

The construction of a low cost airline network

Facing competition and exploring new markets

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The paper empirically investigates the construction of a low cost carrier network by analyzing JetBlue's entry decisions into non-stop domestic U.S. airport-pair markets between 2000 and 2009. Employing a Cox proportional hazard regression model with time-varying covariates, we find that JetBlue Airways has been entering longer-haul thicker and more concentrated routes; previous airport presence also affects entry positively. We also find that, when establishing new non-stop service between airport pairs, JetBlue focused on secondary airports, thereby avoiding direct confrontation with the network carriers. Looking at the entry into airport pairs, where JetBlue faced incumbent competitor(s), we find that the carrier avoided concentrated airports, as well as routes serviced by the carriers under bankruptcy protection. There is also evidence that JetBlue avoided direct competition with other low cost carriers.

Keywords Airline industry, network, entry, low cost carrier

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1 Introduction

In a number of industries, the success and sustainability of a new firm's business strategy is tied to its sequential decisions to enter multiple markets. A new entrant in industries such as electricity retailing, banking or various modes of transportation therefore faces the key challenge to optimize the sequence of entries in a number of different markets - taking into account possible internal resource constraints and external barriers to entry - in order to operate profitably and to build-up a sustainable market presence. In designing such a sustainable entry pattern, the new entrant has to decide on the optimal mixture of two distinct entry strategies: entering existing markets and facing competition of incumbent firms or identifying and entering new markets which can be expected to create sufficient revenue to contribute to the overall firm's success.

The U.S. airline industry provides a suitable environment for an empirical assessment of the determinants of successful entry in general and the importance of facing competition in existing markets and exploring new markets in particular. On the one hand, the industry has experienced a pronounced consolidation trend in the last decade especially reflected in five high-profile mergers¹ and the demise of several smaller players such as ATA, National and Aloha together with a short-lived failed entry by Skybus. On the other hand, despite this general consolidation trend, the domestic U.S. airline industry witnessed one significant countervailing force: the market entry and growth of JetBlue Airways.² Since its first market appearance in February 2000 until the end of 2009, the low cost airline managed to build up a route network with 60 destinations in 21 U.S. states and transported about 20 million passengers (in 2009) making it the 10th largest airline in the United States. Furthermore, despite its rapid growth, JetBlue Airways still managed to realize an overall net income of about USD 200 million, and therefore belongs to the small group of profitable airlines.³

¹The mergers are American Airlines-Trans World Airlines (2001), US Airways-America West Airlines (2005), Delta Air Lines-Northwest Airlines (2009), United Airlines-Continental Airlines (2010), Southwest Airlines-AirTran Airways (2010, announced).

²We believe that it is too early at the time of this writing to consider Virgin America - the youngest player on the US market - as a second successful entrant in the domestic U.S. airline industry. Since its market entry in 2008, the carrier only managed to turn profitable for the first time in third quarter of 2010.

³Data source: Bureau of Transportation Statistics at <http://www.transtats.bts.gov/carriers.asp> (accessed on 22 March 2011).

Although numerous examples of failed low cost carriers assert that a cost advantage is not a sufficient condition for market success, JetBlue Airways is different. One frequently cited distinctive characteristic is its innovative business strategy that diverges from other low cost carriers in several important dimensions. Instead of relying on remote airports, JetBlue Airways developed hub operations at New York's biggest airport (JFK). The carrier offers high quality services including in-flight entertainment, pre-assigned leather seats with more legroom; it has also signed code-sharing agreements with international carriers such as Lufthansa and Aer Lingus. Furthermore, JetBlue Airways introduced long-haul services on a large scale and therefore brought 'low cost' competition to a type of routes formerly dominated by legacy network carriers.

Against this background, we analyze the factors that have driven JetBlue's entry decisions, from inception to the present day. Data analysis shows that this carrier has been entering longer-haul thicker and more concentrated routes; previous airport presence also affected entry positively. We also find that, when establishing new non-stop service between airport pairs, JetBlue focused on secondary airports, thereby avoiding direct confrontation with the network carriers. Looking at the entry into airport pairs, where JetBlue faced incumbent competitor(s), we conclude that the carrier avoided concentrated airports, as well as routes serviced by the carriers under bankruptcy protection. There is also evidence that JetBlue avoided direct competition with other low cost carriers.

In addition to developing our understanding of low-cost carriers, this study addresses the issue of the nature of entry barriers in the important and visible airline industry. Our findings point to airport dominance as a significant impediment to entry. We also find that apparent entry deterrence effect of airport dominance is not limited to hub or large airports. Further, airport dominance deters entry in both markets where incumbents are present and on new non-stop routes. This suggests that network carriers are able to use their airport dominance to prevent an entrant from establishing a network with a hub at a different airport. At the same time, JetBlue's reliance on secondary airports, along with some evidence that the airline avoided other low-cost players, hints at the necessity for the entrants into the airline industry to differentiate their product as much as possible.

The remainder of the paper is structured as follows. The subsequent second section provides a review of the literature on the determinants of entry

in U.S. airline markets. The third section provides some background on the market entry and growth of JetBlue Airways in the U.S. airline industry, followed by the presentation of our empirical analysis in section four. Section five concludes the paper by summarizing the key results and developing important policy conclusions.

