DOCUMENTO DE TRABALHO

Localized competitive advantage and price reactions to entry: Full-service vs. low-cost airlines in recently liberalized emerging markets

Alessandro V. M. Oliveira

Cristian Huse

Instituto Tecnológico de Aeronáutica
São José dos Campos, Brasil, 2009

Localized Competitive Advantage and Price Reactions to Entry: Full-Service vs. Low-Cost Airlines in Recently Liberalized Emerging Markets

Alessandro V. M. Oliveira[1]

Aeronautics Institute of Technology

Cristian Huse[2]

London School of Economics

Abstract

This paper empirically investigates price reactions to the entry of the low-cost carrier Gol Airlines in the Brazilian domestic market in 2001. Given the significant reduction in yields on entered routes, the paper performs an econometric analysis of the determinants of pricing power along with the analysis of the pattern of price reactions by incumbent legacy carriers. Using data from a panel of routes disaggregated at the airline level, we obtain that (i) both airport and route presence are relevant at explaining pricing behavior; (ii) price responses vary significantly according to flight distance and the amount of seats supplied by the entrant, in the sense that the shorter the route, and the more the seats offered by the newcomer, the stronger the price reactions from the incumbents, with significant point estimates in the range 22-26% in yield reduction for routes as short as 350km (approx 195 miles). The results shed light on the recent deregulation of the Brazilian market and the issue of product differentiation in the industry.

Keywords: Industrial Organization, Entry, Low Cost Carrier, Price Reactions.

[1] Center for Studies of Airline Competition and Regulation (NECTAR) - Instituto Tecnológico de Aeronáutica, Praça Marechal Eduardo Gomes, 50, Vila das Acácias - São José dos Campos – SP, Brazil, 12.228-900. Email Address: A.V.M.Oliveira@gmail.com. The author thanks CAPES and FAPESP.

[2] Stockholm School of Economics. Email address: cristian.huse@sse.edu. Correspondence address: Stockholm School of Economics, Department of Finance, Box 6501, SE-113 83 Stockholm, Sweden. URL: http://fmg.lse.ac.uk/~cristian.

1 Introduction

This paper empirically investigates (reduced form) price reactions of the incumbent full-service carriers (FSCs) to the entry of the low-cost carrier (LCC) Gol Airlines in the Brazilian domestic market, in 2001. The empirical approach we adopt allows uncovering the determinants of pricing power in the industry, such as the presence at the airport and route level as well as elements of product differentiation, and in particular, how price responses vary according to flight distance and the amount of seats supplied by the entrant.

Building upon Evans and Kessides (1993), we make use of an empirical approach that makes possible to uncover the determinants of pricing power in the industry (`localized competitive advantage'), a feature regarded as a precondition for pinpointing the airlines' patterns of behavior with respect to *de novo* entry and also for better understanding competition in a recently liberalized airline market. Using data from a panel of routes disaggregated at the airline level, we obtain that (i) both airport and route presence are relevant at explaining pricing behavior; (ii) price responses vary significantly according to flight distance and the amount of seats supplied by the entrant. More precisely, we obtain that, the shorter the route, and the more the seats offered by the entrant LCC, the stronger the price reactions from the incumbents, with significant point estimates in the range 22-26% for routes as short as 350km (approx 195 miles).

Early contributions to the literature on entry focusing on airlines are Berry (1992), Whinston and Collins (1992) and Joskow, Werden and Johnson (1994). With respect to airline pricing behavior, Evans and Kessides (1993) report several studies investigating post-US liberalization conditions, which they classified as `first-generation' studies, with the methodology of inferring the effects of market structure variables on prices from variation across routes (`inter-routes' investigation), as in Bailey and Panzar (1981) and Hurdel et al. (1989); and the `second-generation' studies, which do account for firm heterogeneity within a route (`intra-route' investigation), such as Borenstein (1989) and Berry (1990). Both types of studies test the contestability theory and aconclude that local market structure matters in the airline industry i.e. concentration-related variables have significant effect on prices. What is more, second-generation studies provided evidence of the significance of market share measures as determinants of within-route competitive advantage, and therefore called attention to the consequences of dominance: "*consumers are willing to pay a premium for the services of the dominant airline* [at an airport]" (Berry, 1990). In fact, those studies usually found relevance for both sorts of measures - market share and concentration - thus reconciling different traditions within the Industrial Organization literature[3] .

In contrast to the consensus of the relevance of considering firm-specific disaggregation in pricing analysis, there has been a debate about whether structure affects performance in this industry at either the route or airport level. Evans and Kessides (1993), for example, argue that, due to linear route system replacement by hub-and-spoke strategies, the increasingly control of airport facilities by fewer airlines, the advent of frequent-flyer programs and the usage of travel agent commission overrides, "*the bulk of any deviation from competitiveness in the airline industry is (now) associated with airport characteristics rather than with the*

[3]Slade (2004b) provides a detailed discussion of the "market share" and "market structure" models within the Industrial Organization literature.

structure of routes"[4]. By making use of route-specific fixed-effects, they found only airport market share effects as statistically significant for the US domestic market, contrary to the results of Borenstein (1989). The reasoning of the alternative views goes as follows: as one airline develops a hub in a given airport, its products become more attractive, as the number of connections, direct flights, and their frequency tend to increase; in the case of business travellers, other perks such as lounges can also appeal. As a result, incorporating characteristics that consumers are willing to pay for allows airlines to mark up their prices, thus the advocated importance of airport presence as an element of pricing power. Alternatively, there view that route presence is the key variable for pricing power is consistent with a view that higher flight frequencies are sufficient as determinants of pricing power.

More recently, there has been a number studies on the specific subject of pricing behavior in response to LCC entry: firstly, Dresner, Lin and Windle (1996), which found significant spillover impacts of LCC entry onto other competitive routes, as on other routes at the same airport and on routes at airports in close proximity to where entry occurred; this analysis was performed by inspecting, among others, the entry of Southwest Airlines into the Baltimore-Washington International Airport, in 1993. Secondly, Windle and Dresner (1999) investigated the impacts of entry by ValuJet into Delta Airline's hub, Atlanta, and refuted the US DOT's claim that the latter increased fares on non-competitive routes to compensate for lost revenues on the competitive routes. Finally, Morrison (2001) examined the total extent of Southwest's influence on competition, by investigating its impacts with actual, adjacent and potential route presence, on other carriers' fares in 1998, obtaining a result of 20 per cent of US airline industry's domestic schedule passenger revenue for that year.

In this paper we estimate a pricing equation to investigate the effects of LCC entry in a way closely related to Evans and Kessides (1993), but incorporating a number of features. First, we perform an analysis of the sources of the incumbents' competitive advantage -- in terms of the determinants of pricing power --, which is relevant for understanding the patterns of price reactions; as in Evans and Kessides (1993), it is possible inference about the locus of competition (whether at the airport or the route level, or both) thus providing additional evidence to the Borenstein-Evans and Kessides's debate. Additionally, we overcome a limitation of the estimation strategy in Evans and Kessides(1993) regarding the identification of variables that do not have within-route variation, such as flight distance.

Second, by using data disaggregated at the airline level, we are in position to examine whether elements of product differentiation are significant determinants of entry and post-entry competition, allowing for heterogeneity of both airlines and routes. Third, by introducing city-specific fixed-effects, we can account for the unobservables (from the point of view of the econometrician) that could affect incumbent's pricing behavior across routes. The introduction of city-, as opposed to route-, specific effects is in line with the estimation strategies followed by Borenstein (1989) and Berry, Carnall, and spiller (1996). While the former uses a measure of the presence at the endpoint airports, the latter uses population and network characteristics at the endpoint cities.

The main contribution of the paper thus consists on the design of an econometric procedure under which one obtains simultaneously (i) the identification of variables that do not have within-route variation, such as concentration level and LCC presence -- thus extending the

[4]Levine (1987) is an influential paper on this issue.

methodology of Evans and Kessides (1993); combined with (ii) the study of the elements of competitive advantage and product differentiation; and (iii) the possibility to test competing explanations for pricing power in terms of market share and market concentration.

Using the framework above we assess the impact of LCC entry on incumbents' prices (and ultimately, the effects of liberalization of the Brazilian airline industry) as well as the extent of price reactions of incumbents according to route distance and market share of the entrant LCC. Starting from the fact that average yields fell by 31-37% for short-haul flights and 16-18% for long-haul flights, regardless of the cut-off point distinguishing the former from the latter, we examine price reactions more closely by controlling for number of seats offered, aircraft size, route distance, and alternative measures of market share and concentration. The main empirical finding is that -- even after controlling for the above variables -- the price reactions are significant in most cases: generally speaking, the shorter the route (and the more the seats offered by the entrant LCC), the stronger the price reactions from the incumbents; although our point estimates are not significant for routes as long as 1250km (approx. 695 miles), they fall in the range 22-26% for routes as short as 350km (approximately 195 miles).

