on airlines entry determinants and an overview of Azul Airlines operations. Section 3 presents the econometric model and a description of the variables used. Section 4 presents the estimation results and discussions. Section 5 presents the conclusions of this research.

2. Airline entry and LCCs

The expansion of the airline industry is closely tied to the growth of the low cost business model airlines. According to the industry, a low cost carrier (LCC) in general has the following characteristics, at some degree: it serves short-haul routes; uses regional or secondary airports; it operates point-to-point; with limited (or without) customer loyalty programs; limited passenger services (no-frills); high proportion of bookings made through the Internet; high fleet utilization; standardized fleet.[11] When an airline operates following some (or all) of the above characteristics, it decreases its costs, which allows for a low fare strategy. Lowering its fares, a LCC can serve price sensitive (usually leisure) passengers, who otherwise would travel through other transport modes, or not travel at all. This increase in demand caused by a decrease in airfares is known in the literature as Southwest Effect.

Morrison (2001) estimated annual fare saving from Southwest Airlines alone, the biggest LCC in the world, to be $12.9 billion, which was 20% of the domestic airline industry at the time of the research. For its low fares compared to other traditional airlines, Southwest was able to catch those

[11] Source: IATA Economics Briefing n. 5, 2006.

price sensitive passengers, increasing the overall airline demand. Such an impact in the industry attracted considerable interest from parties related to this industry, like politicians, publics, and academics.

Since the Airline Deregulation Act in the U.S., the academy has been concerned by the airline market competition with questions regarding prices and route entry by airlines. Several studies have been done in those areas since the U.S. deregulation, especially when other regions started their own airline market deregulation, like Europe or some countries in South America and Asia, allowing scholars to prove the universality of a research. Regarding the studies in the area of route or market entry by airlines, there are two main lines of research regarding low-cost carriers (LCCs) entries.

The first line of research is concerned by the entry effects and responses to the LCCs entries by its competitors. The previous literature has found that LCC effectively lower the fares when it enters a market, or even when it threatens to enter a route (Windle & Dresner, 1999; Morrison, 2001; Goolsbee & Syverson, 2008; Brueckner, Lee & Singer 2013).

The second of them, which is the focus of this paper, studies the LCC entry patterns on a market. It is concerned by LCC choice to operate in a given airport or route given their characteristics. There are several studies in this area, with most of them using the U.S. airline market/Southwest Airlines as reference, e.g. Müller, Hüschelrath & Bilotkach (2012) study the entry patterns of JetBlue Airways . Other markets investigated by the previous literature include European (Warnock-Smith & Potter, 2005; Gil-Moltó & Piga, 2008; de Wit & Zuidberg, 2012; Dobruszkes, Givoni & Vowles, 2017), Asian (Fu, Lei, Wang & Yan, 2015; Wang, Tsui, Liang & Fu, 2016) Brazilian (Oliveira, 2008) and Australian (Homsombat, Lei & Fu, 2014).

2.1 Airline entry in a market

The literature of airline entry patterns is tied to the U.S. airline market deregulation in 1978. At first, most of the researches tended to analyze the airline market as a whole, not focusing yet on LCC. For example, Morrison & Winston (1990) analyzed the dynamics of airline pricing and competition in the airline industry. Regarding the entry and exit of airlines, they used a Probit model and found that when a carrier is already operating at a pair of airports, it has a significant impact on its entry decision, whereas a competitor activity on an airport-pair does not discourage entry. And an interesting result

from this work is that a high fare on a given route negatively affects entry decisions, which can be explained by entry barriers, high costs or incumbent carriers' response to entry.

Joskow, Werden & Johnson (1994) found a similar result to Morrison & Winston (1990) as entry is driven by cost factors, specifically that airlines tend to enter city pairs if the price (or fare) is low. Sinclair (1995) further expanded the literature by showing strong evidence that entry and exit decision by airlines is affected by the size and utilization of a hub-and-spoke system, as incumbent with a strong hub system can inhibit entry while an entrant with a strong hub system will entry a market.

Dresner, Windle & Yao (2002) studied the effects of barriers on entry decision, showing that slot controls, gate constraints and, specially, gate utilization during peak hours affect negatively the entry decision on an airport-pair. Gil-Moltó & Piga (2008) analyzed the European airline market in regards to low-cost and traditional carriers' entry. Among different variables tested, some confirmed what was seen on previous studies, like the presence in the city-pair, but some variables presented interesting results. For example, the number of companies already operating on a route is positively correlated to entry. This was explained by the authors by the fact that a lower number of companies in a route is due to the presence of a dominant airline and/or entry barrier at that route. Alternatively, size market presented a negative correlation that can be explained by dominant airline/entry barrier as well.

The literature has also investigated the specific cases of low-cost carrier entry determinants in a market, which will be discussed next.

2.2 Literature for entry patterns of LCCs

Regarding the LCC entry patterns literature, Ito & Lee (2003) analyzed the growth of LCCs in the U.S. airline industry and the factors that influence their entry. According to their work, the most impactful predictor of a LCC entry is market density. Also in this study, the price variable showed to affect positively on entry decision, contrary to previous researches on network carriers, like Morrison & Winston (1990) and Joskow, Werden & Johnson (1993), showing that LCCs concentrate their entry in markets where incumbents were earning a large price markup. Boguslaski, Ito & Lee (2004) further expanded the literature by analyzing the evolution of Southwest's entry strategies over the years, finding a change in behavior in choosing routes to operate, from dense and short-haul markets to thin and long-haul markets. Both these works leads to believe that LCCs are not bound to fly only dense

and short-haul markets and serve leisure passengers anymore, and that network carriers will be more exposed to LCC competition over the years.

