REGULATORY REFORM OF THE BRAZILIAN AIRLINE MARKET: AN ASSESSMENT OF THE EFFECTS ON COMPETITION

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Abstract

This study aims to develop a competition model for a relevant subset of the Brazilian airline industry: the air shuttle market of Rio de Janeiro – São Paulo route, a pioneer service created in 1959. The competition model presented here contains elements of both vertical product differentiation and representative consumer. We also use the conduct parameter approach to infer about the behavior of airlines in the market, under three situations: a quasi-deregulation process (from 1998 on), two price-war events (1998 and 2001), and a shock in costs, due to the currency devaluation (1999). Results permitted making inference on the impacts of liberalization on competition, and investigating an alleged collusive behavior in 1999.

1. INTRODUCTION

This study aims to develop a competition model for a relevant subset of the Brazilian airline industry: the air shuttle service on Rio de Janeiro - São Paulo route. The first air shuttle in the world was created in this market in 1959, called 'Ponte Aérea' (Air Bridge), as an agreement of airline managers, and has dominated this airport-pair, linking the city centers for almost forty years.

Air shuttles are usually characterized by frequent service, walk-on flights, with no reservations, and short-haul markets. Nowadays this concept is very common in the airline industry, usually providing service for highly time-sensitive passengers, with notorious examples being the Eastern Airlines' Boston-New York-Washington and the Iberia's Madrid-Barcelona. These airlines were pioneers in launching air shuttles in the United States (1961) and in Europe (1974), respectively[1].

The competition model presented here was developed to represent the rivalry and strategic interdependence among individual air shuttles and coalitions on the route. It contains elements of vertical product differentiation, in a very special case, as it assumes the representative consumer hypothesis, in a different framework from Sutton's (1986). It also uses the conduct parameter approach (as in Genesove and Mullin, 1998) to infer about the behavior of airlines in the market, under three conditions, found in the sample: a quasi-deregulation process (from 1998 on), two events of price war (1998 and 2001), and a shocking event in costs (1999).

The methodology permitted making inference on the impacts of liberalization by authorities, on the competition in the market. Besides that, it also permitted investigating an alleged collusive behavior in the second semester of 1999, when all airlines set the same price increase, right on the same day.

2. HISTORICAL BACKGROUND

The domestic air transportation in Brazil is a fast-growing industry. According to the Department of Civil Aviation, there were 27 billion seat-kilometers available in 2001, against 12 billion in 1992, representing a growth amount of more than ten percent per year, a much higher rate if compared to the percentage growth of the country's overall economy.

Like most airline industries around the world, Brazilian air transport is rather dependent on both domestic and international economic conditions, due to its derived demand characteristics. In fact, this situation can even be aggravated when the country experiences usual currency exchange instability, often affecting not only the demand for international traveling, but also aircraft leasing, maintenance, and fuel costs. Indeed, a relevant overshooting of costs, in dollars, and consequent airline financial crisis was recently observed, caused by the governmental change in monetary regime allowing fluctuation. Figure 1 shows the degree of correlation among the effective exchange rate US$/R$ and the unit costs of one of the major Brazilian airlines:

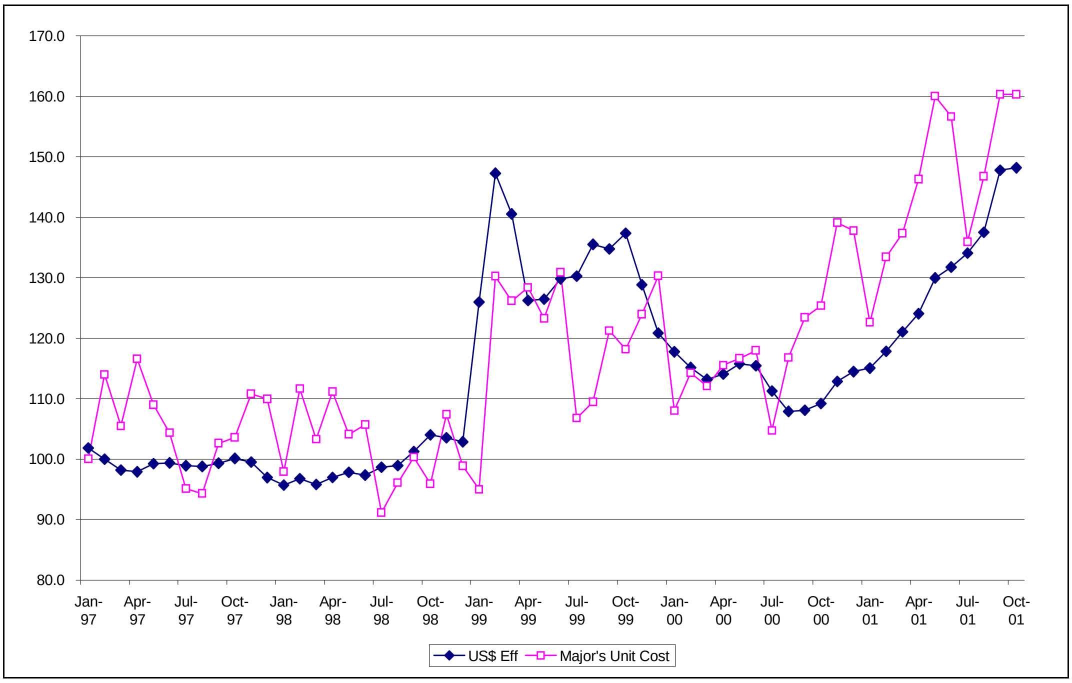

Figure 1 – Evolution of Effective Exchange Rate US$/R$ and Unit Costs of a Brazilian Airline[2]

