Limited Access to Airport Facilities and Market Power in the Airline Industry

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Abstract

We investigate the role of limited access to airport facilities as a determinant of the hub premium in the US airline industry. We use original data from competition plans that airports are required to submit to the Department of Transportation in compliance with the Aviation Investment and Reform Act for the 21st Century. We collect information on the availability and control of airport gates, leasing arrangements, and other restrictions limiting the expansion of airport facilities.

We find that the hub premium is increasing in the ticket fare. We find that control of gates is a crucial determinant of this premium. Limits on the fees that airlines can charge for subleasing their gates lower the prices charged by airlines. Finally, control of gates and restrictions on sublease fees explain high fares only when there is a scarcity of gates relative to the number of departures out of an airport.

Keywords: Market Power, Airline Industry, Barriers to Entry, Hub Premium, Airport Facilities.
JEL Codes: L13, L93.

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1 Introduction

In this paper, we investigate the size and the determinants of the "hub premium," by which we mean the difference between the fares charged for trips into and from airports where major airlines have their hubs, and the fares that are charged for similar trips except that they do not originate from or end in a hub.

We focus on the role of "operating" practices limiting access to airport facilities that Borenstein (1989) and the Government Accounting Office [GAO (1989, 1990)] identified as a set of potential barriers to entry in the airline industry and that could explain the hub premium, and more generally, high airline fares.[1] Such operating practices are quite simple to describe. Airlines need ticket counters, baggage check-in rooms, baggage claim areas, and, most importantly, enplaning/deplaning gates to provide service at an airport. However, access to these airport facilities is typically regulated by long term exclusive contracts between airlines and airports. Thus, new entrants typically can only gain access to an airport by paying sublease fees.[2] These institutional barriers to entry should be associated with higher prices, particularly at airports where gates are a scarce resource, such as airports where the number of departures is very large relative to the number of gates available.

We build a unique and original dataset to measure the importance of "operating" practices as determinants of the hub premium. The original data are from competition plans that airports are required to submit to the Department of Transportation in compliance with the Aviation Investment

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[1] See Carlton (2004), Schmalensee (2004), and McAfee, Mialon, and Williams (2004) for a recent debate on the economics of barriers to entry. The institutional barriers to entry we examine in this paper are the result of explicit contractual agreements that limit potential competitors' access to the necessary airport facilities to offer service.

[2] Borenstein (1989) and studies by the Government Accounting Office [GAO 1989, 1990] also identified "marketing" practices that might explain higher fares. Incumbent airlines use frequent flyer programs (FFPs) and volume incentives to travel agents to build a loyal customer base, making entry by new carriers more difficult. Direct data on these practices remains unavailable.

and Reform Act for the 21st Century (AIR 21). AIR 21, which was signed into law in April, 2000, stated that beginning in fiscal year 2001, no federal grant would be made to fund any one of a set of "major" airports unless the airport had submitted a written competition plan. The competition plan must include information on the availability of airport gates and related facilities, leasing and sub-leasing arrangements, gate-use requirements, gate-assignment policies, and whether the airport intends to build or acquire gates that would be used as common facilities.[3]

We estimate a linear specification of the (reduced form) pricing equation. To control for the significant number of unobserved factors impacting both consumers' decisions to fly and the costs of offering service on any particular route, we include route-carrier fixed effects. This has the advantage of providing a clear source of identifying variation for the parameters of interest while still allowing us to recover the impact of time invariant barriers to entry on equilibrium pricing decisions using the minimum distance procedure of Chamberlain (1982).

We report three main findings. First, the hub premium is increasing in the ticket fare. The hub premium is lower than 10 percent at the 10th percentile of the fare distribution and almost as high as 25 percent at its 90th percentile.

Second, we find that the hub premium is reduced by almost one half if we include our measures of barriers to entry in the empirical analysis. We show that the control of gates leased on an exclusive basis by an airline is a crucial determinant of the hub premium. In particular, if the percentage of gates controlled by the carrier increases from 10 to 30 percent, the prices increase by 3 percent. Other variables that are associated with high premia are those that record the presence of restrictions on the fees that airlines can charge for subleasing their gates. Prices are 2 percent

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[3] Section 155.f.(1-2), H.R. 1000.

lower when limits on sublease fees are in place.