Oliveira (2008) analyzed a LCC entry pattern in Brazil, and he concluded that the airline entry behavior was indeed consistent with the classic Southwest entry pattern – focusing on dense and short-haul routes. The interesting aspect of his work is that he also found evidence that the Brazilian LCC had changed his entry pattern during the following years of its foundation, pairing with the JetBlue's entry pattern – focusing on long-haul routes. This was explained by the author as effect of idiosyncrasies of the country, like unobserved economies of scope.

Müller, Hüschelrath & Bilotkach (2012) studied the entry pattern of the LCC JetBlue Airlines in the U.S. domestic airline industry. They showed that the JetBlue consistently avoided concentrated airports, and instead targeted concentrated routes, making use of secondary airports on thicker routes, avoiding competition with network carriers. They also showed that JetBlue targeted longer-haul markets on non-stop markets, and avoided slot-restricted airports and routes already operated by other LCCs.

Boguslaski, Ito & Lee (2004) and Oliveira (2008) conclusions that the LCC entry patterns was changing through the time was also studied by de Wit & Zuidberg (2012), in a research about the growth limits of the low cost carrier model. They analyzed the European and American airline market, and concluded saying that there was a sign of saturation in continental market for LCCs, pointing towards a strategy of decreasing frequencies and increasing route distances. They also pointed new business strategies that could be adopted by LCCs, which includes shifting to primary airports, hubbing, entering codeshare agreements or alliances, and acquiring or merging with other airlines.

Dobruszkes, Givoni & Vowles (2017) studied the shift of LCCs to primary airports, one of the new business strategies cited by Wit & Zuidberg (2012). They also analyzed the European and U.S. low cost airline market, reasoning that both markets are considered mature compared to other regions. Their work analyzed the data from Ryanair and Southwest until 2015 and confirmed the trend of increasing the number of operations from major airports, having as implication an increase in competition between LCCs and traditional network carriers.

The literature shows that LCC entry pattern is following a trend that negates the classic market-choosing paradigm, operating now thin and long distance markets and using major airport. Regarding

the airline entry model, one of the objectives of this research is to further investigate this trend using Azul Airlines as the object of study.

2.3 Azul Airlines

Azul Airlines is a Brazilian LCC founded in 2008 by David Neeleman, the same name behind the foundation of JetBlue and WestJet, an American and Canadian LCC, respectively. Neeleman saw an opportunity to invest in the Brazilian market due to the recent expansion of the LCC Gol in this market (Oliveira, 2008) and especially due to Varig's bankruptcy, which was one of the biggest Brazilian airlines at the time (Oliveira, 2017). Azul started with 3 destinations in December, 2008, serving the following airports: Viracopos, Salvador and Porto Alegre, the first being nominated as Azul's hub since the beginning of the airline's operation. Figure 1 shows these destinations in the Brazilian map.

Today, Azul is one of the biggest airlines in Brazil, with a fleet size of 134 aircrafts, 104 destinations and 30% of the total number of departures in the country.[12] Figure 2 shows the Azul domestic network in December, 2018.

Figure 1 - Azul's network - Dec, 2008

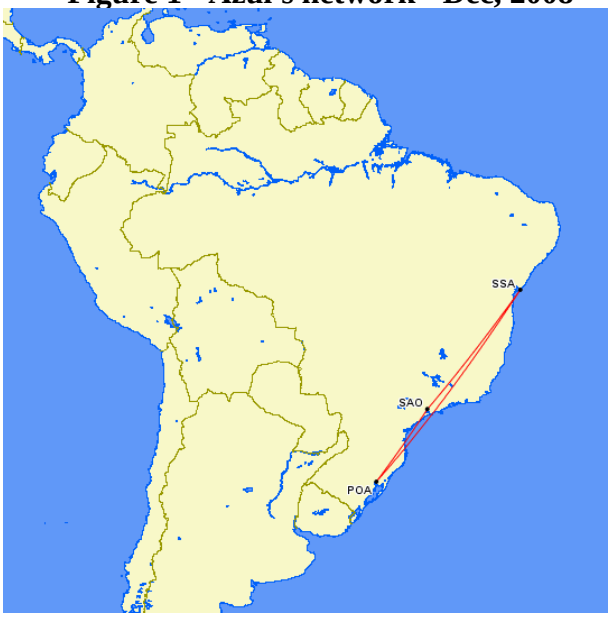
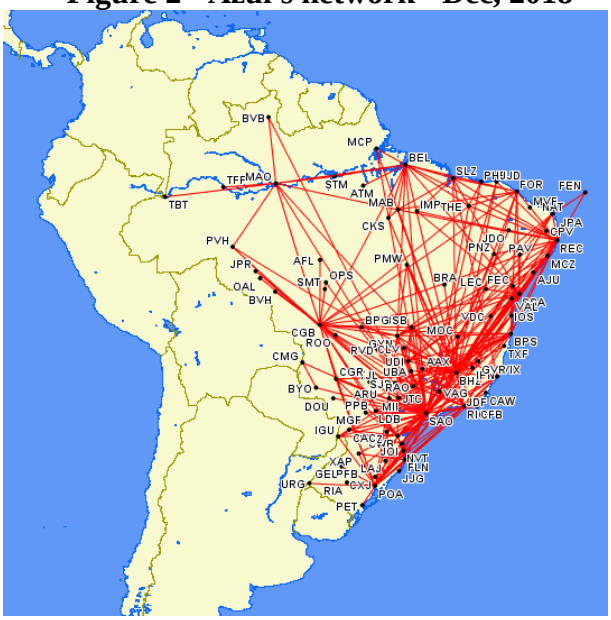


