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Airline capacity setting after re-regulation: The Brazilian case in the early 2000s

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A B S T R A C T

The Brazilian airline industry is one of the few cases where there was temporary re-regulation of the market after years of economic liberalization. This was done on the basis of excess capacity and after systemic financial crises. Regulators reintroduced mechanisms for market intervention in 2003–2004, with airlines no longer allowed to expand frequencies and fleets at will. Additionally, a code-share agreement between the two biggest network carriers was encouraged to increase the overall profitability. This study looks at an extensive panel of routes to identify elements that affected the decisions Brazilian domestic scheduled passenger airlines made regarding capacity, the factor most affected by the re-regulation.

1. Introduction

The Brazilian airline industry is one of a few cases where a government has temporarily re-regulated the market after years of economic liberalization. In 2003, the Department of Civil Aviation—the Brazilian aviation authority at the time—following the directives of the new federal governstarted implementing measures of re-regulation, aimed at controlling alleged excess capacity systemic financial crisis and over-competition. Undoubtedly, the effect of these measures was on capacity, as airlines were no longer allowed to expand flight frequencies or fleets without permission. This paper identifies factors that affected the decisions Brazilian domestic scheduled passenger airlines made given these capacity constraints. In particular, we explore the impacts that two episodes had on the capacity-setting behavior of the airlines: the economic re-regulation measures of 2003 and the code-share agreement that the two biggest network carriers put in place as a mechanism for increasing overall profitability.

Our focus is on the evolution and the determinants of market supply by airlines. Capacity at the market level is a result of the competitive interactions among profit-maximizer firms, once they decided whether to enter and what kind of positioning they will have in the market. In the airline industry, network design and product perishability add complexity to this decision-making. Indeed, firms do not make independent decisions across markets, and, although they set capacity individually in each of the routes served, they frequently relocate supply by changing the aircraft types or the number of flights. Additionally, capacity setting in a selected route impacts capacity setting on other routes and, therefore, there may be network externalities. This is reinforced if inputs of factors like crew and fleet are roughly constant in the short term. Moreover, since seat-kilometers cannot be stored, airlines must continuously recommit the capacity they set in the market. This is consistent with the partial equilibrium approach of Berry (1992), which assumes that, at the beginning of each period, airlines have to decide whether to operate or not in a given market, given the structure and size of their networks and past sunk investments.

We therefore take advantage of this peculiarity of the airline industry, namely that firms have to commit with capacity in each market and in each period once entry decisions are made. This is peculiar because in other industries firms make decisions on capacity very infrequently. The variability in supply conditions, and consequent capacity changes by airlines, allows econometric investigation of capacity setting at the market level. We examine Brazilian scheduled airlines in the early 2000s. Brazil has experienced major macro-supply shocks, such as the exchange rate over-shootings of 1999 and 2002 that significantly impacted fuel, maintenance and leasing costs, and, ultimately, capacity. The aim is to identify the capacity formation process of Brazilian scheduled passenger airlines between the third quarter of 1998 and the fourth quarter of 2004, making use of a panel of routes. The span of this sample allows contemplation of the entry of a successful low-cost carrier in Brazilian market (GOL *Linhas Aéreas Inteligentes*), in early 2001, the period of the re-regulation, and of the short-lived code-share agreement between the two biggest network carriers from 2003 on.

2. Characteristics of air transportation in Brazil

The airline industry is one of the sectors of the Brazilian economy that are usually regarded as "strategic" by many market

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analysts and by the government with a role in fostering integration between regions—not unimportant role for a country of approximately 8.5 million square kilometers. Air transport represents about 3% of the country's gross domestic product. Brazil is also the most important airline market in Latin America. Of the 75 million passengers in the macro-region, in 2000 35% of domestic and international traffic was carried by Brazilian airlines. In 2000, Varig had the largest market share in South America (14.9%), followed by Aeromexico (13%), Tam (11.9%) and Mexicana (11.7%). Table 1 shows for 2002 the relative importance of domestic and international traffic, and various sub-markets for the Brazilian airline industry, in terms of revenue. Brazilian air transportation experienced a steady traffic growth in terms of revenue passenger-kilometers (RPK), available seat-kilometers (ASK) and load-factor between 1995 and 2004. The ASKs produced by the airlines grew almost 60% and revenue by 80%, as load factors grew by 12% (Fig. 1).

