Financial distress, survival network design and airline pricing: an events study of a merger between a low cost and a full-service carrier

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Abstract

This paper develops an events study to investigate the price effects of the acquisition of a financially distressed full-service carrier by a low-cost airline in Brazil. We account for the bankrupt carrier's survival network design strategies pursued during reorganization that may be a source of sample selectivity bias. Additionally, as rivals' pricing could be aimed at driving the distressed carrier out of the market, we treat distress as endogenous. Our results uncover permanent price reductions induced by the merger, shedding light on the role of bankruptcy protection in the airline industry.

Keywords: airlines; bankruptcy; merger; sample selection; network design; econometrics.

JEL Classification: D22; L11; L93.

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1. Introduction

Airline bankruptcies still remain a major concern for regulators, governments, and the traveling public. Recent collapses in the United Kingdom and Germany constitute evidence that the risk associated with an abrupt cease of operations by a bankrupt carrier - which may leave in some cases hundreds of thousands stranded passengers - represents a serious issue for authorities. Additionally, in case of international passengers, governments may have to make notable disbursements to cover repatriation costs.[1]

In the aftermath of major bankruptcies in recent years in the USA, the airline industry of that country has witnessed intense consolidation and, as some European airline executives have suggested, the same is expected to occur in Europe.[2] Concerns of market entry restrictions due to reduced access to takeoff and landing slots at congested airports together with downgraded service quality and higher fares, on the other hand, presents authorities with yet another challenge. Faced with the choice of approving an anticompetitive consolidation or allowing for the withdrawn from the market of the failing firm's assets, the US Department of Justice's merger guidelines advice for the former. So far, however, available empirical results associated with this issue have arisen solely from research devoted to consolidation effects (Kim & Singal, 1993; Peters, 2006; Hüschelrath & Müller, 2014), with no attention being given to differing circumstances to which the failing-firms were subjected to - particularly, the degree of deterioration of their financial health.

In face of that, we aim at contributing to the existing literature by addressing the following research question: "What are the effects of the extent of a company's financial distress as well as the events of its bankruptcy filing and its subsequent acquisition on both its own and on its rivals' average prices?." We treat financial distress as endogenously determined with airfares, motivated by the contention that low market prices may drive firms into financial distress, while the latter may induce the bankrupt firm towards an aggressive pricing behavior and a spiral of price responses by rivals.[3] Price responses in this context may be motivated by a goal of either

[1] "*Airlines body eyes bankruptcy law review to reduce stranded passengers*" - Reuters, Feb. 9, 2018.

[2] "*European airline CEOs see further consolidation*" – Air Transport World, Mar. 7, 2018.

[3] This possible reverse causality relation is discussed in Peters (2006) and addressed in Phillips & Sertsios (2013). Busse (2002), who investigates the effects of a company's financial distress on its propensity to engage in price wars, handles a similar endogeneity issue.

keeping the existing market shares or even completely driving the bankrupt carrier out of the market.[4]

Prior research has found evidence of considerable network reductions made by bankrupt carriers, specifically in periods prior to their filings (Lee, 2009; Ciliberto & Schenone, 2012), corroborating the hypothesis that distressed companies are compelled to selectively reduce their networks, allocating its resources in its most profitable routes to improve their financial condition. These survival network design strategies, however, may come at a cost, since reductions in its number of destinations may negatively affect these companies' network attractiveness to customers while also impairing their competitive advantages – arising, for example, of lower costs associated with economies of scope and density. Regarding the bankrupt carrier's rivals, on the other hand, these strategies may prove to be an unambiguous signal of weakness, making it an easier prey. We suggest that rival airlines, once aware of these network adjustments, may respond more aggressively in prices on routes which they perceive as having a greater probability of exit from these distressed carriers.

We employ Brazilian air transportation data corresponding to the period between 2002 and 2009, including the events of the bankruptcy of the full-service airline Varig in 2005 and its acquisition by low cost carrier Gol Linhas Aéreas in 2007.[5] The sample period accounted for being free from terrorist attacks, economic recessions, mergers between other airlines or companies under bankruptcy protection,[6] together with the reasonable time interval between the bankruptcy filing and the acquisition events, constitute an interesting market environment for the investigation of their isolated effects. Moreover, separate econometric models for the distressed company's and its rivals' airfares are considered, in order to inspect any systematic differences in the competitive behavior and market incentives between the bankrupt airline and its competitors.

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[4] Discussions concerning financial distress as a consequence or a cause of price competition can also be found in Barla & Koo (1999) and Hofer *et al*. (2009).

[5] Fageda and Perdiguero (2014) also study the issue of mergers between low cost carriers and full-service carriers.

[6] Brazil's New Bankruptcy Law was sanctioned in February 2005, establishing the judicial reorganization institute and superseding the *concordata*. Based on the U.S. Chapter 11, the judicial reorganization institute introduces the figures of the debtor in possession and the automatic stay, in addition to the approval by the company's creditors of the proposed recovery plan. Despite distressed carrier Vasp being present during the analyzed period, the company had its last regular flights reported by ANAC in November 2004, providing a sufficient time window for the isolation of the effects of Varig's bankruptcy protection, which was filed in June of 2005.

Our study therefore makes three main contributions: (1) we develop a unifying framework to investigate the effects on airfares of a company's financial distress and both its bankruptcy filing and acquisition events in one econometric framework. (2) We explicitly account for the possible endogenous relationship between the distressed company's financial condition and its rivals' airfares. (3) Moreover, given the survival network design strategies undertaken by the distress company in response to changes in its financial condition, we extend the previous literature by considering a model that accounts for nonrandom, bankruptcy-related, route assignment adjustments that may bias the obtained estimates.

The remainder of this paper is organized as follows. Section 2 reviews the existing literature regarding the effects of bankruptcy filings, financial health and consolidation events on airfares. Results related with network adjustments made by distressed airlines are also considered. Section 3 specifies our research design, with the data set, the development of our empirical model and the estimation strategy employed being presented. The estimation results are evaluated in Section 4, along with robustness checks. Summary and conclusions are provided in the last section.

2. Conceptual framework

In this section, we review the major findings relating pricing behavior with bankruptcy filings (2.1), financial distress (2.2) and mergers and acquisitions (2.3). Additionally, we present some considerations regarding network adjustments made by distressed carriers and how these survival strategies can affect airline pricing models and their estimates (2.4).

2.1. Effects of bankruptcy filings on airfares

Results related with the effects of a bankruptcy on the company's own airfares have shown consistent evidences of reductions in the periods preceding and during the bankruptcy filings (Borenstein & Rose, 1995; Barla & Koo, 1999; Hofer *et al*., 2005; Lee, 2009; Ciliberto & Schenone, 2012), although some ambiguity regarding the following periods has persisted. The findings of Borenstein & Rose (1995) and Ciliberto & Schenone (2012), on one hand, suggest this period being followed by increases in airfares, while the works of Hofer *et al*. (2005) and Lee (2009), on the other, indicate airfare reductions.

Concerning the effects of bankruptcies on rivals' airfares, studies such as Lang & Stulz (1992) have suggested that in the presence of information asymmetry, filing for bankruptcy could serve as an unambiguous signal of a company's financial vulnerability, making the period associated with the said event more prone to predatory behaviors by their financially sound counterparts, given the limitations of the bankrupt company in financing a price war, with similar arguments being found in Borenstein & Rose (1995) and Barla & Koo (1999). Nevertheless, consistent empirical evidence supporting those arguments has not yet been found. While Barla & Koo (1999) and Lee (2009) provide evidence of airfare reductions, the results of Borenstein & Rose (1995) point to increases in airfares by the bankrupt's competitors - suggested by the authors as following from the shift of the bankrupt company's passenger demand towards their rivals. Furthermore, Ciliberto & Schenone (2012) did not find robust results in their research.

2.2. Effects of financial distress on airfares

Being the bankruptcy filing a result of a continuous process of deterioration of a company's financial health, Borenstein & Rose (1995) suggested that the degree of financial distress culminating in a bankruptcy filing could be the real reason behind the price reductions observed for the bankrupt company. On this issue, Hofer *et al*. (2005) provide a minor link between the literatures of bankruptcy filings and financial distress by means of a comparison between their effects on the bankrupt company's airfares. Their results support the claim that higher levels of financial distress result in lower prices - consistent with the hypothesis that financially distressed companies need to generate cash in order to meet immediate financial obligations and ensure their long-term survival. Further support to this result is presented in Hofer *et al*. (2009) - who investigate moderating effects of a set of characteristics of firms and markets on this relation – and Hofer (2012) – who considers how this relation changes during a company's turnaround process. Regarding the bankruptcy event, their results corroborate those previously obtained in that literature.

In addition, Phillips & Sertsios (2013) compare the effects of financial distress and bankruptcy on a company's product quality and pricing behavior, finding that an airline's quality decisions are differently affected by each of them. Treating the financial distress and bankruptcy variables as endogenous, their results corroborate Hofer *et al*. (2005) in that they report prices being negatively affected by financial distress. The authors, however, do not find statistically significant results of price changes associated with the bankruptcy relative to the financial distress variable. Moreover, none of these studies (Hofer *et al*., 2005, 2009; Hofer, 2012; Phillips & Sertsios, 2013) pursued the analysis of effects on competitors' prices nor accounted for both the bankruptcy event and the financial distress variable in the same model.

In a similar vein to Lang & Stulz (1992), Borenstein & Rose (1995) and Barla & Koo (1999), Opler & Titman (1994) and Hofer (2012) provide a justification for such an analysis, arguing that a firm's *financial distress* may induce aggressive responses by rivals, seeking to take advantage of the firm's weakened condition to gain its market share. To the best of our knowledge, no previous study of the airline industry has explicitly investigated this relation. Our first hypothesis is therefore the following:

Hypothesis H_1: The financial distress of the bankrupt company negatively affects its rivals' airfares.

2.3. Effects of consolidations on airfares

While a group of studies have suggested positive effects on consumer welfare associated with mergers and acquisitions of airlines, derived specifically from higher frequencies of flights (Bailey & Liu, 1995; Richard, 2013; Vaze, Luo & Harder, 2017), the literature regarding its effects on airfares presents consistent results of price increases. As examples related to the American market, we cite the studies of Borenstein (1990), Werden *et al*. (1991), Kim & Singal (1993), Singal (1996), Morrison (1996), Kwoka & Shumilkina (2010) - which form the body of work associated with merger and acquisition of the 1980s, and the studies of Luo (2013), Hüschelrath & Müller (2013, 2015) and Shen (2017) – which investigate mergers and acquisitions of the 2000s and 2010s. Similar results are also found in the Spanish market by Fageda & Perdiguero (2014) and in the Chinese market by Zhang (2015).