Figure 2 - Azul's network - Dec, 2018



At the airport level, the Azul's growth can be observed by checking the passenger movement per year in the Viracopos airport. Being a secondary airport, located close to the two biggest airports in Brazil, Guarulhos and Congonhas, Viracopos has historically presented a yearly passenger movement

[12] Source: Azul Airlines Press Release.

below 0.9 million. After the Azul entry in the Brazilian market in 2008 and choosing Viracopos as its hub, the yearly passenger movement has grew to 10 million in 2014, an impressive growth in 6 years.[13]

To continue growing, Azul has announced in 2018 its intention to enter up to 35 new destinations in the next few years, 25 of them being domestic cities.[14] Most of these cities are located in the South, Southeast and Northeast region of Brazil, which brings the question: how does Azul choose which cities it will serve in the future? What characteristics are important to Azul and what are their effects, positively or negatively affecting its entry probability?

Besides investigating Azul's entry model, this research also aims to understand the effects that a merger can have on airlines entry model, especially when an airline starts its operation based on a LCC model, like Azul, and it merges with an airline with a different business model, in this case, a regional airline. The next session will discuss the LCC mergers in the industry.

2.4. LCC mergers and acquisitions in the industry

There are several cases of airline mergers and acquisitions in the industry, but to maintain the scope of this research, three of them will be discussed in this session.

The first is the Southwest case, which has acquired AirTran in September, 2010[15]. One of the main reasons for this acquisition was to enter Hartsfield-Jackson Atlanta International Airport, the biggest airport in the world by passenger movements and the primary hub of Delta Airlines. By absorbing AirTran, Southwest was able to become the airport's second largest carrier. Besides the presence in Atlanta, the AirTran acquisition has also enabled Southwest to expand its domestic network by 25%, making Southwest the largest domestic carrier based on the number of passengers[16]., and dominate some airports, like Milwaukee and Baltimore[17].

Seeing the Southwest's expansion through an acquisition, JetBlue has also tried this move to increase its presence in the American domestic market by bidding on Virgin America's takeover[18].

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[13] Source: Hórus Labtrans

[14] Source: Azul Airlines Press Release.

[15] "Southwest, determined to expand, buys AirTran" (The New York Times, September, 27, 2010)

[16] "What has AirTran done for Southwest Airlines?" (Forbes, December, 11, 2014)

[17] "Southwest Acquires Aritran: Six Reasons This is a Great Move" (CBS News, September, 27, 2010)

[18] "Virgin America gets takeover bids from JetBlue and Alaska Air" (Bloomberg, March, 28, 2016)

Although it followed Southwest's steps on acquisitions, JetBlue was not able to acquire Virgin, which was taken by Alaska Air. But this move shows that JetBlue's business model does not avoid mergers and acquisitions; in fact it considers a valid strategy to expand its business.

This strategy was inherited by Azul in Brazil, the airline that was based on JetBlue's business model. In 2012 Azul and Trip announced a merger of their operations[19], Trip was a Brazilian, and at the time the biggest Latin America regional airline, and with this merger, the group Azul-Trip was able to become the third biggest airline in Brazil, serving 96 destinations. Figure 3 shows Azul's network before the merger, present in 259 directional city-pairs in May, 2012 and Figure 4 shows the Azul-Trip group network, present in 594 directional city-pairs in June, 2012.

Figure 3 - Before the merger

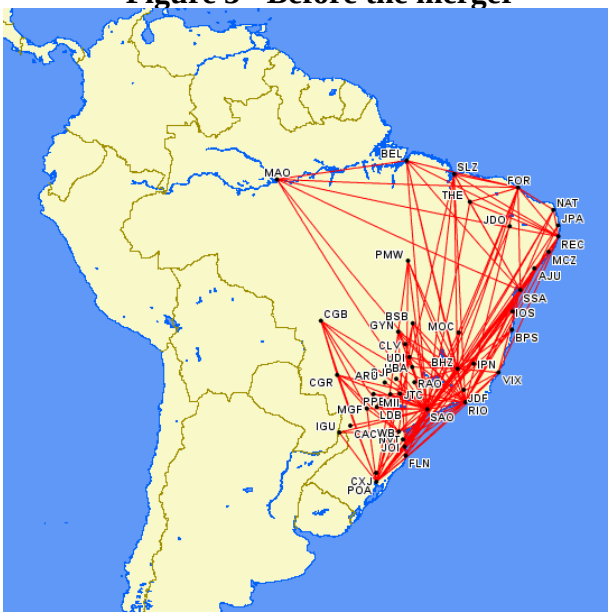
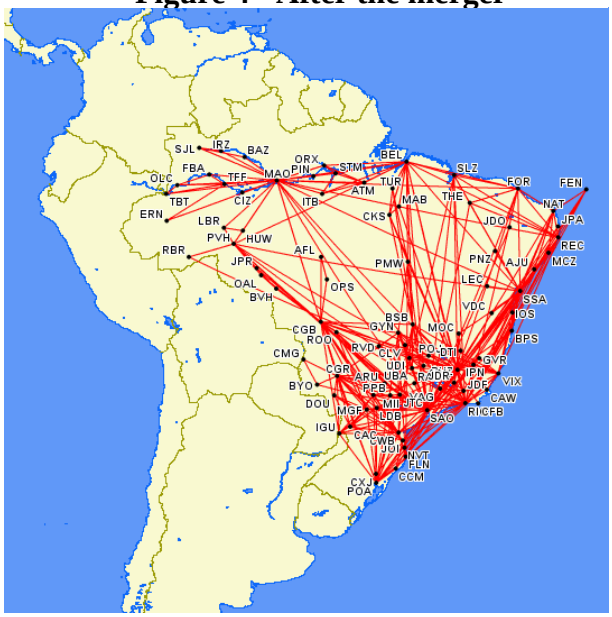