Added to that, Brazilian's domestic segment has been inserted in a gradual and continuous process of economic liberalization. Started at the end of the eighties, within a broader governmental program for deregulation of the country's economy, this series of changes in the authorities' policy can be divided into three main periods: the first phase, with the stimulus of new airlines to be entering in the market and the introduction of lower and upper bounds for prices (1989-1997); the second phase, with more liberalization of route entry and bounds (1998-2001); and the third phase, with virtually full deregulation (from August 2001). As a result, a remarkable increase in the degree of industry's competitiveness was recently observed; notably, the rivalry among airlines led price to have relevant reductions, and market has been expanded since 1998.

This phenomenon was exacerbated on Rio de Janeiro - São Paulo route, the country's densest flow, linking its most well known cities. One important subset of this market is the airport-pair Santos Dumont (SDU, Rio de Janeiro) - Congonhas (CGH, São Paulo), one of the so-called Special Airport-Pairs – SAPs. They are airports located close to the city center, in the main cities of the southeast of Brazil and with connections to Brasília, the capital of Brazil. Notably, the SDU-CGH airport-pair is closely related to the competition of non-reservations, walk-on, ***air shuttles*** in the market. In fact, the first air shuttle in the world was created there, in 1959, the 'Ponte Aérea' (Air Bridge)- two years before the pioneer service of Eastern Airlines shuttle in the United States.

Since its creation, this air shuttle had a remarkable feature that helps to understand market dynamics nowadays: it was formed by an alliance of airlines, in a code share agreement by Varig, Cruzeiro and Vasp, in order to compete with the dominant firm in the market (Real). In the medium term, however, it became the dominant airline itself, with a considerable stake for almost forty years, constituting one of the most durable alliances of commercial air transport.

With the gradual deregulation measures of the nineties, the agreement started losing strength. After years of operations, under the approval of the regulators3, its dominance started to be criticized, especially due to fearing for exercise of market power in the newly liberalized market conditions. In fact, when regional airlines were allowed to enter the route, in 1989, the 'Ponte Aérea' was seen more as a cartel of major airlines, than as a common pooling agreement.

However, only in 1998, competition was finally introduced in the SDU-CGH airport-pair. This was stimulated by another step towards deregulation, when the authorities put an end to the regulatory barriers to entry in all DCF routes, and thus, permitted a rupture in the quasi-monopoly structure of the market, in January 1998. This process ultimately led to the dissolution of the cartel, announced in June.

The end of the cartel did not represent an end of air shuttle features on the route. On the contrary, new air shuttles were created by the existing airlines, in order to attract highly time-sensitive demand, and to cope with the increasingly fierce competition. Next section provides a more detailed description of the main characteristics of the market.

3. MARKET CHARACTERISTICS

In general, air shuttle markets are characterized by very frequent service4, with hourly (or less-than-hourly) walk-on flights, usually not requiring reservations. There might be slight variations due to country-specific airline legislation but, basically, the main idea of shuttles is to serve a very time-sensitive demand5. In addition to that, air shuttles are commonly operating on short-haul routes, such as Washington-New York, Madrid-Barcelona, etc.

The SDU-CGH air shuttle market is formed by central-site airports in Rio de Janeiro and São Paulo, and is a non-stop flight of approximately 50 minutes (365 kilometers). This airport-pair is a subset of the market, consisting of the route linking those cities, which includes International Airports of Galeão / Antônio Carlos Jobim (GIG, in Rio de Janeiro) and Guarulhos (GRU, in São Paulo). Nevertheless, among the four possible airport-pair compositions, GIG-GRU is the most relevant alternative to SDU-CGH. Table 1 presents how demand is distributed on airport-pairs in this city-pair market:

Table 1 – Demand Distribution on Airport-Pairs[6]

AIRPORT-PAIR	1 SEM 1997		1 SEM 2001	
GIG-GRU	396,889	26,4%	359,777	14,8%
GIG-CGU	3,793	0,3%	183,935	7,6%
SDU-GRU	3,166	0,2%	7,010	0,3%
SDU-CGU	1,101,390	73,2%	1,879,428	77,3%
Total RJ-SP	1,505,238		2,430,150	+61%

Concerning the airport-pair route, other alternatives for travelers include coach and telecommunications possibilities. The former represents the only transportation alternative to air travel, since a rail system for passengers is not available. The latter has usually been reported as relevant by the transportation literature: “During the economic downturn of the early 1990s [in the United States] (...) many businesses were relying on facsimile machines, electronic mail, and videoconferences in place of air travel”; and “(...) the demand for business and some personal air travel will be diminished in future years, to a degree that is hard to predict, as these technologies are improved and become less expensive” (O’Connor, 1995). Besides that, it must be emphasized that the telecommunication industry was privatized and liberalized, during the mid-nineties in Brazil, and the consequent fall of tariffs made this alternative even more attractive to consumers of the SDU-CGH market.