2 The determinants of entry in U.S. airline markets

An airline network is basically constructed by multiple market entry decisions. In determining these entry decisions, the airline management basically has to answer two key questions: 'Is entry profitable?' and 'Is entry possible?' With respect to the former question, it can be expected that current and expected profitability of a particular market typically is a key determinant in the decision to enter the market. In general, it is reasonable to assume that a profit-maximising, risk-neutral firm will enter a market if the net present value of expected post-entry profits is greater than the sunk costs of entry. As post-entry profits depend on post-entry competition, the entry decision therefore is connected to the expectations of the entrant about the conduct and performance of the firms after entry. Furthermore, the level of sunk costs incurred is a critical determinant of the entry decision (see e.g. Besanko et al., 1996, 396 ff.). The higher the necessary sunk costs to enter an industry are; the higher is the risk of entry, and the lower are the expected profits. Additionally, the entry condition above clarifies that profits immediately after entry are not necessary for a rational entry decision. It is sufficient that e.g. market growth expectations should promise sufficient profits in the future. With respect to airline markets, this condition means that an entry decision must not be guided by the isolated profit expectations on the route actually entered but typically has to take account of the revenue and profit contribution of the respective passengers over the entire network of the respective airline.

Although the expected profitability certainly is a key determinant of entry, empirical studies have regularly found evidence that abnormal profits are not competed away by entry but remain persistent for longer time periods (see generally Geroski, 1995; Joskow et al., 1994, for the U.S. airline industry). This finding suggests that an entrant also have to answer the question

to what extent entry into a particular market is possible. This finding implies that a positive net present value (which at least outweighs sunk costs) is a necessary but not sufficient condition for entry as barriers to entry can reduce or even eliminate entry incentives. For the U.S. airline industry, commentators leave no doubt that several potentially significant (structural and/or strategic) barriers to entry have developed after deregulation. For example, in a report on ‘Aviation Competition - Challenges in Enhancing Competition in Dominated Markets’, the US General Accounting Office (2001) identified the following operating and marketing barriers, which might constrain new entry into airline markets: Access to airport facilities, such as gates, ticket counters, baggage handling and storage as well as take-off and landing slots; Frequent flyer programs; Corporate incentive agreements; Travel agent commission overrides; Flight frequency; and Network size and breadth.

Given this general reasoning on the determinants of entry in airline markets, the existing empirical research can broadly be separated into two different strands of research. The first group of papers focuses on the estimation of structural models of entry decisions and consists of contributions by Bresnahan and Reiss (1990, 1991), Reiss and Spiller (1989), Berry (1992), Dunn (2008), and Ciliberto and Tamer (2009). For example, Reiss and Spiller (1989) incorporate both entry and price competition in a structural model and investigate competition between differentiated direct and indirect services. They find that the indirect services are significantly more competitive if a direct competitor is also in the market. Dunn’s (2008) study investigates the decision of an airline to offer high-quality nonstop service between cities given that the airline may or may not be offering lower quality one-stop service. Dunn finds that competition with rival one-stop service is an important determinant of non-stop entry (complementary to direct competition between nonstop entrants). The presence of a rival offering one-stop service in the market reduces the probability of entry suggesting that there is competition between one-stop and nonstop entry. Furthermore, Berry (1992) estimates a model of airline entry with heterogeneous firms and finds that an airline’s market share on routes departing from a particular airport is an important determinant of entry into other routes from that airport. Ciliberto and Tamer (2009) build on Berry’s contribution but relax the assumption that entry affects the profitability of competition airlines symmetrically. They are able to show significant heterogeneity in competition between airlines.

The second group of empirical papers follows a reduced form approach

and estimate the likelihood of entry as a function of firm and market characteristics. Starting with the contribution of Sinclair (1995) who focuses on the importance of hub-and-spoke networks for route entry and exit decisions, Boguslaski et al. (2004) estimate a model of city-pair entry for Southwest Airlines using data from 1990 to 2000. In addition to a quantification of the market characteristics which have influenced Southwest's entry decisions, the authors find evidence that Southwest's entry strategies have changed significantly throughout the decade. Furthermore, the study by Lederman and Januszewski (2003) estimates a reduced form model of entry into airport-pair markets. The authors assume that an airline starts operating a route as soon as the incremental profits - depending on demand, cost and expected competitive characteristics of the route - from serving that route are positive. The model then explains entry as a function of the respective airline's own characteristics and the characteristics of all actual and potential competitors on the route. The probit estimations with a dataset for the U.S. domestic airline industry between 1996 and 2000 provide some evidence consistent with the hypothesis that low cost carriers may aim at expanding the variety of products in order to soften competition. Interestingly, Lederman and Januszewski (2003) conclude that in order to be successful, low cost carriers must either offer a differentiated product (i.e. enter new markets in the terminology of this paper) or alternatively providing products similar to existing ones but at lower prices (i.e.. entry into existing markets in the terminology of this paper).

3 Background: The market entry and growth of JetBlue Airways

Given the review of existing studies on the determinants of entry, this section narrows the view down to the market entry and growth of one particular airline: JetBlue Airways. The unique position of JetBlue Airways as the only significant and successful entrant in the domestic U.S. airline industry in the last decade justifies such a detailed investigation of its determinants. Before we present our econometric approach in section 4 (which concentrates solely on the role of network construction in explaining the success of JetBlue Airways), this section aims at providing some general background information on the market entry and growth of JetBlue Airways. In particular, after

a brief general characterization of JetBlue Airways in the following section 3.1, the subsequent section 3.2 focuses on the presentation and discussion of descriptive evidence on the entry pattern of JetBlue Airways.