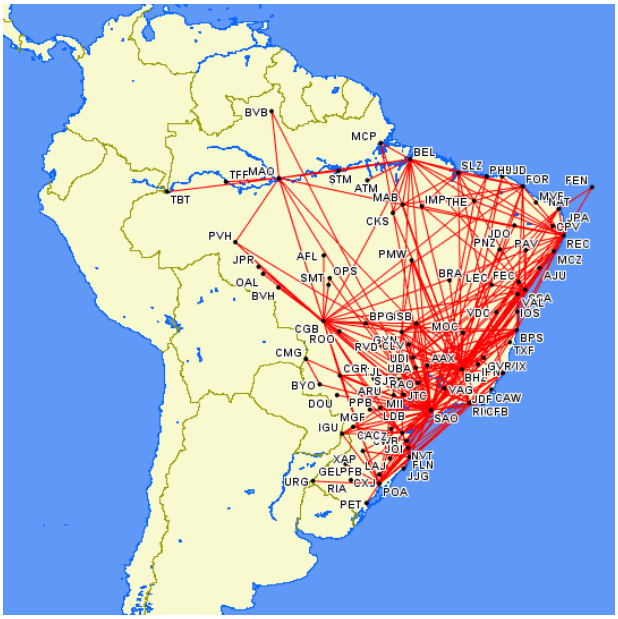
Figure 4 - After the merger



After the merger, there was a period in which the group Azul-Trip adjusted its network by exiting non-profitable cities, until it gets to the network configuration, serving 464 city-pairs as of December, 2018, shown in Figure 5.

[19] "Azul and Trip merge to create Brazil's third largest airline" (International Valor, May, 28, 2012)

Figure 5 - Azul's network - Dec, 2018



Source: gcmap.com

Looking at its network configuration in December, 2018, one can ask: how did the merger affected Azul's entry decision after 2012? How does a merger between a low-cost carrier with a regional airline impacts the former's entry model?

The effect of an airline merger in its entry decision is a subject not well explored in the literature yet, so one of the main contributions of this research is to fill this gap in the literature investigating how the merger with Trip has impacted Azul's entry decision in the period post-merger. In order to do so and answer the questions made before in this session, an econometric model will be used. The empirical modeling is explained in the next session.

3. Empirical modeling

This paper's goal is to identify the factors which have influenced Azul's entry decisions in the Brazilian domestic routes. In order to achieve this goal, a Probit model is estimated using a panel data. The unit of observation is a domestic directional city-pair where Azul is present, assuming that (a) airports within the same extended city area are represented by the city and the mean value of the airports' variables are used, and (b) the route São Paulo-Rio de Janeiro is different than Rio de Janeiro-São Paulo, thus counted as 2 different routes. The main reason to use city-pairs rather than airport-pairs as the observation unit is to understand Azul's geographic expansion since 2008, a reasoning also used by Boguslaski, Ito & Lee (2004) in their paper which they analyzed the Southwest Airlines' entry patterns.

3.1. Econometric model

The econometric model used in this research builds up on the empirical specification of the previous studies of airline entries found in the literature, as Morrison & Winston (1990), Sinclair (1995), Dresner, Windle & Yao (2002), Ito & Lee (2003), Boguslaski, Ito & Lee (2004), Oliveira (2008), Gil-Moltó & Piga (2008) and Müller, Hüschelrath & Bilotkach (2012). In this literature, the entry decision is usually explained by characteristics of airport/city, route, demand and competition. In this model, it will be considered four categories of variables: distance, demand, city-pair and competition. Equation (1) presents the empirical model of Azul's entry decision in the Brazilian airline industry, with the aforementioned categories of variables grouped in brackets.

$$
\begin{aligned}
&ENTRY_{kt} = \\
&(\beta_0 + \beta_1 KM\ 500\text{-}1000_k + \beta_2\ KM\ 1000\text{-}2000_k + \beta_3\ KM\ 2000m_k) \\
&+ (\beta_4\ PAX_{kt} + \beta_5\ MAXCON_{kt} + \beta_6\ MAXCON_{kt} \times HUBAZ_{kt} + \beta_7\ TOURISM) \\
&+ (\beta_8\ LARGEHUB_{kt} + \beta_9\ MAXDEL_{kt}) \\
&+ (\beta_{10}\ HHI_{kt} + \beta_{11}\ HHI_{kt} \times HUBAZ_{kt} + \beta_{12}\ MAXHHI_{kt} + \beta_{13}\ LCCMAJ + \beta_{14}\ LCCMED \\
&+ \beta_{15}\ RGCMED + \beta_{16}\ RGCSMA + \beta_{17}\ FSCMED) + u_{kt}.
\end{aligned}
\tag{1}
$$

where *k* denotes the route, i.e. the directional city-pair, and *t* denotes the time period. The components of Equation (1) are the following:

- *$ENTRY_{kt}$ is the probability of the event of Azul entering a directional city-pair k in time t.*

Regressors: distance

- *KM 500-1000$_k$ is a dummy variable to account for city-pair k with a geodesic distance between 500 and 1000 km.*
- *KM 1000-2000$_k$ is a dummy variable to account for city-pair k with a geodesic distance between 1000 and 2000 km.*
- *KM 2000m$_k$ is a dummy variable to account for city-pair k with a geodesic distance higher than 2000 km.*

The base case for these dummy variables is the city-pair k with a geodesic distance between 250 and 500 km.