The industry has experienced considerable market entry, expansions, bankrupticies and exits. Three out of the four most important airlines flying at the end of the 1990s have now either closed operations or downsized radically. Transbrasil, for example, ceased operations in December 2001 and Vasp stopped its services in January 2005. Further, after years of negative financial results, Varig dramatically downsized its labor force, fleet and network in 2006. A debt-free organization, "Nova Varig" ("New Varig") was then sold to a group led by one of its former subsidiaries, cargo carrier Varig Log.[1] Some major expansions also occurred. Tam Airlines became an international carrier with a fleet of over 90 new-generation Airbus and Fokker jets. Gol Airlines, the first low cost carrier in Latin America, was established in 2001 and is, as of 2007, the second biggest airline in Brazil. It has ordered more than a 100 narrow-body aircraft from Boeing and is pursuing an expansion of routes in both Brazil and other Latin American countries.

Other changes involve general agreements between established airlines. The most important—in terms of magnitude of involved airlines and duration of the agreement—was the code-share agreement between Tam and Varig, aimed as an intermediate step that would culminate in a merger between them. This broad agreement was signed in the beginning of the second quarter of 2003 and lasted until the second quarter of 2005. Its effect on domestic air transportation supply was seen to amount to cartel conduct. As a result the Brazilian Secretariat for Economic Monitoring (SEAE), an executive office of Finance Ministry, filled a lawsuit against the airlines—a process that culminated in a Federal resolution forbidding the agreement to proceed, contrary to the policy of the aviation authorities of a few years earlier.

3. The evolution of economic regulation of airlines in Brazil

Until recently, one of the characteristics of the Brazilian air transport industry was the gradual and continuous process of economic liberalization that had been initiated in the early 1990s by the Department of Civil Aviation within a broader governmental program for de-regulation of Brazil's economy.

From 1973 to 1986 regulation was linked to industrial policy. The government established a framework of four national airlines and five regional airlines to regulate and promote the industry's development; a policy effectively completed in 1976. Prices were fixed, entry was banned, and the country was divided into five main monopolies for the regional airlines. Competition between regional and national trunk airlines was virtually absent. From 1986 to 1992, the government began being more intrusive in terms of macroeconomic interference in the industry, especially with respect to inflation stabilization targeting. This policy was generic and involved interfering in the pricing of all infrastructure and led to artificially low air fares that hit the finances of the airlines.

Table 1
Air transport revenues by segment (2002).

Sub-market	International	Domestic	Total	%
Scheduled-Pax	4,734	8,671	13,405	85
Charter-Pax	18	241	259	2
Mail	50	176	226	1
Freight	1,148	709	1,857	12
Others	0	21	21	0
Total	5,950	9,818	15,768	100

Source: Statistical Yearbook of the Department of Civil Aviation (vol. II); ii. In million BRL, values deflated to 2004 by using IBGE's Índice Nacional de Preços ao Consumidor Amplo.

Liberalization started in 1992, although some measures of de-regulation were already present from 1989 (e.g. fare bands). During this first round of liberalization, regional monopolies were abolished, with the exception of airport-pairs linking the centers of four major cities—São Paulo, Rio de Janeiro, Belo Horizonte and Brasília—the so-called "special airport-pairs". Furthermore, the policy of four nationals and five regionals was abolished, and entry was stimulated by the regulator, leading to a tide of new small airlines into the market.

To replace price fixing, reference prices and bounds from −50% to +32% of the main fare were introduced. Competition in prices was seen as "healthy" for the industry, and was encouraged; fare bounds were conceived only as temporary instruments for enhancing price rivalry. This can be regarded as a period of inactive stabilization policy control, as there was no need for the macroeconomic authorities to interfere in the market, no pressure for price increase, and lower instability on the costs side, as exchange rates were stable during most of it. In the late 1990s, the aviation authorities decided to remove the two main regulatory devices still remaining: the fare bounds and the exclusivity of rights for operating special airport-pairs by regional airlines. This generated the second round of liberalization (enacted in December 1997 to January 1998), which triggered intense price and frequency competition.