3.1 A brief characterization of JetBlue Airways

JetBlue Airways was founded by David Neeleman in February 1999 under the name 'NewAir'. Neeleman as well as several of JetBlue's key executives were former Southwest employees. In September 1999 the airline was awarded 75 take-off and landing slots at New York's JFK airport, followed by the granting of formal U.S. authorisation in February 2000. JetBlue started operations on 11 February 2000 with services from New York JFK to Buffalo and Fort Lauderdale, rapidly extending its route network in the following years. In December 2009, the network included 60 destinations in 21 U.S. states, complemented by destinations in eleven countries in the Caribbean and Latin America. JetBlue operates a base at New York's JFK airport, and has developed focus city⁴ operations in Boston, Orlando, Fort Lauderdale, Long Beach, and San Juan (Puerto Rico). In 2004, JetBlue transported about 11.6 million passengers on U.S. domestic flights. This number increased to about 20 million passengers in 2009 - a share of about 3 percent of all domestic passengers - making JetBlue the 10th largest airline in the United States.⁵ Despite the rapid growth of JetBlue in partly difficult periods of the U.S. economy, the airline realized an overall net income of \$201 million (after subtracting the net losses experienced in four of the ten business years⁶).

Although JetBlue is usually classified as low cost carrier, its business strategy has certain peculiar characteristics. First, the airline provides high quality service in several important service dimensions such in-flight entertainment, and pre-assigned leather seats with more legroom. Second, JetBlue does not only concentrate - like most other low cost carriers - on short- and medium-haul markets, but also enters long-haul markets typically only offered by the network carriers. Third, although considered as a low cost carrier, JetBlue has recently started to enter alliance agreements with foreign

⁴A focus city is typically defined as a location that is not a hub, but from which the airline has non-stop flights to several destinations other than its hubs.

⁵Data source: Bureau of Transportation Statistics at <http://www.transtats.bts.gov/carriers.asp> (accessed on 22 March 2011).

⁶The net losses were realised in 2000 (USD 21 million), 2005 (USD 20 million), 2006 (USD 1 million) and 2008 (USD 76 million). For the raw data, see <http://www.transtats.bts.gov/> (accessed on 22 March 2011).

and domestic network carriers such as Aer Lingus and Lufthansa (code-share agreements) or American Airlines (interline agreement).⁷ JetBlue is considered a likely future member of one of the three large global airlines alliances: Star, SkyTeam and oneworld.⁸ Despite its rather unconventional business strategy, a quick look at the cost side of JetBlue reveals that it actually is a 'low cost' airline. While the network carriers show average costs of 10.96 cents per available seat mile (ex fuel), the average value for the low cost carrier group drops to 7.06 cents. In 2009, JetBlue had average costs of 6.62 and therefore clearly below even the average cost level in the group of low cost carriers.⁹ Complementary to the low cost-low fare approach, JetBlue offers a high quality product as confirmed, e.g., by the Airline Quality Rating (AQR) Scores¹⁰, which always show a top rank for JetBlue Airways in both the entire group of major airlines, and the sub-group of low cost airlines since its first appearance in the rating in 2003.

3.2 Patterns of entry by JetBlue Airways

Given the brief general characterization of JetBlue Airways as a rather untypical low cost carrier, this section narrows the focus down to the patterns of entry by JetBlue Airways. As a starting point for such a discussion, Figure 1 provides an overview of the entry activities of JetBlue Airways between 2000 and 2009.

In the left chart of Figure 1, the number of market entries by JetBlue Airways between 2000 and 2009 is plotted. In addition to the respective overall numbers, the chart also provides a differentiation between market entries in existing markets (i.e., markets which were already operated by another airline when JetBlue Airways entered) and market entries in new markets (i.e., markets which have not been operated by another airline in the year prior to the entry of JetBlue Airways). As shown in the chart, overall entry activity by JetBlue Airways has been substantial. Between 2000 and

⁷See <http://www.jetblue.com/about/ourcompany/lufthansa/> for a detailed characterisation of the agreement with Lufthansa (accessed on 22 March 2011).

⁸Since Lufthansa acquired a 19 percent stake in JetBlue in December 2007, Star Alliance is the most likely choice.

⁹Data source: US DOT Form 41 via BTS, Schedule T2 & P6 & P52.

¹⁰The AQR is a common method of comparing airline quality on combined multiple performance criteria. AQR scores for the calendar year are based on 15 elements in four major categories of airline performance: On-time performance (OT), denied boardings (DB), mishandled baggage (MB) and customer complaints (CC). The AQR is derived by Wichita State University (now in cooperation with Purdue University).