The plan of the paper is as follows. Section 2 presents the background of the deregulation measures of the airline industry in Brazil and the characteristics of the newcomer in the market. In section 3, we discuss how FSCs are expected to react to the entry of a LCC and how these products might differ. The empirical framework is detailed in Section 4, and the results are reported and discussed in Section 5. The final section concludes.

2 The Airline Industry

2.1 The Low-Cost Carrier Niche

The LCC market niche is usually associated with the *Southwest Airlines Paradigm* (SWP), mainly because that airline pioneered this sort of operations, during the seventies, and because its standards are deliberately reproduced successfully around the world[5].

The main characteristics of this paradigm, according to Doganis (2001) are fleet standardization, simplification or elimination of in-flight service, use of less congested secondary airports, direct sales to consumers, ticket-less or electronic tickets, dense, short-haul, point-to-point flights with no interlining or transfers (which implies a simple network structure, with absent or weak feed to long-range flights), single-class cabin lay-out, simple or no frequent-flyer program, high level of fleet utilization, and highly motivated employees[6]. Moreover, LCC's are typically associated with a very aggressive pricing strategy, typically with the use of simplified fare structure with few or no restrictions, and low one-way fares[7].

---

[5] As the Chief Executive of Ryanair once said: "*We went to look at Southwest. It was like the road to Damascus. This was the way to make Ryanair work*" (Doganis, 2001).

[6] This description refers to what can be considered "classic" Southwest paradigm. One has to bear in mind, as we will see below, that Southwest's actual patterns of operations has had some changes recently: "*its strategy evolved during the latter half of the decade to include a much more heterogeneous mix of markets, including a number of markets which were both long-haul and surprisingly thin*" (Boguslaski, Ito and Lee, 2004).

[7] Tretheway (2004) points out that the introduction of low one way fares ultimately served to undermine the ability of the FSC's to price discriminate, and not only resulted in a considerable increase in competition but also in an exposure of the problems associated with the FSC business model.

The cost advantage obtained by Southwest Airlines emerged mainly from a very careful choice of markets, which usually makes it possible to focus on short-haul routes and on markets where it can have dominant market share, and to exploit economies due to higher seating density and higher aircraft utilization. According to Boguslaski, Ito and Lee (2004), Southwest has unit costs that are 28 to 51 per cent lower than the US major airlines, considering 2001 US DOT's unit cost figures.

2.2 The Brazilian Domestic Airline Market

The removal of regulatory barriers in the Brazilian airline industry in the early 1990s had a crucial role in the process that ultimately led to the entry of Gol, the first scheduled low cost airline in Latin America and to an unprecedented increase in degree of competitiveness in the sector. Started at the beginning of the nineties within a broader governmental program for deregulation of the country's economy, the measures of liberalization were then performed gradually, in three main rounds, by the Department of Civil Aviation (DAC).

In the First Round of Liberalization, the then-existing regional airlines' monopolies were almost fully abolished, and newcomer entry was stimulated, which led to a wave of small, full-service airlines in the market. Also, price competition was now seen as "healthy" for the industry, and was therefore encouraged; fare bounds were used as temporary instrument of enhancing price competition.

In the late 1990s, DAC decided removing two relevant regulatory devices remaining in the market: the fare bounds and the exclusivity of operations of some very dense and profitable routes by regionals[8]. This generated the Second Round of Liberalization (enacted in Dec/97-Jan/98), which triggered much strategic interaction by airlines, with intense price and frequency competition. The removal of fare bounds was, however, not totally effective, due to interference of macroeconomic authorities (then recent converts to the inflation-targeting mechanism), not allowing price increases after the currency devaluation of January 1999.

Finally, in 2001, most of the remaining economic regulation was removed, and airlines could set their prices freely from that period on. It can be called a quasi-deregulation period, as entry, fares and frequencies were almost entirely liberalized. This was concomitant with the entry of the Gol and its innovative positioning in the LCC segment.

Gol Airlines was not only the first scheduled LCC of Brazil, but also within all Latin America, with operations started in January 2001[9]. In contrast with the US and European scenario, the Brazilian airline industry is particularly difficult for the implementation of typical LCC operations, mainly because of lack of secondary airports with required infrastructure[10]. What is more, the policy orientation followed by DAC since the First Round of Liberalization was clearly to facilitate newcomers' entry in order to reduce entry barriers as much as possible. On account of that, and considering that the major Transbrasil Airlines

[8] Airport-pairs linking city centres of four major cities, and called "special" airport-pairs, SAP. The cities were São Paulo, Rio de Janeiro, Belo Horizonte and Brasília.

[9] Gol Airlines and U Air (Uruguay) are the only scheduled LCC's based in Latin America nowadays. Some North-American LCC's provide service to Mexico and the Caribbean, such as JetsGo, Frontier and JetBlue, but do not have operational basis at the region (source: website lowcostairlines.org).

[10] As discussed below, this justifies the use of city- instead of route-fixed-effects in the empirical model.

started exiting the market in mid 2001, it was relatively straightforward for Gol to enter the same airports as its opponents, in direct competition with incumbents in virtually all situations.

Table 1 presents some of the characteristics of Gol, in its first year, 2001, and compares it with the major incumbents in the market (Varig, Vasp and Tam). One can see that Gol's unit costs an yields were roughly a third lower than its average opponents', which guaranteed eight-percent higher load factor[11] and the only black figure of profits in the industry in that year.

Table 1 - Comparison of Gol and Incumbents (2001)[12]

Figure		Gol	Incumbents*
Air Passenger Traffic	million	1,652	25,533
Load Factor	%	60.2%	55.8%
Unit Cost (Seats.Km)	R$	0.108	0.159
Yield (Pax.Km)	R$	0.184	0.263
Operational Profit/Loss	%	2%	-9%

** Varig + Vasp + Tam*

3 Reactions to Entry and Low-Cost Carrier Positioning

3.1 Reactions to LCC Entry

There is a number of ways incumbents can respond to LCC entry. Matching prices is the most commonly used but usually has undesirable outcomes, if employed without other strategic moves, such as product differentiation. As put by De Villemeur, Ivaldi and Pouyet (2003) in their study of railways,

"*Price competition with homogenous services triggers a vigorous price war and erodes the profits of operators. Therefore, taking entry as given, there exists a strong incentive for both the incumbent and the entrant to differentiate their product in order to recover some profits*".

Besides that, differences in efficiency between newcomer and incumbents may be crucial in determining the ultimate post-entry result. Even assuming both product heterogeneity and an efficiency gap between FSC's and LCC's, the sort of incumbents' reactions may still be determined by the degree of market segmentation and brand loyalty, network structure, ability to commit to pre-entry strategy, newcomer's expected capacity, etc.

One key way of responding to entry which received special attention by the Brazilian authorities was through raising potential entry barriers caused by incumbents' excess capacity. An intense debate over the existence of excess capacity in the airline industry has recently

[11] One can also consider a backwards causation, that is, higher load factors determining lower unit costs and yields.

[12] Source: DAC's Statistical Yearbook, vol. II.

been established in Brazil, especially since the Third Round of Liberalization. In fact, due to new governmental orientation in the beginning of 2003, DAC has started a process of market re-regulation in order to make capacity more in line with demand, and this was performed by interfering in airlines' freedom to set flight frequencies and to acquire new aircraft[13]. The argument for re-regulation is that excess capacity caused pressure to fill empty seats, and thus made airlines' profitability to plunge. What is more, it was argued that the problem first arose because deregulation stimulated airlines to increase capacity pre-emptively: by using it as competitive instrument to avoid further expansion of other incumbents and by the newcomer, the policy ultimately led the market to a situation of super-competition.

Table 2 - Evolution of Excess Capacity and Profitability[14]

Year	Excess Capacity (%)	Operational Profits (%)
1982	34.2	-3.6
1983	40.0	0.3
1984	42.5	-10.8
1985	36.1	5.8
1986	27.9	5.5
1987	34.0	4.4
1988	38.7	2.1
1989	31.6	-4.8
1990	33.6	-18.3
1991	44.4	-6.5
1992	46.9	-5.1
1993	46.4	-0.1
1994	43.2	13.8
1995	41.9	13.2
1996	42.1	12.9
1997	42.8	10.6
1998	40.9	2.4
1999	44.9	-2.7
2000	41.4	5.8
2001	41.6	-7.2
2002	43.2	-8.2

Table 2 gives an idea of the evolution of excess capacity (equivalent to one minus the average domestic load factors, that is, the average percentage of empty seats) and operational profits in the industry, and permits comparing pre-liberalization (until 1991) with post-liberalization (from 1992) figures.

