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Airport choice and airline choice in the market for air travel between the San Francisco Bay area and greater Los Angeles in 1995

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1. Introduction

This paper empirically investigates the impact of airport and airline supply characteristics on the air travel choices of passengers departing from one of three San Francisco Bay area airports and arriving at one of four airports in greater Los Angeles. It does so by estimating a conditional logit model for the market of air travel between both metropolitan areas in 1995, and using the estimated model to simulate three counterfactual scenarios. First, reducing access times to San Francisco International airport by 10% for all travelers increases the market share of that airport by 4.5%-point. United Airlines benefits from the reduced access times, as its market share increases by 2.9%-point. Second, reducing average delays at San Francisco International airport by 10% has similar aggregate effects to the first scenario, but indicates that leisure travelers value access time reductions more than reduced delays. Third, entry of Southwest airlines in San Francisco International airport increases the market share of Southwest airlines by 5%-point to 15-%point, depending on assumptions concerning its continuation of services at Oakland International Airport, and assuming that rival carriers do not respond in terms of prices or service levels.

Many studies of competition in the airline industry define markets for air travel in terms of airport pairs. While justified in markets where both the trip origin and the destination are served by a single airport, this approach is less suitable for markets characterized by a high density of demand, where travelers often have a choice of airport at both the travel origin and the travel destination. In domestic travel, large metropolitan areas (for example Boston, Chicago, Los Angeles, New York, the San Francisco Bay area, Washington D.C.) typically are served by several airports that provide flights to a similar set of destinations. In intercontinental travel, substitutability of airports is less dependent on immediate spatial proximity. For example, airports in Amsterdam, Brussels, Frankfurt, London and Paris may be viable alternatives for leisure travel destined to Western Europe. In both cases, the airports are fairly close substitutes, and it is desirable to take this into account in analyzing competition in this type of market.

The interaction between airlines is more complex in such a multi-airport setting as compared to a single airport context, because additional choices need to be made concerning pricing and service characteristics for different, substitutable airports. Airport behavior is more complex as well. Airports may be effectively controlled by an airline, they may be profit-maximizers or surplus-maximizers. In each of these cases, the airports' spatial market power is limited by the presence of substitute airports, and this affects their choices regarding capacity and access charges. While this paper stops well short of providing an integrated model of supply and demand in multi-airport markets for air travel, it does shed light on how the structure of demand in such a setting affects the business environment of airports and of airlines.

Obtaining insight in the separate role of airports and of airlines in shaping competition in multi-airport markets is relevant, for example in the context of further deregulation in the industry. Such deregulation could take the form of airport privatization, which may alter the relations between airports and airlines. Predicting the effects of deregulation requires a model allowing the construction of counterfactual scenarios for alternative regulatory environments. The sources and effects of market power in counterfactuals may be very different from what is currently observed in an industry characterized by close ties between dominant carriers and certain airports.

Section 2 provides a review of related literature, and a description of our contributions to it. In short, our analysis complements the literature on competition in the airline industry by focusing on the joint choice for an airport and an airline that is made by travelers who have access to more than one departure and/or arrival airport. Much of the existing literature on airline competition defines air travel markets as markets between airports. The analyses that do refer to the availability of substitute airports usually have no detailed model of airport choice at their disposal. Our work also extends the literature on airport choice. While some work in that area models the joint airport and airline choice, it pays less attention to the definition of air travel markets and the nature of competition in those markets.

Section 3 describes the data and the results of the conditional logit model estimates. The model is estimated using a combination of datasets that describe the choices, the choice sets and the costs for passengers departing from either San Francisco International airport (SFO), Oakland International airport (OAK), or San Jose International airport (SJC), to either Los Angeles International airport (LAX), Burbank airport (BUR), Ontario airport (ONT) or John Wayne airport (SNA). SFO, OAK and SJC are in the San Francisco Bay

Area; LAX, BUR, ONT and SNA are in greater Los Angeles. All data are for October 1995. Our dataset contains sufficient information to conclude that the Bay Area airports are reasonably close substitutes. Less information is available for the arrival airports, so we also consider a model where LAX is the only arrival airport. While our model differs in important respects from earlier airport choice models, the basic findings concerning the determinants of airport choice are similar, indicating that the various components of time costs of using an airport are important. Airline choice is found to be dependent on the quality of service and to some extent on fares. However, dummy variables are important both for airports and for airlines. The weighted conditional logit estimation helps provide estimates of these dummies that can reliably be used in counterfactual scenarios.

The estimated model is used to calculate counterfactual scenarios. These scenarios are defined and the simulation results are discussed in section 4. There are two scenarios that consider the effect of changing the time cost of using one airport: one in which the access time to SFO is cut by 10% (or by 5 minutes) for all (actual or potential) users, and one in which the average delay associated with traveling through SFO is cut by 10% (or by 5 minutes). The results for both scenarios show that reducing relative time costs is an effective way of increasing market share of the airport and of airlines that dominate that airport (United Airlines in the case of SFO). A third counterfactual scenario assumes that Southwest Airlines enters at SFO (where it was not actually present in October 1995). One version of that scenario assumes that Southwest duplicates its existing Oakland operation in SFO, and the other version assumes that it transfers its Oakland operation to SFO. Both scenarios lead to a substantial market share increase of Southwest. This is hardly surprising for the “duplication version”, but slightly more so in the “transfer version”. This finding does not show that Southwest was irrational by staying in Oakland, as cost effects and capacity constraints are not taken into account, and we make the strong assumption that rivals do not respond to Southwest’s actions. The result is driven by the fact that SFO is the preferred departure airport. In all of the counterfactual scenarios, changes at the level of airlines or departure airports have relatively small effects on the market shares of arrival airports. This is partly explained by the relatively small concentration of airlines at specific airports in greater Los Angeles.

Section 5 summarizes and concludes.

2. Literature

This section discusses three strands of related literature: analyses of airport choice, studies of the role of airports, and models of airline competition.

2.1 Airport choice models

There is a relatively small class of models, to which the airport and airline choice model presented in section 3 belongs, that study how travelers choose an airport when departing from a multi-airport region. The main contributions are by Skinner (1976), Harvey (1987), Ashford and Bencheman (1987), Pels et al. (2001, 2003), Basar and Bhat (2002, 2004) and Hess and Polak (2003, 2005). The choice for an airport may be modeled in combination with ground access modal choices or with airline choices, and the models are estimated using discrete choice techniques of varying complexity and generality. There is wide consensus that ground access times and quality of service (often measured by flight frequencies) strongly affect the choice for a particular airport.

Pels et al. (2001) analyze the joint choice for an airport and an airline in the San Francisco Bay Area using a nested logit model. They find that a model where first the airport is chosen and then the airline is statistically preferred to a model with the reverse choice structure. Using the same dataset and a nested logit model to look at the joint choice of access mode and airport, Pels et al. (2003) find that the mode choice patterns imply high values of time. Basar and Bhat (2002, 2004) estimate a probabilistic choice set multinomial logit (PCMNL) model of airport choice by business travelers residing in the Bay Area. Such a model lets the choice set be constructed by travelers, in particular allowing for the possibility that travelers do not take all departure airports into account. They find that access time matters, more so than frequency. However, the PCMNL model finds a weaker effect of access time and a stronger effect of flight frequency, as compared to the standard multinomial logit model. Most recently, Hess and Polak (2004) analyze airport choice in the San Francisco Bay Area using a mixed multinomial logit specification, so allowing for random preference variation. This is found to be relevant because, for example, not all variation in the sensitivity of airport choice to access time is captured by control variables.

Many airport choice studies, including ours, rely on the same central data source (the 1995 air passenger survey for the Bay Area airports). The specific focus in this paper leads to three substantial differences. First, our model focuses on a specific set of destinations (four airports in or around Los Angeles), rather than lumping all destinations together as is done in the mentioned studies. In doing so, we delineate a specific market in which carriers compete directly. The particular market is served by direct connections, so that aspects of network competition (other than hub dominance, which we take to be exogenous to the market under study) are relatively unimportant. Also, unobserved variation in egress times is lower when arrival airports are controlled for. Second, it contains a more detailed representation of flight choice. For example, we consider differences between business and leisure travel, between week and weekend travel, and between peak and offpeak travel, etc. We use information on fares and on airport delays, and we allow for specific hub dominance and Southwest airlines effects. Finally, we correct for choice based sampling, more particularly for over-sampling of passengers departing from San Jose airport, in order to obtain an estimated model that is suitable for counterfactual simulation.

2.2 The role of airports

Part of the literature on the airline industry is concerned with the role of airports in general, and with the relation between airlines and airports in particular. The standard assumption here is that airports are monopoly providers of access to a given region. One observation is that the allocation of airport capacity[1] to airlines in the U.S. is more often guided long-term contractual arrangements (e.g. gate leasing contracts and federal limitations) than by airlines' willingness to pay (FAA/OST, 1999).[2] Airports assign slots within an exclusive use, preferential use, or common pool arrangement. As a result, potential entrants face difficulties obtaining access to many airports, airports rely on revenues from one or a few carriers[3], and airlines may have veto power concerning

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[1] Access to airports is broader than access to slots, including terminal and handling access, etc..

[2] Unregulated allocation on the basis of willingness to pay does not necessarily lead to efficiency when there is imperfect competition (e.g. Borenstein, 1988).