A distinction between the effects on airfares arising from mergers between healthy companies and those involving a company in financial distress is presented in Kim & Singal (1993). Their results suggest that fares much lower than average are exerted by distressed companies in periods prior to their mergers, with fare increases in periods after the event being substantially greater than those practiced after mergers between healthy companies. The authors further observe the reproduction of this pricing pattern by these companies' rivals. Corroborating those results, Peters (2006) reports sharp increases in airfare values in periods following the acquisition of the distressed carrier People Express by Continental Airlines, while Hüschelrath & Müller (2014), who investigate the merger between bankrupt legacy carrier US Airways and America West Airlines, indicate fare changes made by the resulting company in periods after the merger being matched by their competitors.

Results of Hüschelrath & Müller (2013), while also finding substantial increases in fares on all affected routes immediately after exit events resulting from mergers, report, however, that their values are reduced to those charged prior to those exits in the medium and long-terms, what the authors justify as a result of efficiencies and entry-inducing effects. Similar conclusions are obtained by these authors in a case study published in 2015 concerning the merger between Delta Airlines and Northwest Airlines. However, while three of the mergers in their sample involved a bankrupt firm, the authors did not pursue the investigation of possible differences between these mergers and those associated with financially sound carriers. Based on this strand of the literature, our second hypothesis is presented below.

Hypothesis H_2: In the mid and long terms after a consolidation involving a distressed company, average market prices will decrease as a result of efficiencies and entry-inducing effects.

2.4. Financial distress and network adjustments

Aside from the effects of bankruptcies on airfares, studies such as Lee (2009) and Ciliberto & Schenone (2012) provide results pertaining to the effects of bankruptcies on capacities.[7] In their modeling, they considered these dimensions as regressands separately, with their base model consisting of the same set of regressors. Both studies have suggested significant reductions in the bankrupt carriers' capacities in periods prior to their filings, with lower levels being kept throughout the bankruptcy process. Liu (2009) evaluates the effects of financial ratios - namely, financial leverage and liquidity ratios - on the propensity of distressed carriers to enter new markets. Her results suggest that, as the financial leverage of a legacy company is increased, its propensity to enter new markets is reduced, an evidence not found by the author in the case of LCCs.

The results of the above literature therefore suggest that as the distressed company's financial condition is worsened, its sample of operated markets will be strategically reduced, as the company resources are allocated in its most profitable routes - a survival network design strategy. Moreover, if the company's financial condition is improved, the company will probably prioritize returning its operations to abandoned markets instead of embracing new ones. However, such bankruptcy-related route assignment adjustments pose important challenges to the existing literature on the effects of bankruptcies on airfares. In particular, it

[7] Lee (2009) considers number of seats and fares, while Ciliberto & Schenone (2012) employ, additionally, combinations of airports, number of routes, flight frequencies and load factors.

presents serious generalization issues associated with the nonrandom selection of markets by the bankrupt. Reiss & Spiller (1989), for example, consider the possible existence of unobservable cost and demand variables that affect both the presence and airfare decisions of a carrier. We believe that sample selection may be especially relevant to the case of bankrupt carriers, who are typically forced to constantly reevaluate the markets they participate. We therefore have the following hypothesis:

Hypothesis H_3: The survival network design strategies performed by the distressed carrier produce a self-selection of most profitable routes that affects its own and competing airlines' pricing behaviors.

3. Research design

3.1. Data

Data utilized in this research is publicly made available by the National Civil Aviation Agency (ANAC), the Brazilian Institute of Geography and Statistics (IBGE), the Institute of Applied Economic Research (IPEA) and the Brazilian Securities and Exchange Commission (CVM). The data panel is composed of monthly observations of routes of the Brazilian domestic market comprising the period between January 2002 and June 2009, mostly related with the operation of the carriers Varig, Vasp, Tam and Gol. As can be seen in Figure 1, which presents the market share evolution at the national level of these companies from January 2000 to June 2009, at any given time more than 80% of the market was held by them.

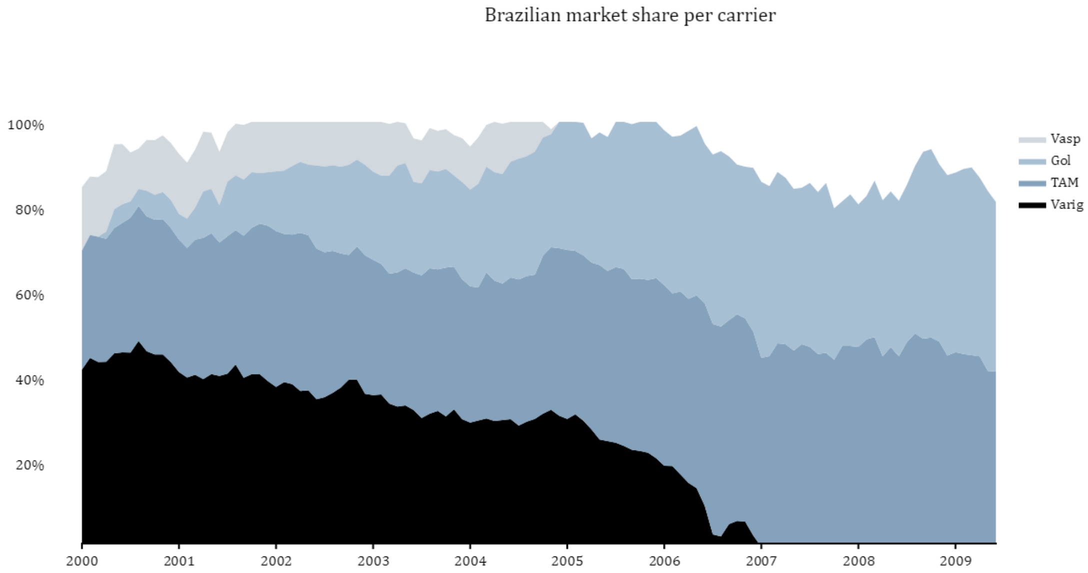

Figure 1 - Market shares of the analyzed companies at the national level

Source: National Civil Aviation Agency, with own calculations, 2000-2009.

Similar to Evans & Kessides (1993) and Barla & Koo (1999), we defined a route as a city pair, which presupposes the aggregation of the traffic from all airports serving a given city. Moreover, in this research we differentiate the direction of a given route, with flights starting from a point *i* towards a point *j* and flights starting from a point *j* towards a point *i* being associated with different markets. The direction is important due to possible variations in the demand conditions between the two endpoints. A similar procedure can be found in Lee (2009). Routes containing on average less than thirty passengers per month in each direction or less than 3 observations with Varig's presence in the period prior to its bankruptcy filing were excluded. Furthermore, we also removed from our analysis routes containing a number of less than 60 observations overall, in order to study the most enduring connections. Thus, a total of 84 markets is analyzed. The panel datasets associated with both the bankrupt carrier's and their rivals' airfares are unbalanced. This follows from market entries and exits observed during the period, although Varig's airfare dataset is further affected by the network reduction promoted by the company. It should be noted that most of these routes are, nevertheless, associated with the 90 monthly observations from January 2002 to June 2009.

Furthermore, we divide the routes into two groups, one containing routes operated by Varig throughout the sample period, the other containing routes exited by the airline during the period of its bankruptcy protection or after its acquisition by Gol. With this, we seek to supplement the analysis of its survival network design strategies, uncovering any differing effect of these events on each of these groups.

3.2. Heckman corrections

As previously discussed, estimates of airfare models may be potentially biased given the bankrupt carrier's nonrandom selection of markets to keep its operations. Similarly, it is conceivable that the company's presence may be correlated with its rivals' unobservable airfare determinants, regardless of the company's financial health or its bankrupt status.[8] This may be justified on the grounds of the presence of one additional competitor influencing its rivals' preferred pricing behavior.

Given the *ceteris paribus* effect of each variable in a regression model, controlling for the effects of a company's presence on its rivals' airfares allows us to make better inferences about the isolated effects of its financial distress and its bankruptcy and acquisition events. We further model this relation as endogenous, since it is possible that rivals' airfares may affect a company's decision to remain in a given route. In this way, the conditional mean of the error term with respect to the regressors - in particular to the bankrupt carrier's presence - can be different from zero. Denoting the bankrupt carrier's presence by *v*, we have Equation 1.

$$E[yield|\boldsymbol{X}, v] = \boldsymbol{X}\beta + E[\epsilon|\boldsymbol{X}, v] \quad (1)$$

In order to account for both of the aforementioned issues - namely, sample selection (in the case of the bankrupt carrier's airfare model) and binary variable endogeneity (in the case of its rivals' airfare model), we employ the procedures proposed by Heckman (1979) and Heckman (1978), respectively. These procedures consist of two stages, with the first one comprising the formulation of a model to estimate the probability of the bankrupt carrier to operate a given route in a given period of time.

Accordingly, we assume that the unobservable determinants of the bankrupt carrier's presence are correlated with the unobservable determinants of both its rivals' airfares and its own airfares. Derived from the assumption that the error terms ϵ and ζ (the unobservable determinants of the rivals' airfares and the company's presence, respectively) follow a bivariate

[8] This concern can be found in Ciliberto & Schenone (2012).

normal distribution and have expected value equal to zero, for the rivals' airfare model, we have Equations 2 and 3:

$$\mathrm{E}[yield|\boldsymbol{X}, v = 1] = \boldsymbol{X}\beta + \rho_{\epsilon\zeta}\sigma_{\epsilon}\lambda(-\boldsymbol{H}\psi) \tag{2}$$

$$\mathrm{E}[yield|\boldsymbol{X}, v = 0] = \boldsymbol{X}\beta + \rho_{\epsilon\zeta}\sigma_{\epsilon}[-\lambda(\boldsymbol{H}\psi)] \tag{3}$$

Where λ is the ratio of the probability density function to the cumulative distribution function of the standard normal distribution, commonly referred as the "inverse Mills ratio" or the "hazard rate" in survival analysis and, from now on, referred to as "hazard." Furthermore, since the variance of the ζ error term is not uniquely identifiable for the *probit* model of the first stage, its value is commonly defined as being equal to "1".

Introduced by Heckman (1978), this procedure is employed in cases where both values of the independent binary variable - *i.e.*, the bankrupt company's presence - are observed. The term $\rho_{\epsilon\zeta}\sigma_{\epsilon}$ is estimated as a new component of the vector β. Thus, the statistical significance of the coefficient $\rho_{\epsilon\zeta}\sigma_{\epsilon}$ implies the existence of an endogenous relationship between the variable v and the unobservable airfare determinants of the company's rivals.

In the bankrupt company's airfare model, only routes where the company is present can be observed. In this case, the correction proposed by Heckman (1979) for sample selection bias is used instead, consisting solely of Equation 2, repeated for convenience in Equation (4).

$$\mathrm{E}[yield|\boldsymbol{X}, v = 1] = \boldsymbol{X}\beta + \rho_{\mu\zeta}\sigma_{\mu}\lambda(-\boldsymbol{H}\psi) \tag{4}$$

In this case, $\rho_{\mu\zeta}$ is the correlation between the unobservable determinants of the company's airfares (μ) and the company's presence, with the statistical significance of the term $\rho_{\mu\zeta}\sigma_{\mu}$ implying the existence of selection bias in the original model, thus testing the validity of $\mathbf{H}_3$.