Although it is debatable if it is the case that the liberalized market has produced an excess capacity situation (this does not seem to be the tendency of figures in Table 2), it is undoubtedly that the event of Gol's entry can be regarded as a test of the effectiveness of the argument on the use of excess capacity as a competitive device in the market. One would surely expect price reactions to be tougher on routes characterized by higher levels of excess capacity than others - with more empty seats, incumbent's ability to react is higher in case of entry; what is more, if one compared routes not entered with and without excess capacity, one would expect higher prices in the formers.

[13] Gol was the first airline to be impacted by the new measures, as it had short-run plans to lease new aircrafts.

[14] Source: DAC's Statistical Yearbooks (Vol. II).

Alternative non-price reactions to entry include *cost-cutting* (for example, in 2004, United Airlines became the first to delay payment into its pension plans in order to restructure costs), *entering bankruptcy* (a very common move by players in the US - the so-called "Chapter 11", the bankruptcy-court protection which allows airlines to restructuring its loans, leases and capital structure), or even *to become a LCC or create a new LCC subsidiary* in the market: Delta's Song, British Airways' Go-fly are classic examples of LCC subsidiaries. However, given the temporal aspect in raising more thorough responses to newcomer entry and the fact that our data cover only a very limited period (two months), one would expect incumbents' reactions to occur predominantly through prices. In fact, reactions in price following LCC's entry has been extensively reported by literature - for instance, Whinston and Collins (1992) described a "*dramatic fall of roughly 35% in the average price of incumbents on the 15 markets entered by People Express in a given year [of the mid eighties in the US market]*".

3.2 Price Reactions

Given the institutional setting of the Brazilian domestic market and the (restricted) short run focus allowed by our data, we now concentrate on price reactions to LCC entry. Assuming for one moment one can obtain information on two segments - one with higher willingness to pay (business travelers) and the other with lower willingness to pay (leisure travelers), and that there is some degree of interdependence among them, FSC's response in prices to LCC entry may occur in a number of forms:

- i. Not to react in prices, keep existing fare structure
- ii. React in prices, keep existing fare structure
    - ii.1 Reduce prices for leisure travelers and maintain prices for business travelers
    - ii.2 Reduce prices for leisure travelers and increase prices for business travelers
    - ii.3 Reduce prices for both segments
- iii. React in prices but migrate to a simplified fare structure or to single fare scheme

Cases i, ii.1 and ii.2 may be representative of markets with a very high participation of business travelers and in which the disutility associated with traveling with the LCC is high (higher degree of product differentiation). It may be more profitable for the incumbents, in these cases, to increase quality or to stimulate brand loyalty, either *before or after entry*, and either *with or without price changes*. This may be performed, for example, via more flights - the "*cut fares and add flights*" response (see Whinston and Collins, 1992, for the entry of People Express in the 1980s). Other actions may include more advantages to first-class or business-class flyers, better service, more and easier frequent-flyer upgrades, etc.

Cases ii.1 and ii.2 can be also representative of a situation in which the LCC is capacity-constrained and there is strong demand segmentation. In this case, the FSC's may prefer price competition for leisure travelers (using some of the lower fares available in their existing fare structure) in order to lead the LCC to full utilization, specially during peak time; this ultimately permits the FSC to restore the monopoly situation with respect to the business traveler segment (for example, last-minute purchases), increasing its average yields and profitability, specially if followed by increases in own capacity to also capture the new demand generated by the fare war.

When the FSC's possess a well consolidated hub-and-spoke structure, the decision between "price-react" and "not to price-react" is also conditioned by potential network effects. For example, De Villemeur, Ivaldi and Pouyet (2003) emphasize that in this case not only the incumbents may have a substantial cost advantage over the potential entrants, but also a strategic advantage depending on the existence of substitutabilities and complementarities in the network. In fact, entry on a given route (a "local market", part of a network) may have positive spillover effects on the connecting markets served by the incumbents: "*By staying on the market where entry occurred, the incumbent engages in a vigorous price competition (which also erodes the profit of operators on this market). Since connecting services are complements due to the hub-spoke feature of the network, the price competition increases the demand on the complementary markets*" (De Villemeur, Ivaldi and Pouyet, 2003).

Another strategic move of incumbents may be to reduce prices for both segments (ii.3), as mentioned by Alderighi et al. (2004). The authors interpret this reaction as being a direct consequence of the appeal of the LCC for business travelers, which engenders interdependence of both segments. In such cases, "*pricing strategies on the business market and on the leisure market have to be coordinated*". One can observe that ii.2 is also an example of coordinated pricing strategies; in ii.3, however, the willingness-to-pay of business travelers is certainly lower.

And finally, the incumbent can migrate from existing complex fare structure based on yield management techniques, which is typical of FSC's, to a policy of simplified pricing and discontinuation of fare restrictions. The most extreme example of this strategy is Bmi, which in spring 2002 changed to a single fare scheme, removing all restrictions such as minimum stays, advance purchase, etc, to compete with newcomer LCC's (Donnelly, James and Binnion, 2004).

Unfortunately, however, data made public by the DAC is not disaggregated by fare class and therefore it is not possible to pinpoint different patterns of price reactions for business and leisure segments. Even so, one can obtain a clear picture on the behavior of FSC’s that is robust to how one would classify short- and long-haul routes. Table 3 permits having a general idea on the matter, comparing the average yields on routes entered with routes not entered by Gol within the same flight-distance classification. **“Yield”** is defined here as total operating revenues divided by the multiplication of total revenue passengers and kilometers flown[15].

As one can infer from Table 3, the price reactions caused by entry (measured by the percentage difference in incumbents' "Average Yield") were much stronger in short-haul routes (that is, higher than 30%) than on medium-to-long-haul routes (below 20%). This is robust to alternative route classification with respect to distance (cut-offs of 500, 600, 700, 800 and 900 km).

[15] Note that whereas yields are defined on per-kilometre basis, the average price is defined on a per-passenger basis.

Table 3 - Impacts of Entry under Alternative Route Classification

Classification	Cut-Off (Km)	N	Average Yield		Diff. %
			Entry = 0	Entry = 1	
Short Haul	0-500	42	0.609	0.386	-37%
Medium/Long Haul	501-	72	0.371	0.304	-18%
Short Haul	0-600	52	0.576	0.380	-34%
Medium/Long Haul	601-	62	0.363	0.296	-18%
Short Haul	0-700	62	0.565	0.367	-35%
Medium/Long Haul	701-	52	0.347	0.288	-17%
Short Haul	0-800	70	0.542	0.365	-33%
Medium/Long Haul	801-	44	0.333	0.284	-15%
Short Haul	0-900	84	0.513	0.355	-31%
Medium/Long Haul	901-	30	0.324	0.274	-16%

These findings shed light on the reasons why incumbents' responses to LCC's entry vary so much (and so robustly, when considering the alternative cut-off points between short- and long-haul routes) across routes. In what follows, we informally argue that product characteristics and market niche positioning are a very likely explanation for this sort of variation in the incumbents' intensity of response. One can expect the patterns of both entry and reactions to entry to be determined by the degree of perceived product differentiation by the newcomer airline. This issue of entry and product differentiation is empirically inspected by analyzing the *actual patterns of price reactions of incumbents* in some selected city-pairs in the domestic airline market.

3.3 Market Positioning

A very important determinant of the patterns of reaction by incumbent is related to the LCC *positioning* in the market. These paradigms are representative of the way newcomers will place their service in the market and, above all, in which sort of markets they will enter. With the idea of paradigms one has also a notion of how LCC entry will affect existing FSC's and the sort of strategic movement that will emerge from this positioning.

Here we make use of the Southwest Paradigm (SWP) in terms of LCC positioning, and draw attention to two features[16]:

1. the focus on short-haul operations; and

2. the preference for underserved routes (Doganis, 2001) or routes in which it could have a dominant position. Dominance here is defined precisely in the same way as Borenstein (1991), that is, by considering airline market position (or "presence") in terms of market share measures either at the route or at the airport level[17].