[3] Airports may share some of the demand related risk, to the extent that carriers only pay for the actual use of

decisions on airport development. This situation affects competition between airlines, as well as airport prices and airport capacity decisions. Awareness of these problems has induced the adoption of more flexible agreements between carriers and airports. Hartmann (2002) finds that increased flexibility in the arrangements between airports and airlines positively affects airlines' probability of offering a non-stop airport connection, keeping non-routing service characteristics (including prices) exogenous.

A related issue is that of airlines' demand for access to an airport. This depends on, amongst other things, the carrier's network structure and the status of the airport in the network. Brueckner and Zhang (2001) and Brueckner (2004) point out that adoption of a hub-and-spoke network tends to increase service frequency, as fewer routes are used to serve the same (or similar) demand for origin-destination pairs. Brueckner (2002) and Pels and Verhoef (2004) observe that market power, in the form of dominance of an airport by a carrier, leads to partial internalization of marginal congestion costs. More specifically, carriers internalize marginal congestion costs that a flight of theirs imposes on other flights of theirs. Consequently, when a carrier dominates the airport, most marginal congestion costs are internalized, and passengers' airfares reflect congestion costs. Van Dender (2005) finds that profit-maximizing airports will internalize marginal congestion costs through access charges, both in a monopoly and in an oligopoly setting.

The literature on the deregulation and privatization of airports recognizes that airports have spatial monopoly power, but this does not necessarily require a regulatory intervention in the pricing of airside services. The reason is that abuse of market power may be prevented by of the complementarity between the demand for aviation services and the demand for concession services (Starkie, 2000). Concessions represent some 75% of revenue in large U.S. airports, and probably a larger share of profits. Oum et al. (2004) find that the complementarity indeed reduces airside charges, but there is no guarantee that they would be set at the socially optimal level. Regulation then still may be justified, but is not without its costs. In particular, rate-of-return regulation tends to induce over-investment in capacity and price-cap regulation tends to lead to under-investment.[4] Joint

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the facility. In return for sharing the risk with the airline, the length of the contract is reduced.

[4] Evaluations of airport capacity decisions usually take account of airport specific costs and benefits only. Cohen et al. (2003) show empirically that spillovers in terms of travel time savings at connected airports are

price caps on concession and airside services (the ‘dual till price cap’) are less distortionary than separate regulation of airside services (the ‘single till price cap’). On a different note, Forsyth (2001) argues that, while airports do possess market power, the costs of regulation in terms of reduced production efficiency, are likely to outweigh the benefits (in the Australian context, and both for price and access regulation).[5,6]

2.3 Airline competition

The literature on airline competition is much larger than the strands of literature covered in the previous subsections, and it treats various dimensions of competition. This review is limited to topics of direct interest. While much of the literature abstracts away from airport choice – choosing to study price differences across airlines for airport pair routes instead – airport characteristics play an important role in some airline competition studies. In particular, researchers have focused on the impact of “airport dominance” and airport congestion on airline competition.

Early works that have helped establish the role of airport dominance in airline competition include Borenstein (1989, 1991), Berry (1990), Morrison and Winston (1989) and Evans and Kessides (1993).[7] A more recent paper that addresses the issue using a structural approach is Berry, Carnall and Spiller (1997). A key concept underlying each of these papers is that larger airport presence increases the value of frequent flier programs and other airline marketing programs, and this enables airlines to charge higher fares profitably as passengers pay the higher airfare to earn the greater marketing reward offered by the dominating airline. However, the ability of airlines to use airport dominance to extract consumer surplus will depend on the presence of substitute airports. In markets with a single airport, airport dominance implies that the dominating airline can offer to

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important as well.

[5] Forsyth (2001) argues that “profit-limiting” objectives of regulation clash with efficiency requirements in the case of congestion, and that this has stimulated the adoption of alternative (imperfect) slot allocation mechanisms.

[6] Craig et. al (2003) investigate how institutional form affects airport efficiency in the US. They find that airports run by single purpose authorities are less technically efficient (rent dissipation) but are more likely to adopt cost-saving innovations.

[7] Of particular relevance is the Morrison and Winston (1989) study which uses an empirical strategy similar to ours. They estimate the impact of airport presence on airline choice by applying a multinomial logit model to DB1A passenger data. Our study can be considered an extension of theirs – expanding the choice set to include airport choice. Our data also provide more information about the passengers than DB1A.

residents a frequent flier program unmatched by any competitor. But in markets served by multiple airports, the dominance of any one airport by an airline does not necessarily preclude other airlines from offering a similar array of flights.

The San Francisco Bay Area serves as an example: United Airlines (UA) dominates San Francisco Airport (SFO) but Southwestern (WN) dominates nearby Oakland Airport (OAK). This allows each airline to offer an important air travel network to travelers to or from the Bay Area. The effect of airport dominance at each airport on airfare will depend on how substitutable the airports are to travelers. Passengers with strong airport preferences will still be "captured" by the dominating airline at the preferred airport. Furthermore, as noted in Borenstein (1989), price discrimination can be used by airlines to segment the market, separating passengers who might switch among airports from those strongly entrenched in their airport choice.

We estimate substitutability among the three major Bay Area airports using an empirical model that explicitly accounts for airport choice, and use the model to investigate the impact of airport substitution on the benefits of airport dominance by airlines. Using a different approach, Borenstein (2005) provides suggestive evidence that airport competition may reduce the impact of airport dominance on airfare. Table 2 of that paper shows calculated hub premiums at the 50 largest U.S. airports, from 1995 to 2004. Hub airports in metropolitan areas served by multiple airports (e.g. San Francisco Bay Area, Los Angeles, Chicago, New York, D.C.) seem to be associated with lower hub premiums than hub airports in single airport markets (e.g. Charlotte, Cincinnati, Detroit, Memphis Minneapolis), consistent with the notion of airport competition restricting hub premiums.

In recent years, research on airline competition has shifted toward the study of service quality competition, with an emphasis on on-time performance. A central idea here is that flights departing from / arriving at certain airports are prone to travel delay more than others. Apart from natural causes (e.g. fog at San Francisco), airport congestion can contribute to travel delay, with hub airports particularly congested as airlines seek to maximize economics of traffic density (scope). This is demonstrated in Brueckner and Spiller (1994) and Mayer and Sinai (2003). Additionally, Mazzeo (2003) finds that on-time performance is worse (delays are more common and longer) on concentrated routes. This suggests that airlines may use airport dominance to extract surplus from passengers not only through higher airfares but also through cost savings associated with the offering of lower quality service. In a similar way in which airport choice can restrict hub premiums, airport choice may provide an incentive for dominating airlines to offer higher quality (lower delay) service.

Januszewski (2004) provides an estimate of the value passengers attach to on-time performance. Using an exogenous shock to the on-time arrival of flights to LaGuardia, she finds that longer delays imply lower prices, and that the size of the effect depends on the availability of substitutes: when substitute flights are available at the same or at competing airports, changes in service quality have larger effects on prices (the overall effect is estimated at $1.16 per minute of delay, and this increases to $1.55 when there is competition). Flights at the same airport are closer substitutes, and therefore have a larger effect. The effects are larger for business travelers, presumably because they strongly dislike schedule delays.

Our study provides an alternative approach to estimating the value of on-time performance. An empirical model of passenger airport/airline choice can explicitly explore the trade-off between higher airfare and greater on-time performance faced by individual travelers. Our parameter estimates imply a much larger valuation of on-time performance, ranging from $2 to $15 a minute of delay, but this may be due in part to noise in our price data. However, we argue that our findings concerning the relative valuation across passenger types are more robust to noise in our price data. For example, like Januszewski, we find on-time performance to be valued much more by business travelers.

Lastly, we note that airport choice has implications for the empirical literature on airline entry. Much of the literature, e.g. Reiss and Spiller (1989) and Berry (1992), has focused on airport pairs (or city pairs, but without distinguishing among the different city airports). If city airports are imperfect substitutes, then the airport itself serves as a form of product differentiation for the airline that needs to be accounted for. Increased attention has been brought to the issue of low-cost carriers, most notably Southwest, entering the markets of incumbent, hub-and-spoke carriers. Recent research includes Ito and Lee (2004) and Goolsbee and Syverson (2005). Given that low cost carriers often enter the adjacent, non-hub airport in major metropolitan areas (e.g. Southwest using Baltimore Airport to serve the Washington D.C.), current studies may be underestimating the change in market share and incumbent response effected by the entry of a low cost carrier at the *hub* airport. We demonstrate the former concern (market share change) in one of our counterfactual exercises.

3. Estimating an airport and airline choice model for air travel from the San Francisco Bay Area to greater Los Angeles in 1995

3.1 Data and basic specification

This section discusses the estimation of the joint airport and airline choice model on the basis of 1995 data for travel between the San Francisco Bay Area to greater Los Angeles. The final dataset contains information on:

(a) which choice a passenger departing from the Bay Area to greater Los Angeles made, in terms of departure airport, arrival airport, carrier, and departure time (peak or offpeak, where peak hours are from 6-9 am and 3 – 6 pm, with all other hours offpeak);

(b) the choice set, i.e. the set of choice alternatives;

(c) the time and money costs of these alternatives, where the time cost includes the time driving from the initial origin to the airport, the expected flight delays at the departure airport and at the arrival airport during peak and offpeak periods, and the schedule delay cost which is measured by the frequency of flights per airline per airport;[8] the money cost is an approximation of the flight fare;

(d) socio-demographic variables, including whether passengers travel for business or leisure purposes, the exact location of departure in the Bay Area., and whether travelers are residents of or visitors to the Bay Area. Note that the distinction between business and leisure travelers pertains to the reported trip purpose, not to the type of ticket.