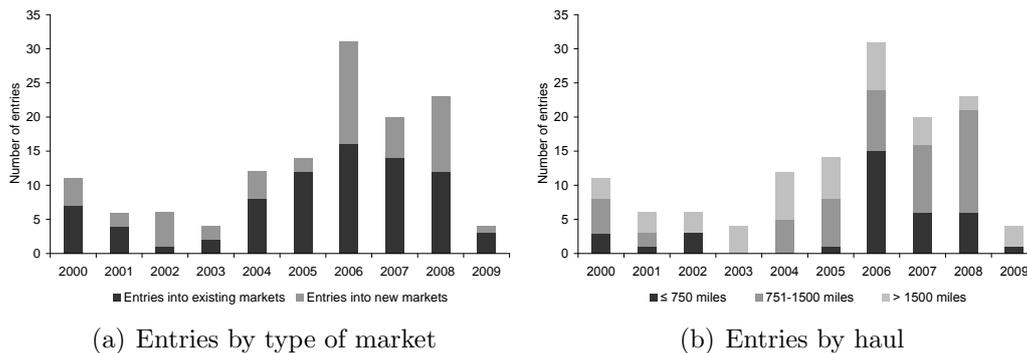


Figure 1: Entry activity of JetBlue Airways (2000-2009)

Source: U.S. DOT, T-100 Domestic Segment Data, authors' calculations

2009, the airline entered 131 domestic markets¹¹ with a clear peak in 2006 where 31 new routes were introduced. As revealed further by the chart, entry into new markets plays a significant role in the business strategy of JetBlue Airways. On average, about 40 percent of all entries created new air routes, with 14 percent in 2005 and 83 percent in 2002 delineating the spectrum. Despite the significance of entry into new markets, in 2009, only 30 percent of the 20 million JetBlue Airways passengers traveled in new markets while the remaining 70 percent flew in existing markets. Furthermore, JetBlue's entry decision have been successful in the sense that the airline only exited from 23 routes out of the total number of routes entries of 131 between 2000 and 2009. 13 of the 23 exits took place in 2008, probably influenced by the unexpected reduction in demand due to economic recession.

Turing from the left chart to the right chart in Figure 1, the number of entries is broken down by length of haul. As shown in the chart, entry activity has been substantial in all three categories. In sum, over the entire sample period, 42 entries (about 32 percent) took place in long-haul markets above 1500 miles, while 53 entries (about 40 percent) were observed in medium-haul markets (751-1500 miles) and the remaining 36 entries (about 28 percent) in short-haul markets up to 750 miles. As further shown in the right chart, there is significant variation in the entry activity of JetBlue Airways. While long-haul routes is the only category that shows entry activity in every year since the birth of JetBlue Airways, short-haul and medium-haul markets

¹¹Non-stop services to unincorporated territories, such as Puerto Rico, are not counted as domestic entries. However, between 2000 and 2009 JetBlue started 11 non-stop services to destinations in Puerto Rico.

show higher absolute peaks (in 2006 and 2008 with 15 entries each).

Additionally, the share of long-haul passengers for JetBlue Airways is significantly larger than for Southwest. Although JetBlue's entry waves in short-haul markets in 2006 and medium-haul markets in 2008 inevitably led to a drop in the share of long-haul passengers from its peak of 36 percent in 2005 to 23 percent in 2009, its long-haul passengers share is still substantially larger than in case of Southwest (8 percent). Although future growth of JetBlue Airways will likely lead to a further convergence - basically because the number of (potentially profitable) long-haul market entries is limited - the focus of JetBlue Airways on long-haul routes in its first years of existence is clearly reflected.¹²

4 Empirical Analysis

Given the review of existing evidence on the determinants of entry in airline markets and the identification of JetBlue Airways as a successful and innovative new entrant, this section aims at investigating the determinants of entry by JetBlue Airways in a rigorous econometric framework. Section 4.1 concentrates on hypothesis development while section 4.2 describes the regression model and section 4.3 the data set. Section 4.4 presents the empirical results separated between entries into existing markets and entry into new markets.

4.1 Hypothesis development

We have identified three main categories of determinants of entry: route characteristics, airport characteristics and demographic characteristics. In the following, we provide motivations for the respective variables in these three categories.

Route characteristics

Five different route-specific variables enter our empirical analysis: Distance, passengers, route HHI, and Chapter 11 route. First, with respect to the

¹²One has to remember that these figures do not include JetBlue Airways routes to Puerto Rico or its international flights to the Caribbean and Latin America which are mostly long-haul.

distance variable, it can be said that although traditionally LCCs focused on short- and medium-haul markets, JetBlue's business strategy has apparently a focus on long-haul routes. We therefore expect that the hazard rate of entry increases with distance. Second, route density was identified as a key determinant of LCC entry in previous studies. We therefore expect that the hazard rate of entry increases with the number of passengers traveling in a certain market. Third, a high route HHI suggests that competition on the respective route is not intensive and the firms might enjoy market power. If there are no barriers to entry, we expect the hazard rate to increase with higher route HHIs. Fourth, a carriers flying under Chapter 11 are often able to take advantage of this status to negotiate hard-to-cut costs with employees, suppliers, and contractors and are therefore able to reduce price. *Ceteris paribus*, we expect that this reduced the profitability of entry and therefore that the hazard rate of entry decreases with one route competitor flying under Chapter 11 protection.

Airport characteristics

Six different airport-specific variables enter our empirical analysis: secondary airport, slot-restricted airport, B6 routes, airport HHI and passenger facility charge (PFC). First, with respect to the secondary airport variable, it is apparent that LCC often use secondary airports as they are cheaper to use, allow shorter turnover times and they increase the likelihood of providing on-time flights. We expect that the hazard rate of entry increases for routes involving a secondary airport. Second, LCC's tend to avoid slot-constrained airports as they are expensive to use, have longer turnover times and reduce the likelihood of delays. We expect that the hazard rate of entry decreases for routes that involve a slot-constrained airport. Third, although LCCs typically focus on point-to-point traffic, it was identified above that JetBlue focuses their operations on a hub and several focus cities. *Ceteris paribus*, we expect that the hazard rate of entry increases for routes that involve one of JetBlue's hub or focus cities. Fourth, LCC's tend to avoid highly concentrated airports as they are expensive to use, have longer turnover times, reduce the likelihood of delays and offers possibilities for strategic behavior of incumbents. We expect that the hazard rate of entry decreases for routes that involve a highly concentrated airport. Fifth, the higher the PFC, the less lucrative is market entry. We expect that the hazard rate of entry decreases for routes that involve an airport with high PFCs.

