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The impact of advance purchase deadlines on airline consumers' search and purchase behaviors

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ABSTRACT

Airlines frequently use advance purchase ticket deadlines to segment consumers. Few empirical studies have investigated how individuals respond to advance purchase deadlines and price uncertainties induced by these deadlines. We model the number of searches (and purchases) for specific search and departure dates using an instrumental variable approach that corrects for price endogeneity. Results show that search and purchase behaviors vary by search day of week, days from departure, lowest offered fares, variation in lowest offered fares across competitors, and market distance. After controlling for the presence of web bots, we find that the number of consumer searches increases just prior to an advance purchase deadline. This increase can be explained by consumers switching their desired departure dates by one or two days to avoid higher fares that occur immediately after an advance purchase deadline has passed. This reallocation of demand has significant practical implications for the airline industry because the majority of revenue management and scheduling decision support systems currently do not incorporate these behaviors.

1. Introduction

Classic theories of consumer search for perishable goods predict that prices should fall as a deadline approaches. For example, the value of bakery goods and newspapers decreases over time, *i.e.*, these products are more valuable at the start of the business day than at the end of the business day. In contrast, products (or seats) in the airline industry are unique in that their value *increases* over time. Consequently, whereas the baker may cut prices as the business day comes to a close, consumer dynamics in the airline industry lead to the opposite effect. That is, prices tend to increase as the flight departure date approaches.

Airlines are able to induce this type of pricing behavior through the use of advanced purchase deadlines. By offering a discount fare that must be purchased by a certain deadline (*i.e.*, a minimum number of days in advance of flight departure), airlines can induce price-sensitive consumers to make their purchases further in advance of flight departure. This leaves less price-sensitive consumers in the market, which allows airlines to charge higher prices for tickets closer to departure.

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In general, airlines typically sell multiple discounted products with different advance purchase deadlines. A study by Puller and Taylor (2012) found, for example, that discounted fare products represented 66% of their sample of U.S. bookings. Among these discounted fare products, 93.3% were associated with just four advance purchase deadlines: 21 days (3%), 14 days (47%), 7 days (32%), and 3 days (12%).

Even though advance purchase deadlines lead to systematic fare increases, their exact timing is uncertain. For example, the presence of the seven-day deadline does not necessarily mean that prices will increase on a flight for tickets purchased six (versus seven) days in advance of departure. This is because revenue management systems determine how many tickets of a particular product should be offered for sale. For flights in which it is expected that a large number of consumers will arrive in the last week prior to departure, the revenue management system will recommend selling a limited number of discounted tickets. From the consumer's perspective, this means that the discounted product with a seven-day advance purchase deadline will sell out more than seven days in advance of departure. As this example shows, the presence of advance purchase deadlines combined with demand fluctuations induces price uncertainty in markets. Further, variation in prices can be particularly high in markets served by both low cost and legacy carriers due to misalignment in product offerings. This misalignment is caused by low cost carriers selling (only) one-way fares and legacy carriers offering a mix of one-way and round-trip fares.

In this paper, we examine how consumers respond to these advance purchase deadlines and associated price uncertainties induced by these deadlines using multiple datasets from an online travel agency (OTA), QL2 Software (a firm that many travel and retail firms use to collect and analyze competitors' pricing information), a major U.S. airline, and the Airlines Reporting Corporation (a clearinghouse that processes all tickets purchased through travel agencies in the U.S., including OTAs). The OTA data provide information on the number of searches and purchases that occur in a market for specific search and departure dates. The QL2 Software data provide information on the fares available to consumers at the time they searched. Online search data from a major U.S. airline are used to validate results and a sample of tickets from the Airlines Reporting Corporation (ARC) is used to validate length of stay assumptions. To model the number of searches (and purchases), we use an instrumental variable (IV) approach to correct for price endogeneity and predict the number of searches (and purchases) in a market for specific search and departure dates. Our results provide insights into the impact of advance purchase deadlines on airline consumers' search and purchase behaviors.

The remaining sections are organized as follows. Section 2 reviews relevant literature to motivate why airlines offer discounted products with associated advance purchase deadlines. Section 3 describes the data. Methodology and empirical results are presented in Sections 4 and 5, respectively. Section 6 uses clickstream data from a major U.S. carrier's website to validate the key findings of the study, namely that consumer search increases immediately prior to advance purchase deadlines and new consumers enter the market over time. Section 7 discusses implications for aviation practice and Section 8 concludes by summarizing the key findings and providing direction for future research.

2. Literature review

Several studies have developed theories to explain why airline prices increase as the departure time nears. The interest is motivated, in part, by the fact that the airline industry does not fit with traditional theories of search theory that predict prices fall in markets with the arrival of homogeneous consumers. McAfee and te Velde (2006) propose a theory to explain why prices rise in the airline and other markets that: (1) face uncertain and high demand; (2) have fixed capacity that can be augmented only at a relatively high marginal cost; (3) sell perishable goods; and, (4) commit to a price schedule (and capacity) at the beginning of the selling period. The last point is applicable to the airline industry, as airlines first set their price schedules by determining what products to sell and at what set of prices. They then use revenue management systems to determine how many products to sell at each price point (Li, 2001). Airline schedules are also published at the beginning of the selling period. McAfee and te Velde (2006) show that in markets that exhibit these four characteristics, prices will rise as the purchase deadline approaches. The increase in prices over time is due to underlying consumer dynamics, and specifically the arrival of new, less price-sensitive consumers.

Many authors model aggregate demand uncertainty by assuming there are multiple consumer types with different arrival processes. In the context of the airline industry, this assumption means that price-sensitive leisure consumers tend to search and purchase fares further in advance of flight departure than price-insensitive business travelers. Li (2001) and Dana (1998, 1999a, 1999b) use an aggregate demand uncertainty framework to show that it is optimal for airlines to offer multiple products distinguished by price and advance purchase deadlines. In this case, the advance purchase deadlines serve to segment the market and can even contribute to efficient allocation of demand across flights (Dana, 1998, 1999a, 1999b; Gale and Holmes, 1992, 1993).

Airlines and researchers have also explored the use of opaque products to stimulate leisure travelers that exhibit a high degree of travel flexibility without cannibalizing revenue from business travelers. Many of these opaque products target "last minute" travelers that can purchase close to departure date and are likely to be price sensitive, but insensitive with respect to travel date and/or destination. See Fay (2008), Gallego and Phillips (2004), Lee et al. (2012), Granados et al. (2008), Jerath