The final dataset is composed of various sources. The primary source is the Airline Passenger Survey, which was conducted in August and October in 1995 by the

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[8] We do not include flight times. Since all passengers fly to greater LA, the variation in flight times can expected to be minimal, and of no consequence to the airport-airline choice. Similarly, we do not include airport egress times and travel times to the final destination. The variation in those time cost components is likely to be relatively small in our study as we focus on a single market and control for the arrival airport, in contrast to much of the airport choice literature.

Metropolitan Transportation Commission (MTC) in conjunction with San Francisco International Airport (SFO), San Jose International Airport (SJC), Oakland International Airport (OAK), and Sonoma County Airport (STS).[9] A relatively large number of interviews was conducted at SJC at the request of the airport authority. A first wave of the survey took place in August 1995, a second one in October 1995. We only use data for October, because of a shortcoming of the August sample.[10] Attention is restricted to passengers accessing the airport by car, so public transport access is excluded. After omitting observations because no fare is reported for the flight or no match could be made with the OAG dataset on flight supply, because of other airport access modes than car, because no income was reported, 1,752 observations remain.

The airline passenger survey is combined with several secondary sources. First, the 1998 Zone-to-Zone car travel times, from a passenger's initial origin in the Bay Area to the airports, are derived from the MTC's transportation network model.[11] Second, the summary of the Origins and Destination Survey (DB1A) as provided by Severin Borenstein is used to provide aggregate fare data and to calculate weights that correct for choice based sampling (oversampling of passengers departing from San Jose airport).[12] The weights obtained from DB1A were validated against T-100 data.[13] Third, Airline Online Performance Data from the Bureau of Transport Statistics provide information on delays at

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[9] http://www.mtc.dst.ca.us/datamart/airpass1.htm.

[10] The August survey reports zero passengers departing from OAK using United Airlines (UA). This contrasts with other sources (OAG and T-100) that indicate a substantial presence of UA at OAK in August of 1995. Since our analysis considers airport and airline choice, it seemed appropriate to exclude the August data.

[11] ftp://ftp.abag.ca.gov/pub/mtc/planning/forecast/RVAL98/

[12] Clearly, fares are measured at a much more aggregated level than other flight characteristics, and may be different from actual transaction prices. Our use of fare information is largely restricted to comparing average differences across flight choices; precise estimation of trade-offs between time and money (values of time) is not possible.

[13] T-100 is an alias for the 'Air Carrier Statistics Databank', based on 'Form 41 Traffic' collected by the BTS. http://www.transtats.bts.gov/DatabaseInfo.asp?DB_ID=110&DB_Short_Name=Air%20Carriers&DB_Name=Air%20Carrier%20Statistics%20%28Form%2041%20Traffic%29&Link=0&DB_URL=Mode_ID=1&Mode_Desc=Aviation&Subject_ID2=0

the level of the origin and destination airports.[14] Fourth, the Worldwide Through Flight Schedules Database obtained from OAG is used to construct passengers' choice sets. We assume that the complete set of flights was actually available to passengers at the time they purchased a ticket.

We estimate a weighted conditional logit model (Manski and Lerman, 1977) defined over travel choices that are a combination of departure airport, arrival airport, airline, and peak or off-peak travel. The choices are conditional on the passengers accessing the airport of choice by car and flying to greater Los Angeles. For our basic specification, a passenger's choice is modeled as the maximization of the indirect utility function (1). The basic specification is estimated for all passengers, and separately for business and leisure travelers. Table 1 provides definitions and summary statistics for the variables used in the basic specification. Airport choice is explained by dummy variables for departure and for arrival airport, as well as dummies for United Airlines (UA) and Southwest Airlines (WN). The latter are introduced because fare variation between carriers does not capture all, or even the most important, reasons why these carriers are chosen. Other relevant characteristics include consumer loyalty programs and airport dominance. At the time of study, UA dominates SFO, and WN dominates OAK. Controlling for a fairly large set of demand characteristics helps limit the problem of endogeneity of fares and travel delay.

$$
\begin{aligned}
V_{ijkt} &= \beta_1 D\_SJC + \beta_2 D\_OAK + \beta_3 D\_WN + \beta_4 D\_UA + \beta_5 D\_BUR \\
&+ \beta_6 D\_ONT + \beta_7 D\_SNA + \beta_8 FARE + \beta_9 FREQ + \beta_{10} ACC\_T \\
&+ \beta_{11} DEL\_T + \beta_{12} INC\_1 + \beta_{13} INC\_2 + \varepsilon_{ijkt}, \\
&\text{where} \qquad (1) \\
&\mathrm{i} \in \{\mathrm{SFO},\ \mathrm{SJC},\ \mathrm{OAK}\}, \\
&\mathrm{j} \in \{\mathrm{BUR},\ \mathrm{LAX},\ \mathrm{ONT},\ \mathrm{SNA(OC)}\}, \\
&\mathrm{k} \in \{\mathrm{AS},\ \mathrm{DL},\ \mathrm{HP},\ \mathrm{QQ},\ \mathrm{UA},\ \mathrm{US},\ \mathrm{WN}\}, \\
&\mathrm{t} \in \{\mathrm{peak},\ \mathrm{off}\}
\end{aligned}
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[14] http://www.transtats.bts.gov.

Table 1 Variable Lists and Summary Statistics for actual choices

Variable	Description	Mean	Std. Dev.	Min	Max
SFO		0.136416	0.343327	0	1
D_SJC	Dummy=1 if departure airport is SJC	0.473173	0.499422	0	1
D_OAK	Dummy=1 if departure airport is OAK	0.390411	0.487982	0	1
D_WN	Dummy=1 if airline is WN	0.696347	0.459966	0	1
D_UA	Dummy=1 if airline is UA	0.170662	0.376321	0	1
LAX		0.457763	0.498355	0	1
D_BUR	Dummy=1 if arrival airport is BUR	0.201484	0.401223	0	1
D_ONT	Dummy=1 if arrival airport is ONT	0.155822	0.362790	0	1
D_SNA	Dummy=1 if arrival airport is SNA	0.184931	0.388353	0	1
FARE	Average Coach Airfare ($)	57.73002	11.00331	50	182
FREQ	Average # of Flights per Hour	0.842751	0.679178	0.08333	4
ACC_T	Access Time (Minutes)	26.82095	21.82145	1.7	173.9
DEL_T	Sum of average departure delay and arrival delay	11.36915	6.763506	1.6638	28.275
INC_3	Fare*(income > $100,000)	8.25343	20.9423	0	182
INC_2	Fare*(income > $50,000)	40.36050	28.4694	0	182
INC_1	Fare	57.73002	11.00331	50	182

* Summary statistics are not corrected for choice-based sampling

Table 2a WESML estimation results for conditional logit model: October 1995 – 4 distinct destination airports: **COEFFICIENTS AND STANDARD ERRORS**

	All		Business		Leisure	
	Coefficient	**Std. error**	**Coefficient**	**Std. error**	**Coefficient**	**Std. error**
D_SJC	**-1.447986**	0.1720878	**-1.240173**	0.2512413	**-1.611446**	0.2459511
D_OAK	**-0.7786696**	0.1277842	**-0.927791**	0.1947074	**-0.6100044**	0.1779013
D_WN	**1.324198**	0.1179326	**1.23517**	0.1511738	**1.079068**	0.1975784
D_UA	**0.5571866**	0.1223479	**0.6534771**	0.1826771	0.2235194	0.1818837
D_BUR	**-0.6211582**	0.0946742	**-0.4245493**	0.1356111	**-0.6279231**	0.1412803
D_ONT	**-0.859001**	0.1048346	**-0.7000365**	0.151479	**-0.8575387**	0.1525593
D_SNA	**-0.969011**	0.129393	**-0.5889601**	0.1634398	**-1.210024**	0.2189575
FARE	**-0.0149216**	0.0058754	-0.0047855	0.0078147	**-0.0244175**	0.0093373
FREQ	**0.2320894**	0.0645731	**0.304347**	0.0766304	**0.5077035**	0.1625734
ACC_T	**-0.0768121**	0.0028532	**-0.0774292**	0.0040216	**-0.0740024**	0.0041517
DEL_T	**-0.0601089**	0.0081565	**-0.0751003**	0.011992	**-0.0572344**	0.0115184
INC_2	**0.0146091**	0.0058057	0.0044778	0.0079349	**0.0194444**	0.0090304
INC_3	0.0042551	0.0059762	0.0027181	0.0074356	0.0081708	0.0107708
Number of Passengers	1752		935		817	
Log LL	-5319.640004		-2702.553332		-2571.901515	

Table 2b WESML estimation results for conditional logit model: October 1995 – 4 distinct destination

airports: MARGINAL EFFECTS (% CHANGE IN PROBABILITY)*

	All	Business	Leisure
D_SJC	-7.878	-7.006	-7.535
D_OAK	-4.534	-4.595	-5.180
D_WN	+7.729	+7.041	+8.006
D_UA	+3.654	+4.053	+3.938
D_BUR	-3.197	-2.152	-3.377
D_ONT	-4.095	-3.247	-4.361
D_SNA	-4.367	-2.856	-4.475
FARE	-0.028	-0.005	-0.040
FREQ	+1.362	+1.688	+1.447
ACC_T	-0.458	-0.430	-0.479
DEL_T	-0.353	-0.417	-0.375
INC_2	+4.502	+1.397	+5.024
INC_3	+1.996	+1.025	+2.176
Number of Passengers	1752	935	817

Marginal effects: weighted average across the (sub)sample, with same weights as estimation

Table 2 reports estimation results for the basic specification and for the subsamples of business and leisure travelers. Table 2a provides coefficient estimates and standard errors. Table 2b shows the marginal effects, which can be compared across subgroups (in contrast to the coefficient estimates).[15] The results in Table 2a are in line with the airport choice literature, indicating that choice alternatives with low prices for a ticket, lower access costs, and less delays are more likely to be chosen. Higher quality of service (flight frequency) makes an option more attractive. The effect of fares is not significantly different from zero for business travelers. The interaction between income groups and fares is positive, consistent with a priori expectation that fare effects become smaller as incomes rise. The airport dummies are precisely estimated and significant. SFO is the preferred departure airport and LAX is the preferred destination airport. Passengers are also more likely to choose an airport that is served by Southwest Airlines or by United Airlines.

