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# Hub location in the South-Atlantic airline market A spatial competition game <sup>☆</sup>

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## Abstract

The paper analyzes the airlines' hub location problem through a spatial competition game played in two stages. First, airlines sequentially choose the location of their hub and second, they compete offering direct or connecting services between each city-pair. Different outcomes in the first stage will affect competition in the second, and as a consequence, the market share that airlines can obtain.

Given actual demand patterns, results of the model are applied to the South-Atlantic airline market. We study the subgame perfect equilibriums obtained as a result of competition in each city-pair to anticipate where airlines will probably locate their hubs once an "open skies" policy is adopted in this market.

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## 1. Introduction

The situation of the air industry until the 1978 Airline Deregulation Act was characterized by a very limited competition among operators. Fares were strictly regulated and market entry was restricted by a route certificate that was officially issued in "a public convenience and necessity"

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<sup>☆</sup> This research has been done while the authors were visiting the Institute of Transportation Studies at UC Berkeley.

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basis. In this context, the only way to attract demand was competing via non-price competition, and regulation versus competition debate was very common in the 1970s and 1980s.

After US airline deregulation airlines could compete with each other, choosing when and where to fly and setting prices freely, and many unpredicted changes occurred in the industry (Levine, 1987): emergence of hub-and-spoke networks, complicated fare structures, frequent flyer programs, competition via travel agencies commissions and computer reservation systems. Neither the theory of perfect competition nor the theory of contestable markets could explain adequately all these events. Many of them were the consequence of the strategic behavior adopted by airlines that was absent under the regulatory regime.

The process initiated in the US had some demonstration effect for the rest of the world. Soon after the US deregulation, new and more liberal bilateral agreements between the US and some European countries (UK, Netherlands, Belgium, Ireland, Germany) were signed. Domestic markets were deregulated to some degree in Canada and Mexico during the 1980s. The European Union took three steps on a gradual process to liberalize its air industry, beginning in 1987 and finishing in 1997 with the creation of the European domestic market for all the European airlines independently of its nationality.<sup>1</sup> International air services to and from Australia and the domestic aviation market has been progressively liberalized during the 1990s.

These deregulatory processes, combined with some other factors, such as, a rising in income and an increasing tourism industry, have contributed to the steady growth of demand in aviation markets. Additionally, the existence of a more competitive environment has also changed the supply curve. Airlines now, have to be more efficient in order to survive in the market.

The adoption of hub-and-spoke networks was one of the most significant innovations that followed the US airline deregulation. For the rest of the world, national carriers operating from one major national airport resembles the hub-and-spoke network configuration.

There are several works that analyze hub location problems and competition issues in hub-and-spoke networks. O'Kelly (1987), in his seminal paper, analyzed the optimal location with air passenger traffic in the United States. After this work, many authors have treated the problem using principally linear programming methods. O'Kelly and Miller (1994) analyzed different hub location patterns using alternative hypotheses about non-hub routes and hub level network topology to resolve the allocation problems. Jaillet et al. (1996) studied the interaction between demand and the choice of aircraft and made a flexible network configuration, analyzing different service policies. Campbell (1994) presented a survey of network hub location problems. A classical problem is how to allocate a number of hubs in a network, assuming that non-hub routes disappear. Game theoretic models have been also applied to analyze airline competition and airline network strategies in a hub-and-spoke environment. Some of the most representative work in this area can be found in Hansen (1990), Oum et al. (1995), Hong and Harker (1992) and Adler (2001).

Although hub location issues have been profusely studied in the literature not very much work has been done considering the dynamic nature of the hub location process. This paper analyzes the hub location problem that airlines face as a spatial competition game played in two stages. First, airlines sequentially choose the location of their hub and second, once locations have been

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<sup>1</sup> For details of the various "Packages" of reforms, see Button et al. (1998), Vincent and Stasinopoulos (1990), Stasinopoulos (1992, 1993).

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