Demographic characteristics

Three different demographic-specific variables enter our empirical analysis: population, average weekly wage and unemployment. First, with respect to population, the larger the population around a certain airport, the larger is the group of potential customers. We expect that the hazard rate of entry increases with the size of the population. Second, the higher the average weekly wage, the higher is the budget for travel and the larger the proportion of business travelers. We expect that the hazard rate of entry increases with the average weekly wage. Third, the higher the degree of unemployment in a region, the smaller is the possibilities to travel. We expect that the hazard rate of entry decreases with increasing unemployment.

4.2 The regression model

Analyzing the construction of a network does not only involve to investigate the decision to serve a route directly but also to investigate at which point in time the route was entered. Investigating the timing of entry distinguishes our approach from previous studies on the determinants of market entry by low cost carriers (e.g. Boguslaski et al., 2004; Oliveira, 2008; Liu, 2009). A convenient set of models which make it possible to account for the sequence of entry are duration models commonly used in survival analysis, but also suitable for entry analysis (see e.g. Haveman and Nonnemaker, 2000). These models explain the hazard rate $\lambda(t)$. In our case of investigating entries, the hazard rate allows us to approximate the probability of starting to serve a route directly within a short interval of time, conditional on not having entered that route up to the starting time of the interval (see Wooldridge, 2002). Formally, the hazard rate for market i at time t is given by

$$\lambda_i(t) = \lim_{h \rightarrow 0^+} \frac{P[t \leq T_i < t + h | t \leq T_i]}{h},$$

whereas T_i denotes the duration between the foundation of JetBlue in the fourth quarter of 1999 and the quarter when entering market i .

To estimate the effect of certain time-constant \mathbf{x}_i and time-varying covariates \mathbf{z}_{it} on the hazard rate, we use a proportional hazard model, expressed by

$$\lambda_i(t|\mathbf{x}_i, \mathbf{z}_{it}) = \lambda_0(t) \exp(\mathbf{x}'_i \boldsymbol{\beta}_x + \mathbf{z}'_{it} \boldsymbol{\beta}_z).$$

As the baseline hazard $\lambda_0(t)$ ¹³ is time-dependent, but not influenced by the covariates, each market has the same baseline hazard of entry. Because of that, comparing market i to market m , one obtains from the model

$$\frac{\lambda(t|\mathbf{x}_i, \mathbf{z}_{it})}{\lambda(t|\mathbf{x}_i, \mathbf{z}_{mt})} = \frac{\exp(\mathbf{x}'_i\boldsymbol{\beta}_x + \mathbf{z}'_{it}\boldsymbol{\beta}_z)}{\exp(\mathbf{x}'_m\boldsymbol{\beta}_x + \mathbf{z}'_{mt}\boldsymbol{\beta}_z)},$$

which is called hazard ratio.

From the formulation of the hazard rate it is easy to see that for a binary covariate x_k shifting from zero to one the hazard ratio is

$$\frac{\lambda(t|\mathbf{x}_i, \mathbf{z}_{it}, x_k = 1)}{\lambda(t|\mathbf{x}_i, \mathbf{z}_{it}, x_k = 0)} = \frac{\exp(\mathbf{x}'_i\boldsymbol{\beta}_x + \mathbf{z}'_{it}\boldsymbol{\beta}_z + 1 \cdot \beta_k)}{\exp(\mathbf{x}'_i\boldsymbol{\beta}_x + \mathbf{z}'_{it}\boldsymbol{\beta}_z)} = \exp(\beta_k),$$

which gives the coefficients an easy interpretation. For a binary covariate x_k shifting from zero to one the hazard increases by $\exp(\beta_k) - 1$. The same interpretation applies for a discrete change of a covariate by one unit. As a semi-parametric estimation method proposed by Cox (1972) imposes no restrictions on the shape of the baseline hazard and therefore allows the baseline hazard to be as flexible as possible, Cox regression is used for the analysis.

4.3 Data and Descriptive Statistics

For conducting our empirical analysis we combined data from several sources. First, we used the U.S. Department of Transportation (U.S. DOT) DB1B Market Origin and Destination Survey to identify a sample of possible routes JetBlue Airways might enter. All routes which are served at least at via two-stops qualify for potential non-stop entry.

Second, we add information on population, average income, and unemployment of the respective Metropolitan Statistical Areas from the U.S. Census Bureau and the Bureau of Labour Statistics. In all our estimations, we restrict the sample to routes which connect the 200 largest Metropolitan Statistical Areas (MSA).

In our regressions we aim to explain network development in general and to distinguish between non-stop entries which result into a non-stop connection which had not exist in the quarter before (entry into new markets)

¹³The baseline hazard is the hazard rate of observations with zero covariates. The covariates shift the baseline hazard multiplicatively.

and non-stop entries which took place in markets which have been served directly by another carrier (entry into existing markets). For entry into new markets we identified all routes which are *only* served via one- or two-stop connections.