Finally, we construct a new measure of congestion, which is here defined as the ratio of total quarterly departures out of an airport over the number of gates at an airport. We show that the interaction of this new variable with the measures of barriers to entry plays a crucial role in explaining the hub premium. At an airport where there are around 600 departures per gate in a quarter (e.g. Atlanta), a 30 percent difference in the gates leased would lead to a difference of 6 percent in the airline prices. At an airport where there are around 200 departures per gate (e.g. Nashville), a 30 percent difference would lead to a difference of 2 percent in prices. Similarly, we show that at an airport where there are around 600 departures per gate, the presence of a limit on the sublease fees lowers the premium by approximately 11 percent but only decreases it by 2 percent at airports with 120 departures per gate. Thus, exclusive control of gates explains high fares only when there is a scarcity of gates relative to the number of departures at an airport. This suggests that efforts to improve access to gates should be concentrated on those "major airports" that are most congested (large number of departures relative to the number of boarding gates).

These results are novel and important because they show a direct, clear, relationship between limited access to airport facilities and hub premia. Previous works could only provide indirect evidence on the relationship between limited access to airport facilities and hub premia. For example, Borenstein (1989) proxied limited access to airport facilities with a measure of airline's "airport dominance," the percentage of passengers flying on one airline at an airport. Borenstein showed that airlines' fares were positively correlated with the airline's share of passengers on the route and at the endpoint airports.[4] Clearly, the main limitation of using indirect evidence is that

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[4] Evans and Kessides [1993] add market and, separately, firm fixed effects and confirm Borenstein's finding that airport dominance by a carrier is correlated with higher fares, but do not find that dominance at the route level is

the proxy might only capture part of the effect that limited access to gates has on hub premia. We show that this is actually the case: once we control for route-carrier fixed effects, the percentage of passengers flying on one airline at an airport does not pick *any* of the effect of limited access to airport facilities on hub premia.

We provide a description of the new data that we collected from the airports' competition plans in Section 2. The fare and passenger data are described in Section 3. Our econometric specification is discussed in Section 4. We then provide a detailed description of the results in Section 5. Section 6 concludes.

2 Limited Access to Airport Facilities

2.1 The Aviation Investment and Reform Act for the 21st Century

In response to governmental, public and academic concern with the existence of institutional barriers to entry in the airline industry, President Clinton signed into law the Wendell H. Ford Aviation Investment and Reform Act for the 21st Century (AIR 21) on April 5, 2000. AIR 21 identified a set of "major airports" that had to be available on a reasonable basis to all carriers wishing to serve these airports. The set of airports identified by AIR 21 were commercial service airports that both had more than 0.25 percent of the total number of passenger boardings each year in the US and where one or two air carriers controlled more than 50 percent of the passenger boardings.[5]

As a result of AIR 21, all of these airports have compiled competition plans. We were able to collect the competition plans and construct a cross-section of data where the unit of observation

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statistically or economically significant. Evans and Kessides conclude that the most promising direction for public policy aimed at improving the industry's performance is to ensure equal access to sunk airport facilities. This is exactly what we confirm in this paper.

[5] These airports consist of large and medium hubs at which one or two airlines board more than 50% of the passengers. See Section (7.2).

is the airport. From these plans, we gathered information on the availability of airport gates, leasing and subleasing arrangements of gates and other airport facilities, as well as airline-airport agreements.[6]

There is one potential limitation of the data that we collected. We only have one observation for each airport, and the observation is for one year between 2001 and 2004. To address this limitation of the data, we restrict our analysis to the years 2002, 2003 and 2004. For these years, the data on the limited access to airport facilities is appropriate, given the long-term nature of the contracts that airlines sign with airports for the use of gates. The 1990 study by the Government Accounting Office reported that 22 percent of the gates at the 66 largest airports were for $3-10$ years duration; 25 percent were for $11-20$ years duration; and 41 percent were for more than 20 years duration (GAO (1990)).[7] It is also worth noting that airlines can not terminate leases unilaterally. For example, in the case of Dallas Love airport, American Airlines was seeking termination of the gate lease agreements with the airport. American no longer used the gates but was obligated to continue paying $335,000 per year.[8] The Dallas Love airport declined to terminate the lease agreement and American will have to pay until 2011, when the lease expires.[9]

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[6] Washington National, New York's La Guardia, and Dallas Love Field (the main hub of Southwest) have "perimeter rules," which limit long-haul flights to and from these airports. For example, non-stop flights from Phoenix to Washington National and New York's La Guardia were prohibited until 2004. Since in this paper we do not distinguish nonstop from connecting service as different products, we do not include perimeter rules in the analysis. Washington National, Chicago O'Hare, and New York's La Guardia and Kennedy have slot controls to reduce congestion by limiting the number of takeoffs and landings per hour. However, we only have the competition plans for Washington Reagan and O'Hare, and including route-carrier fixed effects practically rules out the use of variables measuring the effects of slot restrictions.

[7] For example, in the competition plan submitted by the Philadelphia airport (dated 2000), we read that the lease agreements were signed in 1974 and will expire in 2006. In the competition plan submitted by the Atlanta airport (dated 2000), we read that exclusive-use leases for gates and other facilities expire on September 20, 2010.