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[15] The marginal effects are "own characteristic marginal effects", i.e. the partial derivatives of the probability of an actual choice with respect to a change in that choice's characteristic, taking account of the presence of the interaction terms for income groups. For dummy variables, the marginal effects are defined as the difference in the probability of the actual choice for the case where the dummy equals one vs. the case where it equals zero.

This preference is over and above Southwest's low fares and United Airlines' high frequency of services from SFO to LAX as a hub operator.[16] These results seem consistent with the "Southwest effect" and "hub-dominance effect", as identified in earlier empirical analyses of the airline industry (cf. section 2.3).

Table 2b shows that, while results for business and leisure travelers are largely similar, there are some noticeable differences as well. The marginal effects of a fare change for leisure travelers exceed those of business travelers by an order of magnitude. In addition, the extent to which the fare effect is reduced at higher incomes (cf. the interaction terms) is much larger for leisure travelers. Some smaller differences are that OAK is less attractive at the margin for leisure travelers and that the airline specific effects are smaller for leisure travelers. Somewhat surprisingly, increasing flight frequency has a larger marginal effect for leisure travel.

We argued above that the use of weights to correct for choice based sampling matters for the reliability of the counterfactual scenarios. This can most easily be seen by comparing the marginal effects implied by both models (cf. Table A.2.10 for details). While the marginal effects on the level of all travelers are roughly similar for all non-dummy variables except fares, they differ strongly for dummy variables and especially for departure airport dummies. The weighted estimation produces much larger marginal effects both for SJC and OAK, and a much weaker effect for fares. The first of these differences carries through for business and leisure travelers separately, while the difference in the fare effect is large for business travel only.

The relevance of defining a market in terms of city pairs rather than airport pairs can be gauged, in principle, by comparing the basic specification to a set of estimations on the level of airport pairs. Detailed estimation results for subsamples per airport pair are reported in appendix 3. The subsamples do not allow estimation of all airline and/or airport dummies, and coefficients are estimated with less precision than in the basic specification, so preventing an accurate comparison of the economic implications of both

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[16] The October 1995 survey reports a 75% market share of UA at SFO (USair: 15%, Delta: 7%). UA has a market share of 18% at OAK and is not present at SJC. Southwest dominates both OAK (75%) and SJC (85%). It is not present at SFO. In terms of arrival airports, Southwest dominates BUR (82%), ONT (94%) and SNA (56%). UA carries 18% of passengers at BUR, 23% at LAX, 6% at ONT and 11% at SNA.

specifications.[17]

3.2 Alternative specifications

Alternative model specifications differ from the basic one in two possible ways. First, the set of arrival airports is restricted to LAX only. This alternative checks the robustness of results against different treatments of travel destinations, which is useful because no information on the final travel destination and on egress times from destination airports is available.[18] In addition, LAX dominates the set of arrival airports, so it is useful to consider it by itself. Table A.2.10 shows that the relative effects of explanatory variables are similar for the LAX only model, as compared to the basic specification, with the exception of the effect of frequency for leisure travelers (which is driven by an idiosyncratic choice pattern for that case). Second, the estimations are repeated for subgroups of travelers, on the assumption that different groups may choose differently. Distinctions are made between peak and offpeak travelers and between weekday and weekend travelers. We also consider a separate model for Bay Area residents (i.e. visitors are excluded) and a model containing interaction terms between airports and airlines. Considering Bay Area residents alone helps control for airport choice issues. It could be the case, for example, that Bay Area residents make well informed choices concerning the departure airport, but pay less attention to the arrival airport. More in general, departure and arrival airport choices can be asymmetrical. When that asymmetry really is one regarding “home” and “away” airports, then the distinction between residents and visitors provides insight into that asymmetry. The model with extra interaction terms helps distinguish airport effects from airline effects, which may be confounded if not interaction terms are included, because of airline dominance issues (UA at SFO, WN at OAK). The model with the interaction terms between airports and airlines is not significantly different

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[17] The relevance of looking at city pairs instead of airport pairs could also be assessed by comparing our base case estimation to one in which airport pairs are pooled. Such an equation allows choice sets to differ across consumers, but not coefficients. This case is more similar to what is usually estimated in the industrial organization literature. TO BE COMPLETED

[18] We also estimated a model without the arrival airport dummies. The arrival airport dummies pass the likelihood ratio test of joint significance for all conventional significance levels.

from the model without those terms.

4. Counterfactual scenarios

This section reports on three counterfactual scenarios that were calculated using the models presented in the previous section. The scenarios are designed to provide insight into the role of airport characteristics and airline behavior on the market under consideration (not to analyze particular policies), taking account of the model as a whole rather than its separate coefficients. The first scenario, labeled "Access SFO" reduces access times to SFO by a uniform percentage of 10% for all travel origins and travel times. The second scenario, "Delay SFO", reduces SFO delays by 10%. The third scenario, labeled "Southwest SFO" considers the effect of entry by Southwest Airlines into SFO. There are two versions of the "Southwest SFO" scenario: in version 1 ("duplicate") Southwest duplicates its 1995 operation at OAK in SFO, while in version 2 ("transfer") Southwest transfers its entire OAK operation to SFO. In both versions, Southwest is assumed to charge the same prices at SFO than it in fact charged at OAK, and United Airlines or any other airline is assumed to not respond in any dimension.[19]

In interpreting the scenarios, we compare the results from the counterfactual scenario to the predicted values of the estimated model, the "baseline" and not to the observed values. The random error term is assumed to be the same, at the level of an observation, in the baseline and in the counterfactual scenario.[20] Both scenarios also take the decision to travel by air as given, so they only consider substitution between travel alternatives in response to a change in travel options or travel costs.

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[19] Ito and Lee (2004) find incumbent response to low cost carrier entry to be fairly accommodating.

[20] This procedure abstracts from the "percent correctly predicted" statistic as a measure of goodness of fit. In fact, such a statistic is flawed as it relies on the assumption that the alternative with the highest probability will be chosen each time, instead of the appropriate interpretation that each alternative will be chosen a number of times when the choice is repeated often (Train, 2003: 73).

Table 3 Key results for counterfactual scenarios: percentage market shares (% change with respect to baseline)*

	Baseline	Access SFO	Delay SFO	Southwest SFO	
		-10%	-10%	Duplication	Transfer
All passengers					
% from SFO	29.42	33.96 (+15.4)	31.41 (+6.8)	46.79 (+59.0)	61.71 (+109.8)
% from SJC	28.08	26.75 (-4.7)	27.52 (-2.0)	22.88 (-18.5)	26.56 (-5.4)
% from OAK	42.50	39.29 (-7.6)	41.07 (-3.4)	30.32 (-28.7)	11.74 (-72.4)
% with UA	31.21	34.07 (+9.2)	32.52 (+4.2)	19.58 (-37.3)	27.94 (-10.5)
% with WN	55.58	52.27 (-6.0)	54.27 (-2.4)	71.49 (28.6)	60.70 (9.2)
% with other	12.96	13.66 (+5.4)	13.21 (+1.9)	8.92 (-31.2)	11.36 (-12.3)
% to BUR	20.79	20.37 (-2.0)	20.65 (-0.7)	21.33 (2.6)	21.12 (1.6)
% to LAX	46.70	47.30 (1.3)	47.17 (1.0)	43.91 (-6.0)	45.17 (-3.3)
% to ONT	15.90	16.03 (0.8)	15.78 (-0.8)	18.10 (13.8)	17.81 (12.0)
% to SNA	16.60	16.29 (-1.9)	16.40 (-1.2)	16.66 (0.4)	15.90 (-4.2)
Business only					
% from SFO	31.51	35.76 (13.5)	33.91 (7.6)	45.47 (44.3)	56.58 (79.6)
% from SJC	36.08	34.54 (-4.3)	35.26 (-2.3)	30.86 (-14.5)	34.32 (-4.9)
% from OAK	32.41	29.71 (-8.3)	30.83 (-4.9)	23.67 (-27.0)	9.10 (-71.9)
% with UA	32.70	35.72 (9.2)	34.51 (5.5)	21.02 (-35.7)	27.54 (-15.8)
% with WN	54.10	50.78 (-6.1)	52.22 (-3.5)	69.17 (27.9)	60.68 (12.2)
% with other	13.20	13.50 (2.3)	13.26 (0.5)	9.811 (-25.7)	11.78 (-10.8)
% to LAX	20.90	20.52 (-1.8)	20.75 (-0.7)	21.28 (1.8)	21.16 (1.2)
% to BUR	42.02	42.63 (1.5)	42.66 (1.5)	39.52 (-5.9)	40.40 (-3.9)
% to ONT	15.89	15.99 (0.6)	15.73 (-1.0)	18.02 (13.4)	18.12 (14.0)
% to SNA	21.19	20.86 (-1.6)	20.86 (-1.6)	21.18 (0.0)	20.31 (-4.2)
Leisure only					
% from SFO	27.26	31.95 (17.2)	29.25 (7.3)	46.62 (71.0)	66.26 (143.1)
% from SJC	19.80	18.76 (-5.3)	19.38 (-2.1)	15.40 (-22.2)	19.13 (-3.4)
% from OAK	52.93	49.29 (-6.9)	51.37 (-2.9)	37.98 (-28.2)	14.60 (-72.4)
% with UA	29.68	32.39 (9.1)	30.88 (4.0)	18.98 (-36.1)	29.72 (0.1)
% with WN	57.63	53.93 (-6.4)	53.06 (-7.9)	72.61 (26.0)	58.64 (1.8)
% with other	12.69	13.68 (7.8)	13.06 (2.9)	8.41 (-33.7)	11.64 (-8.3)
% to LAX	20.71	20.21 (-2.4)	20.51 (-1.0)	21.42 (3.4)	20.92 (1.0)
% to BUR	51.55	52.31 (1.5)	52.05 (1.0)	48.61 (-5.7)	50.18 (-2.7)
% to ONT	15.89	16.01 (0.8)	15.79 (-0.6)	18.07 (13.7)	17.55 (10.4)
% to SNA	11.85	11.47 (-3.2)	11.64 (-1.8)	11.90 (0.4)	11.34 (-4.3)