Another relevant characteristic of the period was the instability of exchange rates, especially the devaluation of January 1999, that resulted in a major increase in airlines' operational costs and impacted their activities with decreases in RPK and a smothered ASKs in 1999 (Fig. 1). Confronted by strong inflationary pressures, the macroeconomic authorities (Ministério da Fazenda) started interfering in the industry by initiating constraints on the ability of airlines to increase their prices. They had to wait for authorization from both the Department of Civil Aviation and the Finance

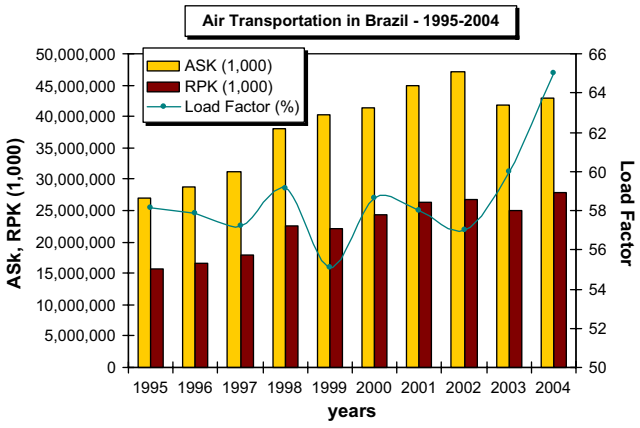

Fig. 1. The path of ASK and RPK.

[1] Varig was later incorporated by Gol Airlines.

Ministry. Additionally, the antitrust authorities were now closely monitoring the market.

In 2001, most of the remaining economic regulations were removed, and macroeconomic interference reduced. The sector entered a "quasi-de-regulation" period, as entry, price and frequencies were almost entirely liberalized. However, after a severe financial crisis for most airlines in 2002, the aviation authorities started implementing re-regulation in 2003, aiming at controlling an alleged excess capacity and over-competition in the market. New aircraft imports were banned, economics-related controls of flight frequencies were put in place again, and strategies that would lead to more market concentration, such as the code-share agreement between Varig and Tam, were stimulated.

4. Airline capacity setting

Here we study the determinants of airline capacity setting in Brazil, paying special attention to the impacts of the economic re-regulation measures and the code-share agreement of 2003 on supply. Capacity formation is examined by using a panel data of domestic routes. Route-specific data on flight operations were collected from the Department of Civil Aviation and disaggregated by airline/flight code. Like data from OAG (Official Airline Guide), these data contain complete details of the seats supplied by the scheduled airlines on domestic routes, with information about days of operation, airline, the assigned aircraft etc. The econometric model was the following:

$$\begin{aligned} seats_{kt} = {} & \alpha_{kt} + \beta_1 seats_{kt-1} + \beta_2 gdp_t + \beta_3 usd_t + \beta_4 drereg_t \\ & + \beta_5 dcodeshare_{kt} + \beta_6 dlccpres_{kt} + \beta_7 adjseats_{kt} \\ & + \beta_8 minairpseats_{kt} + \beta_9 trend + \sum_{s=2}^{4} \beta_{10+s} season_s \\ & + u_{kt} \end{aligned} \quad (1)$$

Indexes k and t represent route and time (quarter).

The dependent variable is the average number of weekly seats offered on route k, for the weekly average for quarter t. The use of the lagged valuable, $seats_{kt-1}$, reflects the expectation of a time series pattern in the data. The right-hand side variables include factors behind supply decision shifts. Two macroeconomic variables are included: gdp_t, Brazilian's GDP, and usd_t, the effective exchange rate in t. The former was built from nominal data obtained from Brazilian Geography and Statistics Institute and reduced to constant values using a wide consumer price index (Índice Nacional de Preços ao Consumidor Amplo), while the latter was obtained from the Brazilian Central Bank. These variables account for, respectively, global demand and cost conditions. Regulatory issues are dealt with the inclusion of $drereg_t$, a binary variable that assumes the value 1 whenever the observation belongs to the Re-regulation regulatory period, which started in the second quarter of 2003 and was active up to the end of the sampled period, in the fourth quarter of 2004, and 0 otherwise.

Four variables are proxies for market-specific conditions. $minairpseat_{kt}$ represents the minimum connectivity each route k has at time t and was obtained by picking the smallest number of weekly scheduled domestic seats supplied—whether in departure or in arrival movements—at each extreme of the pair of airports on route k, in time t. Another market variable included is $adjseats_{kt}$, which is an indicator of the number of $seats_{kt}$ in departing and/or arriving movements at adjacent airports, as in Morrison (2001). This variable has non-zero values when an observation refers to the cities of Belo Horizonte, Rio de Janeiro and São Paulo, where two commercial airports provide local communities with scheduled operations, one centrally located and other located in the outskirts of the city.