The demand for air transportation in Brazil has some peculiarities, which were well described by Franco et al. (2002): “The price elasticity of demand for domestic flights is low. A study carried out by the Airlines Labor Union -SNEA indicates that 71% of the passengers in Brazil between 1980 and 1996 were in business trips, while the international average is 55%, according to the IATA. Most of the passengers are middle age businessmen (74%) with a high purchasing power.

According to a survey of the Brazilian Newspaper *Gazeta Mercantil*, the three most important factors taken into account by businessmen when choosing the companies are the existence of direct flights, the time of departure and the number of frequencies. Prices of air tickets came only in the fourth place”[7].

Basically, there were 5 airlines operating in the airport-pair, in the period under analysis: Varig, Vasp, and Transbrasil (trunk), and Tam and Rio-Sul (regional). Recently, a low-cost carrier (Gol) has entered in the market and Transbrasil was out of it, due to its bankruptcy. Besides that, Tam has become one of the country’s major airlines, along with Varig and Vasp. All airlines use B737-200 (132 seats) to operate this route, except for Rio-Sul (B737-500 and ERJs) and Tam (A319)[8].

Table 2 provides an idea of the evolution concerning the code-share agreements in the market. It can be inferred that, except for Vrg-Rsl, which is an agreement of a major airline with its subsidiary, other formal coalitions have not been permanent after the dissolution of ‘Ponte Aérea’ service. On the contrary, both Vsp-Tba shuttle (Sep/98-May/99) and Tam-Tba agreements (May/00-Jan/01) were unstable and short-lived.

Table 2 – The evolution of Agreements in the CGH-SDU Airport-Pair

Codeshare	1997				1998				1999				2000				2001			
Agreements	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q
Ponte Aerea	■	■	■	■	■	■														
Vrg-Rsl							■	■	■	■	■	■	■	■	■	■	■	■	■	■
Tba-Vsp							■	■	■	■										
Tam-Tba														■	■	■				

Finally, concerning its concentration levels, a considerable decrease in the flight frequency concentration was observed, since the liberalization measures of 1998. This can be seen in Figure 2, which depicts the evolution of the Herfindhal-Hirschman index:

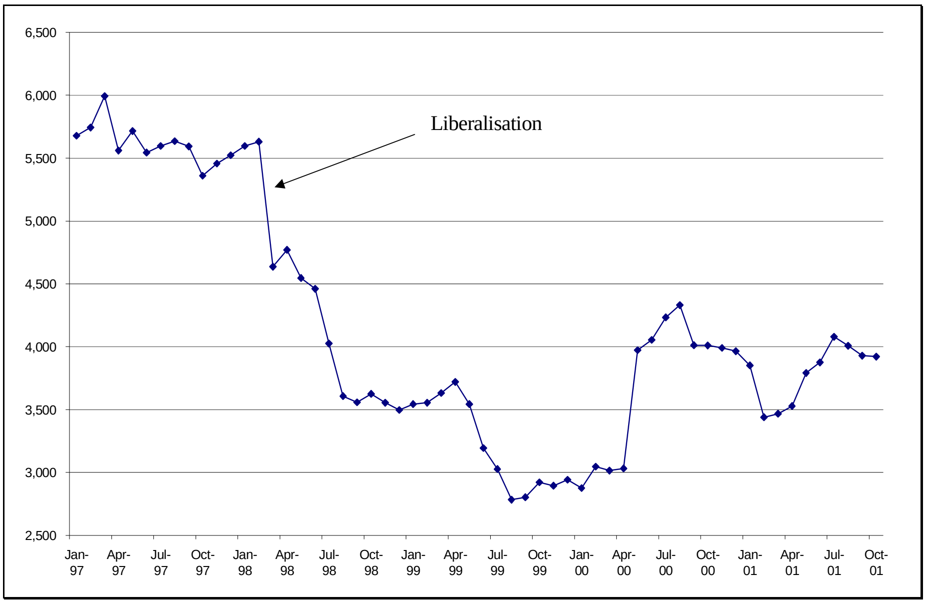

Figure 2 – Herfindhal-Hirschman Index Path[9]

4. THEORETICAL MODEL

The following subsections contain the proposed theoretical framework, for modeling competition in air shuttle markets, such as the Brazilian 'Ponte Aérea': demand (4.1), costs (4.2) and pricing/conduct sides (4.3); its empirical counterpart is found in section 5.

4.1 Demand Side

Consider a market with both *vertical product differentiation* and *representative consumer*. These assumptions form the core of the present model, and can be regarded as a reasonable representation of the Brazilian air shuttle market, as following discussed.

Firstly, the use of vertical product differentiation features for modeling competition, in the airline industry, follows Marín's (1995)[10], and there is clear evidence that this assumption makes even more sense, in this particular sort of market (air shuttles). If we consider *flight frequency* as the most relevant competitive variable here, then it seems coherent to suppose that an increase in the level of this characteristic, represents a benefit for all passengers and not only for a subgroup. Therefore, this timesaving benefit, with such additional flights, is global and relevant, since it reduces schedule delays for the passengers[11].