* The results are based on the models estimated on the entire sample and on subsamples for business travelers or leisure travelers. The reported shares are the weighted average across the 500 simulations, with weights equal to those of the estimation model. For the common choices, the same shocks were used for all 5 cases. For SFO Southwest, additional shocks were generated for the new choices (SFO-WN). The rationale is that the shocks are largely unobserved passenger characteristics.

The bracketed numbers are interpretable as elasticities, with the caveat that no income effects are taken into account.

Reducing access costs to SFO by 10% for all travelers increases its share in the market for travel to greater Los Angeles from 29.4% to 34%, a 15.4% increase. Nearby OAK loses more market share (-7.6%) than SJC (-4.7%). The increase in market share is stronger in the market for leisure travel (17.2%) than in the market for business travel (13.5%). The percentage loss of market share for business passengers at OAK is -8.3%, vs. -4.3% at SJC; while the percentage loss for leisure travel at OAK is -6.9%, vs. -5.3% at SJC. The increase of SFO's share for business travel is mainly to the detriment of OAK, while its share increase for leisure travel is more evenly compensated by a loss both at OAK and SJC. SJC and OAK are substitutes for SFO in the market for leisure travel as well as in the market for business travel, but SJC is a closer substitute for SFO in the market for leisure travel than in the market for business travel. This is plausibly explained by the difference in distance and hence in access costs: SJC is further away for many passengers, and this leads to an access time cost that is especially high for business travelers, given their higher opportunity cost of time.

The impact of reduced access times on airlines is largely determined by the presence of airlines at airports. A higher market share for SFO implies a higher market share for United Airlines and for other airlines, while Southwest loses market share. The loss for Southwest follows from its absence from SFO, and its dominance at OAK (which experiences the largest decline in market share). Reducing access times to SFO has limited effects on market shares of arrival airports. The dominance of LAX is reinforced through the increase of United Airlines' market share, while BUR and SNA loose some market share. The transfer of changes in the Bay Area to greater LA is mediated by airlines. Since the market shares of airlines at airports in greater LA display less concentration than in the Bay Area, the effects in greater LA can be expected to be fairly small in general.

The impact of reducing delays at SFO ("delay SFO") is somewhat similar to that of reducing access times,[21] but there are some differences. The impact of reducing delays at

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[21] Interpreting the percent changes in market shares reported in Table 3 as market share elasticities, it can be seen that the elasticities with respect to access times are between 1.7 and 2.5 times as large as those with respect to delay times; the average ratio is 2.16. Table 1 shows that access times are 2.3 times as large as delay times at the sample average. This suggests that delay times and access times are roughly equally

SFO affects business travel at the competing airports to a larger degree than it affects leisure travel at those airports: SJC's share in business travel drops by 2.3% and OAK's share in business travel drops by 4.9%; the corresponding reductions for leisure are 2.1% and 2.9%. This contrasts to "access SFO", where SJC was more strongly affected in the leisure segment and OAK was more strongly affected in the business segment. One interpretation is that business travelers are more sensitive to service improvements that lead to more reliable travel or to lower expected schedule delay costs, than leisure travelers. This is confirmed by comparing counterfactual scenarios in which access times and delays are reduced by 5 minutes (see appendix 4). Business travelers value access time reductions and delay time reductions in the same way, while leisure travelers value access time reductions more than reduced delays. Reduced delays at SFO negatively affect Southwest given its absence from that airport, and LAX is the only arrival airport that experiences an increase in its market share (mediated through United Airlines).

The two scenarios concerning entry of Southwest at SFO have large effects, as could be expected. When Southwest duplicates its OAK operation at SFO, this increases its market share from 55.6% to 71.5% (a 28.6% increase). When Southwest abandons OAK and transfers the entire operation to SFO, its market share increases from 55.6% to 60.7%. Since duplicating the operation increases costs much more than transferring it, the transfer to SFO generates a larger payoff to the dollar. If Southwest moves into SFO, it benefits from that airport's status as most preferred departure airport. This is true despite the fact that it faces stronger competition from United Airlines at SFO. Note our assumption that no airline changes its prices or supply decisions in response to Southwest's entry at SFO. If, for example, United Airlines would cut its fares at SFO in response to Southwest's entry, that would lead to smaller changes in market share, in particular for the "transfer" scenario. United Airlines experiences a bigger loss of market share under duplication than under transfer, because duplication increases the relative size of Southwest in the market while a transfer does not. In terms of arrival airports, any increase of Southwest's market share leads to a lower market share of LAX, because Southwest's arrivals in greater LA are less concentrated in LAX than is the case for other airlines (in

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valued by travelers.

particular United Airlines).

Entry by Southwest at SFO affects business travelers to a slightly smaller (relative) degree in the case of duplication: the market share of United Airlines drops by 35.7% for business travelers as compared to 37.3% for all travelers. When Southwest transfers its operation to SFO, the market share of United Airlines drops by 15.8% in the business travel market, compared to a 10.5% decline when all passengers are considered. This suggests that a transfer to SFO would especially strengthen Southwest's position in the market for business travelers.

5. Conclusion

We estimate a conditional logit model of airport and airline choice in the market for air travel from the San Francisco Bay Area to greater Los Angeles, and we interpret the estimation results by considering counterfactual scenarios. Defining the market on the level of metropolitan areas rather than airport pairs is relevant, both on statistical grounds and in terms of economic interpretation. Changing the generalized costs of using a departure airport, whether in terms of access times or expected delays, strongly affects the market shares of departure airports. Business travelers respond equally strongly to changes in access times and delays, while leisure travelers respond more strongly to access time than to delay changes. Entry of Southwest at SFO strongly affects the market share of departure airports as well. The effects of the counterfactual scenarios regarding time costs of airport use, on airlines' market shares are substantial, given that airlines concentrate their operations in different airports. Entry by Southwest at SFO increases its market share, also when it transfers its operation to SFO and abandons OAK. The effects on the market shares of arrival airports are more limited. This is partly explained by the relative lack of concentration of airline operations in arrival airports in greater Los Angeles.

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Appendix 1 Construction of the variables

1. ACC_T: airport access time by car

   - Find which TAZ matches to SFO, SJC, and OAK

   The MTC airline passenger survey records the travel analysis zone (TAZ) for each passenger who was interviewed. The MTC maintains a set of travel analysis zones for use in MTC planning studies. These TAZs are typically small area neighborhoods or communities that serve as the smallest geographic base for travel demand model-forecasting systems. The zone system used in the MTC survey is the 1099 zone system developed in 1993. The MTC 1099 zone is equivalent to the 1990 census tract. The 1990 census tract information can be found in Bay area census website (www.bayareacensus.ca.gov). From the file which compares TAZ and census tract (ftp://ftp.abag.ca.gov/pub/mtc/), SFO, SJC, and OAK match “165”, “323”, and “647” respectively.

   - Use “Zone-to-Zone travel times and distances for auto” data to get “ACC_T”

   We find travel times depending on which time of day a passenger drives and on the vehicle occupancy rate. For example, if a passenger drives during peak hours and reports that two people were in vehicle, we use peak-hour driving time for ride 2.

2. FREQ: frequency of service

   Using OAG data, we first calculate the number of flights depending on the departure time and the day of week. We count the number of flights within peak hours (6-9 AM and 3-6 PM) or off-peak hours (all remaining hours). Then we divided the number of flights by 6 or by 18 to get frequency per hour.

3. FARE

   We use Severin Borenstein’s DB1A fourth quarter 1995 average fares for direct flights

4. DEL_T

   The departure and arrival delays for all flights flown out of (SFO, SJC, OAK) to (BUR, LAX, ONT, SNA) for (August, October) of 1995 were used to calculate the monthly mean departure delay and the monthly mean arrival delay for each combination of origin and destination airport. DEL_T is the sum of average departure delay and arrival delay by peak and off-peak.

Appendix 2 Estimation results for alternative model specifications

This section presents results for alternatives to the basic specification of Table 2. All alternatives include the departure airport dummies. For estimations on departure airport-specific subsamples, cf. Appendix 3. Bold indicates 5% significance, italic indicates 10% significance.

