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Airline–airport agreements in the San Francisco Bay Area: Effects on airline behavior and congestion at airports ☆

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ABSTRACT

This paper provides a methodological framework to analyze the decisions of airlines and travelers taking into account the contractual agreement between airports and airlines. This contract sets the fees that carriers pay for landing, the rental rate for the terminal space that they occupy, as well as the methodology to determine these charges. Using data from San Francisco International Airport (SFO) and Metropolitan Oakland International Airport (OAK), we quantify the effects of changes in the agreement on the behavior of airlines and congestion at airports. In particular, we look at modifications in the design of charges and variations in the operating costs at airports. Counterfactuals suggest that different methodologies to compute charges and changes in airport costs may induce airlines to behave differently, affecting delays at airports.

Our structural model captures important characteristics of the airline industry: endogeneity of airport charges with respect to decisions of travelers and carriers, correlation across markets, and two decision variables of airlines (fares and frequency of flights).

1. Introduction

Interactions between airlines, travelers and airports in the U.S. have been the object of several studies since airline deregulation at the end of the 1970s. The rise of air traffic and limited capacity of airports have led researchers to study the efficiency of carrier operations at airports. However, most of the empirical work does not take into account the relationship between airports and airlines. This contractual relationship sets the fees that airlines pay for landing and the rental rate for the terminal space that they occupy. In this paper, we analyze how these charges are determined and how they affect the strategic behavior of carriers and the level of congestion at airports. Our empirical application is based on the competition between the two main airports located in the San Francisco Bay Area: San Francisco International Airport (SFO) and Metropolitan Oakland International Airport (OAK).

In the U.S., landing fees and rental of terminals are designed to let airports achieve financial self-sufficiency. The methodology to determine these charges is airport specific and follows guidelines proposed by the Department of Transportation (DoT). Charges are the result of well defined pricing schemes that depend on measurable variables (for instance, parking revenues, maintenance costs, retail-shop revenues, weight of aircraft, and number of landings). If one of the components of the schemes changes, the airport operator may be obliged to modify the charges even if such a modification is unpopular among airlines and the press. For instance, Los Angeles International Airport (LAX) recently increased its landing fees for the 2014 fiscal year from $4.46 to $4.60 per 1000 pounds of the maximum gross landing weight (MGLW) of passenger aircraft. This rise was motivated by an increase in the cost of operating the airport. Charges can also change due to shocks in the demand for airport services. For example, retail-shop revenues clearly depend on the number of travelers, and the number of flights reaching airports is another variable affecting airport fees. Using data from OAK and SFO, we characterize the equilibrium behavior of travelers and airlines, and quantify the response of carriers and congestion at airports when airport costs affecting the pricing schemes change. Since OAK and SFO apply different methodologies, the behavior of carriers is also expected to be different at these airports.

Charges may be designed to be low in order to attract carrier operations, but at the same time they can also cause congestion. This seems to be the case at SFO, since it uses revenues generated at the parking lots to reduce the amount that airlines pay for the use of its infrastructure. OAK, on the other hand, does not take these revenues into account when it computes landing fees and

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rental charges. While the SFO methodology is appropriate in periods of airport overcapacity, this is not the case when the airport operates at the maximum of its possibilities, as SFO will do in the near future. Without investments in new infrastructure (e.g. new terminals, runways, or air-traffic control technology upgrades), SFO needs to consider alternatives to manage congestion. One solution is to revise the methodology used to determine its charges. To explore the effects of such a change, the last part of the paper analyzes the consequences of SFO adopting the contract scheme used by OAK.

In order to characterize the interaction between travelers, carriers and airports, we use a structural model where demand and supply functions are specified. The demand is formed by heterogeneous travelers with different locations (origin or destination) in the San Francisco Bay and different tastes. The airline profit function depends on the pricing scheme (landing fees and rental rates) charged by airports, with carriers deciding on fares and the frequency of flights. At the same time, charges are endogenously determined by the behavior of travelers and airlines. We use recent advances in estimation of two stage games (Villas-Boas, 2007; Fan, 2013) to estimate the model.

There are few papers addressing empirically the role of airport charges. Van Dender (2007), Bilotkach et al. (2012a), and Bel and Fageda (2009) analyze how market factors affect the level of these charges. However, they do not explicitly model the relationship between airlines and airports. In contrast, Ivaldi et al. (2011) present a structural model introducing landing fees and travelers' charges. They treat airports as platforms and show the existence of two-sidedness effects. While they consider airports as profit maximizing monopolists, we model the determination of fees and rates using rules based on cost recovery, which is more consistent with the methodology applied by the two main airports in the San Francisco Bay. Moreover, none of the aforementioned works considers the fact that charges are endogenously determined by the behavior of travelers and carriers, and neither considers the role of charges as a tool to manage flight delays.