3.3. Route selection model

Equation (5) presents our route selection model:

$$\begin{aligned}\mathbb{P}\{v = 1|\boldsymbol{H}\} = \Phi(\boldsymbol{H}\psi) = \Phi(&\psi_0 + \psi_1 \ln\left(GDP_{gr}\right) + \psi_2 \ln\left(c_{fuel}\right) + \psi_3 f_{CGH} \\ &+\psi_4 Pres_{LCC} + \psi_5 Pres_{Dtr} + \psi_6 Cshr \\ &+\psi_7 t_{pre-bkt} + \psi_8 t_{bkt} + \psi_9 t_{post-mgr} + \omega_{\ i})\end{aligned} \tag{5}$$

where $\mathbb{P}$ denotes probability measure, $\boldsymbol{H}$ denotes the model's set of regressors, ψ the model coefficients and Φ the cumulative distribution function (CDF) of the standard normal distribution. The presence variable v has route (*i*) and time (*t*) variability. Equation (5) has the following variables:

- v_{it} is a binary variable accounting for the presence of the airline Varig in route *i* and period *t*. The presence of a company is designated by the value 1 in a given route in periods associated with the operation of at least 1 (one) regular flight. Source: Statistical Data Reports of Air Transportation (ANAC), with additional manipulations made by the authors;
- $(GDP_{gr})_{it}$ is a monetary variable defined as the product of the origin and destination cities' GDPs, for a given route *i* in a given period *t*, adjusted by the IPCA deflator to a value comparable to January 2015. For the computation of the GDPs, we consider the entire geographic area of the mesoregion as defined by the Brazilian Institute of Geography and Statistics (IBGE), with São Paulo cities having additional mesoregions. Source: (IBGE).[9]
- ${c_{fuel}}_{it}$ is a monetary variable calculated as the average unit cost of fuel per available seat kilometer (ASK) for all aircraft with designated flights on a given route, adjusted by the IPCA deflator to a value comparable to January of 2015. Source: Unpublished data of costs, expenses and monthly operations disaggregated by type of aircraft and by air carrier (ANAC), data from the VRA database (ANAC), and additional manipulations made by the authors;
- ${f_{CGH}}_{it}$ is a variable differing from zero only on routes containing São Paulo as one of its endpoints. It is calculated as the number of flights associated with the original city pair, having the São Paulo airports replaced with the Congonhas airport, a slotted airport from which Varig held a considerable share of slots. Source: ANAC's database of regular flights(VRA), with additional manipulations made by the authors;
- ${Pres_{LCC}}_{it}$ is a binary variable accounting for the presence of the airline Gol on route *i* and period *t*. Its objective is to control for the existence of an LCC rival. Source:

[9] Due to the annual periodicity of this data, its values were interpolated in order to produce a monthly series.

Statistical Data Reports of Air Transportation (ANAC), with additional manipulations made by the authors;

- ${Pres_{Dtr}}_{it}$ is a binary variable accounting for the presence of the airline Vasp on route *i* and period *t*. Defined in a similar way to the previous variables, it is included to assess the effects of the presence of a distressed rival. Source: Statistical Data Reports of Air Transportation (ANAC), with additional manipulations made by the authors;
- $Cshr_{it}$ is a binary variable assuming the value 1 in city pairs and periods in which the codeshare agreement between TAM and Varig was operationalized. It lasted from March 2003 to April 2005. Source: Secretariat of Economic Monitoring (SEAE) of the Brazilian Ministry of Finance;
- ${t_{pre-bkt}}_{it}$ is an increasing discrete linear variable, differing from zero in periods prior to June 2005;
- ${t_{bkt}}_{it}$ is an increasing discrete linear variable, differing from zero in periods after June 2005 (inclusive) and before April 2007;
- ${t_{post-mgr}}_{it}$ is an increasing discrete linear variable, differing from zero in periods after April 2007 (inclusive);
- $\omega_{\,i}$ denotes route random effects.

The time trend variable was included in order to control for the periods of expansion and contraction of the company's network. This variable is interacted with the period during which the bankruptcy protection was in force and with the post-acquisition period, in order to identify possible moderating effects.

3.4. Airfare models

Given the results of the route selection model, the Hazard variable can be generated, being incorporated as an explanatory variable in the airfare models. We present the model associated with the bankrupt carrier's airfares in Equations (6).

$$\begin{aligned} ln(Y_{bankrupt}) = {} & \beta_0 + \beta_1 ln(c_{fuel}) + \beta_2 ln(HHI_{max}) + \beta_3 ln(PAX) \\ & + \beta_4 Pres_{LCC} + \beta_5 Pres_{VSP} + \beta_6 Cshr \\ & + \beta_8 Dist_{bankrupt} + \beta_9 Hazard \end{aligned}$$

$$+\sum_{q=-3}^{3}\theta_q Kept_{bkt+q} + \sum_{r=-3}^{8}\omega_r Kept_{mgr+r}$$

$$+\sum_{s=-3}^{6}\mu_s Abdn_{bkt+s}$$

$$+\gamma_i + \gamma_t + trend_{origin} + trend_{destination} + \epsilon_{bankrupt} \qquad (6)$$

where the airfare variables have route (i) and time (t) variability. Equations (6) have the following variables:

- ${Y_{bankrupt}}_{it}$ is a monetary variable, used as a proxy for the average price paid by Varig's passengers per kilometer flown, in a given route i and in a given period t, adjusted by the IPCA deflator to a value comparable to January 2015. Source: Intra-regional and inter-regional yield data (ANAC), with additional manipulations made by the authors.
- ${HHI_{max}}_{it}$ is the maximum Herfindahl-Hirschman index between the origin and destination cities of a given route, being employed in this research to control for the market concentration at the airports (or cities, for multi-airport regions). Source: Statistical Data Reports of Air Transportation (ANAC), with additional manipulations made by the authors.
- PAX_{it} is a variable defined by the total number of paying passengers, being disregarded those observations with a value lower than 30 for a given month and routes associated with less than 60 observations overall. Source: Statistical Data Reports of Air Transportation (ANAC), with additional manipulations made by the authors.
- $Financial\ distress_t$[10] is a variable defined as the negative value of Altman's *Z*"-score (2002).[11] This procedure is adopted in accordance with Hofer *et al.* (2005, 2009) and Hofer (2012), in order to facilitate the interpretation of the variable's coefficients in the regression models. The *Z*"-score is defined by Equation (7):

[10] This variable is not directly accounted in our models, due to its lack of variability at the route level. However, the inclusion of time fixed effects in all of the adopted specifications controls for its influences (with the proviso that it cannot be distinguished from other factors varying only in the time dimension).

[11] The Z"-score is a revised version of the Z-score (Alman, 1968), being more suitable for service companies.

$$Z" = (6{,}56)X_1 + (3{,}26)X_2 + (6{,}72)X_3 + (1{,}05)X_4 \quad (7)$$

It comprises the ratio of working capital to total assets (X_1); retained earnings to total assets (X_2); earnings before interests and taxes (EBIT) to total assets (X_3) and book value of equity to total liabilities (X_4). Values higher than 2.6 indicate financial health, with values lower than 1.1 indicating severe financial distress. Source: Quarterly Financial Statements (ITR) of publicly traded companies - made available by the Brazilian Securities and Exchange Commission (CVM) - and data from the Air Transport Yearbook (ANAC).[12]

- $Dist_{banktrupt_{it}}$ is a modified variable.[13] Given the lack of variability of the Z"-score (and consequently the financial distress variable) at the route level, the interaction between Varig's financial distress and its route passengers share is considered. Source: Quarterly Financial Statements (ITR) of publicly traded companies (CVM), data from the Air Transport Yearbook (ANAC) and Statistical Data Reports of Air Transportation (ANAC), with additional manipulation made by the authors.
- $Kept$[14] is a set of binary variables indexed in *i* and *t* utilized to account for the quarterly evolution of the routes operated by Varig throughout the analyzed period. Source: Statistical Data Reports of Air Transportation (ANAC), with additional manipulations made by the authors.
- $Abdn$ is a set of binary variables indexed in *i* and *t* accounting for the quarterly evolution of routes operated by Varig before and during its bankruptcy protection period, but left after the acquisition event. Similarly, the variable accounts for the routes operated before but abandoned after its bankruptcy filing period. In other words, it comprises routes that were abandoned after any of the two events under investigation. Source:

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[12] Due to the quarterly periodicity of this data, its values were interpolated in order to produce a monthly series.

[13] The adopted procedure is based on Lee (2009), who promotes the interaction between the time dummies associated with the periods surrounding the analyzed companies' bankruptcies and their respective market shares on each route. With this procedure, the author seeks to investigate possible differences in the effects generated by these events which are dependent on the degree of exposure of a given route to a bankruptcy.

[14] In this research, we chose to estimate a model distinguishing two groups of routes, *i.e.*, routes kept by Varig after its acquisition and routes abandoned by the company after its acquisition or after its bankruptcy filing, in order to verify the existence of particular effects caused by those events on each of these groups. Further information on the construction of these groups can be found in Section 3.5.

Statistical Data Reports of Air Transportation (ANAC), with additional manipulations made by the authors.

- γ_i denotes route fixed effects; γ_t denotes time fixed effects; $trend_{origin}$ and $trend_{destination}$ are, respectively, the time trends associated with the origin and destination cities and $\epsilon_{bankrupt}$ and ϵ_{rivals} are the disturbance terms. $\beta, \theta, \omega, \mu$ are the unknown parameters.

The rivals' airfare model has the variable Y_{rivals} as its regressand, which is a monetary variable, calculated as the weighted average of the yields of Varig's rivals, having as its weights the companies' respective passenger shares on a route i and at a period t. Similar to the previous variable, it is adjusted by the IPCA deflator to a value comparable to January 2015. Its source is the intra-regional and inter-regional yield data from ANAC, with additional manipulations made by the authors.

Furthermore, additionally to the regressors of the previous model, the rivals' airfare model also encompasses a greater set for the $Abdn$ dummy variables and the $Dist_{rivals_{it}}$ variable, which is defined in a similar way to $Dist_{banktrupt_{it}}$, being expressed by the sum of the products between the route passengers shares associated with each one of Varig's rivals and their respective financial distress variables. For its construction, data from the Quarterly Financial Statements (ITR) of publicly traded companies (CVM), from the Air Transport Yearbook (ANAC) and from the Statistical Data Reports of Air Transportation (ANAC) were employed.

The remaining variables for both models are as described in the route selection model. Descriptive statistics of the distressed carrier's and its rivals' airfare models can be found in Tables 2 and 3, respectively.

Formal hypothesis tests over the estimated coefficients of the set of quarterly dummy variables is utilized to empirically inspect the impact of the bankruptcy filing and the acquisition events. The same procedure is utilized for the estimated coefficients of the $Hazard_{it}$ variable (to inspect the occurrence of sample selection bias and/or endogeneity) and the estimated coefficients of the $Dist_{banktrupt_{it}}$ and the $Dist_{rivals_{it}}$ variables (to inspect the impacts of the extent of financial distress of the bankrupt carrier and of its rivals, respectively).