Table A.2.1 Unweighted conditional logit model

	All		Business		Leisure	
	Coef	std	Coef	std	Coef	std
D_SJC	**-0.4698348**	0.1415993	-0.2356283	0.207185	**-0.6419647**	0.2040363
D_OAK	**-0.2547159**	0.1138012	**-0.3958045**	0.1709261	-0.1151059	0.1608373
D_WN	**1.250002**	0.0986267	**1.155128**	0.1274633	**1.057215**	0.1689632
D_UA	**0.4233159**	0.1072732	**0.4876764**	0.1596125	0.172161	0.1594794
D_BUR	**-0.6599267**	0.0798926	**-0.4252314**	0.1124069	**-0.7553939**	0.121962
D_ONT	**-0.8481022**	0.0861486	**-0.7024435**	0.1233093	**-0.8567347**	0.1269179
D_SNA	**-0.7973684**	0.1049751	**-0.477768**	0.1332655	**-1.000825**	0.1817449
FARE	**-0.0240341**	0.0060691	-0.0109768	0.0078554	**-0.0348878**	0.0095901
FREQ	**0.26627**	0.0595921	**0.341538**	0.0699605	**0.6038817**	0.1553817
ACC_T	**-0.0742017**	0.0023778	**-0.0710724**	0.0032155	**-0.075289**	0.0036026
DEL_T	**-0.0599464**	0.0068608	**-0.0698116**	0.0098912	**-0.0629283**	0.0099438
INC_2	**0.0156041**	0.0059238	0.0037791	0.0078534	*0.0170721*	0.009194
INC_3	*0.0101384*	0.0058682	0.0087272	0.00732	0.014329	0.0110742
Number of Obs	1752		935		817	
Log LL	-5207.6231		-2789.6669		-2377.4435	

Table A.2.2 WESML estimation results for conditional logit model: October 1995 – aggregation of LA airports

	All		Business		Leisure	
	Coef	std	Coef	std	Coef	std
SJC	**-0.9465817**	0.1599404	**-0.8836796**	0.2387498	**-1.088943**	0.226647
OAK	**-0.600818**	0.1236872	**-0.7696969**	0.1926949	**-0.4676924**	0.1687158
WN	**0.8778944**	0.1027772	**0.9405048**	0.1343419	**0.5127755**	0.1662694
UA	*0.2118871*	0.1168724	**0.3872756**	0.1814022	-0.1474859	0.165979
FARE	**-0.0254676**	0.0054351	-0.0076634	0.0073137	**-0.045727**	0.0083435
FREQ	**0.4504831**	0.056288	**0.4450585**	0.0688821	**1.001898**	0.1374618
ACC_T	**-0.0707673**	0.0026568	**-0.0733975**	0.0038225	**-0.0664845**	0.0038018
DEL_T	**-0.0282496**	0.0073567	**-0.0543445**	0.0108494	**-0.0292315**	0.0109474
INC_2	**0.0162655**	0.0060791	0.0044679	0.0080675	**0.0231415**	0.0096399
INC_3	0.0051412	0.0063966	0.0029637	0.0075582	0.0108364	0.0123495
Number of Obs	1752		935		817	
Log LL	-5383.032085		-2719.585714		-2604.770356	

Table A.2.3 WESML estimation results for conditional logit model: October 1995 – LAX only

	All		Business		Leisure	
	Coef	std	Coef	std	Coef	Std
SJC	**-2.241109**	0.2215697	**-2.084351**	0.3219254	**-2.55014**	0.3292768
OAK	**-1.391752**	0.1667707	**-1.587518**	0.242835	**-1.320651**	0.2471541
WN	**2.001872**	0.2081546	**1.398882**	0.3150095	**2.815839**	0.399198
UA	**1.061413**	0.1704902	**0.8223436**	0.2599463	**1.492941**	0.2973512
FARE	**-0.0371149**	0.0115903	*-0.0344025*	0.0185807	-0.0263661	0.0175559
FREQ	0.1034877	0.0980113	**0.3554278**	0.1336131	*-0.4986464*	0.272685
ACC_T	**-0.0811181**	0.004257	**-0.0846698**	0.0064236	**-0.0767606**	0.0057741
DEL_T	**-0.0707371**	0.0099851	**-0.1063882**	0.0163049	**-0.0372414**	0.0144328
INC_2	**0.0224951**	0.0105285	0.0000539	0.0160249	**0.032278**	0.0143046
INC_3	**0.0300796**	0.0120547	0.0160219	0.0161723	**0.0514548**	0.0189455
Number of Obs	802		385		417	
Log LL	-1652.777415		-797.9057587		-841.7231436	

Table A.2.4 **WESML estimation results for conditional logit model: October 1995 – PEAK, all arrival airports**

	All		Business		Leisure	
	Coef	std	Coef	std	Coef	std
D_SJC	**-1.061891**	0.254356	**-0.657955**	0.354659	**-1.285090**	0.411838
D_OAK	-0.397143	0.214826	-0.369553	0.300365	-0.341410	0.348642
D_WN	**1.206568**	0.164153	**0.790856**	0.195181	**1.464968**	0.328016
D_UA	0.156915	0.176660	-0.048634	0.246273	0.178218	0.301968
D_BUR	**-0.378933**	0.152169	0.027620	0.214812	**-0.525373**	0.241994
D_ONT	**-0.426492**	0.143781	-0.059145	0.199448	**-0.674508**	0.223956
D_SNA	**-0.566156**	0.174721	-0.067760	0.212114	**-0.794492**	0.352532
FARE	*-0.017804*	0.009216	-0.004664	0.010092	**-0.038787**	0.017257
FREQ	**0.676800**	0.124650	**0.833397**	0.143576	**1.055328**	0.358911
ACC_T	**-0.089389**	0.004883	**-0.092182**	0.006754	**-0.083572**	0.007225
DEL_T	-0.016929	0.019453	-0.022828	0.025255	0.025017	0.034281
INC_2	*0.016797*	0.008989	0.002585	0.010404	*0.030392*	0.015932
INC_3	0.007451	0.007124	0.004028	0.010104	0.016960	0.012144
Number of Obs	724		431		293	
Log LL	-1495.8283		-845.02336		-627.88764	

Table A.2.5 **WESML estimation results for conditional logit model: October 1995 – OFFPEAK, all arrival airports**

	All		Business		Leisure	
	Coef	std	Coef	std	Coef	Std
D_SJC	0.055988	0.484841	0.320814	0.717721	-0.689664	0.722984
D_OAK	-0.236686	0.260129	-0.495047	0.404705	-0.248959	0.365431
D_WN	**1.141331**	0.159128	**1.291080**	0.213714	**0.637226**	0.252061
D_UA	**0.556161**	0.168395	**0.823634**	0.268083	0.052532	0.232763
D_BUR	-0.012270	0.175998	0.097491	0.246791	-0.107371	0.270372
D_ONT	0.010479	0.271178	0.150367	0.397514	-0.317480	0.406353
D_SNA	0.250372	0.278082	*0.576278*	0.348770	**-0.307736**	0.490963
FARE	**-0.021545**	0.008305	-0.014441	0.012131	**-0.031196**	0.012792
FREQ	*0.166911*	0.088097	0.165190	0.108669	**0.547126**	0.208895
ACC_T	**-0.138139**	0.007810	**-0.148232**	0.012782	-0.127539	0.009819
DEL_T	*0.047670*	0.027358	0.042821	0.041546	0.004530	0.041203
INC_2	*0.016337*	0.008370	0.009577	0.012388	0.018603	0.012280
INC_3	-0.002121	0.010278	-0.002592	0.012090	-0.002626	0.019517
Number of Obs	1028		504		524	
Log LL	-2379.1963		-1084.0389		-1266.2517	

Table A.2.6 **WESML estimation results for conditional logit model: October 1995 – WEEK, all arrival airports**

	All		Business		Leisure	
	Coef	Std	Coef	std	Coef	Std
D_SJC	**-1.285600**	0.197234	**-1.137136**	0.270018	**-1.407604**	0.299729
D_OAK	**-0.735906**	0.152929	**-0.907026**	0.215260	**-0.465536**	0.226624
D_WN	**1.281287**	0.123653	**1.302370**	0.158781	**0.962831**	0.207613
D_UA	**0.317553**	0.143313	**0.602638**	0.201044	-0.297882	0.222976
D_BUR	**-0.723874**	0.113003	**-0.481378**	0.148948	**-0.955548**	0.183532
D_ONT	**-0.715175**	0.117953	**-0.636916**	0.162088	**-0.714111**	0.179508
D_SNA	**-0.740702**	0.134544	**-0.460239**	0.169276	**-1.039741**	0.230756
FARE	-0.006622	0.005665	-0.001487	0.007292	-0.009763	0.009214
FREQ	**0.246108**	0.072374	**0.275343**	0.082926	**0.511465**	0.194877
ACC_T	**-0.079694**	0.003341	**-0.076031**	0.004339	**-0.083714**	0.005342
DEL_T	**-0.057425**	0.009500	**-0.065890**	0.012992	**-0.058340**	0.014315
INC_2	*0.008648*	0.005779	0.002982	0.007544	0.007552	0.009432
INC_3	0.001439	0.006735	0.000912	0.007946	0.004665	0.013609
Number of Obs	1300		781		519	
Log LL	-3701.7426		-2203.2734		-1463.1574	

Table A.2.7 **WESML estimation results for conditional logit model: October 1995 – WEEKEND, all arrival airports**