Secondly, considering the representative consumer hypothesis, as in Spence (1976) and Dixit and Stiglitz (1977), this particular shuttle service market has the majority of its consumers with similar features, concerning their trip purposes, staying periods, reservation habits, time sensitive demands; then it is also reasonable to conclude that, to aggregate them, would not cause a significant loss of generality. Indeed, even when performing the modeling of consumer segments, for this specific market (Oliveira, 2003), the results did confirm a relatively high homogeneity, concerning its consumers' preferences[12]. Besides that, one relevant conclusion when using this assumption is (as in any non-addressing approach) that, the representative consumer will acquire a variety of products. It also seems reasonable, if we think of air shuttle as having "walk-on" features, that passengers would usually choose the next flight available, in the overall timetable, guaranteeing that each firm will have positive market shares, and that is also very correlated to the flight frequency. Consider then, the following utility function $u_r(.)$ for the representative consumer[13]:

$$u_r(i) = \delta_0 \left(\frac{\phi f_i}{p_i} \right)^{\delta_r} \quad , \quad \phi > 0 \quad , \quad 0 < \delta_r < 1 \qquad (1)$$

Where f_i, f and p_i, are, respectively, firm i and the market's flight frequencies, and firm i's price; ϕ represents the value attributed to frequency (value of waiting time, as in Berechman and Oz, 1995). $<\delta_0, \delta_r>$ is a vector of unknown parameters.

Term δ_r contains three main characteristics: first, it is positive and lower than one, in order to represent the diminishing marginal utility; second, it is decreasing in firm i's market supply share (f_i/f, hereinafter called ν_i); and third, it is decreasing in a measure of airport dominance, ψ_i[14], based on Borenstein (1991). For the present case, these variables were developed focusing only the traffic, originated at one airport for other DCF routes[15], because they tend to be more homogeneous, and account for the effect of regional airline monopoly, previous to the liberalization of 1998.

Thus, δ_r was modeled as in (2):

$$\delta_r = \delta_1 - \delta_2 \nu_i - \delta_3 \psi_i \qquad (2)$$

Where $<\delta_1, \delta_2, \delta_3>$ is a vector of unknown parameters.

Firm i's market share[16] can be developed then, as in (3):

$$s_i = s\left[\frac{u_r(i)}{u_r(i^-)}\right] = \beta_0 \left[\frac{u_r(i)}{u_r(i^-)}\right]^{\beta_1} = \beta_0 \left[\frac{p_i / f_i}{p_{i^-} / f_{i^-}}\right]^{-\beta_1^* + \beta_2^* \nu_i + \beta_3^* \psi_i} \qquad (3)$$

with $\left\langle \beta_1^*, \beta_2^*, \beta_3^* \right\rangle = \beta_1 \left\langle \delta_1, \delta_2, \delta_3 \right\rangle$

Where index i^- is used for firm i's *average opponent*, as in Slade (1986); s_i is firm i's market share, and $<\beta_0, \beta_1>$ is a vector of unknowns.

Consider now, the following market demand function:

$$q = \alpha_0 p^{-\alpha_1} \prod_{k \geq 2} X_k^{\alpha_k} \qquad (4)$$

Where q, p and X are, respectively, market size, overall price, and a vector of demand shifters. Price p is a result of a geometric average of the firms' prices, p_j, expressed by their shares of total flight frequencies, ν_j (j = 1,2,...,N), as in (5):

$$p = \prod_{1 \leq j \leq N} p_j^{\nu_j}, \quad \nu_j = \frac{f_j}{f}, \quad \sum_{1 \leq j \leq N} \nu_j = 1 \qquad (5)$$

By using (3), (4) and (5) it is possible to extract the own demand of firm i, as well as its cross price elasticity:

$$\eta_{ii} = -\beta_1^* - \nu_i \left(\alpha_1 - \beta_2^*\right) + \beta_3^* \psi_i \quad \text{and} \quad \eta_{ii^-} = +\beta_1^* - \beta_2^* \nu_i - \alpha_1 \nu_{i^-} - \beta_3^* \psi_i \qquad (6)$$

4.2 Costs Side

Taking into consideration the following Cobb-Douglas total (short-run) variable cost function:

$$\mathrm{TC_i} = \varphi\ \mathrm{K_i^{\varpi_k} Q_i^{\varpi_0}} \prod_{\mathrm{g}} \Gamma_{\mathrm{ig}}^{\varpi_{\mathrm{g}}} \qquad (7)$$

Where TC_i, K_i and Q_i are, respectively, firm i's total variable cost, capital level, and production *for all routes*, C_{i0} is firm-specific fixed cost (within variable categories), Γ_{ig} is the price of production factor g, paid by firm i, and ω_g is firm i's production cost elasticity.

The marginal cost function related to (7) is, as follows:

$$\mathrm{MC_i} = \frac{\partial \mathrm{TC_i}}{\partial \mathrm{Q_i}} = \varpi_0 \varphi\ \mathrm{K_i^{\varpi_k} Q_i^{\varpi_0 - 1}} \prod_{\mathrm{g}} \Gamma_{\mathrm{ig}}^{\varpi_{\mathrm{g}}} \qquad (8)$$

In order to provide a link, between MC_i (overall marginal cost) and c_i (route-level marginal cost), the Brander and Zhang's (1990) definition[17] was applied:

$$c_i = MC_i d \left(\frac{d}{\bar{d}_i}\right)^{-\lambda} \quad \mathrm{c_i} = \mathrm{MC_i d}\left(\frac{\mathrm{d}}{\mathrm{AVSTLE_i}}\right)^{-\lambda} \qquad (9)$$

Where d is the airport-pair distance and $\bar{\mathrm{d}}_\mathrm{i}$ is firm i's average stage length. λ is a route-specific parameter, usually equal to 0.50 in transport economics literature, followed herein[18]. It accounts for the phenomenon of "cost taper" meaning that "total cost per passenger-*mile* drops as the length of the trip grows" (O'Connor, 1995). Cost taper may be a relevant feature, especially in the context of short-hauls, due to the higher costs per seat-mile – known as the "short-haul problem", usually affecting air shuttle markets[19].