Table 2 - Descriptive statistics - variables of the distressed carrier's airfare model

Variables		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Pearson's Correlation										
ln Varig's yield	(1)	1.0000								
ln Fuel costs	(2)	0.4332	1.0000							
ln maximum city HHI	(3)	0.0067	0.0444	1.0000						
ln # of Passengers	(4)	0.1012	0.0888	0.2518	1.0000					
LCC presence (Gol)	(5)	0.0035	-0.0593	-0.5487	-0.1637	1.0000				
Distressed carrier presence (VASP)	(6)	0.0058	-0.0114	-0.5280	-0.0526	0.6884	1.0000			
Codeshare	(7)	0.0472	0.0287	-0.2571	-0.0095	0.4638	0.2145	1.0000		
Varig's distress	(8)	-0.0142	-0.1493	-0.4013	-0.3415	0.4249	0.3306	0.2271	1.0000	
Hazard	(9)	-0.2346	0.0835	0.4749	-0.1216	-0.5049	-0.4369	-0.1068	-0.3928	1.0000
Univariate statistics										
Mean		-0.051	-2.298	-1.027	10.023	0.537	0.420	0.269	1.273	0.413
Standard deviation		0.432	0.468	0.154	0.984	0.499	0.494	0.444	1.389	0.467
Minimum		-2.869	-7.344	-1.472	6.851	0.000	0.000	0.000	0.000	0.000
Maximum		1.467	-1.009	-0.280	12.370	1.000	1.000	1.000	8.409	2.354

Table 3 - Descriptive statistics - variables of the rivals' airfare model

Variables		(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Pearson's Correlation											
ln Rivals' yield	(1)	1.0000									
ln Fuel costs	(2)	0.5351	1.0000								
ln maximum city HHI	(3)	-0.1177	0.0450	1.0000							
ln # of Passengers	(4)	0.0822	0.0459	0.0971	1.0000						
LCC presence (Gol)	(5)	0.1463	0.0001	-0.6389	-0.1129	1.0000					
Distressed carrier presence (VASP)	(6)	0.1047	0.0169	-0.6149	-0.0506	0.7743	1.0000				
Codeshare	(7)	0.1914	0.0406	-0.3429	-0.0062	0.5918	0.3856	1.0000			
Own distress	(8)	0.1195	-0.0277	-0.5879	-0.0982	0.6720	0.6459	0.2056	1.0000		
Varig's distress	(9)	0.0648	-0.0748	-0.5585	-0.1634	0.5723	0.5004	0.3172	0.5913	1.0000	
Hazard	(10)	0.0104	-0.0016	-0.0713	0.1693	-0.1102	-0.0853	-0.0594	0.0962	0.0849	1.0000
Univariate statistics											
Mean		-0.389	-2.302	-0.958	9.843	0.389	0.298	0.204	-3.901	0.818	0.008
Standard deviation		0.475	0.424	0.173	0.907	0.488	0.458	0.403	2.659	1.266	0.716
Minimum		-1.746	-7.344	-1.472	6.806	0.000	0.000	0.000	-10.071	0.000	-3.958
Maximum		1.565	-0.787	-0.280	12.370	1.000	1.000	1.000	10.179	8.409	2.354

3.5. Estimation strategy

The presence of variables associated with market concentration and the number of passengers may introduce bias in our estimates, due to established endogenous relationships with respect to the airfare variables. The concern about the endogenous relationship between the number of companies in a given market and its profitability can be found in Berry (1992), with the work of Evans, Froeb & Werden (1993) providing a detailed exposition about the causes and consequences of the endogeneity of market concentration variables with respect to airfares. Regarding the number of passengers, its endogenous relationship arises from the simultaneity of supply and demand (prices influencing demand that, in turn, influences prices). Similarly, we opted for addressing the endogenous relationships between both the bankrupt carrier's and its rivals' financial distress with respect to the airfare variables.[15]

This prompted us to employ an instrumental variable estimator, with our identification strategy consisting of a set of structural, lagged and Hausman instruments (Hausman, 1996). Regarding the Hausman-type instruments, we employed a similar procedure to that presented in Mumbower *et al*. (2014) and Bendinelli *et al*. (2016), with the instrumentation of the endogenous variables of a given route being carried out by the employment of the values of the same variables in different routes, using current or lagged values. This type of instrumentation exploits the panel structure of the data by assuming correlation between the endogenous variable and the instrumental variable through markets, with the instrument being uncorrelated with local unobservable shocks to which the endogenous variable may be subjected. The structural instruments consist of demand shifters, commonly used to identify variables in price models, which are expected to influence the variables of market concentration, number of passengers and/or the extent of financial distress.

Our set of instruments comprises (1) variables associated with the *origin and destination cities*: income distribution, as measured by the Gini coefficient, average income per capita adjusted for income inequality,[16] GDP, population, number of destinations and slot HHI and (2) variables associated with a given *route*: average aircraft size, load factor, route maximum share, proportion of delayed or cancelled flights and proportion of connecting passengers. To enhance the statistical relevance of the instrument set, we employed the following variations of the instrumental variables: maximum value between the cities of origin or destination, the minimum value, the product, and their geometric and arithmetic means.

The Hansen-Sargan J test (Hansen, 1982; Sargan, 1958) was employed to verify the validity of the full set of over-identifying conditions. Its statistic can be interpreted as an orthogonality test

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[15] We highlight the works of Borenstein & Rose (1995) and Barla & Koo (1999), who conjecture about the possible endogenous relationship between the bankruptcy filing and the airfares. However, it is not expected that such a relation would have had an effect on our results, in view of the steady improvement of Varig's financial health (See Figure 8 in the Appendix) and the fact that the period prior to the bankruptcy filing did not indicate significantly lower airfares in relation to the base case of January 2002, in deflated values (see the graph in Section 4.2). A similar conclusion can be made regarding the rivals' airfares, since lower prices are more likely to increase the level of financial distress when compared to higher prices (in the graphs related to the rivals' average airfares, presented in Section 4.3, one notes similar prices to those of the base case being charged prior to the bankruptcy filing). The interested reader is referred to Borenstein & Rose (1995) for further details of the issues addressed in this note.

[16] According to a procedure suggested in Sen (1976).

of the regression residuals in relation to the exogenous variables. For all of the considered specifications, the Hansen J tests did not reject orthogonality, supporting exogeneity of instruments. Concerning the relevance of the proposed set of instruments, we employed the Kleibergen-Paap rk LM underidentification test (KP), from which followed the rejection of the null hypothesis of underidentification. We also tested for weak identification using the Cragg-Donald Wald F statistic and the Kleibergen-Paap rk Wald F statistic (Weak CD and Weak KP). While the statistic proposed by Kleibergen and Paap (2006) is more suitable for specifications having a panel data structure or having non-independent and/or non-identically distributed error terms, we opted to evaluate both of these tests for this research. We had evidence for rejecting the hypothesis of weak instruments. The results of all of these tests are reported in the tables of Section 4.

We performed tests of heteroscedasticity and autocorrelation in the residuals of the airfare equations. Regarding autocorrelation, we implemented the Cumby–Huizinga test, which accounts for an error term with a moving average of arbitrary order q, endogenous regressors and the possibility of employing the GMM estimation. The test indicated the presence of autocorrelation of order 17. With respect to heteroscedasticity, we implemented the Pagan-Hall, White/Koenker and Breusch-Pagan/Godfrey/Cook-Weisberg tests, employing alternative specifications of levels, squares, cross-products of regressors and fitted values of the regressand. These tests suggested the rejection of the null hypothesis of homoscedastic disturbances. Consequently, heteroscedasticity and autocorrelation consistent standard error estimates were employed.

As previously mentioned, Heckman corrections for sample selection and endogenous binary variables contain a first stage in which a random effects *probit* estimator is applied to an auxiliary dataset of balanced panel data consisting of all observed routes (operated by any given airline). This model has Varig's probability of serving a route in a given period as its regressand. The estimation method employed in the second stage is the two-step feasible efficient generalized method of moments estimator (2SFEGMM) with arbitrary heteroscedasticity and autocorrelation consistent standard error estimates. This stage is associated with the bankrupt carrier's and its rivals' airfare models and has the specification presented in Eq. (6). We utilize a bootstrap method to correct the standard errors of the second-stage regression to account for the presence of the estimated Hazard variable among the regressors. Special attention was given to the stratification of the data, that is, the separation of the data by individuals (routes) and the independent resampling of the values associated with each one of them. Moreover, we opted for the more conservative procedure of resampling with replacement the *observations* of the original panel – in contrast with the procedure of resampling with replacement the estimated *residuals* – a procedure referred to as “pairs bootstrap”, which does not rely on the correct specification of the linear regression model nor assumes independence of the residuals in relation to the regressors.

4. Results

4.1. Route selection model

Table 4 presents the estimation results of the route selection *probit* model, the first step in the Heckman correction procedures utilized. Column (6) of Table 1 presents the results of the main empirical model estimation. Column (7), related with an alternative specification, is included in order to provide both a greater comparability between the route selection model and the airfare models, and a greater understanding of the evolution of the bankrupt carrier's presence in the quarters surrounding the bankruptcy and acquisition events.

We observe that in Column (6) of Table 1 the time trend variables suggest an almost constant rate of abandonment by the company in relation to the periods prior to and during the bankruptcy protection and the period after the acquisition, with the coefficients of the related trends presenting the values -0.0672, -0.0641 and -0.0585, respectively. A closer look at the time evolution of Varig’s presence is provided in the Column (7) specification. After obtaining the probability marginal effects[17] related to the quarterly dummy variables, we have Figure 2, where all the variations are given with respect to the base case (the period between January 2002 and August 2004).

[17] The probability marginal effect of a dummy variable is the increase (decrease) in probability associated with changing the value of this variable from zero to one, all else being equal.