	All		Business		Leisure	
	Coef	std	Coef	std	Coef	Std
D_SJC	**-2.158415**	0.366180	**-1.828838**	0.679470	**-2.377937**	0.463604
D_OAK	**-1.158869**	0.262869	**-1.170916**	0.471263	**-1.195154**	0.344651
D_WN	**1.638231**	0.326217	**0.801017**	0.472925	**1.853904**	0.509895
D_UA	**1.153161**	0.294993	0.711079	0.470100	**1.284946**	0.435692
D_BUR	**-0.371828**	0.182139	-0.091470	0.342876	-0.309691	0.246189
D_ONT	**-1.246546**	0.226750	**-1.000045**	0.409577	**-1.266353**	0.296635
D_SNA	**-1.547359**	0.366833	**-1.092272**	0.544379	**-1.495842**	0.523593
FARE	**-0.054851**	0.016956	-0.035304	0.032077	**-0.072396**	0.021716
FREQ	**0.308440**	0.156393	**0.559148**	0.220302	0.434880	0.329098
ACC_T	**-0.068781**	0.005672	**-0.085426**	0.010904	**-0.058818**	0.006910
DEL_T	**-0.065962**	0.016021	**-0.122502**	0.030749	**-0.047273**	0.019813
INC_2	**0.036989**	0.015703	0.009848	0.030952	**0.048784**	0.018607
INC_3	0.017533	0.013780	0.023442	0.022715	0.015913	0.018827
Number of Ob.	452		154		298	
Log LL	-1548.0241		-481.68073		-1047.7158	

Table A.2.8 **WESML estimation results for conditional logit model: October 1995 – Bay Area RESIDENTS ONLY**

	All		Business		Leisure	
	Coef	std	Coef	std	Coef	std
D_SJC	**-1.643781**	0.2482741	**-1.415406**	0.3665937	**-1.840911**	0.3609792
D_OAK	**-0.617423**	0.1879627	**-0.621832**	0.2843455	**-0.7353675**	0.2726101
D_WN	**1.139669**	0.1723741	**0.8738934**	0.2420279	**0.8225613**	0.2690789
D_UA	0.209022	0.1776687	*0.4538332*	0.256772	*-0.4731085*	0.2758103
D_BUR	**-0.643724**	0.1329299	-0.3037887	0.1946372	**-0.6157301**	0.2012644
D_ONT	**-0.854165**	0.1451674	**-1.112304**	0.2452754	**-0.438084**	0.1942311
D_SNA	**-1.09629**	0.1888585	**-0.8028248**	0.2648092	**-0.9038939**	0.2931143
FARE	-0.0125702	0.0093242	-0.0137095	0.0148702	-0.0204656	0.0141602
FREQ	**0.4348326**	0.095107	**0.4490163**	0.1199779	**1.274663**	0.2429795
ACC_T	**-0.0722955**	0.0039051	**-0.0661763**	0.0053800	**-0.0781613**	0.0057115
DEL_T	**-0.0824037**	0.0114757	**-0.1081542**	0.0175474	**-0.0868276**	0.0160115
INC_2	0.0065636	0.0091287	0.0052003	0.0145496	0.0018483	0.0131829
INC_3	**0.0183609**	0.0089173	*0.0200459*	0.0111178	0.0254393	0.0168361
Number of Obs.	825		381		444	
Log LL	-2455.039488		-1146.770568		-1266.179855	

Table A.2.9 **WESML estimation results for conditional logit model: October 1995 – ADDING AIRLINE – AIRPORT INTERACTIONS to the basic specification**

	All		Business		Leisure	
	coeff	std	coeff	std	coeff	Std
D_SJC	**-1.628475**	0.200360	**-1.240590**	0.282143	**-2.290880**	0.327584
D_OAK	**-0.676946**	0.148866	**-0.875526**	0.226143	-0.304633	0.203113
D_WN	**1.481380**	0.139725	**1.232852**	0.161238	**1.738382**	0.281297
D_UA	**0.461679**	0.155178	**0.711000**	0.231119	-0.030991	0.219286
D_BUR	**-0.620432**	0.098852	**-0.466266**	0.138283	**-0.634070**	0.146979
D_ONT	**-0.839552**	0.107463	**-0.740437**	0.154528	**-0.804275**	0.154852
D_SNA	**-0.980581**	0.130534	**-0.615866**	0.163472	**-1.300709**	0.223394
LAX*UA	-0.034102	0.154442	-0.229321	0.240568	-0.167825	0.217769
OAK*WN	-0.339205	0.208110	-0.070724	0.285542	**-1.169109**	0.342532
FARE	**-0.013725**	0.005878	-0.004573	0.007810	**-0.019316**	0.009319
FREQ	**0.260795**	0.072913	**0.361214**	0.097725	**0.676185**	0.174624
ACC_T	**-0.076792**	0.002851	**-0.077296**	0.004026	**-0.073773**	0.004145
DEL_T	**-0.060118**	0.008154	**-0.077826**	0.012301	**-0.058488**	0.011416
INC_2	**0.014343**	0.005753	0.004432	0.007892	**0.018277**	0.008813
INC_3	0.004165	0.005870	0.002722	0.007415	0.007500	0.010113
Num of Obs.	1752		935		817	
Log LL	-5317.902879		-2701.829907		-2563.901486	

Table A.2.10 WESML estimation results for conditional logit model: October 1995 – MARGINAL EFFECTS FOR THE ALTERNATIVE SPECIFICATIONS

	Basic specification			Unweighted			LAX only		
	All	Business	Leisure	All	Business	Leisure	All	Business	Leisure
D_SJC	-7.878	-7.006	-7.535	-3.095	-2.510	-2.672	-21.307	-20.728	-22.727
D_OAK	-4.534	-4.595	-5.180	-1.592	-1.326	-1.593	-17.922	-18.111	-18.777
D_WN	+7.729	+7.041	+8.006	+6.372	+6.360	+6.913	+26.670	+18.431	+37.759
D_UA	+3.654	+4.053	+3.938	+3.090	+2.497	+2.901	+15.448	+11.249	+23.255
D_BUR	-3.197	-2.152	-3.377	-3.673	-3.106	-3.492			
D_ONT	-4.095	-3.247	-4.361	-4.393	-3.706	-4.254			
D_SNA	-4.367	-2.856	-4.475	-4.159	-3.537	-3.834			
LAX*UA									
OAK*WN									
FARE	-0.028	-0.005	-0.040	-0.078	-0.056	-0.089	-0.258	-0.430	-0.070
FREQ	+1.362	+1.688	+1.447	+1.701	+1.432	+1.635	+1.431	+4.731	-7.250
ACC_T	-0.458	-0.430	-0.479	-0.474	-0.399	-0.456	-1.121	-1.127	-1.116
DEL_T	-0.353	-0.417	-0.375	-0.383	-0.322	-0.368	-0.978	-1.416	-0.541
INC_2	+4.502	+1.397	+5.024	+4.844	+3.917	+5.121	+14.190	-0.038	+22.542
INC_3	+1.996	+1.025	+2.176	+5.281	+4.569	+5.576	+29.040	+8.777	+44.491

Marginal effects are not comparable between (Basic/Unweighted) and (LAX only) as the choice sets are different.

Appendix 3 Estimation results with separate departure airports

The weighting procedure used throughout the paper has the purpose of correcting for oversampling at SJC. Since the estimates presented here are for subsamples that distinguish departure airports, no weighting is used.

Table A.3.1 WESML estimation results for conditional logit model: October 1995 – SEPARATE MODELS FOR DEPARTURE AIRPORTS – INCLUDING ALL ARRIVAL AIRPORTS - ALL TRIP PURPOSES

Market	(SFO-All arrival)		(SJC-All arrival)		(OAK-All arrival)	
	coeff	std	coeff	std	coeff	std
D_WN			**0.4035221**	0.2059696	**-2.443168**	0.4598222
D_UA	**1.447899**	0.3469058			**-3.241702**	0.4743494
D_BUR	**-2.244744**	0.3976806	-0.138391	0.1753771	**-0.400933**	0.1343374
D_ONT	**-1.862924**	0.3768791	**-0.484587**	0.1615279	**-0.340425**	0.1412648
D_SNA	-0.334222	0.5353014	**0.5279269**	0.22647	*dropped*	
FARE	**-0.029484**	0.0118672	**-0.132622**	0.0218892	**-0.158719**	0.0223111
FREQ	-0.037276	0.1437413	-0.008379	0.2341627	-0.324124	0.20005
ACC_T	-0.002287	0.0117868	**-0.030763**	0.0116636	0.0051398	0.0056535
DEL_T	**0.0474932**	0.0201115	**-0.042497**	0.0129628	**0.0439259**	0.0135548
INC_2	**0.0215874**	0.0087771	**0.0357169**	0.0157845	0.0007457	0.0129013
INC_3	-0.012978	0.0099756	0.0138363	0.0158836	**0.0382967**	0.0163115
Num of Obs	239		829		684	
Log LL	-508.96533		-1979.7514		-1654.4827	

Table A.3.2 WESML estimation results for conditional logit model: October 1995 – SEPARATE MODELS FOR DEPARTURE AIRPORTS – INCLUDING ALL ARRIVAL AIRPORTS – BUSINESS ONLY