[16] As Windle and Dresner (1999) state: "*Southwest Airlines focuses on short haul routes into underutilized or secondary airports, and as a result often does not directly compete with established carriers*".

[17] Borenstein (1991) measures dominance using different proxies and getting consistent results. He uses shares of passengers, shares of aircraft departures, shares of seat-departures, and share of seat-mile-departures. The latter is developed so as to "*weight by plane size and the average size of purchase (distance) made by each firm's customers*", and is the unit of measurement of dominance used in the empirical model here (see Section 4).

Undoubtedly, there is no clear cut-off that divides either "short-haul" from "medium-to-long-haul" markets or "underserved" to "well-served" markets. However, continuous variables such as route flight distance and incumbents' market share are expected to influence the degree of perceived product differentiation between airlines as they determine the attributes of each market.

Given the above description, one can consider the problem of Gol's entry in the Brazilian airline industry as an entry situation where the newcomer has a product which is differentiated with respect to the incumbents' in the sense of being of lower quality. More precisely, given the less leg space, the simpler (if existing) in-flight service and frequent-flyer program etc., consumers would rather use a FSC than a LCC at similar prices. It then follows that, given the quality distinction between FSC's and LCC's, intuitively one would expect higher disutility of longer flight haul (because of LCC's lack of in-flight meals, have smaller leg space etc) - one evidence for that being the fact that airlines usually have a broader variety of in-flight frills in, for example, intercontinental flights from US and Europe, than for flights within either regions. Quality competition may then be much more apparent in longer-haul markets, whereas price competition is usually tougher in short-haul markets.

On a related matter, in routes where FSC presence is high, market entry is less effective due to lower levels of recognition by consumers (the "dominant-firm advantage" effect[18], discussed in Borenstein, 1991), in non-dominated routes. Also, in this situation the newcomer LCC is usually in disadvantage with respect to flight frequencies, having as a consequence a relatively higher average time gap between flights (higher "schedule delay").

In short, as a LCC, Gol is expected to enter short-haul markets not dominated by incumbents, following the SWP. In this sort of markets, it can be argued that either the disutility of traveling with LCC is lower or the competitive advantage of incumbents is lower. And thus the probability of Gol capturing a broader range of consumers (not only budget travelers) is higher, as the product is perceived to be less heterogeneous than the FSC's'.

On the other hand, product differentiation becomes more evident in both long haul and well-served markets. In the first case, the longer flight time may be regarded as a disadvantage if passengers have lower in-flight comfort[19]; in the second case, one may find that route presence by incumbents is sufficient enough to provide them with competitive advantage. In these markets, one would expect reactions to entry to be softer.

---

[18] Berry (1990), for example, when describing airport dominance in the US market, states that "*incumbent airlines are the major source of financing for many airports and therefore gain a large degree of bureaucratic control over airport operations. This control may enable them to block the entry or expansion by rivals. Airlines with a large presence in a given city also gain advantages from frequent flyer plans and nonlinear travel agent commission schedules*". In terms of route dominance, as mentioned before, one can consider competitive advantage of large route presence coming from lower distance between flights (which appeals to business travellers) and therefore can be considered a proxy for higher service quality levels. The dominance effect can be regarded as one of the main reasons for Southwest's avoidance of head-on competition with incumbents in the United States.

[19] This is even clearer in the Brazilian case, in which Gol usually offers flights with many stops and/or connections, especially for long-haul routes. The disutility associated with the LCC is, therefore, higher on routes with higher flight sector.

4 Empirical Analysis

4.1 The Data

4.1.1 Overview

The data we use was supplied by Brazil's Department of Civil Aviation (DAC), and is a collection from published and non-published data disaggregated by airline at the directional city-pair level[20]. The dataset corresponds almost entirely to the selection present in DAC's *Average Yield of Monitored Airport-Pairs Report* – unfortunately, there is no Brazilian equivalent to the U.S. Department of Transportation's *Origin and Destination Survey*, a 10 % random sample of all tickets in domestic markets of that country. On the contrary, DAC relies on information provided monthly by airlines – more specifically, the average yield per airport-pair in the sample, aggregating all non-stop and one-stop traffic in a given market.

The sample consists of airline-specific monthly data for 82 city-pairs over October and November 2001. It is representative of 76 out of the country's 100 densest airport-pairs[21], and accounts for 61% of total regular domestic air traffic in Brazil. The final sample size consists of 408 observations, for an average number of airlines between two and three per route.

Although one could well argue that the data could not be representative of typical airline activities, for being collected in the subsequent months after September 11, 2001, this is not a major problem here, as the dataset consists of only domestic routes. In fact, DAC's dataset is formed only by domestic airport-pairs, which served to minimize problems of abnormal interference in demand and cost conditions. This can be illustrated by inspecting traffic figures in DAC's 2001 Statistical Yearbook: in the fourth quarter of 2001, there were 6,982 million domestic pax-km against an average of 6,909 million in the first three quarters of that year, which clearly indicates that the industry was operating as usual during the period[22].

Another possible criticism to the data would be sample selection, as route choice is made arbitrarily, not consisting of a complete set of densest airport-pairs. On the contrary, it is formed by a selection of routes sampled from a broader population of routes. When conducting the final process of liberalization, in 2001, DAC selected a set of 126 airport-pairs in order to monitor airline's pricing behavior; this set was chosen by using a mix of strategic, geographic, and economic criteria, rather than one homogeneous criterion of relevance such as density, and ultimately comprised the Average Yield of Monitored Airport-Pairs Report mentioned above. On account of that, here some procedures were employed in order to reduce the potentiality of selection bias in the sample choice, and thus only routes between airports present in the ranking of the thirty largest airports (in terms of traffic) were considered[23]. As a

[20] In the sense that flights going from A to B are treated differently as the ones from B to A. Evans and Kessides (1993) also use the city-pair definition of a route; in contrast, Morrison (2001) implements an analysis disaggregated at the airport-pair level, in order to capture the effect of “adjacent" route presence. Berry, Carnall and Spiller (1996), Evans and Kessides (1993) and Borenstein (1989) use directional markets also makes use the assumption of directional markets; on the other hand, Ito and Lee (2003b) and Richard (2003) use non-directional markets.

[21] As it will be seen below, airport-pairs were aggregated into city-pairs in order to generate the final database.

[22] The typical seasonality in Brazil consists of Q-2 and Q-3 with most of the business traffic (and business travellers constitute more than 60% of total traffic).

[23] Other criteria were also experimented in conjunction with the 30-largest-airports rule. For example, the

consequence, twelve routes were dropped from the original dataset; also, airport-pairs were aggregated into city-pairs, in order to permit comparison with the results of Evans and Kessides (1993)[24], and therefore the 82-city-pairs sample was generated[25].

A final caveat related to the sample is the definition of city-pair used here. Due to the procedures of data collection employed by DAC, here a *city-pair* includes only a subset of the direct traffic between two given cities: the non-stop and the one-stop flights. This explicitly excludes more-than-one stop flights and indirect traffic (flight connections), which certainly constitutes a major limitation for the analysis. It is important to emphasize, however, that this definition usually comprises most part of the origin-and-destination traffic between two given cities in Brazil.

4.1.2 Data Description

For every city-pair considered, we use information on prices, seat availability, measures of airline market share and market concentration, distance between endpoints, and on the presence of the LCC Gol. Table 2 presents a brief description of the data as well as some sample statistics. The Appendix explains in more detail the process of data construction.

The first variable available is $\mathbf{price}_{ikt}$, the price of incumbent airline i in city-pair k and period t. Nominal prices were used as inflation is negligible within the two months. It is expressed in local currency (BRL – Brazilian Real). We also consider $\mathbf{snst}_{ikt}$ and $\mathbf{spk}_{ikt}$, respectively the percentage of seats available in *non-stop flights* of airline i, on route k and month t and the percentage of seats available in *peak-hour flights*[26] of airline i on route k and month t. The last measure of seat availability considered is $\mathbf{asz}_{ikt}$, the average number of seats per flight for airline i in city-pair k and period t.

The measures of market share used are $\mathbf{cpms}_{ikt}$ and $\mathbf{cms}_{ikt}$, the former being a proxy for route presence, consisting of the market share of seats available of the i-th (incumbent) airline in city-pair k and time t, and the latter being a proxy for airport presence, measuring the average percentage of seats available on all origin and destination routes in both endpoints cities (aggregation of all airports within a city).

