Modeling the Spatial Variation in U.S. Airfares Utilizing Geographically Weighted Regression

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ABSTRACT

Modeling airline fares is quite challenging due to the constantly changing fare structure of the airlines in response to competitors, yield management principles, and a variety of political and economic changes, and has become more complex since deregulation. This paper attempts to add to the literature by providing a more in-depth look at fare structure using a multivariate approach. A total 6,200 routes between 80 primary U.S. airports are analyzed using linear and geographically weighted regression models. The results from the global models reinforce some of the expectations mentioned in the literature, while the local models provide an opportunity to analyze the spatial variation of influencing factors and predictability.

Keywords: Airfares, Airline Pricing, Airports, Geographically Weighted Regression, Multivariate Model, Passenger Air Travel

INTRODUCTION

The deregulation of the airline industry created a myriad of changes in the U.S. system that has both defended and sparked debate on the wisdom of such policy change for over 3 decades (Bailey, et al, 1985; Borenstein, 1989; Brenner, 1988; Brown, 1987; Dobson, 1995; Goetz & Dempsey, 1989; Graham, et al, 1983; Meyer, et al, 1981; Rose, 1981; Shaw & Ivy, 1994; Toh & Higgins, 1985). Other parts of the world, particularly Europe, have been heavily influenced by the US experience in the deregulated era which has prompted waves of deregulation (liberalization), the build-up of large hubs to collect and redistribute passengers, mergers and acquisitions, marketing and operational alliances, as well as code-share partnerships to create larger systems that cut across political boundaries creating greater economies of scale and scope that has truly brought about the concept of a ‘global airline’
Many geographers have been interested in the spatial change in network structure resulting from deregulation. These changes were required in order to maximize passenger loads and the usage of aircraft, which resulted in the hub-and-spoke system we see today. The hub-and-spoke system created a hierarchy in air transport where some airports, those selected as transfer and collection hubs in the networks of the major airlines (hubs), were elevated in connectivity importance, and those not selected as major transfer and collection points (spokes) often declined in relative connectivity importance within the system; and some airports were completely left behind in the hub-and-spoke structure losing service altogether (Chan, 1982; Ivy, 1993a, 1993b; Jemiolo & Oster, 1987; Maraffa & Kiel, 1985; Warren, 1984). O’Kelly (1986a; 1986b, 1987) and others (Bauer, 1987; Chou, 1990; Fleming & Hayuth, 1994; Ivy, 1991; Lopuszynski, 1986; O’Kelly & Lao, 1991; O’Kelly & Miller, 1994; Shaw, 1993; Song, 2006) have made significant contributions to the understanding of the selection, positioning and interaction of hubs within the network design. The connectivity advantages of hub cities can often translate into economic advantages such as creating an attractive force to large firms when locating or relocating administrative and research based employees or helping to restructure an urban economy in general (Debbage, 2000; Debbage & Delk, 2001; Ivy, et al, 1995), as well as other positive and negative impacts for the airports, airlines, communities housing the hub airport and passengers living in the hub city (Kanafani & Ghabrial, 1985).

This article aims to add to the literature on airline fare pricing and demand, which has become much more complex since deregulation. Historic data and literature indicates that airfares in the past were less of a mystery. Distance traveled once played the strongest role in determining airline fares (Cherington, 1958; MacAvoy & Snow, 1977; O’Connor, 1985). The Civil Aeronautics Board (CAB), predecessor of the Federal Aviation Administration (FAA), recommended that coach fares comprise a flat terminal charge related to the fixed cost structure of the airline industry plus an additional line-haul charge related to the variable or operating cost structure largely based on trip mileage. As distance increased, the fixed costs per unit decreased as they were spread over the greater distance and the variable operating costs would become a greater part of the fare structure. The overall effect was that airline fares would increase at a decreasing rate for flights of greater distances. It is anticipated that the major forces driving the spatial variation of airfares in the U.S. has become increasingly heterogeneous, perhaps applicable, however, to a small number of variables.

Modeling airline fares today is quite challenging due to the constantly changing fare structure of the airlines based on high levels of competition, shrinking profits through much of the deregulated era and sophisticated yield management principles. Airlines typically change fares several times per day to respond to competitors’ fare changes while aiming to maximize revenues, thus any meaningful analysis of airfares must include a data collection period over as short of a window as possible (Holloway, 2008; Vasigh, et al., 2010; Wensveen, 2007). This becomes challenging because the collection of airline fares for a large data set is quite tedious and time consuming, explaining why there are relatively few studies that attempt to analyze airline fares in great detail.

The goal of this research is to model factors that influence the construction of airline fares within the United States. We will examine how these factors and the explanatory power of these factors vary in geographic space and time. Geographically weighted regression will be used to provide greater depth to the understanding of the regional effect of the possible predictors of airline fares.
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