Market	(SFO-All arrival)		(SJC-All arrival)		(OAK-All arrival)	
	coeff	std	coeff	std	coeff	std
D_WN			0.2661189	0.2377729	**-1.880922**	0.8418118
D_UA	1.124348	0.7514048			**-2.469362**	0.9236809
D_BUR	**-1.95479**	0.7625264	0.1554767	0.2204472	-0.011991	0.268397
D_ONT	**-1.642814**	0.5736994	-0.230919	0.2098922	-0.017509	0.285047
D_SNA	0.6537186	1.027902	**0.6979992**	0.2573809	*dropped*	
FARE	-0.025126	0.0161843	**-0.094301**	0.0249851	**-0.131**	0.0466104
FREQ	0.2080108	0.2847647	0.4028138	0.2751015	0.1201194	0.3537374
ACC_T	-0.022583	0.0202084	0.0050955	0.0142185	0.0149314	0.0088773
DEL_T	0.0050707	0.0356699	**-0.038335**	0.0160752	0.0176612	0.0236117
INC_2	0.0093165	0.0106447	0.0091711	0.0198468	0.0027392	0.0238734
INC_3	-0.014522	0.0122419	0.0143072	0.0179522	**0.0575924**	0.0233487
Num of Obs	130		539		266	
Log LL	-276.48884		-1314.4914		-648.01483	

Table A.3.3 WESML estimation results for conditional logit model: October 1995 – SEPARATE MODELS FOR DEPARTURE AIRPORTS – INCLUDING ALL ARRIVAL AIRPORTS – LEISURE ONLY

Market	(SFO-All arrival)		(SJC-All arrival)		(OAK-All arrival)	
	coeff	std	coeff	std	coeff	std
D_WN			0.1917771	0.5160574	**-2.464**	0.6414128
D_UA	**2.090369**	0.7785731			**-3.296131**	0.7019033
D_BUR	**-2.886247**	0.7475692	-0.096838	0.3811929	**-0.526819**	0.21229
D_ONT	**-2.273862**	0.6473705	-0.38812	0.3219824	*dropped*	
D_SNA	**-2.632841**	1.153607	0.8965149	0.6266809	**-0.157**	0.0332497
FARE	-0.021365	0.0206568	**-0.19684**	0.0564436	-0.4513	0.5104956
FREQ	-0.800855	0.5593484	0.2470859	0.7063047	-0.002496	0.0074953
ACC_T	0.0085099	0.015272	**-0.080879**	0.0247401	**0.0512032**	0.0189827
DEL_T	**0.090014**	0.032059	*-0.03819*	0.0224417	**0.0038797**	0.0156004
INC_2	0.0320278	0.0163815	*0.0473552*	0.0264933	0.0209098	0.0233694
INC_3	-0.00946	0.0181667	0.0081249	0.0343893	-0.157	0.0332497
Num of Obs	109		290		418	
Log LL	-221.35776		-648.31654		-998.90567	

Table A.3.4 WESML estimation results for conditional logit model: October 1995 – SEPARATE MODELS FOR DEPARTURE AIRPORTS – LAX ONLY– ALL TRIP PURPOSES

Market	(SFO-LAX)		(SJC-LAX)		(OAK-LAX)	
	coeff	std	coeff	std	coeff	std
D_WN			**0.8743542**	0.278324		
D_UA	**1.160537**	0.4700525				
FARE	*-0.041203*	0.0218201	**-0.131378**	0.0331957	**-0.585158**	0.0973236
FREQ	0.015593	0.1632982	-0.567624	0.4511226	**-0.852065**	0.3552432
ACC_T	*0.0322631*	0.0167862	**0.0628755**	0.0249853	0.0131395	0.0146679
DEL_T	**0.0757175**	0.0245363	**-9.703751**	2.924701	**0.0773748**	0.0255702
INC_2	**0.054472**	0.0212918	0.0442721	0.0305216	0.0180989	0.0967785
INC_3	0.0094073	0.0275429	-0.003563	0.0269089	0.0876385	0.1638281
Num of Obs	173		327		302	
Log LL	-254.44884		-415.13627		-363.02401	

Table A.3.5 WESML estimation results for conditional logit model: October 1995 – SEPARATE MODELS FOR DEPARTURE AIRPORTS – LAX ONLY– BUSINESS ONLY

Market	(SFO-LAX)		(SJC-LAX)		(OAK-LAX)	
	coeff	std	coeff	std	coeff	std
D_WN			0.6087447	0.3515888		
D_UA	**2.065613**	0.9759691				
FARE	-0.0370345	0.0404602	**-0.0774723**	0.0321773	**-0.4455586**	0.1980134
FREQ	-0.0449392	0.3105073	0.372824	0.5378831	-0.4799583	0.530971
ACC_T	0.0404964	0.0316054	**0.0681281**	0.0308403	-0.0028149	0.0221612
DEL_T	*0.0724574*	0.0440952	-3.445977	3.96301	0.0188941	0.042281
INC_2	0.0036639	0.0344999	0.0031464	0.0316202	-0.1628758	0.1693809
INC_3	0.0007812	0.0349414	-0.0049441	0.0293931	0.2435013	0.2306399
Num of Obs	84		195		106	
Log LL	-120.01998		-262.70718		-130.15109	

Table A.3.6 WESML estimation results for conditional logit model: October 1995 – SEPARATE MODELS FOR DEPARTURE AIRPORTS – LAX ONLY– LEISURE ONLY

Market	(SFO-LAX)		(SJC-LAX)		(OAK-LAX)	
	coeff	std	coeff	std	coeff	std
D_WN			**1.761393**	0.8114296		
D_UA	**1.929636**	0.6932619				
FARE	-0.018614	0.0210154	**-0.32746**	0.0948332	**-0.789334**	0.1517454
FREQ	**-1.014935**	0.4560567	**-7.641156**	2.574548	**-2.121639**	0.8200437
ACC_T	**0.0315584**	0.0156509	0.0499468	0.0439044	0.023664	0.0198064
DEL_T	**0.1237667**	0.028469	**-34.96022**	9.777556	**0.1360528**	0.0379876
INC_2	**0.0823119**	0.0230345	**0.1523068**	0.0733537	0.1392368	0.1180219
INC_3	0.0233802	0.0356677	-0.012644	0.0750303	-0.013747	0.2374633
Num of Obs	89		132		196	
Log LL	-211.46447		189.73		-227.80859	

Appendix 4 Counterfactual scenarios: reducing access times and delays by 5 minutes (repeating other scenarios for convenience)

Table A.4.1 Key results for counterfactual scenarios: percentage market shares (% change with respect to baseline)*

	Baseline	Access SFO	Delay SFO	Southwest SFO	
		- 5 minutes	**- 5 minutes**	Duplication	Transfer
All passengers					
% from SFO	29.42	35.74	34.34	46.79 (+59.0)	61.71 (+109.8)
% from SJC	28.08	26.24	26.65	22.88 (-18.5)	26.56 (-5.4)
% from OAK	42.50	38.02	39.01	30.32 (-28.7)	11.74 (-72.4)
% with UA	31.21	35.38	34.45	19.58 (-37.3)	27.94 (-10.5)
% with WN	55.58	50.87	51.97	71.49 (28.6)	60.70 (9.2)
% with other	12.96	13.75	13.58	8.92 (-31.2)	11.36 (-12.3)
% to BUR	20.79	20.28	20.39	21.33 (2.6)	21.12 (1.6)
% to LAX	46.70	47.39	47.25	43.91 (-6.0)	45.17 (-3.3)
% to ONT	15.90	16.11	16.06	18.10 (13.8)	17.81 (12.0)
% to SNA	16.60	16.21	16.29	16.66 (0.4)	15.90 (-4.2)
Business only					
% from SFO	31.51	37.65	37.47	45.47 (44.3)	56.58 (79.6)
% from SJC	36.08	33.90	33.96	30.86 (-14.5)	34.32 (-4.9)
% from OAK	32.41	28.45	28.57	23.67 (-27.0)	9.10 (-71.9)
% with UA	32.70	37.20	37.06	21.02 (-35.7)	27.54 (-15.8)
% with WN	54.10	49.33	49.48	69.17 (27.9)	60.68 (12.2)
% with other	13.20	13.47	13.46	9.811 (-25.7)	11.78 (-10.8)
% to LAX	20.90	20.41	20.42	21.28 (1.8)	21.16 (1.2)
% to BUR	42.02	42.73	42.72	39.52 (-5.9)	40.40 (-3.9)
% to ONT	15.89	16.10	16.10	18.02 (13.4)	18.12 (14.0)
% to SNA	21.19	20.75	20.76	21.18 (0.0)	20.31 (-4.2)
Leisure only					
% from SFO	27.26	33.50	32.06	46.62 (71.0)	66.26 (143.1)
% from SJC	19.80	18.39	18.71	15.40 (-22.2)	19.13 (-3.4)
% from OAK	52.93	48.11	49.22	37.98 (-28.2)	14.60 (-72.4)
% with UA	29.68	33.48	32.58	18.98 (-36.1)	29.72 (0.1)
% with WN	57.63	52.69	53.84	72.61 (26.0)	58.64 (1.8)
% with other	12.69	13.83	13.58	8.41 (-33.7)	11.64 (-8.3)
% to LAX	20.71	20.12	20.25	21.42 (3.4)	20.92 (1.0)
% to BUR	51.55	52.43	52.24	48.61 (-5.7)	50.18 (-2.7)
% to ONT	15.89	16.10	16.05	18.07 (13.7)	17.55 (10.4)
% to SNA	11.85	11.36	11.46	11.90 (0.4)	11.34 (-4.3)

* The results are based on the models estimated on the entire sample and on subsamples for business travelers or leisure travelers. The reported shares are the weighted average across the 500 simulations, with weights equal to those of the estimation model. For the common choices, the same shocks were used for all 5 cases. For SFO Southwest, additional shocks were generated for the new choices (SFO-WN). The rationale is that the shocks are largely unobserved passenger characteristics.