Next we consider two measures of market concentration based on the Hirschman-Herfindhal index (HHI) - $\mathbf{cphhi}_{kt}$ is the HHI calculated at the city-pair level (the market share variable used in this calculation was $cpms_{ikt}$), whereas $\mathbf{chhi}_{kt}$ is the HHI calculated at the city level, that is, extracting a simple average of origin and destination endpoint cities' concentration (market share variable was cms_{ikt}).

---

criterion of routes' density was used, with similar estimation results.

[24] Evans and Kessides (1993) use observations of only the fourth quarter of 1988, for the US airline industry. In that case, they had data disaggregated by airline, and controlled for route-specific effects.

[25] Some city-pairs were discarded from the original database due to some inconsistencies between the Average Yield Report and the HOTRAN Report, and also in order to drop observations from routes in which the participation of small regional airlines was abnormally high.

[26] Here, "peak time" was defined considering all flights with departure within 5am to 10am (morning peak) and 4.30pm to 10pm (evening peak) on weekdays, and those with departure from 7pm to 10pm on Sundays.

Table 4 – Data Summary and Descriptive Statistics[27]

Variable	Description	Mean	Std. Dev.	Min.	Max.
$price_{ikt}$	*Average Price*	275.063	124.330	57.883	791.395
$snst_{ikt}$	*Seats on Non-stop Flights (fraction)*	0.799	0.316	0.000	1.000
spk_{ikt}	*Seats on Peak-Hour Flights (fraction)*	0.491	0.315	0.000	1.000
asz_{ikt}	*Average Aircraft Size*	120.582	266.815	50.000	211.680
$cpms_{ikt}$	*City-Pair Market Share (fraction)*	0.339	0.167	0.097	1.000
cms_{ikt}	*City Market Share (fraction)*	0.337	0.129	0.077	0.647
km_{k}	*Flight Distance*	836.2354	527.296	84.342	2695.487
$cphhi_{kt}$	*City-Pair Concentration Level*	0.345	0.198	0.058	1.217
$chhi_{kt}$	*City Concentration Level*	0.355	0.042	0.294	0.578
$preslcc_{kt}$	*Presence of LCC in the City-Pair*	0.640	0.481	0.000	1.000

We also have information on $\mathbf{km_k}$, the one-way distance between origin and destination airports. Finally, $\mathbf{preslcc_{kt}}$ is a dummy variable that accounts for the presence of Gol Airlines in the city pair on route k and time t.

4.2 The Econometric Methodology

Airline pricing studies can be classified into the following categories: first, the *inter-routes analysis*, in which data is disaggregated at the route level, and usually a cross-section of routes is considered; market-level variables such as flight distance, number of airlines, concentration, route presence of LCC's, presence of LCC on adjacent routes, etc. are used in order to estimate an average price equation. Examples in the literature being Dresner, Lin and Windle (1996) and Morrison (2001), among others.

Alternatively, pricing studies can be performed via an *intra-routes analysis*, in which data is disaggregated at the airline level; carrier-specific characteristics such as route market share, airport market share and network size out of an airport, percentage of seats in direct or round-trip flights, etc., are used to control for effects of heterogeneity among firms in the market. Examples being Borenstein (1989), Berry (1990) and Evans and Kessides (1993).

The methodology we follow here is an intra-routes analysis of the pricing decisions of FSC incumbents in response to Gol Airlines' entry in the Brazilian airline industry. In order to do so, the basic framework considered here is the fixed effects procedure of Evans and Kessides (1993)[28]. In their study, Evans and Kessides control for inter-route heterogeneity in price by having individual route effects, a procedure that can be implemented in a very straightforward way by, for example, employing the least-squares dummy variables (LSDV) estimator with route-specific dummies. These dummies ultimately serve to "*control for (...) omitted route-specific variables that can significantly bias the parameters estimates of the price equation*"

[27] Source: DAC.

[28] In their words, "*we note that most of the sample variation in price is due to differences at the route level that are unmeasured and invariant to a carrier's identity*".

(Evans and Kessides, 1993). Their econometric framework can be summarized by the following pricing relation:

$$\ln(price_{ikt}) = X_{ikt}\beta + v_k + \varepsilon_{ikt} \quad (1)$$

where $price_{ikt}$ is the average price of airline i on route k and time t, X_{ikt} is a vector of variables that are airline, route and time specific, v_k are route-specific effects, and ε_{ikt} are the disturbances, whereas β is the parameter vector of interest.

Nevertheless, it is important to emphasize that the econometric procedure described above is subject to a major limitation with respect to the identification of variables that do not have within-route variation, such as concentration level and LCC presence, the latter being a major issue in the present paper. In order to overcome this problem, without disposing of the controls for heterogeneity across routes, the authors also make use of a random-effects model, and then estimate the following model:

$$\ln(price_{ikt}) = X_{ikt}\beta + Z_{kt}\gamma + v_k + \varepsilon_{ikt} \quad (2)$$

where Z_{kt} is a vector of variables that are route-specific and γ is the associated parameter vector. This procedure is not immune to criticism, however, as the main hypothesis of this approach is that route effects v_k are not correlated with X and Z[29] – otherwise estimates of β and γ will be biased. In fact, when testing for such correlation by making use of the Hausman test of the equivalence between fixed and random effects, they thoroughly rejected the no-correlation hypothesis. This caused severe problems of inference with respect to route-specific variables, potentially making their framework inappropriate for investigating the impacts of LCC entry, the ultimate goal here.

Fortunately, it is possible to devise an econometric procedure that overcomes this problem without completely abandoning the core idea of the analysis of Evans and Kessides (1993), which aims at the control of most of route-specific idiosyncrasies. Here we propose controlling for the effects of route origin and destination cities (CFE), instead of controlling for route-specific effects (RFE). Therefore, for each city k there will be two effects to be controlled – one for the city-of-origin k_1 (v_{k1}) and another for the city-of-destination k_2 (v_{k2}):

$$\ln(price_{ikt}) = X_{ikt}\beta + Z_{kt}\gamma + v_{k1} + v_{k2} + \varepsilon_{ikt} \quad (3)$$

By following the above procedure, one is able to control for unobservable effects at both the origin and destination endpoint cities, which can be done by city dummies – these provide an economical way to capture and control for a large number of truly significant variables, which can be regarded as being actually city-specific, instead of route-specific; also, most of them are in fact unobservables (from the point of view of the researcher).

[29] This assumption is likely to be invalid; for example, unobserved advertising effects on airline's pricing might be correlated with the presence of LCC, or the unobserved premium due to a higher proportion of business travellers might be correlated with the proportion of non-stop flights, etc.

Most of these effects are expected to generate persistent heterogeneity in the error structure across cities, which can be controlled via city-specific dummies. Besides that, and provided that each city possesses at least one route (and ideally groups a reasonable deal of routes), it has the advantage of permitting the identification of the subset of variables that do not vary within routes, and particularly the presence of the LCC. Another advantage is that it is not necessary to rely on the hypothesis of no-correlation between X and Z and the route effects, as with the random effects model[30].

4.3 Model Specification

The specification we adopt is given by

$$
\begin{aligned}
\ln\left(price_{ikt}\right) = \\
= \alpha_0 + \alpha_1 snst_{ikt} + \alpha_2 spk_{ikt} + \alpha_3 asz_{ikt} + \alpha_4 fpms_{ikt} + \alpha_5 apms_{ikt} \\
\alpha_6 fhhi_{kt} + \alpha_7 ahhi_{kt} + \alpha_8 \ln km_k + \alpha_9 \left(\ln km_k\right)^2 + \alpha_{10} preslcc_{kt} \\
+ \alpha_{11} preslcc_{kt} \ln km_k + \sum_l \upsilon_{0l} DC_l + \sum_j \upsilon_{1j} FSC_j + \upsilon_2 DM + \varepsilon_{ikt}
\end{aligned}
\qquad (4)
$$

with the variables as described in the previous section - note the use of the logarithm for prices and distances, as well as the inclusion of a squared distance term, to capture nonlinearities as in Berry (1990) – plus the slope shifter **$preslcc_{kt}$ * ln km_k** for $preslcc_{kt}$, and **DC's**, **FSC's** and **DM** being, respectively, city-specific, incumbent-specific and month-specific dummies.

As for the signs of the coefficients associated to the explanatory variables, since non-stop flights represent both lower disutility for the consumer, and lower costs for the airline, prices may react positively or negatively given a change in **$snst_{ikt}$**, depending on the balance between those two effects. In what regards **spk_{ikt}**, one would expect that the higher one airline's share of seats on flights during peak-time (in comparison to the average) the higher the competitive advantage of this firm, and the higher will be its prices[31]. With respect to **asz_{ikt}**, the effect depends on the balance between two effects, accurately described in Borenstein (1989), "*On flights of more than 500 miles, larger equipment has a lower per-seat-mile cost (...). On the other hand, the quality of the product is higher on larger planes, which are generally more comfortable and are thought to be safer*".