We distinguish these routes into routes which are not served directly but via one- or two-stop connections and into routes which are served directly by at least one other carrier. This approach allows us to explain network development generally and to distinguish between entry into new markets and entry into existing markets. Routes which are served directly by at least one other carrier are included in the regressions when investigating non-stop entry into existing markets.

We use traffic data from the U.S. DOT in order to identify non-stop market entry of JetBlue Airways and to construct some of our explaining variables. More precisely, we use the T-100 Domestic Segment database for the period from 2000 to 2009. This data set contains monthly domestic non-stop segment data reported by U.S. air carriers when both origin and destination airports are located within the boundaries of the United States and its territories. We used T-100's information on origin, destination, available capacity, number of departures, and number of passengers for each of the major carriers¹⁴ to construct a quarterly panel data-set of non-directional non-stop route airport-pair markets. We dropped airline-route observations with less than 12 quarterly departures and airline-route observations which were only served one quarter between 2000 and 2009. An entry event of JetBlue Airways is determined by the quarter when we first observe the airline providing non-stop scheduled services. Furthermore, we were able to construct some of the airport characteristics such as airport concentration, the number of routes JetBlue already serves from an airport, or the airport's passenger share from the T-100 data. Data on passenger facility charges collected by airports was retrieved from the Federal Aviation Administration (FAA).

Non-stop entry is explained by route characteristics, airport characteristics, and MSA characteristics. Distance is measured as the non-stop distance

¹⁴The T-100 data set also includes traffic data for regional carriers who support the major airlines. Although most of these typically small carriers are legally independent, their economic existence is often tied to a large network carrier. For example, in most instances, regional carriers do not issue their own tickets but refer to the network carrier for all flight bookings. For our analysis, regional carriers are merged to the respective major carrier for which they operate on a specific route.

in 100 miles. Existing market demand is approximated by total passengers. As described in section 4.1, we also account for market concentration (*Route HHI*), low-cost carrier competition (*LCC*), and cost advantages of competitors which fly under chapter 11 protection (*Chapter 11 route*). With regard to airport characteristics, we include a dummy variable which becomes one if one of the airports is a secondary airport (*Secondary airp.*), a dummy variable which becomes one if one of the airports is slot constrained (*Slot restr. airp.*), and a dummy which becomes one if one of the airports is not a major hub (*Non-HUB*). Furthermore, we include the number of routes which Jet-Blue serves directly (*B6 routes*), the passenger facility charge (*PFC*), and concentration (*Airp. HHI*) at the respective airport. To capture city characteristics the number of inhabitants (*Population*), average income (*Income*), and the unemployment rate (*Unempl.*) is included. A summarizing table which explains how all variables are constructed can be found in Table 1. Descriptive statistics are provided in Table 2.

Table 1: Description of variables

Variable	Description
<i>Route characteristics</i>	
Distance	Non-stop distance in 100 miles
Passengers	Sum of passengers (in thousands) in the previous period (DB1B)
Route HHI	Route HHI in the previous period (DB1B)
Chapter 11 route	At least one Chapter11-airline serves the route
LCC comp.	Number of other low-cost carrier serving the market
<i>Airport characteristics</i>	
Secondary airp.	At least one airport is a secondary airport
Slot restr. airp.	At least one airport is slot-restricted
B6 routes	JetBlue routes from the airports in the previous period (Mean)
Airp. HHI	HHI at the airports in the previous period (Mean)
Non-HUB	Airport's passenger share below 0.25 percent (at least one of the airp.)
PFC	Passenger Facility Charge (Mean)
<i>City/MSA characteristics</i>	
Population	Population estimate in Mio (Mean)
Income	Average weekly wage in 1995 USD (Mean)
Unempl.	Unemployment rate (Mean)

Table 2: Summary statistics

Variable	All markets		One- or two-stop markets		Existing non-stop markets	
	Mean	Std. D.	Mean	Std. D.	Mean	Std. D.
Route characteristics						
Distance	11.094	7.558	11.632	7.724	8.432	6.005
Passengers	8.763	28.352	2.143	3.962	41.573	58.450
Route HHI	55.581	24.712	54.691	25.116	59.990	22.084
Chapter 11 route	0.326	0.469	0.372	0.483	0.101	0.301
LCC comp.	0.310	0.614	0.222	0.513	0.746	0.845
Airport characteristics						
Secondary airp.	0.201	0.401	0.200	0.400	0.205	0.404
Slot restr. airp.	0.069	0.254	0.049	0.216	0.169	0.375
B6 routes	0.630	1.940	0.567	1.890	0.938	2.145
Airp. HHI	37.258	14.730	37.334	14.979	36.878	13.425
Non-HUB	0.781	0.414	0.872	0.334	0.330	0.470
PFC	3.400	1.044	3.375	1.045	3.526	1.030
City/MSA characteristics						
Population	2.382	2.621	2.089	2.478	3.832	2.820
Income	576.107	75.723	565.377	71.114	629.290	75.424
Unempl.	5.270	1.585	5.264	1.584	5.299	1.585
Observations	420,219		349,670		70,549	

Source: U.S. DOT T100 Market Segment and DB1B Origin and Destination Survey, U.S. Census Bureau, Bureau of Labor Statistics, authors' calculations.