Table 4 – Estimation results of the distressed carrier's route selection model

Variables	(1) Varig's presence	(2) Varig's presence	(3) Varig's presence	(4) Varig's presence	(5) Varig's presence	(6) Varig's presence	(7) Varig's presence
ln Gravitational GDP	0.4421***	0.2195**	0.2260**	0.2211**	0.1666	0.1909*	0.2493
Ln Gravitational Population							0.1237
ln Fuel costs	-0.2651***	-0.2804***	-0.3305***	-0.3178***	-0.2890***	-0.2790***	-0.6335***
Nr. Of flights (Congonhas)		0.0023***	0.0022***	0.0022***	0.0022***	0.0022***	0.0031***
LCC presence (Gol)		-0.2702***	-0.2980	-0.2986	-0.3296	-0.2692	-0.6171**
Distressed carrier presence (VASP)		-0.3143***	-0.2372***	-0.2317***		-0.4068***	-0.3363**
Codeshare			-0.2961***	-0.2476**	-0.3242***	-0.2651**	-0.7980***
Time trend	-0.0491***	-0.0512***	-0.0530***				
Time trend (pre-bankruptcy)				-0.0556***	-0.0599***	-0.0672***	
Time trend (post-bankruptcy)				-0.0534***			
Time trend (during bankruptcy)					-0.0563***	-0.0641***	
Time trend (post-merger)					-0.0530***	-0.0585***	
3 quarters before the bankruptcy filing							-0.4938***
2 quarters before the bankruptcy filing							-0.9962***
1 quarter before the bankruptcy filing							-1.1936***
Bankruptcy filing quarter							-1.0240***
1 quarter after the bankruptcy filing							-0.3838*
2 quarters after the bankruptcy filing							-0.8082***
3 quarters after the bankruptcy filing							-1.3349***
3 quarters before the acquisition							-3.1349***
2 quarters before the acquisition							-4.8287***
1 quarter before the acquisition							-4.5208***
Acquisition quarter							-4.2658***
1 quarter after the acquisition							-5.4021***
2 quarters after the acquisition							-4.9152***
3 quarters after the acquisition							-3.7457***
4 quarters after the acquisition							-3.1228***
5 quarters after the acquisition							-3.2423***
6 quarters after the acquisition							-3.1081***
7 quarters after the acquisition							-3.5414***
8 quarters after the acquisition							-4.4704***
Random effects control	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*	*yes*
R_g^2 *(Maddala)*	0.280	0.286	0.288	0.288	0.288	0.290	0.393
R_g^2 *(Lave)*	0.296	0.345	0.343	0.344	0.346	0.348	0.410
R_g^2 *(McKelvey & Zavoina)*	0.641	0.732	0.731	0.731	0.735	0.736	0.846
Prop. of correctly predicted zeros	0.649	0.719	0.715	0.713	0.733	0.731	0.754
Prop. of correctly predicted ones	0.816	0.840	0.844	0.845	0.835	0.837	0.852
LR χ^2 *statistic*	2031.49	1784.75	1791.34	1784.62	1783.29	1782.78	2175.63
p-value	0.001	0.001	0.001	0.001	0.001	0.001	0.001
Nr. of observations	6597	6597	6597	6597	6597	6597	6597

*Notes: p-value representations: ***p<0.01, ** p<0.05, * p<010. The column in grey contains our preferred model.*

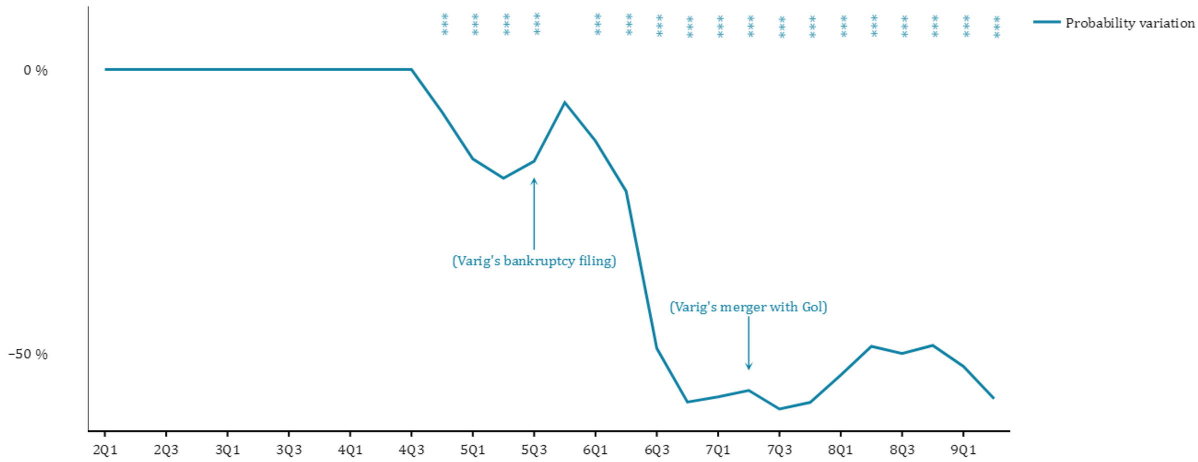

Figure 2 – Variations in the distressed carrier's probability of presence

One can readily see a reduction in the probability related with the company's presence in the three quarters prior to its bankruptcy filing in relation to the base case, with the company showing signs of expansion of its flight network in the quarter associated with the bankruptcy filing. The suspension of debt collection and the illegality of the arrest of leased equipment resulting from the bankruptcy protection helps to explain these results. The sharp reduction in the probability of the company's presence shown in Figure 2, associated with the second and third quarters of 2006, can be justified by the arrest of the company's aircraft conducted by American leasing companies, on July 21 of 2006, the same day as the suspension date by the company of most of its flights.

Columns (1) to (5) of Table 1 present a set of robustness checks for the results of Column (6) specification. The results of these robustness checks indicate that most control variables remain statistically significant and consistently show the expected sign in all specifications and, more importantly, that our empirical analysis of the bankrupt carrier's presence is not affected by these perturbations.

4.2. Bankrupt carrier's airfare model

Next, we examine the bankrupt carrier's airfare equation. Two different second-stage regressions are reported. While both specifications of Table 5 include time and route fixed effects controls, Column (2) presents additionally origin and destination time trends. This is made in accordance with Ciliberto and Schenone (2012), who suggest that companies with operations on routes with decreasing demand are more prone to fall into bankruptcy, with this trend possibly biasing the estimates. Lee (2009), on the other hand, argues that shocks of supply and demand intense enough to force a firm into bankruptcy are more likely to occur at the level of the economy as a whole, when compared to shocks associated with specific markets.[18] Based on the aforementioned, we opted to report both specifications.

Regarding the control variables, the estimated coefficients of fuel costs, maximum city HHI, number of passengers, codeshare, the presence of an LCC and the presence of a distressed carrier all have shown the expected signs, with most of these undergoing only minor variations in Columns (1) and (2) specifications. The most evident effects of the removal of the time trends were the gain of statistical significance for the codeshare, the number of passengers and the financial distress variables.

In the case of the financial distress variable (which is weighted by the distressed carrier's market shares), noticeable time trends for both the company's market shares and its Z"- score were verified,[19] providing a plausible explanation for the loss of statistical significance in models accounting for these trends. However, even having the time trends variables removed, the results presented in Column (2) suggest that the distress variable had little influence on Varig's airfares. These results find support in those obtained by Hofer (2012), who studies the effects of financial distress on airfares, accounting for the company's position in its turnaround process (composed by the downturn and recovery phases). His results indicate that improvements in a company's financial health contribute ultimately to increases in its airfares, with these changes in pricing behavior not being observed immediately and being preceded by a period of price reductions. In light of these results - and in view of the period under analysis being comprised only by the recovery phase of Varig's financial health - the observed moderate effect are justified.

The hazard variable coefficient was statistically significant in both specifications presented in this section, as well as in further robustness checks included in Table 9 in the Appendix, supporting $\mathbf{H_3}$, *i.e.*, that sample selection is a relevant issue in such airfare models. Furthermore, the robustness checks indicate that its omission overestimates the coefficients of the LCC's presence and the city HHI variables, with its effects on the latter being more pronounced. On the other hand,

[18] Our results for the coefficients of the time trends variables support this assertion, as most of these presented similar magnitudes and negative signs.

[19] The reader is referred to Figure 1 of Section 3.1 and Figure 6 in the Appendix, depicting the evolution of the market share and the Z"-score variables for the analyzed companies, respectively.

its omission also implies the underestimation of both the coefficient and the statistical significance of the fuel cost variable.

Table 5 – Estimation results of the distressed carrier's airfare model

Variables	(1) *ln Varig's yield*		(2) *ln Varig's yield*	
ln Fuel costs	0.0661***		0.0450***	
ln maximum city HHI	0.5286**		0.6354***	
ln # of Passengers	-0.5854***		-0.1799	
Codeshare	0.0333**		0.0345	
LCC presence (Gol)	-0.1035***		-0.1408***	
Distressed carrier presence (VASP)	0.0328		0.0026	
Varig's distress	-0.0632**		-0.0317	
Hazard	-0.2029***		-0.3267***	
Route group	***kept***	***abandoned***	***kept***	***abandoned***
3 quarters before the bankruptcy filing	0.2736***	0.2399***	0.2340***	0.2188***
2 quarters before the bankruptcy filing	0.2581***	0.1616***	0.2161***	0.1297***
1 quarter before the bankruptcy filing	0.0533	-0.0078	-0.0762	-0.1004
Bankruptcy filing quarter	0.0597	0.1176*	-0.1142*	0.0043
1 quarter after the bankruptcy filing	0.3089***	0.2679***	0.1246*	0.1368**
2 quarters after the bankruptcy filing	0.1596**	0.1520*	0.0569	0.0821
3 quarters after the bankruptcy filing	-0.1861**	-0.1986**	-0.3390***	-0.3058***
3 quarters before the acquisition				
2 quarters before the acquisition				
1 quarter before the acquisition	-0.3902***		-0.5472***	
Acquisition quarter	-0.4002***		-0.7248***	
1 quarter after the acquisition	-0.1325		-0.2916***	
2 quarters after the acquisition	-0.0751		-0.3753***	
3 quarters after the acquisition	-0.3993***		-0.6373***	
4 quarters after the acquisition	0.6020***		0.2077	
5 quarters after the acquisition	0.3254***		0.0082	
6 quarters after the acquisition	0.0402		-0.2908**	
7 quarters after the acquisition	0.0434		-0.3327***	
8 quarters after the acquisition				
Time fixed effects control	*yes*		*yes*	
Route fixed effects control	*yes*		*yes*	
Origin and destination time trends	*no*		*yes*	
Adjusted R^2	0.8545		0.8663	
Root-mean-square error	0.1467		0.1406	
F statistic	116.443		109.981	
KP statistic	100.688		68.168	
KP p-value	0.0001		0.0001	
Weak CD statistic	21.3914		13.6965	
Weak KP statistic	28.0885		17.7778	
J statistic	0.2428		0.0026	
J p-value	0.6222		0.9590	
Nr. of observations	3202		3202	

*Notes: Results produced by the two-step feasible efficient generalized method of moments estimator (2SFEGMM); statistics robust to heteroscedasticity; first-stage results produced with the probit model of Table 5.1, Column (6); standard errors of the estimated coefficients were bootstrapped with a panel bootstrap procedure to account for the two-stage nature of the Heckman correction; fixed effects and time trends omitted; OLS, RMSE and F statistics reported for the equivalent OLS estimation; p-value representations: ***p<0.01, ** p<0.05, * p<010. The column in grey contains our preferred model.*