4.3 Pricing and Conduct Relations

This study follows Berry (1990) and Berry, Carnall and Spiller (1996), assuming static price competition for airline market, with product differentiation[20].

Then, a first-order condition can be developed, as follows:

$$\underset{p_i}{\mathrm{Max}}(p_i q_i - tc_i) \Rightarrow p_i = c_i - \frac{\theta_i}{\eta_{ii}} p_i$$

$$p_i\left(1-\frac{\theta_i}{\eta_{ii}}\right) = c_i \rightarrow p_i = c_i\left(1-\frac{\theta_i}{\eta_{ii}}\right)^{-1} \rightarrow \ln p_i = \ln c_i - \ln \varphi_i$$

$$\frac{p_i - c_i}{p_i} = -\frac{\theta_i}{\eta_{ii}} \rightarrow L_i = -\frac{\theta_i}{\eta_{ii}} \rightarrow L_i^{\eta} = \theta_i(.)$$

$$\underset{p_i}{Max}(p_i q_i - tc_i) \Rightarrow p_i \frac{\partial q_i}{\partial p_i} + q_i \frac{\partial p_i}{\partial p_i} - \frac{\partial tc_i}{\partial p_i} = 0 \Rightarrow \tag{10}$$

$$\Rightarrow p_i \frac{\partial q_i}{\partial p_i} + q_i - c_i \frac{\partial q_i}{\partial p_i} = 0 \Rightarrow p_i = c_i - \left(\frac{\partial q_i}{\partial p_i}\frac{\partial p_i}{\partial p_j}\right)^{-1} q_i = c_i - \left(\frac{\partial q_i}{\partial p_i}\theta_i\right)^{-1} q_i \frac{(p_i q_i)}{(p_i q_i)} \Rightarrow$$

$$\Rightarrow p_i = c_i - \theta_i \frac{\partial p_i}{\partial q_i}\frac{q_i}{p_i} p_i \Rightarrow p_i - c_i = \frac{\theta_i}{\eta_{ii}} p_i \Rightarrow \frac{p_i - c_i}{p_i} = \frac{\theta_i}{\eta_{ii}} = \ell_i$$

Where tc_i, c_i, θ_i and ℓ_i are, respectively, firm i's total cost, marginal cost, conduct parameter (in a conjectural variations framework), and Lerner index. An estimated conduct function can be directly identified by calculating the *elasticity-adjusted Lerner index*, $LI_i^{\eta} = \ell_i \eta_{ii} = \theta_i$, as in Genesove and Mullin (1998). The present study follows Oum, Park and Zhang (1996), and assumes the following linear relationship for the conduct function:

$$LI_i^{\eta} = \theta_i = \varphi_0 + \sum_k \varphi_k Z_k^1 + \sum_l \varphi_l Z_l^2 + \sum_m \varphi_m Z_m^3 \tag{11}$$

Where Z^1, Z^2, and Z^3 are variables representing, respectively, (firm and market) demand, costs and market structure[21].

Basically, there are three notable benchmarks for θ_I to assume, which can be compared to an estimated conduct:

If $\theta_i = 0$, then p = c and then, we have Bertrand conduct for homogeneous product;

If $\theta_i = 1/N$, then, we have Cournot conduct for homogeneous product;

If $\theta = 1$, there is matching behavior in prices ($\partial p_i / \partial p_j = 1$);

Equations (3), (4), (7) and (11) are a system of equations, and form the model of competition proposed here, which is estimated in the following section.

5. EMPIRICAL MODEL

This section provides an empirical counterpart of the model, developed in the last section:

equations (12), (13), (14) and (15) presented as follows:

$$\ln\sigma_i = b_1 - b_2 \ln r_i + b_3 \nu_i \ln r_i + b_4 \psi_i \ln r_i - b_5 \ln \sigma_0 + \sum_k \chi_{1k} d_{1k} + \varepsilon_1 \qquad (12)$$

Where $r_i = [(p_i/f_i)/(p_{i-}/f_{i-})]$; σ_0 is the market share of an *outside alternative* (in this case it is the market share of the alternative airport-pair GIG-GRU22), and σ_i is the market share of firm i. The outside alternative is used here, in order to add up restriction to be imposed: σ_i is equal to q/q* (where q* is the market, as a whole), and σ_0 is a dropped equation, calculated as a residual $(1 - \sigma_i)$[23]. For a discussion of outside alternative, see Anderson, de Palma and Thisse (1992). The χ_{1k}'s and the d_{2k}'s are, respectively, unknowns and dummy variables expressing the firm-specific shifts, in the market share equation.