[30] One point must be emphasised, however: although the proposal of controlling for the effects of groups of routes (endpoint cities) instead of individual route effects can be thought as permitting a consistent estimation under the LSDV approach, further investigation into the asymptotic properties of this particular setting are still required. Asymptotically, if the number of routes, k, goes to infinity, the number of cities tends to increase at a lower rate, which might confirm its properties. Moreover, as it will be pointed out in next section, as the number of airlines per route in the data sample is notably low (the average is between 2 and 3 airlines per route), one would think as a reasonable procedure to control for groups of routes instead, in order to increase the statistical significance of estimates (the average number of routes per city is between 8 and 9).

[31] There can be much variability in prices according to flight-time, especially in more congested airports, such as Congonhas (CGH) in São Paulo.

The measures market share $\mathbf{cpms_{ikt}}$ and $\mathbf{cms_{ikt}}$ represent firms' relative positions (capacity) in the market at, respectively, route and airport levels, serving as indicators of *localized pricing power*, as with Evans and Kessides (1993)[32]. Together with the concentration measures, they can also serve as proxies for convenient service of dominant airlines at the route and airport levels and higher advertising levels (if advertising is increasing in the level of operations out of a city); $\mathbf{cms_{ikt}}$ can also be regarded as a proxy for the effects of frequent flyer programs. Thus, they are expected to have coefficients with positive sign, meaning that dominance of capacity in the market confers competitive advantage to airlines.

Finally, $\mathbf{preslcc_{kt}}$ controls for the reactions to entry by incumbents in the market, and the introduction of the slope-shifter serves, along with $\mathbf{cpms_{ikt}}$ and $\mathbf{cms_{ikt}}$, as a straightforward way to inspect the significance of the stylized fact presented in the previous section, with respect to the effects of flight distance on product differentiation in the market. One would expect a positive coefficient associated with this variable, in case of product differentiation effects.

4.4 Endogeneity, Instruments and Estimation Technique

One might well argue that Equation (4) contains a set of potential endogenous variables, such as $\ln price_{ikt}$, $snst_{ikt}$, spk_{ikt}, asz_{ikt}, $cpms_{ikt}$, cms_{ikt}, $cphhi_{kt}$, $chhi_{kt}$, $preslcc_{kt}$ and $preslcc_{kt}*\ln km_k$. In order to inspect this issue, we define instrumental variables likely to be helpful in estimating the model – once these instruments were obtained, we performed tests of the validity of instruments and tests of exogeneity.

In what regards endogeneity, the literature on airline pricing tells us that the most common instruments consider a combination of the following procedures:

1. use of exogenous demand and cost shifters;
2. use of demand and cost characteristics of rivals on the route or of the same firms on other routes; and
3. use of lagged, artificial or transformed variables.

A combination of approaches 1 and 2, for example, is found in Berry, Carnall and Spiller (1996) and Borenstein (1989). In the former study, population and network characteristics at the endpoint cities are used in conjunction with the characteristics of other products in the market (very much in the spirit of Berry, Levinsohn, and Pakes, 1995). They treat prices, market shares and spoke densities as endogenous.

In the latter study, a measure of the presence at the endpoint airports (in terms of emplanements, which are treated as exogenous) is used as an instrument for endogenous route market share of passengers. Also, Borenstein instruments route HHI's using a measure that accounts for the squares of shares of rivals, assuming that "*the concentration of traffic on a route that is not carried by the observed airline is exogenous with respect to the price of the observed carrier, e.g. TWA's price on Boston-Los Angeles route does not affect how the passengers it doesn't get are divided between American and United*".

[32] After the Second and Third Rounds of Liberalisation, changes in capacity were made easier via a simplification in the process of flight frequency requests to DAC. One can argue that, apart from highly congested airports, such as CGH and PLU, capacity is short-run adjustable for most of the routes.

On the other hand, Evans and Kessides (1993) prefer making use of approach 3, and develop a "restricted rank" of firms on a route - calculated in descending order, that is, the largest firm on the route has a rank of one, etc – so as to identify route market shares. This rank is restricted as they set the largest value of the rank at three, a procedure undertaken in order to avoid the effect of small carriers, whose market shares are not significantly different from their next closest competitors in the rank – in their words: "*With the restricted rank, we lump all but the two largest carriers on a route into one category, and we must assume that changes in prices for (...) small carriers will not be large enough so as to move them out of this group*".

Moreover, approach 3 is also employed by Evans, Froeb and Werden (1993), and Marín (1995), which use lagged variables. The former instruments route HHI's using a one-year lag of that variable, but assigning a value of 0 if the route was not among the top 1,000 in the previous year in their data. They also use a dummy variable indicating if the route was in the top 1,000 in the previous year as instruments. And the latter uses lagged variable to instrument a "relative advertising goodwill" variable, but combines this procedure with approach 1, making use of exogenous variables coming from an estimated demand equation.

In order to account for endogeneity of right-hand-side variables, we used a combination of approaches 1 and 3. Firstly, we used lagged variables (one year) – for instance, $cpms_{ikt}$ (t = October 2001) is instrumented by $cpms_{ikt-12}$ (t-12 = October 2000). By using this kind of instruments, we take advantage of the fact that the FSC Transbrasil exited the industry in 2001 and then figures in 2000 year could reflect a market with roughly the same number of major airlines (that is, the three major airlines left and Gol), which served to increase correlation between instruments and endogenous variables.

With respect to the instrument for $preslcc_{kt}$, there was clearly a problem of extraction of past realizations, as Gol entered the market only in 2001. On account of that, market share of Transbrasil Airlines and a dummy of its route presence in 2000 were used, since Gol had significant incentives to avoid entering routes left by the bankrupt. We also make use of the market share of Transbrasil, and of variables accounting for the percentage of flights made by Fokker, Boeing and Embraer aircraft on the route, all lagged by one year[33]. The validity of the suggested set of instruments was not rejected by a Hansen J test of orthogonality.

[33] The mix of aircraft (jets, regional, etc.) on a given route can be regarded as one of the determinants of the level of service, which is certainly a demand shifter.

5 Results

5.1 Estimation Results

In this section we implement the estimation of a pricing equation with city effects (CFE) and, for comparison purposes, also present the estimation with route effects (RFE), as in Evans and Kessides (1993).

Table 5 - Estimation Results[34]

Variables	ln ($price_{ikt}$)	
	GMM Route Effects	GMM City Effects
constant	5.551 ‡ (0.071)	0.310 (0.682)
$snst_{ikt}$	-0.045 (0.047)	-0.052 * (0.029)
spk_{ikt}	0.045 (0.050)	0.061 † (0.027)
asz_{ikt}	-0.071 † (0.036)	-0.077 ‡ (0.029)
$cpms_{ikt}$	0.162 † (0.066)	0.133 † (0.067)
cms_{ikt}	0.691 ‡ (0.139)	0.759 ‡ (0.143)
$cphhi_{kt}$		0.041 (0.068)
$chhi_{kt}$		-0.180 (0.998)
ln_km_k		1.051 ‡ (0.175)
$(ln\_km_k)^2$		-0.042 ‡ (0.015)
$preslcc_{kt}$		-1.210 ‡ (0.361)
$preslcc_{kt} * ln\ km_k$		0.170 ‡ (0.058)
N. Observations	408	408
Centered R2	0.961	0.946
Hansen J Statistic	0.223	0.986

*, †, ‡ mean significant at, respectively, 10% , 5% and 1% levels. Fixed-effects not reported.

The standard IV approach here would be to perform 2SLS estimation, relying on the

[34] Wald test of joint significance of the city-effects: chi2 (18) = 69.55, P-Value = 0.0000.

conditional homoskedasticity assumption. However, this assumption was strongly rejected in our preliminary estimations (implying that the estimator is inefficient), so that we employ the two-step Generalized Method of Moments, which is efficient in the presence of arbitrary heteroskedasticity. Table 5 reports the results.