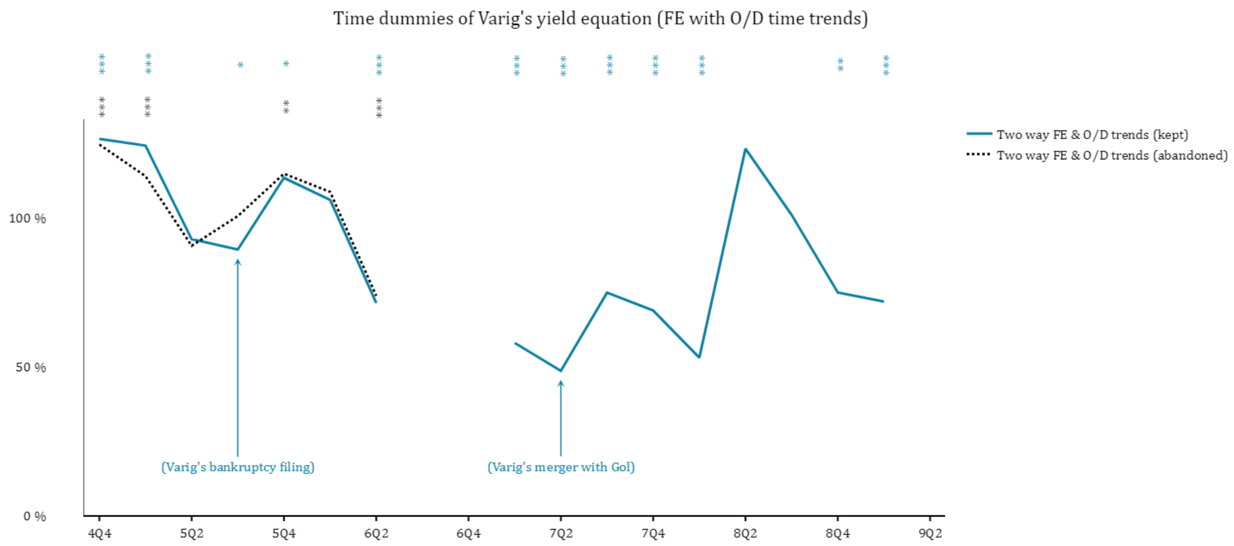

Figure 3 – Variations in the distressed carrier's yield variable

Concerning the effects of the bankruptcy and the acquisition events on the distressed carrier's airfares, Figure 3 illustrate the percentage changes suggested by the dummy variables with respect to the base case of January 2002,[20] obtained after the exponentiation of the estimated coefficients presented in Table 5.[21]

It should be noted that the graphs suggest higher airfares being charged between 9 and 3 months prior to the bankruptcy filing, with the period comprising the 3 months prior to the event being characterized by reduced airfares. We note that no significant difference between the two route groups are observed. These results find support in Borestein and Rose (1995) and Hofer *et al*. (2005), who report decreases in airfares in periods prior to the bankruptcy protection event and those of Lee (2009), which reports airfare cuts being carried out in periods prior to filing with the most intense cut being associated with the quarter of the filing itself, and with average fares showing an increasing (but modest) time trend in subsequent quarters. It is noteworthy that, similarly to Lee (2009), the results of Ciliberto and Schenone (2012) also point to reductions in airfares associated with the bankruptcy protection period with respect to values exerted prior to

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[20] The choice of a base case period far apart in time from the analyzed events is used in Lee (2009) in accordance with Kennedy (2000), whose results from examining the operational performance of bankrupt companies and their rivals suggest that the majority of decreases in performance for both the company under bankruptcy and its rivals occur in periods close to the bankruptcy filing or in the early stages of the bankruptcy. Thus, the use of periods directly preceding a bankruptcy as a base case could bias the estimates of the effects of the event *per se*.

[21] A similar procedure is described in Greene (2012), ch. 6, p. 150. Taking $E_{jan/02}[y|\boldsymbol{X}] = 100\%$ we have that $E_{apr/06}[y|\boldsymbol{X}] = (e^{FE_{apr/06}})E_{jan/02}[y|\boldsymbol{X}]$, or $E_{apr/06}[y|\boldsymbol{X}] = (e^{FE_{apr/06}})$.

the event. In the period between 6 and 12 months after the filing, time trends of decreasing fares can be seen.

Together with the results obtained by the specification associated with Column (7) of the route selection model presented in Section 4.1, airfare increases and subsequent reductions appear to have followed an expansion and subsequent contraction of the company's flight network. An interpretation for these variations is presented in Lee (2009), who argues about the contraction of the flight network of a bankrupt company and the associated reductions in airfare values being a result from the company having less freedom for charging price premiums due to the provision of extensive networks. From this perspective, the observed oscillations seem to be a direct result of the attractiveness of the company's network. During the next six months, associated with the third and fourth quarters of 2006, however, the company no longer reports its airfare values, a period characterized by the operation of a very small number of routes.[22]

The situation faced by the company in this period can be compared with that of Eastern Air Lines, which almost ceased its operations in the second quarter of 1989, as a result of a strike by its mechanics, pilots and flight attendants, remaining active on only 22 routes and returning to normal operations only in the third quarter of the same year.[23] Borenstein & Rose (1995) found sharp airfare reductions associated with this company, suggesting that they were a result of its progressively degraded reputation along with the strike of its employees.

In fact, airfare reductions resulting from a worsening reputation seem to provide another plausible explanation for what happened with Varig, especially in the first two quarters of 2006, after the arrest of its aircraft. As argued in Busse (2002) and also discussed in Ciliberto & Schenone (2012), companies under bankruptcy have incentives to charge lower fares, since their potential passengers need to be persuaded to do business with a company that may cease to exist.

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[22] Thus, imparing any inference as to who (Varig or its rivals) initiated the sharper airfare reductions. Predatory pricing behavior being exerted by the company's rivals in this period is not discarded, given the company's high vulnerability. This hypothesis is presented in more detail in Section 4.3 together with the analysis of the effects of the merger for both airfare models, after the presentation of the results associated with the rivals' airfares.

[23] Its bankruptcy (among others) is investigated in Borenstein & Rose (1995) and Barla & Koo (1999).

4.3. Rivals' airfare model

Similarly to the bankrupt carrier's airfare model, we present two different second-stage regressions, with and without origin and destination time trends. These correspond to Column (2) and Column (1) of Table 6, respectively.

The estimated coefficients of the control variables have shown the expected signs, with most of these undergoing only minor variations in Columns (1) and (2) specifications, with the notable exception of the maximum HHI related with the origin and destination cities, which lost its statistical significance with the inclusion of the time trends in Column (2).

The hazard variable coefficient was statistically significant in both specifications, suggesting that there is, in fact, an endogenous relationship between a company's presence and its rivals average airfares, which compels us to not reject $\mathbf{H_3}$. It is worth noting that this result was considerably moderate when compared to that obtained in the bankrupt carrier's airfare model. Furthermore, robustness checks included in Table 10 in the Appendix suggest only mild effects caused by the omission of the hazard term on other variables' coefficients.

Moving on to the rivals' financial distress variable, the models suggest that it did not have significant influences on the airfares charged by these companies. Similar conclusions can be drawn about the effects of Varig's financial distress variable, which, although presenting statistical significance in Column (2), did not show robustness throughout specifications, thus rejecting $\mathbf{H_1}$.[24]

Figure 4 illustrates the percentage changes suggested by the dummy variables with respect to the base case of January 2002, obtained after the exponentiation of the estimated coefficients presented in Table 6.

[24] The reader is referred to Table 10 in the Appendix.

Table 6 – Estimation results of the rivals' airfare model

Variables	(1) In Rivals' yield		(2) In Rivals' yield	
ln Fuel costs	0.0653***		0.0648***	
ln maximum city HHI	0.5183***		0.3425	
ln # of Passengers	-0.8610***		-0.5190***	
Codeshare	-0.0327		-0.0272*	
LCC presence (Gol)	-0.2884***		-0.3743***	
Distressed carrier presence (VASP)	0.0789***		0.0611**	
Rivals' distress	0.0167		0.0013	
Varig's distress	-0.0082		-0.0914**	
Hazard	0.0311**		0.0205*	
Route group	***kept***	***abandoned***	***kept***	***abandoned***
3 quarters before the bankruptcy filing	0.0715	0.0960	0.1076*	0.1102
2 quarters before the bankruptcy filing	0.0501	-0.0182	0.0520	0.0008
1 quarter before the bankruptcy filing	-0.4424***	-0.3493***	-0.5973***	-0.4940***
Bankruptcy filing quarter	-0.2980**	-0.2079	-0.4871***	-0.3421***
1 quarter after the bankruptcy filing	-0.0105	0.0016	-0.2136	-0.1767
2 quarters after the bankruptcy filing	-0.1760	-0.2275	-0.3812***	-0.4077***
3 quarters after the bankruptcy filing	-0.2257	-0.2100	-0.5509***	-0.5211***
3 quarters before the acquisition	-0.2490	-0.2438	-0.5189***	-0.5132***
2 quarters before the acquisition	-0.3231*	-0.3446*	-0.6249***	-0.6311***
1 quarter before the acquisition	-0.6765***	-0.5714***	-0.9178***	-0.7926***
Acquisition quarter	-0.6715***	-0.4966***	-1.0164***	-0.8372***
1 quarter after the acquisition	-0.4352***	-0.2679*	-0.6594***	-0.4893***
2 quarters after the acquisition	-0.2612	-0.1005	-0.6007***	-0.4333***
3 quarters after the acquisition	-0.3936***	-0.3875***	-0.6305***	-0.6148***
4 quarters after the acquisition	0.1912	0.2213	-0.1658	-0.1365
5 quarters after the acquisition	-0.0938	-0.0430	-0.3975***	-0.3375**
6 quarters after the acquisition	-0.1487	0.0216	-0.4381***	-0.2845*
7 quarters after the acquisition	-0.3151***	-0.2277**	-0.5813***	-0.4820***
8 quarters after the acquisition	-0.3920***	-0.3319***	-0.7238***	-0.6633***
Time fixed effects control	*yes*		*yes*	
Route fixed effects control	*yes*		*yes*	
Origin and destination time trends	*no*		*yes*	
Adjusted R^2	0.8077		0.8165	
Root-mean-square error	0.2080		0.2032	
F statistic	139.976		127.766	
KP statistic	60.9493		57.9251	
KP p-value	0.0001		0.0001	
Weak CD statistic	13.0764		11.5275	
Weak KP statistic	12.6792		11.7918	
J statistic	0.0002		0.1133	
J p-value	0.9884		0.7365	
Nr. of observations	6284		6387	

*Notes: Results produced by the two-step feasible efficient generalized method of moments estimator (2SFEGMM); statistics robust to heteroscedasticity; first-stage results produced with the probit model of Table 5.1, Column (6); standard errors of the estimated coefficients were bootstrapped with a panel bootstrap procedure to account for the two-stage nature of the Heckman correction; fixed effects and time trends omitted; OLS, RMSE and F statistics reported for the equivalent OLS estimation; p-value representations: ***p<0.01, ** p<0.05, * p<010. The column in grey contains our preferred model.*