Total demand is estimated, using the following relation:

$$\ln q^* = \begin{cases} a_0 - a_1 \ln p + a_2 \ln gdp_{t-1} - a_3 \ln irate_{t-1} + a_4 coach_{t-1} + \\ + a_5 tel_{t-3} + a_6 dlowcst - a_7 dfire + \varepsilon_2 \end{cases} \qquad (13)$$

Where p is an overall price variable (for both inside and outside alternative, measured by its passenger-kilometers estimate); gdp is a gross domestic product index; irate is an interest rate index; coach is an average index of coach prices in Rio de Janeiro and São Paulo states; and tel is an average index of telecommunication prices, at the same area; dlowcst and dfire are dummy variables representing, respectively, the entry of a low cost carrier at the international airport, GIG, in 2001, and the fire at the SDU airport, in 1998.

Total variable cost function, related to (7), is as follows:

$$\ln TC_i = \ln C_{i0} - \omega_k \ln K_i + \varpi_0 \ln Q_i + \varpi_1 \ln L_i + \varpi_2 \ln F + \varpi_3 \ln USD + \varepsilon_3 \qquad (14)$$

Where L_i is the average labor prices of firm i; F and USD are, respectively, the overall fuel prices in dollars, and the average real/dollar exchange rate.

Finally, the Lerner Index equation is, as follows (15):

$$LI_i^{\eta} = \gamma_0 + \gamma_1 hhi + \gamma_2 q^* + \gamma_3 \delta_i + \gamma_4 dagr + \gamma_5 dus_{99} + \gamma_6 dfire + \sum_m \chi_{2m} d_{2m} + \varepsilon_4 \qquad (15)$$

Where hhi is the Herfindhal-Hirschman index of concentration, dagr is a dummy for shifts, due to code-share agreements, and dus_{99} is a dummy for the first months after the 1999's currency devaluation. Again, the firm-specific shifts are included, by using χ_{2k}'s and d_{2k}'s.

A two-step, two-stage least squares procedure, is used here – as suggested by Slade (2001)[24] – for equations (12), (13) and (15). Data was available, in monthly basis, from Jan-97 to Oct-01, for both SDU-CGH and CGH-SDU directional markets[25]. A panel of all airlines of the route (VRG, VSP, TBA, TAM and RSL) forms the sample, and code-share agreements are counted as only one player. Total variable cost function is estimated with OLS, by using a panel of the nineteen most important airlines of the country (4 trunk and 15 regional), in quarterly basis (Q1-97 to Q3-01). All information was kindly given by Brazil's Department of Civil Aviation.

Exogenous demand (gdp and irate) and cost (K, F, USD, $\bar{d}_i$) variables are used as instruments, except for labor's prices L, possibly endogenous in such market of highly skilled workforce. Thus, other input price variables (fuel and effective exchange rate) were regarded, as non-correlated with either demand or first-order condition shocks, and were then used for estimation purposes. Coach and telecommunication prices of other regions in Brazil, were also used as instruments[26].

A quite relevant variable, the flight frequency, could be regarded as exogenous, for at least two reasons. Firstly, the permission for route assignment (CLA), by the national commission, was still needed in case of any changes; secondly, CGH airport is a highly congested airport, with fixed slots, and thus, it is not only difficult to quickly adjust flight frequencies to demand shocks, but also it would be a very hard strategic decision, for any airline to take, since it could be irreversible. However, it is nevertheless feasible, for any airline, to respond demand shocks by adjusting its flight capacity, either by changing the aircraft being used, or by using the available slot, offering its service to a different city. On account of that, the flight frequency on the route was *not* used as an instrument of the analysis.

Table 3 presents the results of the model estimation.

Table 3 – Estimation Results[27]

$\ln \sigma_i$		$\ln q^*$		ln TCi		LI^{η}_i	
constant	-2.677	constant	5.277	constant	-1.114	constant	0.307
	(0.13)		*(0.82)*		*(1.01)*		*(0.03)*
$\ln r_i$	-0.770	ln p	-0.600	$\ln K_i$	0.051	hhi	0.398
	(0.05)		*(0.04)*		*(0.02)*		*(0.10)*
$v_i \ln r_i$	0.882	$\ln gdp_{t-1}$	1.252	$\ln Q_i$	0.643	q*	-0.024
	(0.20)		*(0.13)*		*(0.01)*		*(0.00)*
$\psi_i \ln r_i$	0.141	$\ln irate_{t-1}$	-0.207	$\ln L_i$	0.476	s_i	-0.397
	(0.07)		*(0.02)*		*(0.05)*		*(0.04)*
$\ln \sigma_0$	-0.515	$\ln coach_{t-1}$	0.471	ln F	0.268	dagr	0.099
	(0.08)		*(0.12)*		*(0.12)*		*(0.01)*
d_{11}	1.042	$\ln tel_{t-3}$	0.244	ln USD	0.459	dus_{99}	-0.101
	(0.17)		*(0.03)*		*(0.20)*		*(0.01)*
d_{12}	0.804	dlowcst	0.051			d_{21}	-0.473
	(0.04)		*(0.01)*				*(0.01)*
d_{13}	-0.212	dfire	-0.186			d_{22}	-0.444
	(0.05)		*(0.01)*				*(0.01)*
d_{14}	-0.398					d_{23}	-0.345
	(0.06)						*(0.02)*
						d_{24}	-0.397
							(0.03)
Observ.	378	Observ.	378	Observ.	321	Observ.	378
R2	0.884	R2	0.807	R2	0.957	R2	0.936
F test	361.8	F test	226.8	F test	1442.4	F test	616.2
Std.Dev.	0.289	Std.Dev.	0.083	Std.Dev.	0.457	Std.Dev.	0.062