4.4 Empirical Results

Our estimation results are presented in Table 3. We first report results for the entire sample, and then we break the sample into cases of entry into new and existing markets. The distinction between the two types of markets is simple: new markets correspond to airport pairs that had no non-stop service before entry of JetBlue (such as New York JFK - Long Beach route); whereas existing routes are markets where other airlines were present before JetBlue showed up. Note that of 124 entries covered by our data analysis, 45 were new entries, and 79 are classified as entries into existing routes.

The following four factors appear in all three regressions reported in Table 3 as robust predictors of JetBlue's entry decisions. First, JetBlue was more likely to enter more concentrated airport-pair routes. Holding other variables constant, the hazard of entry increases by about 20 percent if the route's HHI increases by 10 percentage points. This result is very intuitive - other things equal, more concentrated markets are likely associated with higher profits, which invite entrants. On the other hand, the carrier shied away from concentrated airports. Comparing the magnitudes of the two coefficients, we see that airport concentration appears as a very strong entry deterrent. For instance, comparing the effect of a decrease in airport concentration¹⁵ with that of an otherwise equal increase in route concentration¹⁶; we see that the former is considerably more likely to attract entry by JetBlue than the latter. This figure is based on results for the entire sample. Next, JetBlue is apparently more likely to enter a route, if the carrier is present at both endpoint airports. If JetBlue serves one more non-stop route from each of the endpoint airports, the hazard of entry increases by 24 percent ($= \exp(0.216) - 1$). This is understandable as a significant sunk investment into airport facilities, marketing etc. is necessary to start off a new airport presence. Finally, effect of population on the likelihood of entry is also robust and significant in all specifications.

With respect to other variables, we observe the following effects on entry. Distance exhibits significant effect in the entire sample, and for entries into existing markets. Consistent with what is believed about JetBlue's strategy, the carrier is more likely to enter longer-haul routes already served by its competitors.

¹⁵A one percentage point decrease in the mean airport HHI increases the hazard of entry by 9.2 percent

¹⁶A one percentage point increase in the route's HHI increases the hazard by 1.7 percent

Table 3: Cox Regressions on non-stop entry

Variables	All non-stop entries		Non-stop entry into connecting markets		Non-stop entry into existing non-stop markets	
	coeff.	s.e.	coeff.	s.e.	coeff.	s.e.
Route characteristics						
Distance	0.277***	(0.064)	0.089	(0.088)	0.407***	(0.083)
Distance ²	-0.008***	(0.002)	-0.003	(0.003)	-0.011***	(0.003)
Passengers	-0.000	(0.001)	0.056***	(0.017)	0.000	(0.002)
Route HHI	0.017***	(0.005)	0.018**	(0.009)	0.018***	(0.007)
LCC comp.	-0.180	(0.136)	-0.304	(0.278)	-0.366**	(0.172)
Chapter 11 route	-0.621**	(0.282)	-0.428	(0.485)	-0.873**	(0.424)
Existing market	1.086***	(0.311)				
Airport characteristics						
Secondary airp.	0.559**	(0.225)	1.406***	(0.421)	0.159	(0.294)
Slot restr. airp.	-0.963***	(0.328)	-0.743	(0.594)	-0.915**	(0.409)
B6 routes	0.216***	(0.021)	0.229***	(0.037)	0.213***	(0.025)
Airp. HHI	-0.097***	(0.013)	-0.057***	(0.021)	-0.118***	(0.016)
Non-HUB	-1.317*	(0.708)	-1.416	(0.952)	1.437	(1.322)
Airp. HHI × Non-HUB	0.009	(0.023)	0.005	(0.027)	-0.083	(0.059)
PFC	0.116	(0.136)	0.029	(0.188)	0.269	(0.212)
City/MSA characteristics						
Population	0.190***	(0.038)	0.167***	(0.061)	0.186***	(0.052)
Income	0.004***	(0.001)	0.004	(0.002)	0.004**	(0.002)
Unempl.	-0.359**	(0.169)	-0.238	(0.271)	-0.514**	(0.234)
Observations	420,219		349,670		70,549	
Markets	13,052		11,800		2,583	
Entries	124		45		79	
Log-likelihood	-845.2		-302.8		-440.3	
χ^2	599.6		208.0		302.6	

Notes: *** p<0.01, ** p<0.05, * p<0.1, standard errors in parentheses. Interval censoring is accounted for using the Efron approximation.

Source: U.S. DOT T100 Market Segment Data, U.S. DOT DB1B Origin and Destination Survey, U.S. Census Bureau, Bureau of Labor Statistics, authors' calculations.

Marginal effect of distance is decreasing, as evidenced by the negative coefficient on distance squared. The marginal effect becomes negative for distances above 1731 miles. The effect is mainly driven by entry into existing non-stop markets since the effect is not statistically significant for entry into connecting markets. For entry into existing non-stop markets, the turning point of the effect lies at 1850 miles. Number of passengers served on the market predicts entry into new routes, but not into existing markets. This result simply implies that JetBlue did its homework to identify markets with many connecting passengers (traveling with one or two stops en route), and without non-stop services. Presence of other low-cost carrier(s) serves as an important deterrent for entry into new markets. JetBlue also has tried to avoid routes, served by the airlines under Chapter 11 bankruptcy protection. This result appears counter-intuitive at first: routes served by financially distressed airlines sound like a good target to pursue. However, Busse (2002) showed that airlines under financial strain are more likely to initiate price wars. It is possible that this is what has kept JetBlue away from those markets.