The route distance is one of the most studied variables in airline entry models, with authors usually using one single variable to account for distance and not separating it in short, medium and long haul. This separation was done before by Ito & Lee (2003), Lederman & Januszewski (2003) and Boguslaski, Ito & Lee (2004), and one positive aspect from this approach that can be used in the present research is that it enables an understanding of the type of the operation Azul is focused, with shorter routes signaling a regional approach to its operations. Another positive aspect is that it can be used to compare Azul with JetBlue, as observed by Müller, Hüschelrath & Bilotkach (2012), JetBlue consistently enters longer routes in the American domestic market. Thus, these variables are intended to capture the effect of route distance on Azul's entry decision in the Brazilian domestic market and check if it follows JetBlue's entry model.

The expectation for these variables is as follows: it should present a positive value for longer routes in the early years of Azul's foundation, as its business model is based on JetBlue's long-haul entry pattern. But as Azul has merged with Trip, a regional airline, it is expected to present a positive value for shorter routes after 2012, becoming consistent with a regional airline model.

Regressors: demand

- PAX_{kt} is the total number of revenue passengers on the directional flight segment of *city-pair k and time t* divided by the number of the days in the month, which is multiplied by 1000. This variable intends to capture the density of the route, which Boguslaki, Ito & Lee (2004) defined as one of the most positive indicators of a LCC entry in a route. The expectation for this variable in the present research is to present a positive value as well.
- $MAXCON_{kt}$ is a variable to account for the maximum number of passengers in connection between the endpoint cities of *city-pair k and* time t. It is a variable not well explored in the literature yet; its objective is to capture Azul's probability to enter in a route with high number of passengers in connection, especially those from its competitors. The expectation for this variable is not defined by the authors yet.
- $MAXCON_{kt}$ *x* $HUBAZ_{kt}$ is the interaction between the variable MAXCON and the presence of Azul's hub in one of the endpoints of the city-pair k in time t. It intends to check if the likelihood

of Azul's entry in a new city gets higher if it can be connected to one of its hubs, which are São Paulo since December, 2008, Belo Horizonte since May, 2012 and Recife since October, 2010. The expectation is that this variable presents a positive value, as Azul's operation is based on consolidation of flights in its hubs.

- $TOURISM_{kt}$ is the proportion of passengers in charter flights in the city-pair k in time t. It acts as a proxy to tourist or seasonal routes, and the expectation is to present a positive value with Azul's entry, based on results found by Lederman & Januszewski (2003) and Boguslaski, Ito & Lee (2004)

Regressors: city-pair

- $LARGEHUB_{kt}$ is a dummy variable to account for the presence of a hub considered large by FAA (more than 1% of national passenger share) in one of the endpoints of the city-pair k in time t. This variable applied in a way that doesn't make distinction between different airlines was studied before by Sinclair (1995), and his results show that the presence of a hub in one of the endpoints is not significant to determine the entry strategy of airlines. In this research, its main objective is to check if Azul tries to enter in its competitors' hubs. The expectation for this variable is to present a negative value, i.e. Azul does not enter in a route connected to its competitor's hubs.

- $MAXDEL_{kt}$ is a proxy for airport congestion in one of the endpoints of city-pair k in time t. Analyzed by previous literature, this variable presents mixed results, having a negative effect on entry according to Ito & Lee (2003) and Tan (2011) and a positive effect according to Gil-Moltó & Piga (2008). The first two claimed that airlines avoid congested airports by entering secondary airports close to the congested one; the latter said that when an airport is congested, is a sign that there are a high demand in that route, thus making an airline keen to entering that market. In this research, MAXDEL is expected to present a negative value, as congested airports are usually linked to slot restricted airports.

Regressors: competition

- HHI_{kt} is the Herfindahl-Hirschman index of concentration of revenue passengers of *city-pair k in time t*. This variable aims to capture the effect of airline market dominance at the route level and has already been observed in previous literature, most of them concluding that airlines tend

to not enter dominated routes. In this research is expected to present a negative value, i.e. Azul does not enter in a route already dominated by another airline.

