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Impact of aircraft size and seat availability on airlines' demand and market share in duopoly markets

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Abstract

We build a nested logit model to study the roles of aircraft size, together with service frequency, seat availability and fare, in airlines' market share and total demand in non-stop duopoly markets. We find that airlines can obtain higher returns in market share from increasing service frequency than from increasing aircraft size, and our study confirms an *S*-curve effect of service frequency on airlines' market share. We find that the available capacity per flight—net of capacity absorbed by connecting passengers—affects market share in the same manner whether it is derived from a larger proportion of a smaller aircraft or smaller proportion of a larger one.

Keywords: Aircraft size; Seat availability; Airline demand; Market share; Duopoly market

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1. Introduction

In the late 20th century, when most major airports in the United States were congested and the flight delays were a major concern to both passengers and carriers, the airlines often demanded airport capacity enhancement through building new runways or installing more sophisticated traffic control systems, both of which were very expensive. In the meantime, the airport managers, government policy makers and aircraft manufacturers have been asking the questions of whether the airlines would increase the size of aircraft in their fleet, rather than the number of flights, to accommodate increasing travel demand, and how airlines' choice of aircraft size would influence demand, market share and profit.

The tragedy of September 11 and the slowdown of the economy in both domestic and international markets in the new millennium have significantly changed the airline business. Travel demand has diminished due to security concerns and economy downturn; low cost carriers are competing more aggressively and penetrating in more markets; passengers are unwilling to pay for a premium price due to more transparent prices available on the Internet. To account for these factors, most network carriers, such as American Airlines and United Airlines, are in the process of reconstructing their business models. Simplifying and reconstructing aircraft fleet is a critical component in these reorganization plans, which would result in only the most profitable aircraft type(s) being retained in the fleet. Thus the same question posed by the old environment is equally salient in the new one: what are the market share and profit implications of varying flight frequency and aircraft size to provide a given level of air transport capacity?

The recognition and study of the impact of aircraft size and frequency on airline demand started with the introduction of the concept of "schedule delay", first introduced by Douglas and Miller (1974), and subsequently applied by Viton (1986). "Schedule delay" has two components. The first is frequency delay, which represents the elapsed time between an individual traveler's preferred time and the time of a scheduled flight. The second component is stochastic delay, which represents the additional elapsed time when preferred flights are fully booked. Douglas and Miller estimated empirical frequency and stochastic delay functions by using regression and simulation methods. Frequency delay decreases with frequency, while stochastic delay decreases with frequency and aircraft size, and increases with demand in the market. For the same service frequency provided by the airlines, the larger the aircraft, the higher the probability that a passenger can get a seat on a preferred flight and therefore enjoy a more convenient service. The concept of "schedule delay" was used in a linear regression model by Abrahams (1983) to estimate total air travel demand in a single market. In order to specify "schedule delay," Abrahams used the frequency delay function introduced by Eriksen (1977), and the stochastic delay function introduced by Swan (1979). These two functions have the same form as those proposed by Douglas and Miller (1974), but the parameter values are different. Thus these models capture effects of both frequency and aircraft size.

Instead of using the negative term "schedule delay", Eriksen (1977) and Russon and Hollingshead (1989) used the terms "level of service" or "quality of service"—which are functions of service frequency and aircraft size in a format similar to "schedule delay"—in their models of air passenger travel demand.

Other researchers focused on "service frequency" or "frequency delay" to study the influence of airlines' service on travel demand. Hansen (1990) used service frequency, fare and flight distance