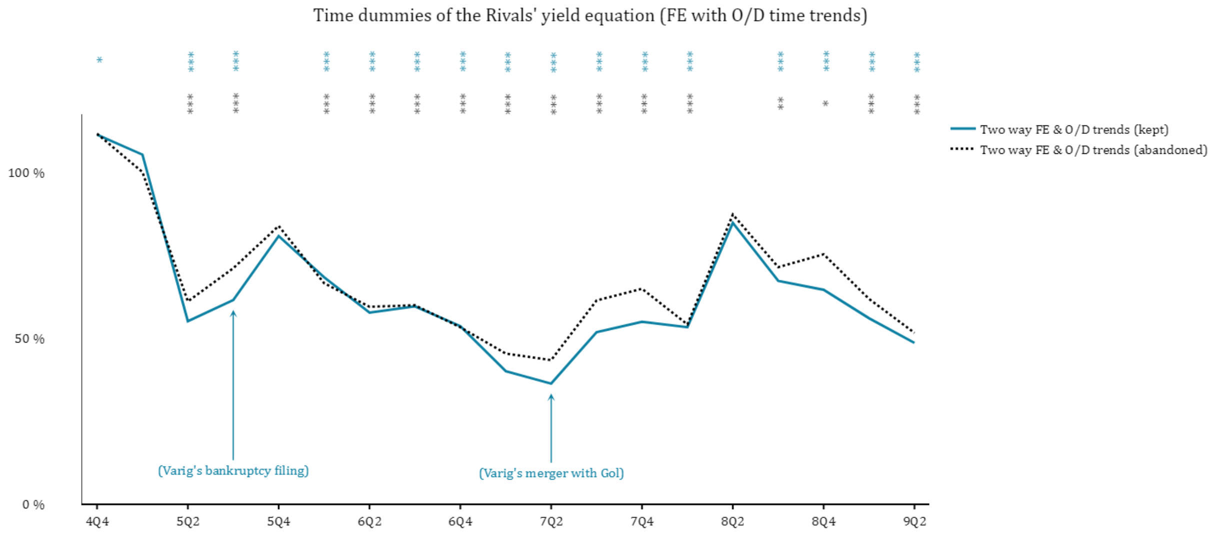

Figure 4 – Variations in the rivals' yield variable

The graph suggests airfares similar to the base case of January 2002 being charged between 9 and 3 months prior to the bankruptcy filing, in deflated values. Drastic reductions, however, are observed in the quarter preceding the filing, with the models of Columns (1) and (2) suggesting airfare reductions of 36% and 45%, respectively.[25] Furthermore, both models suggest increases in relation to these values in the quarter of the filing itself, although airfares remained significantly below the average of previous quarters.

These results suggest that the bankruptcy filing itself did not instigated predatory pricing behavior on Varig's rivals, what can be ascribed primarily to the media coverage of the company's financial situation, which motivates the rejection of the argument of uninformed competitors. However, extreme price reductions promoted by Varig's rivals in the quarter associated with the arrest of its aircraft and in the three following quarters do support such a theory.

With the continuous improvement of Varig's financial health over the period between January 2002 and June 2006, one can say that the company gave the clearest signs of vulnerability during and directly after the arrest of its aircraft, what would thus provide support to this conjecture. Furthermore, as argued in Barla and Koo's (1999),[26] predatory pricing practices may be related with an attempt by one or more competitors to influence the terms of a potential

[25] These results were robust in alternative specifications having removed the time fixed effects, with controls for a time trend (common to all routes) and seasonality being employed instead.

[26] These authors detect price cuts being carried out mainly by the rivals of the bankrupt companies in their research.

acquisition of the distressed company or to reduce the value of its assets - particularly gates and slots - in case of liquidation. This is specially suitable for Varig's case, since both of its main competitors during these events, TAM and Gol, had already shown signs of interest in possible joint efforts with the company.

Regarding the acquisition event, both models indicate moderate changes, with the dummy variables from the model with time trends suggesting slight reductions in relation to previous quarters. Both models imply, however, increasing trends for airfares in the two groups of routes in the quarters following the acquisition event, reaching peak values in the second quarter of 2008, suggesting that the effects of the increased market concentration that followed the acquisition have prevailed any possible efficiency gains obtained by the merger, at least in the short term. Furthermore, these results are in line with those of Kim & Singal (1993), Peters (2006) and Hüschelrath & Müller (2014), discussed in Section 2.3.

After the third quarter of 2008, however, the dummy variables indicate constant airfare decreases until at least the second quarter of 2009, the last months contained in our database. Taking into account that the airline Azul, at the time an adept of the LCC model, had its establishment in May 2008 with its first flights being offered in December of the same year, our results find support in those presented by Hüschelrath and Müller (2013), which suggest decreasing trends for airfares in the medium- and long-term after mergers. The authors ascribe these decreasing trends to efficiencies resulting from the merger and, particularly relevant to the case in hand, to post-merger entry-inducing effects. In this way, our results provide support to $\mathbf{H_2}$.

4.4. Robustness checks

The work of Morrison *et al*. (1996) presents a particularly insightful interpretation for the observed changes in average airfare values. The authors consider the possibility of these changes being only a reflection of exogenous changes in the number of passengers associated with the airfare classes made available by the companies. The example given in Barla and Koo (1999), of how cuts made by a company in its full fare coach can provide a reduction in demand for this category in its rivals' flights helps to clarify this issue. The authors argue that observed reductions in rivals' average fare values may represent only changes in their passenger mix, made up of a larger proportion of low-fare passengers after such an initiative. In this case, to assume that there was predatory behavior by the rivals would be misleading.

Due to this possibility, the analyses presented in Sections 4.2 and 4.3 were performed for both the 25th and 75th percentiles of both Varig's and its rivals' airfares.[27] A close look at the quarterly dummies associated with these regions of the airfare distributions[28] indicates similar variations resulting from the bankruptcy and the acquisition events to those previously reported, with the most important results found being confirmed by these experiments and the stated conclusions remaining unchanged.

Conclusion

This paper investigated the market outcomes of the events of the bankruptcy, and the subsequent acquisition, of a major full-service carrier (Varig Airlines) by a low-cost carrier (Gol Airlines) in Brazil in the late 2000's. We contribute to the literature by modelling the survival network design strategies of the financially distressed carrier during bankruptcy in a sample selection framework. Additionally, we examine the effect of endogenous financial distress on both the bankrupt's and its opponents' pricing. Our estimates point to a permanent price reduction triggered by the events, and thus suggest that in this case the effects of merger-related synergies more than compensated the market power effect on prices. The results suggest that bankruptcy protection in the airline industry may have a role not only in avoiding the undesired consequences of service discontinuation of carriers that may imply in many stranded passengers, but also in sustaining the competition for the assets - *e.g.* airport slots - and the market share of the bankrupt firm. As a result, our findings suggest that, under certain circumstances, aviation authorities may see the bankruptcy event as an opportunity to keep and foster the competitive behavior in the airline industry and therefore it should be regarded as possibly beneficial to the economic welfare in the market.

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[27]A similar procedure is employed in Lee (2009), with the work of Morrison *et al*. (1996) adopting the 20th and the 80th percentiles.

[28] The changes in the quarterly dummies associated with the 25th and 75th percentiles for both Varig's and its rivals' airfare models can be seen in Tables 7 and 8, respectively, along with the changes in the quarterly dummies associated with the average airfares for both models.

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Appendix

Table 7 – Estimation results of the distressed carrier's airfare model (percentiles)

Variables	(1) ln Varig's yield (25th percentile)	(2) ln Varig's yield (Average)	(3) ln Varig's yield (75th percentile)
ln Fuel costs	0.0196**	0.0397***	0.0371***
ln maximum city HHI	0.1676***	0.1175***	0.0392
ln # of Passengers	-0.1238***	-0.1043***	-0.0160
Codeshare	-0.0451***	0.0252*	-0.0126
LCC presence (Gol)	-0.0806***	-0.1034***	-0.0155
Distressed carrier presence (VASP)	-0.0510***	0.0078	0.0099
Rivals' distress	-0.0101***	0.0031	0.0118***
Varig's distress	0.0088*	0.0070	0.0024
Hazard	-0.1340***	-0.3464***	-0.3537***
3 quarters before the bankruptcy filing	0.0350	0.0649	0.2330***
2 quarters before the bankruptcy filing	-0.0073	0.0455	0.2375***
1 quarter before the bankruptcy filing	-0.2754***	-0.2099***	0.1429***
Bankruptcy filing quarter	-0.4602***	-0.2124***	0.1895***
1 quarter after the bankruptcy filing	-0.2124***	0.0031	0.0762**
2 quarters after the bankruptcy filing	-0.1893***	-0.0414	0.1876***
3 quarters after the bankruptcy filing	-0.6798***	-0.3952***	0.0356
3 quarters before the acquisition			
2 quarters before the acquisition			
1 quarter before the acquisition	-0.9941***	-0.5601***	-0.0143
Acquisition quarter	-0.8540***	-0.6707***	-0.0745*
1 quarter after the acquisition	-0.6505***	-0.2605***	0.0507
2 quarters after the acquisition	-0.6443***	-0.3248***	-0.1643***
3 quarters after the acquisition	-0.6883***	-0.5611***	-0.2739***
4 quarters after the acquisition	-0.2116***	0.2463***	0.1246***
5 quarters after the acquisition	-0.2423***	0.0602	0.1061**
6 quarters after the acquisition	-0.3372***	-0.2689***	0.1259***
7 quarters after the acquisition	-0.5661***	-0.3257***	0.0115
8 quarters after the acquisition			
Time fixed effects control	yes	yes	yes
Route fixed effects control	yes	yes	yes
Origin and destination time trends	yes	yes	yes
Adjusted R^2	0.8758	0.8648	0.9367
Root-mean-square error	0.1390	0.1414	0.0866
F statistic	123.410	111.990	257.670
Nr. of observations	3264	3264	3264

*Notes: p-value representations: ***p<0.01, ** p<0.05, * p<010.*

Table 8 – Estimation results of the rivals' airfare model (percentiles)