- HHI_{kt} *x* $HUBAZ_{kt}$ is the interaction between route HHI and presence of Azul's hub in one of the endpoints of the city pair k in time t. Its objective is to check if Azul enters a route which it can be the dominant one by connecting the new city to one of its hubs. It is expected to have a positive value, consistent with Azul's regional segment and consolidation of flights in its hubs.
- $MAXHHI_{kt}$ is the maximum Herfindahl-Hirschman index of concentration of revenue passengers in one of the endpoints of *city-pair k in time t*. This variable aims to capture the effect of airline market dominance at the city level and has also been observed in previous literature, most of them concluding that airlines tend to not enter dominated airports. It is expected to present a negative value, i.e. Azul does not enter in a city already dominated by another airline.
- $LCCMAJ_{kt}$ is a dummy variable to account for the presence of the LCC Gol in the city-pair k in time t. It is expected to present a negative value, i.e. Azul avoids direct competition with Gol.
- $LCCMED_{kt}$ is a dummy variable to account for the presence of the LCC WebJet in the city-pair k in time t. It is expected to present a negative value, i.e. Azul avoids direct competition with WebJet. This variable is present in the database from December, 2008 to November, 2012. After this period, WebJet was incorporated by Gol.
- $RGCMED_{kt}$ is a dummy variable to account for the presence of the regional carrier Trip in the city-pair k in time t. It is expected to present a negative value before the merger, i.e. Azul avoids direct competition with Trip, and positive value after the merger, in which Azul incorporated Trip's routes.
- $RGCSMA_{kt}$ is a dummy variable to account for the presence of a small regional carrier in the the city-pair k in time t. It is expected to present a negative value, i.e. Azul avoids direct competition with small regional carriers.
- $FSCMED_{kt}$ is a dummy variable to account for the presence of the full-service carrier Avianca in the city-pair k in time t. It is expected to present a negative value, i.e. Azul avoids direct competition with Avianca. This variable was added because Avianca was a small regional airline called OceanAir before May, 2010, and after its name change, most of its routes were incorporated by Avianca.

Regressors: flight operations & costs

- u_{kt} *is the associated error term.*

Henceforth, the indexes *k* and *t* will be omitted. Table 1 presents descriptive statistics of the main variables of the empirical model.

Table 1 - Descriptive statistics of the main variables

Variable	Unit	Mean	Std.Dev.	Min	Max
KM_250_500	dummy	0.229	0.420	0.000	1.000
KM_500_1000	dummy	0.322	0.467	0.000	1.000
KM_1000_2000	dummy	0.259	0.438	0.000	1.000
KM_2000m	dummy	0.111	0.314	0.000	1.000
PAX	nr. of pax	0.497	1.155	0.000	14.213
MAXCON	proportion	0.253	0.113	0.000	0.963
TOURISM	proportion	0.045	0.126	0.000	0.997
LARGEHUB	dummy	0.941	0.235	0.000	1.000
MAXDEL	proportion	0.171	0.070	0.000	1.000
HHI	index [0,1]	0.695	0.277	0.206	1.000
MAXHHI	index [0,1]	0.499	0.245	0.232	1.000
LCCMAJ	dummy	0.509	0.500	0.000	1.000
LCCMED	dummy	0.033	0.179	0.000	1.000
RGCMED	dummy	0.151	0.358	0.000	1.000
RGCSMA	dummy	0.143	0.350	0.000	1.000
FSCMED	dummy	0.141	0.348	0.000	1.000

3.2. Data

As stated in the beginning of this session, this data set consists of the panel data of domestic directional city-pairs in Brazil, and the time period considered was from December, 2008 to December, 2018, totaling 72.769 numbers of observations. The main data source is available from Civil Aviation Integrated System (SINTAC), which is within the National Civil Aviation Agency (ANAC) data system. All variables were extracted from SINTAC except MAXDEL, which was extracted from Active Regular Flight (VRA), also within ANAC's system. In order to better simulate Azul's entry model, this research used 12 months lagged variables, considering the entry planning horizon of the airline.

4. Discussion of results

This section will first present and discuss the estimation results for Azul's entry model, analyzing it through four different groups of variables: distance, demand, city-pair and competition. After the discussion of the results, it will present the comparison between Azul's entry model before and after the merger with JetBlue's entry model, which results were extracted from Müller, Hüschelrath & Bilotkach (2012).

4.1. Estimation results

Table 1 presents the estimation results for the following specifications: (1) All sample, (2) period before Azul's merger with Trip and (3) period after Azul's merger with Trip. Each group will be analyzed separately.

Regarding the distance variables, the data shows that Azul avoids longer routes (Columns 1 and 3), but it wasn't always like this: before the merger, Azul had a positive and statistically significant coefficient for routes with distance between 1000 and 2000 km, showing its early preference for medium-long hauls, consistent with JetBlue's business model. After the merger with trip, its business model shifted from JetBlue's longer routes model to a regional oriented behavior, focusing on shorter routes and developing their regional business segment. These results also shows that Azul does not follow the trend in the LCC entry pattern literature, which authors like Boguslaki, Ito & Lee (2004), Oliveira (2008) and de Wit & Zuidberg (2012) observed that LCCs around the world were increasingly entering longer routes.

With respect to demand variables, some of them presented expected results, e.g. PAX and TOURISM. Both of them have a positive and statistically significant coefficient, agreeing with previous studies. An interesting fact is the drop in the PAX's coefficient value from before to after the merger, this time confirming the literature (Boguslaki, Ito, & Lee, 2004; Oliveira, 2008; de Wit & Zuidberg, 2012) and showing that Azul is entering thinner routes when comparing to the period before the merger. Regarding the variable MAXCON, it presented a negative coefficient before the merger, showing that Azul used to avoid routes with high number of passengers in connection from other airlines, but after the merger this variable lost its significance, not being an important factor to Azul anymore. On the other hand, MAXCON_HUBAZ's shows that Azul's business model is based on

connecting its new served cities to its existing hubs by presenting a consistent and positive coefficient before and after the merger.