By using the estimated results of Table 3, it is possible to infer about the conduct, performed in the market. Figure 3 presents the path of estimated conduct, considering the average of the whole CGH-SDU air shuttle market:

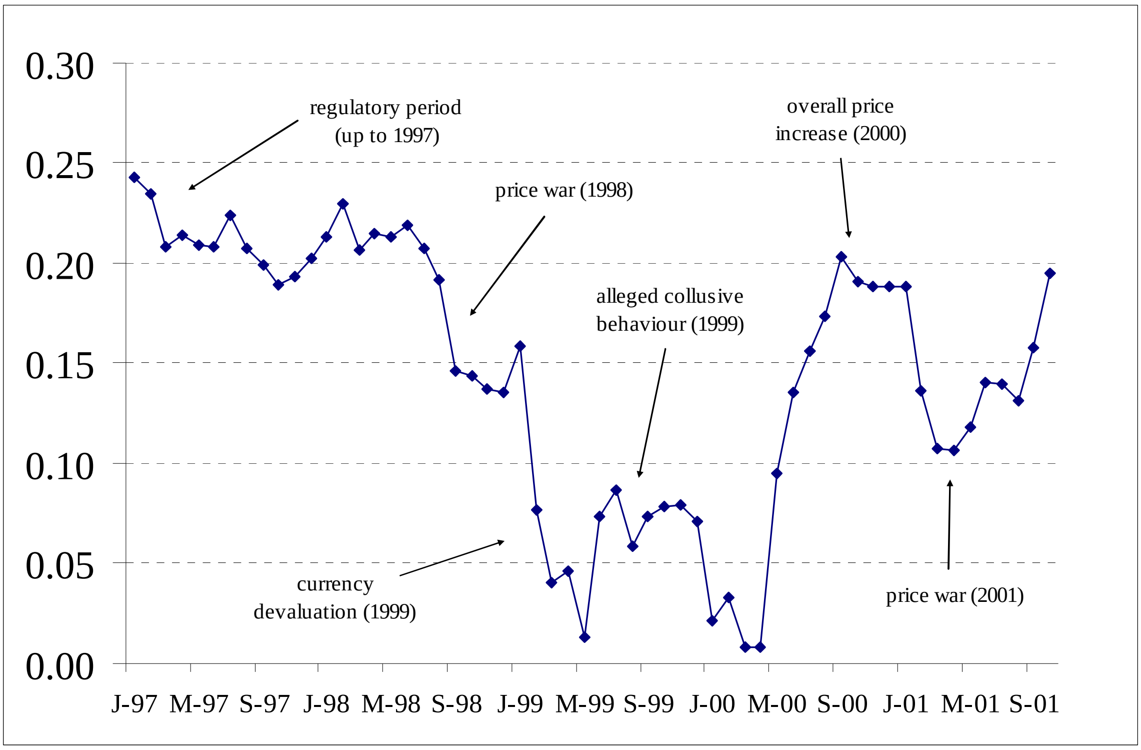

Figure 3 - Path of Estimated Overall Conduct

Figure 3 shows, and makes inference, on how firms behaved, after the liberalization measures in the beginning of 1998. In fact, it can be seen that, during the last months of the 'Ponte Aérea' period (from Jan-97 to the middle of 1998), the average conduct parameter was close to 0.20, a considerably competitive conduct for a cartel structure. This probably means that authorities were successful in regulating the quasi-monopoly, not allowing it to charge profit-maximizing prices.

After the liberalization, however, the conduct decreased considerably, due to three major events: the 1998 and 2001 price wars, and the 1999 supply-shock event caused by the devaluation of the Brazilian currency. Price war means the period triggered by a decrease in more than twenty per cent in the overall fares (as suggested by Morrison and Winston, 1996), and supply-shock means the periods where the index of effective exchange rates, Figure 1, was above 120. In the first case, the conduct parameter was always between 0.10 and 0.15. In the second case, it was as low as zero, virtually indicating marginal-cost pricing.

The coordinated price movement of 4 August 1999, where all airlines increased their prices by ten percent, led the competition authorities to an investigation, based on Brazil's legislation, blaming for collusive behavior. As Figure 3 infers, any pattern of collusion in the overall conduct of airlines, shall be clearly rejected.

CONCLUSIONS

The present study developed a specific framework for modeling air shuttle competition, in the Brazilian airline industry, by using non-addressing approach for vertical product differentiation. Conduct parameter estimation was also performed, and results were used to infer the market behavior, to pre and post-liberalization situations, as well as, under costs shocking conditions.

The main conclusion of this study, refers to a relevant increase in competition, due to the deregulation, specially if considering the two events of price war observed in the market, where the estimated conduct parameter was approximately 40% lower if compared to the pre-liberalization period. Besides that, one cannot reject marginal-cost pricing, for the period subsequent to the costs shocking events.