[8] See the June 30, 2003, Letter from Mr Gwyn, Director of Aviation, City of Dallas, to Ms. Lang, Deputy Director of Airport Planning and Programming, Federal Aviation Administration.

[9] See the February 28, 2005, Letter from Mr Gwyn, Director of Aviation, City of Dallas, to Ms. Lang, Deputy Director of Airport Planning and Programming, Federal Aviation Administration.

2.2 Access to Gates

Airlines require enplaning/deplaning gates to provide service at an airport. An exclusive-use lease gives the lessee the sole right to use the facilities in question. The 1990 study by the GAO reported that nearly 88 percent of the gates at the 66 largest airports were leased to airlines, and 85 percent of those were leased for exclusive use. Most of the remaining gates were leased on a preferential basis, giving the lessee the first right to use the facilities. For example, in Salt Lake City, 96 percent of the gates were leased on an exclusive use basis, and 3 percent were leased on a preferential use basis in 1996 (TRB (1999)). Some airports (16 percent) have use-or-lose provisions for exclusive leases, allowing the airport to gain control of the gate if the lessee does not use the gates. However, an airline must cease all operations for 1 to 3 months before losing the right to the gates, which is unlikely to occur (GAO (1990)).

Among the information included in the competition plans, airports reported the total number of gates available, the number of gates for common use (neither leased on an exclusive or preferential basis), and the number of gates leased to each airline on an exclusive or preferential use basis. We construct three variables to code this information. First, we define the variables $OwnGatesOrigin_{jr}$ and $OwnGatesDest_{jr}$, which measure the percentage of gates leased on an exclusive or preferential basis to airline j at, respectively, the origin and destination endpoints of route r. We construct $OwnGatesOrigin_{jr}$ and $OwnGatesDest_{jr}$ for the following airlines: American, Continental, Delta, Northwest, United, USAir, and America West. We do not make a distinction between exclusive and preferential leases because even in this second framework, airlines can maintain control of the gates as long as they use them. **Table 1** shows that on average an airline controls 13.6 percent of the gates at an airport, but one airline can control up to 79 percent of them.Second, we define the variables $NumberGatesOrigin_{jr}$ and $NumberGatesDest_{jr}$, which measure the number of total gates at, respectively, the origin and destination endpoints of route r.

2.3 Sublease Fees

When an entrant wants to start service at an airport where most of the gates are leased on an exclusive or preferential basis, its main option is to sublease the gates and other facilities from an incumbent. Officials from Southwest Airlines, America West, and other airlines reported that subleases increased their costs by many times what they would face if they leased the gates directly from the airports (GAO (1989, 1990)).

To facilitate entry, some airports have introduced a limit to the fees that can be charged by an airline when subleasing their gates to a competitor. We define the variables $LimitOrigin_r$ and $LimitDest_r$ as categorical variables that are equal to one if, respectively, the origin or destination airport have set a maximum limit on sublease fees. The presence of limits should lower the cost of serving an airport for new entrants and result in lower prices. The variables $MaxLimitOrigin_r$ and $MaxLimitDest_r$ measure the effect of the actual limit set on the sublease fees conditional on $LimitOrigin_r$ and $LimitDest_r$ being equal to one. The higher the maximum limit set by an airport, the higher should be the prices in markets originating and ending in that airport. **Table 1** shows that the average maximum limit is 25 percent.[10]

2.4 Majority-in-Interest Agreements

Some airports (e.g. Dallas/Fort Worth or DFW) share the rights to decide on expansion projects with the airline controlling the majority of their operations (e.g. American at DFW). Airports and

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[10] A negative correlation between the presence of a limit and fares assumes that incumbent carriers are willing to lease gates to competitors. If the maximum limit is set too low, a firm may choose to allow a gate to sit vacant rather than lease it to an entrant who will introduce an additional source of competition.

airlines sign Majority-in-Interest (MII) agreements to this purpose. Airports are willing to sign these agreements because they can get lower interest rates on their debt issues. Airlines are willing to sign MIIs to ensure that the airport does not unilaterally issue additional debt, which the tenant airlines would have to pay with higher lease payments, landing fees, or other charges. In some cases, airlines even have veto power over airport expansions. One way to think of these agreements is that the carriers put themselves at risk as they bear some of the costs of the airport's facilities.

The airport competition plans report whether the airport has a Majority-in-Interest agreement with airlines that serve the airport. However, typically the competition plans are quite vague in the exact specifics of these agreements. We define two variables, $MiiOrigin_r$ and $MiiDest_r$ to measure the effect that these types of agreements have on prices.