Table 2 - Estimation results

	(1) ALL SAMPLE	(2) BEF_MERG	(3) AFT_MERG
KM_250_500	base case	base case	base case
KM_500_1000	-0.1376***	-0.0070	-0.1968***
KM_1000_2000	-0.5952***	0.1986***	-0.7761***
KM_2000m	-0.9395***	-0.0346	-1.1739***
PAX	0.5861***	0.7097***	0.5468***
MAXCON	-0.1540***	-1.6880***	0.0497
MAXCON_HUBAZ	2.0523***	2.6634***	1.9789***
TOURISM	0.4302***	0.6894***	0.5335***
LARGEHUB	0.2633***	0.0336	0.3183***
MAXDEL	0.1016	0.5859***	-0.6837***
HHI	-2.3838***	-1.3319***	-2.6480***
HHI_HUBAZ	0.7528***	0.7497***	0.8326***
MAXHHI	-0.4521***	-3.4283***	-0.1726***
LCCMAJ	-0.9925***	-0.1399***	-1.2396***
LCCMED	0.7247***	0.2581***	-0.6811***
RGCMED	0.1553***	-0.0381	0.7694***
RGCSMA	-1.0299***	-0.1502***	-1.2384***
FSCMED	-1.1569***	-0.8705***	-1.1983***
r2_p	0.3879	0.4114	0.3381
r2_mz	0.6517	0.6942	0.5932
r2_ct	0.8119	0.8888	0.8096
r2_ctadj	0.6105	0.3216	0.4644
chi^2	39099	7087	23532
N_Obs	72769	19301	53468

# p<0.25, * p<0.10, ** p<0.05, *** p<0.01

Regarding the city-pair variables: LARGEHUB shows that before the merger, Azul didn't take this factor in account to enter a route, but after the merger the positive and statistically significant coefficient shows that Azul enters its competitors' hubs; it could happen because these are large cities/airports, and Azul sees it as an opportunity to enter this market and grab some of its competitors' passengers. MAXDEL shows a paradigm shift from Azul: before the merger, Azul entered congested airports, but after the merger it starts to avoid these types of airports. The positive value before the merger can be explained by the early expansion of Azul in the Brazilian domestic market, entering congested airports/cities to stablish its position in the market, namely entering São Paulo and Rio de Janeiro cities. But after the merger, Azul had already stablished its position in the domestic market, and because of its regional business segment, it starts to avoid congested airports/cities. Another explanation for the negative coefficient for MAXDEL after the merger is that Azul doesn't avoid entering congested airports, and rather it can't enter these airports, as most of them are restricted in some way, e.g. slot restriction.

And with respect to competition variables, most of them presented the expected results. A negative coefficient for HHI, both before and after the merger, shows that Azul consistently avoids routes dominated by other airlines, unless Azul itself can be the dominant one, as shown in the variable HHI_HUBAZ; when there is the possibility to connect a city to one of its hubs, and be the only airline in that route, Azul tends to enters this market, as shown by the consistently positive value for HHI_HUBAZ. Analyzing the airport dominance through MAXHHI, when it is concentrated, i.e. dominated by other airline, Azul avoids entering routes connecting to these airports, although its negative effects has diminished after the merger. Regarding the presence of other airlines in the route, LCCMAJ, RGCSMA and FSCMED presented the expected negative values, showing that Azul avoids direct competition from Gol, small regional airlines and Avianca, respectively. LCCMED shows that before the merger the presence of WebJet in a route had a positive impact on Azul's entry, and after the merger it changes. The negative aspect of the presence of WebJet after the merger can be explained to its similarity to Azul's operation, thus Azul avoiding direct competition with WebJet, but the positive value before the merger can be explained by the strong presence of WebJet in Sao Paulo and Rio de Janeiro airports, which were some of the main airports that Azul entered after its foundation. And finally, RGCMED has no statistically significant coefficient for the period before the merger, and a positive coefficient after the merger; RGCMED being the dummy variable representing the presence of Trip in the route, its positive value after the merger can be explained by the incorporation of its routes by Azul.

From these results, one can extract the consistent variables through time and define Azul's core business model. These variables are: PAX, TOURISM, HHI, MAXHHI, MAXCON_HUBAZ and HHI_HUBAZ.

Regarding the first two variables, Azul is always keen to enter routes with high demand, being it for regular or charter passengers. It is something expected from most airlines: they enter a route when there is a demand for that market. Now HHI and MAXHHI shows that Azul always avoided direct competition at route and airports level when these are already dominated by another airline. But HHI_HUBAZ shows that Azul does in fact enter new destinations when it can be the dominant in that market and it usually connect these new destinations with one of its existing hubs, as shown by the variable MAXCON_HUBAZ.

In order to validate this hypothesis of Azul's core business model, this paper investigated the empirical evidences of Azul latest entries. It was discussed in this research that Azul was planning to enter 25 new domestic destinations in the next few years according to a 2018 press release. From that group of destinations chosen by Azul, 3 of them were already entered by the airline at the time this text is being written, and the cities are: Mossoró, Pato Branco and Toledo.

The three of them share the same distance characteristic: they are all connected to an airport within the 500 km distance, showing the regional aspect of Azul post-merger. Mossoró is connected to Recife, while Pato Branco and Toledo are connected to Curitiba. Recife is Azul's hub since 2017, and while Curitiba is not one of the hubs considered in this paper, Azul considers this airport as its "mini-hub", according to its institutional presentation. This shows that Azul's entry model is based on connecting new destination with its hubs or feed the closest airports, as suggested by MAXCON_HUBAZ. And finally, these routes are operated by Azul only, showing that it enters a route when it can be in the dominant position, as suggested by HHI_HUBAZ.