There is a number of interesting results to note. First, regarding the significance and magnitude of the market share variables $cpms_{ikt}$ and cms_{ikt}, one can see that both are significant regardless of the estimation procedure employed – as opposed to what happens to the measures of concentration. This suggests that they are both relevant as indicators of localized competitive advantage. In contrast to Evans and Kessides (1993), which reports the reality in the United States, results for the Brazilian airline industry reveal that structure at the route level still has considerable significance in conditioning intra-firm heterogeneity in prices. Whereas Evans and Kessides (1993) found that "*a firm's perceived pricing power at the route level is actually power conveyed to it through control of airport facilities*", here we find that dominance at the route level can be a source of competitive advantage along with airport presence. These findings are of extreme relevance when analyzing price responses to entry ($preslcc_{kt}$), as one would question the role of routes as a relevant market place (and source of pricing power) in favour of airports nowadays in the airline industry, and these results serve as an indicator that routes are still a locus of competition in recently-liberalized airline markets[35].

There are two main reasons for the significance of $cpms_{ikt}$ in conjunction with cms_{ikt}: First, the still immature stage of liberalization in Brazil, which means that well-known strategies typical of airline deregulated markets, such as hub-and-spoke method, are not fully developed yet, and maybe never become as sophisticated as in the US, as a consequence of the competitive pressure from the LCC's' hub bypassing tendency. And second, the existence of a centralized federal airport management, performed by INFRAERO (Federal Airport Enterprise) in conjunction with DAC: as the main directions over the years were towards giving equal access to airport facilities and terminals to all airlines, airport dominance has been rather rare to happen until very recently.

With respect to the LCC's route presence, one can see, as discussed before, that only the "city-effects model" proposed here is able to identify price reactions to entry, in opposition to the "route effects"[36]. The estimated effect is, as expected, negative and significant, meaning that, independent of airline and route-specific characteristics, incumbents have a propensity to react in prices against the LCC. These results are in line with the findings of Whinston and Collins (1992), Windle, Lin and Dresner (1996) and Morrison (2001), for the US case.

Finally, one can observe that the variable representative of the effects of flight distance on product differentiation ($preslcc_{kt} * \ln km_k$) is significant and has a positive coefficient, which is in line with the discussion in Section 3. This suggests that competition is softer in markets with longer hauls.

[35] In fact the airport as a locus of competition would be representative of the evolution towards a hub-and-spoke network, in which the definition of a complex O-D pair structure confers more competitive advantage than local (route) attributes.

[36] Actually, the "route effects model" would require a detailed inspection in the values of the estimated coefficients of the route dummies in order to permit this kind of analysis.

5.2 The Effect of LCC Presence on Price Reactions

In order to uncover the effects of route dominance on heterogeneity and price reactions one would need to calculate the marginal effects via a given change in $cpms_{ikt}$. The marginal effects of the LCC entry can be extracted from equation (5) in the following way:

[illegible] (5)

The issue with (5) is related to the definition of the impacts of entry on $cpms_{ikt}$ and cms_{ikt} (the two last terms in the right-hand side of the marginal effects relation). With this purpose in mind, scenarios were then built, by considering a LCC entry with a market share of 20%, 25%, 30%, 35%, 45%, 50% and 60% of the route's seats available, and thus by calculating the effect of a corresponding decrease in $cpms_{ikt}$ in the price of the k-th FSC airline. Also, these scenarios considered a hypothetical route with an average of 10% of traffic in the endpoint cities (that is, with a proportional decrease in cms_{ikt}).

Results of these exercises are reported in Table 6, which provides the marginal effects of Gol's route presence on incumbents' reactions, by considering both the market share scenarios and a selection of representative flight distances[37].

By inspecting Table 6, one can see that there are some markets potentially subject to a **"*not-to-react*"** tactic by incumbents[38], on account of the degree of product heterogeneity discussed in Section 3. Indeed, on the one hand, marginal effects are negative and very significant for shorter-haul markets and markets in which the incumbents have higher dominance (or alternatively, in which Gol have lower market share of seats available, measured by $\mathbf{lccms_{ikt}}$).

On the other hand, marginal effects of Table 6 are increasing, that is, competition becomes softer, the higher the flight distance and the lower is Gol's market share. Actually one cannot reject the hypothesis of "not-to-react" in all cases of entry in markets with flight sector higher or equal than 1,250 km; also, if one considers, for instance, a given distance of 900 km, one cannot reject a "not-to-react" tactic in all cases where the LCC's market share is lower than 25%. Therefore, it is possible to infer from this analysis that product differentiation between the LCC and the incumbent FSC's is indeed a very relevant feature in this industry, at least for the period under consideration (2001, the first year of operations of Gol Airlines); these elements of heterogeneity were decisive in conditioning the patterns of price reactions to the LCC's entry.

---

[37] For a better understanding of Table 4, consider the first entry (km_k = 350, $lccms_{ikt}$ = 20%). It is clear that -0.228 = -1.210 + 0.170 * ln(350) + 0.133 * (-20% * 0.339) + 0.759 * (-20% * 0.339 * 10%), where 10% is the assumed relation between the relative size of the route with respect to the total traffic out of a given airport, 0.339 is the sample mean of $cpms_{ikt}$, and the other figures are the coefficients α_4, α_5, α_{10} and α_{11} of equations (10) and (10').

[38] One could use "to acquiesce" or "to accommodate" for this case, but, as these terms are strongly associated with very specific situations in the game theory literature, they were therefore avoided here, and "not-to-react" or "not-to-fight" was then used as meaning "not-to-change-prices".

Table 6 - Marginal Effects of the LCC's Route Presence

$lccms_{ikt}$ \ km_k	350	500	650	900	1,250	1,600	1,750
20%	-0.228 ‡ (0.035)	-0.168 ‡ (0.027)	-0.123 ‡ (0.031)	-0.068 (0.042)	-0.012 (0.058)	0.030 (0.071)	0.045 (0.076)
25%	-0.232 ‡ (0.035)	-0.171 ‡ (0.027)	-0.127 ‡ (0.031)	-0.071 * (0.042)	-0.015 (0.058)	0.027 (0.071)	0.042 (0.076)
30%	-0.235 ‡ (0.035)	-0.175 ‡ (0.027)	-0.130 ‡ (0.031)	-0.075 * (0.042)	-0.019 (0.058)	0.023 (0.071)	0.038 (0.076)
35%	-0.239 ‡ (0.035)	-0.178 ‡ (0.027)	-0.134 ‡ (0.031)	-0.078 * (0.043)	-0.023 (0.058)	0.019 (0.071)	0.035 (0.076)
45%	-0.246 ‡ (0.035)	-0.185 ‡ (0.028)	-0.141 ‡ (0.031)	-0.085 † (0.043)	-0.030 (0.059)	0.012 (0.071)	0.028 (0.076)
50%	-0.250 ‡ (0.035)	-0.189 ‡ (0.028)	-0.144 ‡ (0.031)	-0.089 † (0.043)	-0.033 (0.059)	0.009 (0.071)	0.024 (0.076)
60%	-0.257 ‡ (0.036)	-0.196 ‡ (0.028)	-0.151 ‡ (0.032)	-0.096 † (0.043)	-0.040 (0.059)	0.002 (0.072)	0.017 (0.077)

Notes: i. figures calculated holding $cpms_{ikt}$ at the sample mean; ii. represent an even decrease in the participation of the FSC incumbents in the market; iii. $lccms_{ikt} = 1 - cpms_{ikt}$; iv. values of are representative of the following percentiles: 0.20, 0.35, 0.50, 0.65, 0.80, 0.90 and 0.95.

Conclusions

This paper examined price reactions to the entry of the LCC Gol Airlines, in the Brazilian domestic market, in 2001. By making use of a price equation with city-specific effects, it was in a position of developing an analysis of reactions to entry which shares the advantages of both the intra and inter-routes traditions of the airline pricing literature. In particular, it was possible to perform a study of the determinants of localized competitive advantage in the industry, as Evans and Kessides (1993). Also, and within the same econometric framework, it was possible to investigate the causes of price variation *across* routes, thus providing an analysis of the patterns of price reactions to LCC entry. This was made possible due to an extension of their procedure, in which instead of controlling for route-specific fixed-effects we opted for controlling for city-specific fixed-effects, without recurring to the use of random-effects.

Our results suggest that competition is located at both the route and the airport (city) levels, in contrast to the results found in the previous literature (US market). One can infer that a route is still a locus of competition in recently-liberalized airline markets, mainly those not fully characterized by hub-and-spoke operations.

Also, a significant and negative effect on prices caused by LCC entry was found, indicating that incumbents have indeed high propensity to react in prices, other things held constant. And finally, an analysis of the marginal effects of entry permitted reaching the conclusion that product differentiation between the LCC and the incumbent FSC's is certainly a very relevant feature in this industry and that these elements of heterogeneity were decisive in conditioning the patterns of price reactions to the LCC's entry in its start-up year (2001).