The code-share agreement between Tam and Varig from 2003 to 2004 is controlled with the inclusion of $dcodeshare_{kt}$, a binary variable that indicates if the observation relates simultaneously to one of the routes included in the code-share agreement, and, if so, during the period of this commercial agreement: from the first quarter, 2003 up to the end of period, the fourth quarter, 2004. Concern with the impacts of this type of joint business strategy has been raised by Heimer and Shy (2006), for example. The final variable relating to market structure is $dlccpres_{kt}$. This is a binary variable taking a unity value whenever Gol operates on route k, at time t. The inclusion of this variable follows Morrison (2001). Other variables included for econometric control purposes are binary variables that make reference to seasonal time periods ($season_s$), plus a time trend t.

Data were collected weekly and then averaged to produce quarterly statistics between the third quarter of 1998 and the fourth quarter of 2004, giving 26 quarters of data. Only routes linking the 30 biggest national airports and with non-interrupted air link during the 26 quarters were considered. These airports were obtained after summing up all scheduled domestic number of seats (either arrivals or departures) that go through each airport in an average week. This set of 30 airports account for 90% of weekly domestic seats. In the sampled period, there were 282 direct links satisfying the initial criteria. The application of this methodology generated a sample of 7332 route–quarter pairs. Links that are possible with connecting flights (when there is at least one intermediate de-boarding and re-boarding procedure, with the change of equipment and/or flight number) were not generated. Descriptive statistics are presented in sequence.

As regards macroeconomic variables, GDP is expected to be positively related to capacity since air travel is generally seen as normal good. As far as the exchange rate is concerned, we expect that a strong national currency stimulates airline activity because costs related to aircraft leasing and the import of fuel, spare parts and other inputs are lower. Because the analysis only covers domestic flights, any effects of an exchange rate devaluation on the foreign market will not directly affect the calculations, although there may be secondary effects via such variables as GDP. A negative sign is expected for $drereg_t$ in case of the efficacy of the re-regulation measures of 2003 in decreasing the freedom of airlines to set capacity (Table 2).

It is anticipated that the concentration of seats at the extremes of a route should have a positive impact on supply, a hypothesis consistent with the effects of network connectivity for attracting non-local traffic for the link. This phenomenon corresponds to the effects that hubs have on generating economies of density on links. The variable for adjacent airports is expected to have negative sign because of standard substitution effects. Code-share agreement between Tam and Varig is expected to reduce the capacity in case they effectively coordinated their services as a cartel. Finally, the binary variable for the presence of Gol is expected to exert a positive effect, as the presence of this airline would intuitively seem to be associated creating denser routes. In other words, we expect

Table 2
Descriptive statistics.

Variables	Average	Std. dev.	Min.	Max.
$Seats_{kt-1}$	5073.373	6866.763	36.000	81,831.000
gdp_t	411,853.592	28,831.230	355,256.200	478,340.900
usd_t	106.426	10.044	90.004	124.159
$drereg_t$	0.115	0.320	0.000	1.000
$dcodeshare_{kt}$	0.127	0.333	0.000	1.000
$dlccpres_{kt}$	0.236	0.425	0.000	1.000
$adjseats_{kt}$	2646.230	7576.755	0.000	90,659.030
$minairpseats_{kt}$	27,665.680	31,446.191	140.000	237,416.700

Table 3
Market capacity supply model estimation results.

Variables	FGLS	Arellano–Bond
$seats_{kt-1}$	0.941[a]	0.175[a]
gdp_t	−0.004	0.006[a]
usd_t	−22.429[a]	−1.829[c]
$drereg_t$	−391.988[a]	−100.884[a]
$dcodeshare_{kt}$	−178.549[b]	−273.695[a]
$dlccpres_{kt}$	276.099[a]	361.744[a]
$adjseats_{kt}$	−0.006[a]	−0.024[a]
$minairpseats_{kt}$	0.011[a]	0.119[a]
trend	−21.219	−51.479[a]
$season_2$	26.00	−106.132[b]
$season_3$	49.736	−71.292[c]
$season_4$	441.326[b]	−107.313[b]
constant	4560.942[b]	−469.573