Finally, the analysis did not find any evidence of collusion, concerning the antitrust investigation conducted by the competition authorities, after the overall price increase of August 1999. On the contrary, the hypothesis of airline behavior being more competitive, during the alleged collusive period, than in the pre-liberalization period should be taken into consideration.

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[1] Eastern Airlines' shuttle was purchased by Donald Trump in 1989 and became The Trump Shuttle. This service was operated by USAir after its bankrupt in 1992, and was finally acquired by US Airways in 1998.

[2] Index with both series equal to 100 in Jan-97. Source: IPEA and Department of Civil Aviation.

[3] Since its creation, the Brazilian aviation authorities considered the agreement beneficial for consumers, since it brought a market expansion. As prices were regulated and entry was banned, it was operated as a natural state-controlled monopoly on the route.

[4] US Airways Shuttle, for example, flies 24-daily roundtrips between Boston and LaGuardia, and 14-daily roundtrips between LaGuardia and Ronald Reagan Washington National Airport (October 2002).

[5] In Eastern Air Shuttle, for instance, passengers could buy tickets right on board, whereas the Brazilian authorities did not allow it in 'Ponte Aérea'.

[6] In number of passengers; source: Department of Civil Aviation.

[7] A recent research performed by Sao Paulo's aviation authorities (DAESP, 2002) revealed the following characteristics for the passengers of the state's airports: 65 % male; 54 % age ranging between 21 and 40; 77 % with graduation and/or post-graduation level; 40 % earning between US$ 300 and 1,500 of monthly income; 37% earning between US$ 1,501 and 3,000 of monthly income; 58 % with business purposes; 29 % travelling by air between 2 and 5 times a year. According to a research conducted by the Department of Civil Aviation, passengers in the air shuttle market have the following average profile: 89% with business purposes; 90% of travellers earn more than twenty minimum wages; 60% stay up to one day at their destinations.

[8] The following airline codes will be used hereafter: Vrg (Varig), Vsp (Vasp), Tba (Transbrasil), Tam, and Rsl (Rio-Sul).

[9] Referring to flight frequency shares.

[10] Seminal papers on vertical product differentiation are Shaked and Sutton (1983) and Gabszewicz and Thisse (1979). By considering the consumer representative hypothesis, however, this study assumes a simpler case of vertical product differentiation, without recurring to arbitrating the densities of consumers in a quality space. Passengers' income distribution could be used for this purpose, as in Sutton (1986), but this variable would not well represent this market, especially because corporations, not individuals (businessmen), are the main clients of airlines in this case.

[11] This delay, measured in time units, represents the actual flight departure, when compared to the departure time desired by the passenger.

[12] The demand of the market and the firms is very price-inelastic and time-sensitive for all segments. Results might be different if we consider the disaggregation of weekdays and weekend, however it has not yet been evaluated due to lacking data.

[13] This is similar to the scheme of Cobb-Douglas utility functions, as in Lancaster (1971), Lane (1980), and Caplin and Nalebuff (1986). However, this study considers only one characteristic (flight frequency).

[14] Borenstein (1991, p. 1248) uses the variable APTDOM, measured as 'an airline's share of the passengers, originating their trips at a given airport, and travelling on any route, other than the route under observation'.

[15] As mentioned before, SAP (special airport-pair) routes are the city centre-area airport pairs of the following cities: São Paulo, Rio de Janeiro, Belo Horizonte. Brasília's international airport is usually also included in this definition.

[16] This approach for modelling market share functions can also be found in Roberts and Samuelson (1988) and Marín (1995).

[17] Oum, Zhang and Zhang (1997) also used it.

[18] This is also the base-case evaluated by Brander and Zhang (1990).

[19] O'Connor (1995) mentions the demand and costs of the short-haul problem: "Not only is the cost per seat-mile higher for shorter stage lengths, but the demand is highly elastic (...) since alternative modes of transportation, notably the private automobile, are relatively attractive over shorter distances". Air shuttle markets, however, may not feel so intensively the demand effect, as they are characterised by highly time-sensitive and price-inelastic passengers.

[20] In opposition to Marín (1995), Captain and Sickles (1997), Brander and Zhang (1990), who adopt the hypothesis of quantity-base competition.

[21] For more details, on which variables were used, check equation (15) in section 5.

[22] GIG and GRU are, respectively, Rio de Janeiro and São Paulo International Airports. As mentioned in section 3, this airport-pair is usually considered an alternative to CGH-SDU.

[23] This procedure is similar to the one, used in translog market share systems, for estimating cost functions.

[24] Slade uses a two-step, generalised method of moments (GMM) procedure. This sort of technique can be described as follows: "In the first step, the parameters of the demand equation are estimated (...). In the second step, the estimated demand parameters and the postulated market-conduct and/or marginal-cost function is substituted into the first-order condition, and the remaining parameters are estimated" (Slade, 2001). The author suggests that this kind of procedure – that is, in two steps – has the advantage of not allowing "misspecification of first-order condition to contaminate the demand estimates, in which one typically has more confidence" (Slade, 2001).

[25] Berry, Carnall and Spiller (1996) also consider directional markets for their estimation purposes.

[26] An average of Brasilia and Belo Horizonte coach and telecom prices was developed. It is important to note that gdp, irate, coach and telecom were included as instruments, considering both current and lagged values.

[27] Standard errors are in brackets.