4.2. Comparing Azul with JetBlue

Using the results found in section 4.1., it is possible to compare the results from the present research with the results found by Müller, Hüschelrath & Bilotkach (2012). Their research investigated the JetBlue's entry pattern in the American domestic market, and because Azul was initially based on JetBlue's business model, this paper tried to compare their models. Three entry models were considered: Azul before the merger, Azul after the merger, and JetBlue. To be able to compare these

different entry models from different papers, only the variables present or equivalent in both papers were used, which are: KM, PAX, MAXCON_HUB, LARGE_HUB, HHI, MAXHHI and LCCMAJ. The results are shown in Table 2, following the specification: (1) Azul entry model before the merger with Trip, (2) Azul entry model after the merger and (3) JetBlue entry model. The results for each variable is presented as following: "+" for a positive effect on entry, "-" for a negative effect on entry, and "0" for statistically non-significant coefficient, signaling a neutral effect on entry.

Table 3 - Comparing Azul with JetBlue

Variables	(1) Azul_Before	(2) Azul_After	(3) JetBlue
KM	+	-	+
PAX	+	+	0
MAXCON_HUB	+	+	+
LARGEHUB	0	+	0
HHI	-	-	+
MAXHHI	-	-	-
LCCMAJ	-	-	-

Starting with the similarities: all of them agree on the positive effect of MAXCON_HUB, i.e. Azul and JetBlue business models are based on entering new routes that can be connected to one of their hubs. On the other hand, the dominance of an endpoint airport or the presence of a LCC competitor affects negatively on their entries.

Regarding the HHI of the route, Azul's business model consistently avoids this type of route, as shown by the negative effect on both Azul's models. On the other hand, HHI of the route is a positive indicator for JetBlue. Müller, Hüschelrath & Bilotkach (2012) explained that this result shows that JetBlue sees dominance of a route as a signal that there is a demand that can be claimed there by competing for price, as long the incumbent is not a LCC.

And then there are two similarities between Azul before the merger and JetBlue: both of them agree on positive effect of KM and no-significance on LARGEHUB. Starting with the hub variable, both models agree that the presence of a large hub in one of the endpoints of the route is not taken into account when planning for a route entry, as shown in both studies by a statistically non-significant

coefficient. And finally, both of them prefer to enter longer routes, presenting a positive coefficient on the KM variable. This characteristic is a staple on the JetBlue business model, and Azul has brought this behavior to its operations in Brazil until its merger with Trip, when its business model shifted more towards a regional-LCC operation.

With these results, it can be said that the Azul's early business model, before its merger with Trip, was more similar with JetBlue business model. This is understandable, as the David Neeleman's intent, the founder of Azul and JetBlue, was to bring the latter business model to the Brazilian market. Although his intents, Azul has shown some different characteristics than JetBlue, e.g. divergence on the effect of route HHI: while JetBlue enters dominated routes to compete with its incumbents, Azul consistently avoided direct competition in this type of route, both before and after the merger. This difference and others that can be observed from both airlines in many different aspects can be attributed to the idiosyncrasies of each market that they are inserted on, with each company adapting its business model to serve its market's passengers.

6. Conclusion

The present research developed an econometric model of airline market entry, and in particular it was considered the case Azul's entry in the Brazilian domestic market. One of the objectives of this research was to compare Azul's entry model with the trend observed in the literature, in which LCC airlines were not operating based on the Southwest Paradigm anymore, and instead of entering short and dense routes they are increasingly entering longer and thinner routes. The results show that while Azul is indeed entering in thinner routes when comparing to its early entry model, it is also increasingly entering in shorter routes, between 250 and 500 km, thus disagreeing with the previous studies. This can be explained by its merger with Trip in 2012, a regional airline: after the merger, Azul focused more on its regional segment instead, connecting new served cities to its closest big airport, being it a capital airport or even Azul's hub.

Besides comparing Azul's entry model with the literature, this research also tried to investigate what characteristics Azul takes into account when choosing a new destination. There are some consistent results for all the period considered in this study: Azul's model is heavily based on creating connections with its existing hubs, being the cities of São Paulo, Belo Horizonte and Recife; Azul consistently avoids concentrated routes and airports, thus avoiding direct competition with dominant incumbents; unless Azul itself can be the dominant airline in a route. Another objective of this research was to

investigate the effect of a LCC merger with a different business model, in this case, a regional airline. One of the biggest changes in Azul's entry model was shifting from JetBlue based long-haul routes to regional consistent short-haul routes. With these estimation results, empirical evidence was searched to confirm them, and it was checked that Azul indeed follows this strategy. The airline has recently added 3 new destinations in its network: Mossoró, Toledo and Pato Branco. They are all connected to one of Azul's hubs or mini-hubs, within a 500 km distance, and they were not explored by other airlines at the time of entry, confirming the results found in this research.

And finally, with the estimation results in hands it was capable to compare Azul with its original business model, JetBlue. Using the JetBlue's results found by Müller, Hüschelrath and Bilotkach (2012) a comparative table was created, showing that although both companies has its own idiosyncrasies, and the American and Brazilian airline market have its own characteristics, Azul's business model before the merger was more similar with JetBlue's.

The findings of this research are limited by the fact that it didn't take into account the different types of aircrafts used by Azul. The airline started its operation based on Embraer aircrafts, with capacities ranging from 106 to 118 passengers to serve medium-haul routes; after its merger with Trip it started using ATR aircrafts, with a capacity of 70 passengers and serving shorter routes; and since 2014 Azul started operating Airbus aircrafts, with a higher passenger capacity and able to serve longer-routes. It is therefore recommended that future studies take into account this variety of aircraft in Azul's fleet, with varying capacities and ranges, in order to estimate a model, especially on the effect of the distance variable on entry decision.

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