References

ALDERIGHI, M., CENTRO, A., NIJKAMP, P., and RIETVELD, P. (2004) The Entry of Low Cost Airlines: Price Competition in the European Airline Market. *8th Annual World Conference of the Air Transport Research Society (proceedings)*.

BAILEY, E. & PANZAR, J. (1981) The Contestability of Airline Markets during the Transition to Deregulation. *Law and Contemporary Problems* **44,** 125-145.

BERRY, S. (1990) Airport Presence as Product Differentiation. *American Economic Review* **80,** 394-399.

BERRY, S. (1992) Estimation of a Model of Entry in the Airline Industry. *Econometrica* **60,** 889-917.

BERRY, S., CARNALL, M. & SPILLER, P. (1996) Airline Hubs: Costs, Markups and the Implications of Customer Heterogeneity. *NBER Working Paper Series* **5561,** 41.

BERRY, S.; LEVINSHON, J., and PAKES, A. (1995) Automobile Prices in Market Equilibrium. *Econometrica*, **63**, 841-890.

BOGUSLASKI, R.; ITO, H., and LEE, D. (2004) Entry Patterns in the Southwest Airlines Route System. *Review of Industrial Organization* **25**, 317-350.

BORENSTEIN, S. (1991) The Dominant-Firm Advantage in Multiproduct Industries: Evidence form the U.S. Airlines. *Quarterly Journal of Economics* **106,** 1237-1266.

BORENSTEIN, S. (1989) Hubs and High Fares: Dominance and Market Power in the U.S. Airline Industry. *Rand Journal of Economics* **20,** 344-365.

BORENSTEIN, S. & NETZ, J. (1999) Why Do All the Flights Leat at 8 am?: Competition and Departure-Time Differentiation in Airline Markets. *International Journal of Industrial Organization* **17,** 611-640.

BRANDER, J. & ZHANG, A. (1990) Market Conduct in the Airline Industry: An Empirical Investigation. *Rand Journal of Economics* **21**, 567-583.

DE VILLEMEUR, E.; IVALDI, M., and POUYET, J. Entry in the Passenger Rail Industry: A Theoretical Investigation. *IDEI Report - Institut D´Economie Industrielle*. 2003; 2 (May).

DOGANIS, R. (2001) *The Airline Industry in the 21th Century*. Routledge, London.

DONNELLY, S., JAMES, A., & BINNION, C. (2004) Bmi's response to the changing European airline marketplace. *Journal of Revenue and Pricing Management* 3, 10-17.

DRESNER, M., LIN, J. & WINDLE, R. (1996) The Impact of Low-Cost Carriers on Airport and Route Competition. *Journal of Transport Economics and Policy* **30,** 309-328.

EVANS, W., FROEB, L. & WERDEN, G. (1993) Endogeneity in the Concentration-Price Relationship: Causes, Consequences, and Cures. *Journal of Industrial Economics*, **41**, 431-438.

EVANS, W. & KESSIDES, I. (1993) Localized Market Power in the U.S. Airline Industry. *Review of Economics and Statistics* **75,** 66-75.

HURDLE, G., JOHNSON, R., JOSKOW, A., WERDEN, G. & WILLIAMS, M. (1989) Concentration, Potential Entry, and Performance in the Airline Industry. *Journal of Industrial Economics* **38,** 119-139.

ITO, H. & LEE, H. (2003) Low Cost Carrier Growth in the U.S. Airline Industry: Past, Present, and Future. *Department of Economics Working Papers - Brown University*.

JOSKOW, A., WERDEN, G. & JOHNSON, R. (1994) Entry, Exit, and Performance in Airline Markets. *International Journal of Industrial Organization* **12,** 457-471.

LEVINE, M. (1987) Airline Competition in Deregulated Markets: Theory, Firm Strategy, and Public Policy. *Yale Journal on Regulation* **4,** 393-494.

MARÍN, P. (1995) Competition in European Aviation: Pricing Policy and Market Structure. *Journal of Industrial Economics*, **43**, 141-159.

MORRISON, S. (2001) Actual, Adjacent and Potential Competition: Estimating the Full Effect of Southwest Airlines. *Journal of Transport Economics and Policy* **35,** 239-256.

RICHARD, O. (2003) Flight frequency and mergers in airline markets. *International Journal of Industrial Organization*; **21**, 907-922.

SILVA, E. and ESPÍRITO SANTO Jr., R. Introducing the Low-cost-Low Fare Concept in Brazil: Gol Airlines. *7th Annual World Conference of the Air Transport Research Society*, Paris.

SLADE, M. (2004a) Market Power and Joint Dominance in UK Brewing. *Journal of Industrial Economics*, **52**, 133-163.

SLADE, M. (2004b) Models of Firm Profitability. *International Journal of Industrial Organization*, **22**, 289-308.

SPENCE, M. (1977) Entry, Capacity, Investment and Oligopolistic Pricing . *Bell Journal of Economics* **8,** 534-544.

TOINAVEN, O. & WATERSON, M. (2001) Market Structure and Entry: Where's the Beef? *Warwick Economic Research Papers* **593**.

TRETHEWAY, M. (2004) Distortions of Airline Revenues: Why the Network Airline Business Model is Broken. Journal of Air Transport Management, **10**, 3-14.

WHINSTON, M. & COLLINS, S. (1992) Entry and Competitive Structure in Deregulated Airline Markets: An Event Study Analysis of People Express. *Rand Journal of Economics* **23,** 445-462.

WINDLE, R. & DRESNER, M. (1999) Competitive Responses to Low-cost Carrier Entry. *Transportation Research - Part E* **35,** 59-75.

YAMAWAKI, H. (2002) Price Reactions to New Competition: A Study of US Luxury Car Market, 1986-1997. *International Journal of Industrial Organization* **20,** 19-39.

Appendix – Description of Variables

- **ln price$_{ikt}$** is calculated by multiplying yields available in DAC's Average Yield Report by the flight distance of city-pair k. It is expressed in local currency (R$ or BRL – Brazilian Real) for the monthly, point-to-point traffic, supplied by DAC, and represents BRL per trip (one way). Only incumbent's (FSC's) prices are considered. Average yields are not disaggregated by fare class.
- **snst$_{ikt}$** was calculated using the total number of seats in non-stop flights divided by the total number of seats in all direct flights with either zero or one stop – which is in line with definition of city-pair we use. Data for total number of flights disaggregated by airline and by each day of the week is available in DAC's "Horário de Transporte" (HOTRAN), a data system that generates reports containing operational information of all scheduled flights within the country (non-published information). This information was extracted from their system on a monthly basis for the period 2001-2002, and subsequently aggregated by year.
- **spk$_{ikt}$** was calculated by dividing the total number of seats in peak-hour flights by the total number of seats in all direct flights with either zero or one stop. For this calculation, "peak time" was defined considering all flights with departure within 5am to 10am (morning peak) and 4.30pm to 10pm (evening peak) on weekdays, and those with departure from 7pm to 10pm on Sundays. DAC's HOTRAN Report provides the information of flight number / weekdays / departure times, which made possible the segregation into "peak" and "off-peak" periods.
- **asz$_{ikt}$** is the average number of seats per flight for airline i; weights were calculated based on the number of flight frequencies on route k.
- **cpms$_{ikt}$** is a proxy for route presence, and consists of the market share of seats available of the i-th (incumbent) airline in city-pair k and time t.
- **cms$_{ikt}$** is a proxy for airport presence, and measures the average percentage of seats available on all origin and destination routes in both endpoints cities (aggregation of all airports within a city).
- **cphhi$_{kt}$** is the HHI calculated at the city-pair level (the market share variable used in this calculation was cpms$_{ikt}$),whereas **chhi$_{kt}$** is the HHI calculated at the city level, that is, extracting a simple average of origin and destination endpoint cities' concentration (market share variable was cms$_{ikt}$).
- **ln km$_k$** and **(ln km$_k$)^2** are the logarithm of the distance of route k, and its square. These variables consider the one-way distance between origin and destination airports. This information was provided by Department of Civil Aviation's Laboratory of Simulation and was calculated by using the polar coordinates method. One important issue about these variables is related to distance calculation when the sample presents more than one airport in one or both endpoint cities of the given route. In both cases the latitude and longitude of the airports closest to the city centre were calculated and considered representative of the distance between cities.
- **preslcc$_{kt}$** is a dummy variable that accounts for the presence of Gol Airlines in the city pair on route k and time t. This variable is indicative of the price reactions to Gol's presence undertaken by the FSC's within the sample period.