Interestingly, support for the commonly accepted wisdom that low-cost carriers tend to choose secondary airports appears mixed. It is true that the carrier is more likely to choose secondary gateways when entering new markets; however, the corresponding coefficient is not significant for regression analyzing the carrier's entry into existing routes.

Coming back to the issue of airport concentration, the negative relationship between airport HHI and the likelihood of entry could have two explanations. First, we could interpret this result as implying that JetBlue tries avoiding hub airports, which tend to be concentrated. The second explanation relates to economies of scale: airports located in smaller metropolitan areas might only sustain limited services, and end up being monopolized by a single airline, feeding traffic from the airport to its hub. The airline operating the nearest hub will then end up as a dominant carrier in such small gateways. To account for this possibility, we have included non-hub airport dummy, and interacted that dummy with the airport HHI. To identify non-hub airports, we have used the Federal Aviation Administration's classification: non-hub airports are defined as airports serving more than 10,000 but less than 0.25 percent of entire domestic passenger traffic annually. Our results provide very little support to contention that effect of airport concentration on entry is specific to airports of certain size.

Last but not least, our results show expected effect of demographic variables on entry, even though the corresponding coefficients are not always significant.

With respect to implication of our results for entry barriers in the airline industry, we can say the following. First, the fact that JetBlue focused on secondary airports establishing new non-stop service indicates that it avoided direct confrontation with the network carriers. The other important finding is that JetBlue was more likely to enter routes, if it was already present at both endpoint airports. Collectively, the two results imply that airport presence itself may be an important entry barrier, consistent with Berry (1990). Not only airport presence itself, but also extent of this presence is a defining factor, as clearly evidenced by the relationship between airport HHI and likelihood of entry. As for the route-level entry barriers; the identity of your competitors apparently matters a lot. We find some evidence that JetBlue avoided routes, where it would have to compete with the low-cost and currently financially distressed carriers. This suggests that the carrier evaluated the likely post-entry competition when making entry decisions.

5 Conclusions

In the last decade, the domestic U.S. airline industry has experienced a substantial consolidation trend. In addition to a number of high level mergers, several smaller carriers had to leave the industry. The only countervailing force of this development has been the entry and growth of JetBlue Airways. Since its first market appearance in February 2000 until the end of 2009, the low cost airline managed to build up a route network with 60 destinations in 21 U.S. states and transported about 20 million passengers (in 2009) making it the 10th largest airline in the United States. Furthermore, despite its rapid growth, JetBlue Airways still managed to realize an overall net income of about USD 200 million, and therefore belongs to the small group of profitable airlines.

Against this background, we analyze the factors that have driven JetBlue's entry decisions, from incept to the present day. Data analysis shows that this carrier has been entering longer-haul thicker and more concentrated routes; previous airport presence also affected entry positively. We also find that, when establishing new non-stop service between airport pairs, JetBlue

focused on secondary airports, thereby avoiding direct confrontation with the network carriers. Looking at the entry into airport pairs, where JetBlue faced incumbent competitor(s), we conclude that the carrier avoided concentrated airports, as well as routes serviced by the carriers under bankruptcy protection. There is also evidence that JetBlue avoided direct competition with other low cost carriers.

In addition to developing our understanding of low-cost carriers, this study addresses the issue of the nature of entry barriers in the important and visible airline industry. Our findings point to airport dominance as a significant impediment to entry. We also find that apparent entry deterrence effect of airport dominance is not limited to hub or large airports. Further, airport dominance deters entry in both markets where incumbents are present and on new non-stop routes. This suggests that network carriers are able to use their airport dominance to prevent an entrant from establishing a network with a hub at a different airport. At the same time, JetBlue's reliance on secondary airports, along with some evidence that the airline avoided other low-cost players, hints at the necessity for the entrants into the airline industry to differentiate their product as much as possible.

Given our empirical results, it can be said that successful entry in the U.S. airline industry is still possible as long as the respective entrant understands the key industry characteristics and growth needs and is able to position itself taking into account its relative strengths and weaknesses. The case of JetBlue Airways has especially shown that significant structural and strategic entry barriers can be overcome by a combination of entry in existing and new markets driven by an innovative general business strategy. From a welfare perspective, it is very likely that consumers gain substantially from the existence and growth of JetBlue Airways through substantial reductions in fares. In order to keep and further extend these benefits, antitrust authorities are not only well advised to monitor the industry to identify potential forms of anticompetitive behavior by incumbent firms but they should especially be skeptical with respect to any initiative of network carriers to acquire or merge with JetBlue Airways. Given the efficiency and significance of JetBlue Airways it is very likely that losing this 'maverick firm' would cause substantial anticompetitive effects on many U.S. domestic routes. From a more general perspective, our results suggest that the art of successful firm entry in industries with multiple markets includes both facing competition by incumbents and exploring new markets. Although new firms are well

advised to differentiate their products in order to reduce competitive pressure, successful entry cannot avoid overcoming entry barriers and competing with incumbents directly. Following the famous methodology of Paul Geroski (1991, 1995), industries which demand multiple entries in different markets therefore are a nice example for the importance of both imitative entry in existing markets and innovative entry in new markets. Independent of an answer to the question which type of entry is more important for the economy, consumers will surely profit from both types of entry.

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