Variables	(1) *ln Rivals' yield (25th percentile)*	(2) *ln Rivals' yield (Average)*	(3) *ln Rivals' yield (75th percentile)*
ln Fuel costs	0.0106	0.0435***	0.0289**
ln maximum city HHI	0.3316***	0.2879***	0.2049***
ln # of Passengers	-0.0580***	-0.0829***	0.0234
Codeshare	-0.0464***	-0.0358**	-0.0156
LCC presence (Gol)	-0.3215***	-0.2929***	-0.1963***
Distressed carrier presence (VASP)	0.1221***	0.0964***	0.0759***
Rivals' distress	-0.0074*	0.0080**	-0.0034
Varig's distress	0.0075	-0.0037	-0.0156***
Hazard	-0.0028	-0.0118**	0.0135**
3 quarters before the bankruptcy filing	0.2319***	0.2933***	0.3755***
2 quarters before the bankruptcy filing	0.2172***	0.2929***	0.2759***
1 quarter before the bankruptcy filing	-0.5542***	-0.2691***	0.0409
Bankruptcy filing quarter	-0.3457***	-0.1550***	0.1697***
1 quarter after the bankruptcy filing	-0.2032***	0.0949*	0.2970***
2 quarters after the bankruptcy filing	-0.3703***	0.0068	0.1689***
3 quarters after the bankruptcy filing	-0.4552***	-0.2408***	0.0400
3 quarters before the acquisition	-0.6857***	-0.1265**	0.0475
2 quarters before the acquisition	-0.6552***	-0.3118***	0.1063
1 quarter before the acquisition	-0.6588***	-0.4742***	0.0598
Acquisition quarter	-0.9975***	-0.7110***	-0.1562**
1 quarter after the acquisition	-0.5758***	-0.2105***	0.0383
2 quarters after the acquisition	-0.6196***	-0.3064***	0.0012
3 quarters after the acquisition	-0.5900***	-0.2669***	-0.0586
4 quarters after the acquisition	-0.4325***	0.0259	0.0853
5 quarters after the acquisition	-0.3634***	-0.1186*	0.0178
6 quarters after the acquisition	-0.4315***	-0.1208*	0.0940
7 quarters after the acquisition	-0.4403***	-0.2626***	0.0231
8 quarters after the acquisition	-0.9078***	-0.5446***	-0.0024
Time fixed effects control	*yes*	*yes*	*yes*
Route fixed effects control	*yes*	*yes*	*yes*
Origin and destination time trends	*yes*	*yes*	*yes*
Adjusted R^2	0.7255	0.8135	0.7176
Root-mean-square error	0.2593	0.2048	0.2396
F statistic	83.090	136.430	79.920
Nr. of observations	6554	6554	6554

*Notes: p-value representations: ***p<0.01, ** p<0.05, * p<010.*

Table 9 – Robustness checks of the distressed carrier's airfare model

Variables	(1) ln Varig's yield	(2) ln Varig's yield	(3) ln Varig's yield	(4) ln Varig's yield	(5) ln Varig's yield	(6) ln Varig's yield	(7) ln Varig's yield
ln Fuel costs	0.0390***	0.0140	0.0387***	0.0137	0.0228*	0.0500***	0.0638***
ln maximum city HHI (endogenous)	0.1090**	0.9073***	0.7860***	0.9142***	0.8295***	0.7046***	0.4959**
ln # of Passengers (endogenous)	-0.1085***	-0.2777**	-0.2774**	-0.2867**	-0.2392*	-0.2500**	-0.5792***
Codeshare	0.0259*	-0.0064	0.0130	-0.0076	0.0177	0.0352	0.0296**
LCC presence (Gol)	-0.1022***	-0.1339***	-0.1178***	-0.1322***	-0.1484***	-0.1260***	-0.0959***
Distressed carrier presence (VASP)	0.0074	-0.0246	-0.0008	-0.0244	-0.0315*	-0.0023	0.0309
Varig's distress (endogenous)	0.0069			0.0030	-0.0565	-0.0444	-0.0593*
Hazard	-0.3482***		-0.2847***			-0.3340***	-0.2081***
Time fixed effects control	***yes***	***yes***	***yes***	***yes***	***yes***	***yes***	***yes***
Route fixed effects control	***yes***	***yes***	***yes***	***yes***	***yes***	***yes***	***yes***
Origin and destination time trends	***yes***	***yes***	***yes***	***yes***	***yes***	***yes***	***no***
Adjusted R^2	0.8648	0.8616	0.8647	0.8617	0.8617	0.8648	0.8528
Root-mean-square error	0.1414	0.1431	0.1414	0.1430	0.1430	0.1414	0.1475
F statistic	112.590	110.788	113.148	110.329	110.329	112.594	119.929
KP statistic	———	58.4597	59.0369	67.6084	46.0948	49.7608	81.1161
KP p-value	———	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Weak CD statistic	———	19.0956	18.6617	21.3278	11.8412	12.6612	18.1350
Weak KP statistic	———	23.3051	22.9418	26.9841	11.9697	13.0301	21.7889
J statistic	———	0.6166	0.3993	0.6807	0.0041	0.0001	0.2786
J p-value	———	0.4323	0.5275	0.4094	0.9488	0.9912	0.5976
Nr. of observations	3264	3202	3202	3202	3202	3202	3202

*Notes: Results produced by the two-step feasible efficient generalized method of moments estimator (2SFEGMM); statistics robust to heteroscedasticity; first-stage results produced with the probit model of Table 5.1, Column (6); standard errors of the estimated coefficients were bootstrapped with a panel bootstrap procedure to account for the two-stage nature of the Heckman correction; fixed effects and time trends omitted; OLS, RMSE and F statistics reported for the equivalent OLS estimation; p-value representations: ***p<0.01, ** p<0.05, * p<010*

Table 10 – Robustness checks of the rivals' airfare model

Variables	(1) *ln Rivals' yield*	(2) *ln Rivals' yield*	(3) *ln Rivals' yield*	(4) *ln Rivals' yield*	(5) *ln Rivals' yield*	(6) *ln Rivals' yield*	(7) *ln Rivals' yield*	(8) *ln Rivals' yield*	(9) *ln Rivals' yield*
ln Fuel costs	0.0435***	0.0482***	0.0475***	0.0477***	0.0441***	0.0489***	0.0581***	0.0539***	0.0546***
ln maximum city HHI	0.2879***	0.3217	0.3766	0.2835	0.1733	0.2381	0.2435	0.3081	0.2979*
ln # of Passengers	-0.0829***	-0.5909***	-0.5958***	-0.5969***	-0.5946***	-0.6097***	-0.6329***	-0.6339***	-0.8765***
Codeshare	-0.0358**	-0.0314**	-0.0333**	-0.0306**	-0.0292*	-0.0281*	-0.0217	-0.0258	-0.0247
LCC presence (Gol)	-0.2929***	-0.2871***	-0.2897***	-0.2847***	-0.2827***	-0.2941***	-0.3307***	-0.3292***	-0.2837***
Distressed carrier presence (VASP)	0.0964***	0.0561***	0.0545**	0.0543**	0.0483*	0.0508*	0.0488*	0.0441	0.0793**
Rivals' distress	0.0080**			-0.0028	-0.0159	-0.0081	-0.0045	-0.0092	0.0036
Varig's distress	-0.0037					-0.0147	-0.0645	-0.0570	-0.0138
Hazard	-0.0118**		0.0114					0.0229**	0.0292*
Time fixed effects control	***yes***	***yes***	***yes***	***yes***	***yes***	***yes***	***yes***	***yes***	***yes***
Route fixed effects control	***yes***	***yes***	***yes***	***yes***	***yes***	***yes***	***yes***	***yes***	***yes***
Origin and destination time trends	***yes***	***yes***	***yes***	***yes***	***yes***	***yes***	***yes***	***yes***	***no***
Adjusted R^2	0.8135	0.8132	0.8133	0.8133	0.8133	0.8133	0.8133	0.8135	0.8049
Root-mean-square error	0.2048	0.2049	0.2049	0.2049	0.2049	0.2049	0.2049	0.2048	0.2095
F statistic	136.430	138.193	137.613	137.613	137.613	136.963	136.963	136.435	151.996
KP statistic	———	118.858	120.821	116.273	56.166	55.069	69.496	64.484	56.0904
KP p-value	———	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Weak CD statistic	———	21.1618	21.0092	21.2033	13.5706	13.0475	11.0068	11.0698	11.6428
Weak KP statistic	———	23.9481	24.6409	22.8403	11.7782	11.4413	13.0554	12.2535	11.6572
J statistic	———	1.9971	1.8519	1.9130	1.7417	1.0892	0.0054	0.0083	0.0428
J p-value	———	0.5730	0.6037	0.5907	0.4186	0.5801	0.9412	0.9276	0.8361
Nr. of observations	6554	6387	6387	6387	6387	6387	6387	6387	6284

*Notes: Results produced by the two-step feasible efficient generalized method of moments estimator (2SFEGMM); statistics robust to heteroscedasticity; first-stage results produced with the probit model of Table 5.1, Column (6); standard errors of the estimated coefficients were bootstrapped with a panel bootstrap procedure to account for the two-stage nature of the Heckman correction; fixed effects and time trends omitted; OLS, RMSE and F statistics reported for the equivalent OLS estimation; p-value representations: ***p<0.01, ** p<0.05, * p<010.*

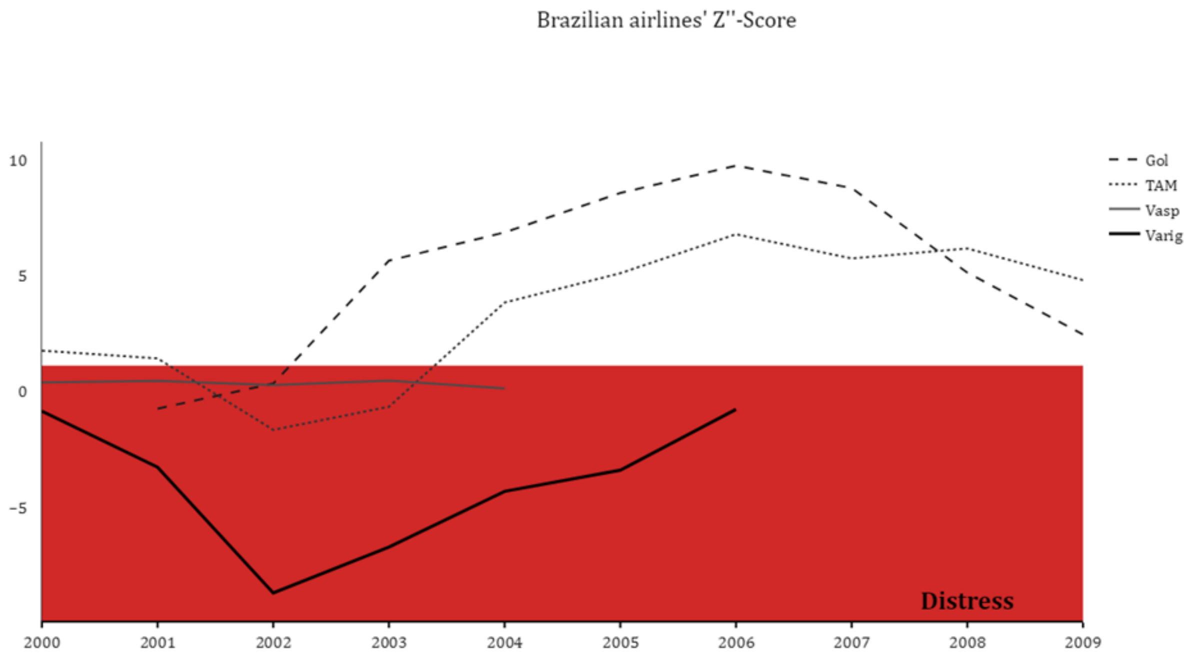

Figure 6 – Annual Z”-scores for the analyzed companies between 2000 and 2009.