Some other contributions are also made from a methodological point of view. First, carriers behave as profit maximizing firms with respect to ticket prices and frequency of flights reaching the Bay Area. Most of the previous literature only focuses on prices. Second, our model captures two sources of correlation across markets: one comes from the possibility that travelers purchasing different products use the same aircraft to reach the San Francisco Bay. The model also captures the fact that planes contribute to congestion at airports, affecting other aircraft even if they operate in different markets.

For our application, we use U.S. domestic flight data from the third quarter of 2006. The Airline Origin and Destination Survey (DB1B), the T-100, and the Airline On-Time Performance data sets from the U.S. Bureau of Transportation Statistics let us include the supply side, analyze elasticities, and perform counterfactuals. In particular, these data sets give us detailed information about product characteristics and the choices of travelers. We will combine them with travelers' demographic information using the American Community Survey (ACS), financial airport information from the Federal Aviation Administration (FAA), and technical aircraft characteristics. Finally, in order to increase the precision of the estimates, we will add additional information obtained from the 2006 Airline Passenger Survey done by the Metropolitan Transportation Commission of the San Francisco Bay (MTC).

Consistent with previous literature, travelers, on average, prefer to use SFO rather than OAK. However, traveler heterogeneity is also an important factor to explain their purchasing pattern. For instance, their decision significantly depends on the distance from their location (origin or final trip destination in the Bay Area) to the airports.

If we look at the relationship between carriers and airports, we observe that changes in the cost of operating airports not only affect landing fees and rental charges, but also carrier decisions regarding the number of flights and size of aircraft, and congestion at the airports. For example, a rise in landing fees as a result of an increment to the operating costs of an airport is accompanied by a decrease in the daily frequency of flights, an increase in the average size of aircraft, and a reduction of airport congestion. These results hold for OAK and SFO, but they are much stronger at SFO. For instance, if the operating cost used to compute charges at SFO increases by 20%, the total number of daily flights reaching the airport decreases by 2.4%, the average weight of aircraft increases by 1.7%, and the average delay of flights at SFO decreases by 8.1%. Similarly, an increase in the cost of operating OAK by 20% reduces the number of daily flights by 0.7%, increases the average weight of aircraft by 1.6%, and reduces congestion at OAK by 2.1%. Our simulations also suggest that changes in the operating cost of one airport barely change the behavior of carriers operating at the competing airport.

Finally, the design of charges may play an important role in the behavior of carriers and congestion at airports. When we analyze the effects of SFO adopting the contract used by OAK, we find a threshold that helps us to identify under which conditions the new contract is useful to reduce flight delays. As we will see in detail later on, each airport uses different cost components to determine charges. The results of SFO implementing the OAK charge scheme depend on the magnitude of the costs used in the new methodology relative to the costs currently used at SFO. For example, if the sum of the cost components in the new pricing scheme is 20% lower than the original one, the number of flights reaching SFO would decrease by almost 4%. Consequently, the level of congestion at SFO would be 12% lower.

The rest of the paper is structured as follows. Section 2 introduces general features of the San Francisco Bay and the airports operating in the area. Section 3 presents the model. Section 4 outlines the optimality conditions of carriers. Section 5 describes the application and data. Section 6 outlines the estimation methodology. Section 7 presents the estimation results. Section 8 analyzes the contractual relationship between airports and airlines. Finally, Section 9 concludes.

2. The nature of the interaction between airlines and airports

To analyze the equilibrium behavior of airlines (fares and flight frequency) and traveler demand, it is necessary to understand the characteristics of each of the airports serving the San Francisco Bay Area, and the nature of the relationship between airports and carriers.

The Bay Area is a region located in Northern California that is home to 7.15 million people distributed around nine counties (Fig. 1). It is served by 3 main airports: San Francisco International (SFO) located in San Mateo County, Metropolitan Oakland International (OAK) in Alameda County, and Mineta San Jose International (SJC) in Santa Clara County. OAK and SFO are located 11 miles apart, while SJC is around 30 miles from SFO and OAK. SFO is the busiest of the three airports and an important entrance to the U.S. from the Pacific.

We focus our attention on SFO and OAK. SJC will be included in the outside option of the model. Such a decision is driven by the lack of passenger data for SJC. The impact of this limitation in our analysis is expected to be low since, as several authors pointed out (Bilotkach et al., 2012b; Brueckner et al., 2014), OAK and SFO are closer substitutes compared to SJC.

Most U.S. airports are operated as independent not-for-profit facilities overseen by a local governmental entity such as a county,