Notes: Omitted fixed effects.
[a] Significant at 1%.
[b] Significant at 5%.
[c] Significant at 10%.

a Gol-effect, similar to the "Southwest Airlines Effect" in the US, with its presence exerting a significant boost to traffic as fare cuts are forced on the market.[2]

5. Results

For estimation, two procedures are used. First, feasible generalized least squares (FGLS) are deployed, allowing for estimation in the presence of AR(1) autocorrelation within panels and cross-sectional correlation and heteroskedasticity across panels. Second, the Arellano–Bond linear dynamic panel-data estimator is used, by treating the unobserved panel-level effects as correlated with the lagged dependent variable $seats_{kt-1}$. Table 3 presents the results.

The calculations indicate that the re-regulation measures ultimately led to a reduction in the supply of seats (the coefficient of $drereg_t$ has a negative sign), as did the code-share agreement between Tam and Varig. Thus, there is evidence that the Brazilian competition authorities were probably correct to expect negative, anti-competitive consequences as a result of the agreement.

Gol's in a market presence was associated with a greater supply of seats; the coefficient of $dlccpres_{kt}$ was positive and highly significant in both the specifications. However, while the positive sign may be an indication of Gol-effect, it may also indicate that Gol elects to enter the denser routes. Oliveira (2008) uses a discrete-choice model with instrumentation of endogenous variables to investigate the determinants of Gol's entry and found that seat availability was associated with route profitability and thus induced the entry. Also, as incumbents were in a fragile financial situation, any preemptive behavior aiming at predation may not have been a realistic explanation for the competitive interaction among players. Lacking a structural model to better address the identification issues, no conclusive answer can be given. Other work has demonstrated, however, that entry by low cost carriers is often followed by a "cut fares and add flights" strategy (Whinston and Collins, 1992), which is consistent with our results.

To explore whether the negative effect of the code-share agreement on supply was fully compensated by the positive effect of Gol's entry, we employed a Wald test of the linear restriction $\beta_5+\beta_6=0$ in Eq. (1). In both models the null hypothesis was not rejected, indicating that the presence of Gol represented a relevant restriction for Varig and Tam to coordinate their schedules and to adjust supply downwards. This is illustrative of how the relaxation of entry barriers may be important in sustaining a competitive environment even when market concentration increases. Today there is a highly concentrated market in Brazil, with Tam and Gol having more than 90% of operations and passengers. Our results suggest that a regulator aiming at stimulating competition may have to pursue a positive strategy of allowing newcomers to more easily access markets, especially at highly congested, slot-constrained airports.

The variables reflecting operations at adjacent airports and route connectivity are also significant and with intuitive signs. The $adj'seats_{kt}$ effect can be seen as as an indication that travelers consider airports in the same geographical region as substitutes to a certain degree. Also, $min'airpseat_{kt}$ shows an expected positive sign, suggesting the possibility of network externalities and the generation of additional demand for each of the routes leaving or arriving at airports with multiple connections.

The macroeconomic variable, gdp_t, is only statistically significant when used with the Arellano–Bond estimator because the inclusion of trend and seasonal effects partially capture national income changes. Also, usd_t has a negative and significant effect on the supply of seats supply, which is in line with the importance that exchange rate-related costs have for Brazilian airlines. Episodes of exchange rate overshooting as after the exchange rate liberalization of 1999 would thus seem to have contributed to the instability in the Brazilian air services market.

6. Conclusions

This paper quantified some of the factors that influence the decision-making of Brazilian airlines regarding their supply of capacity in the domestic scheduled network. It paid particular attention to the re-regulation of the industry in 2003 and a code-share agreement between two of the biggest network airlines. Although the econometric framework lacks adequate demand data, the more straightforward reduced form is sufficient for illustrating the basic forces behind airline capacity setting in Brazil. Available seats were significantly reduced during the period of re-regulation and of the code-share agreement but there is clear evidence that the route presence of a low cost carrier imposed relevant constraints to the potential anti-competitive behavior of the major airlines in the market.

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[2] Morrison (2001) and Boguslaski et al. (2004) explicitly deal with this effect. However, whether Gol Airlines is fully comparable to the low-cost paradigm is unclear (Oliveira, 2008).