3 Airline Data

Our empirical analysis relies on data from three publicly available sources other than the competition plans. Similar to previous studies of the industry, a significant amount of our data comes from the Airline Origin and Destination Survey (DB1B). The DB1B Survey is a 10 percent sample of tickets from all reporting carriers and includes information on the origin, destination, fare paid, as well as details of any connections an individual makes in route to their final destination.

In addition to the DB1B Survey, we also utilize information from the T100 Segment database which provides details on each carrier's non-stop flights between two particular airports. The data are reported on a monthly frequency and include information on the carrier, origin, destination, aircraft type, service class for transported passengers, freight and mail, available capacity (seats), scheduled departures, departures performed, aircraft hours, and load factor.

The remainder of the data we use in our analysis is taken from the Schedule P-12 database which reports quarterly profit and loss statements for carriers with annual operating revenues of $20 million or more. This database includes quarterly operating revenues and expenses, depreciation and amortization, operating profit, income tax, and net income. We discuss the details of how each of these data sources is used in the sections to follow.[11]

3.1 Market Definition

A market is defined as a *unidirectional* trip between two airports, regardless of the number of stops that the traveler had to make in between.[12] This definition permits us to analyze whether the hub premium is different on routes to and from the hub. The dataset includes all markets between airports identified by AIR 21 as the set of "major airports" that had to be available on a reasonable basis to all carriers. There are $1,375$ unidirectional routes (airport-to-airport).

3.2 Carrier Definition

There are nine national carriers between 2002 and 2004: American, Continental, Delta, America West, Northwest, United, USAir and Southwest. Then, there are three low cost carriers with a strong national presence: Airtran, ATA, and Frontier. Finally, there is a remaining group of independent low cost carriers providing mostly regional service. We combine this third group of smaller carriers into one group, which we call the *LCC* type. This helps us avoid dropping small carriers that are present in few markets and use a meaningful grouping while capturing the impact of their presence in the market.

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[11] A more detailed description of the data is given in the Appendix.

[12] See Peters (2006) for the same definition of market.

3.3 Itinerary Fare

The DB1B Survey is a 10 percent sample of tickets sold by airlines in a quarter. This dataset does not provide information on the date when the ticket was sold or used, or on the characteristics of the buyer. However, the dataset does provide information on characteristics of the trip, such as whether the ticket is for round-trip travel and details of any connections made by the passenger. We summarize the airline pricing behavior using the mean, median, the 25th, the 75th, and the 90th percentiles. By doing so, we use some information on the distribution of prices available from the DB1B dataset while using as few statistics as possible.[13]

Table 2 presents summary statistics for the five measures of itinerary fares used in this paper. The fares are measured in 1993 dollars. The difference between the 75th percentile of the fares (166.9 dollars) and the median (121.9 dollars) is twice as large as the difference between the median and the 25th percentile of the fares (97.1 dollars), suggesting that there is much more dispersion at the top of the distribution than at the bottom. This is confirmed by the average ticket fare, equal to 140.9 dollars, almost one standard deviation above the median.

3.4 Hub Categorical Variables

The classification of airports as hubs is to some extent arbitrary because it requires a threshold on the percentage of passengers using the airport who are traveling through, rather than to or from the airport. There are two problems with using such a threshold. First, the percentage of passengers traveling through an airport is a function of the price charged by the airlines, which is the dependent variable. Second, airlines can change their hubs over time. In light of these two

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[13] See Armantier and Richard [Rand, forthcoming] for an interesting way to use information from the distribution of prices.

observations, we use a conservative definition of hubs.

Those airports we define as hubs include: Dallas/Fort Worth, Chicago O'Hare, St. Louis for American Airlines; Houston Intercontinental, Newark, and Cleveland for Continental; Atlanta and Cincinnati for Delta; Phoenix for America West; Minneapolis and Detroit for Northwest; Chicago O'Hare and Denver for United; Charlotte and Philadelphia for USAir. All these airports were hubs over the time period under study.

We define $HubUmbrellaOrigin_{jr}$ to be equal to 1 if the origin airport is a hub of any of the national carriers. We define $HubUmbrellaDest_{jr}$ similarly, using the destination airport. Then, we define $HubCarrierOrigin_{jr}$ to be equal to 1 whenever the observation is for carrier j out of an airport where carrier j is the hub airline. Thus, $HubUmbrellaOrigin_{jr}$ is equal to 1 whenever $HubCarrierOrigin_{r}$ is equal to one, but not vice-versa. We define $HubCarrierDest_{jr}$ similarly. These four categorical variables play a critical role in our analysis because their interpretation is related to the debate on the hub premium in a very simple fashion.

First, these four hub variables will measure whether prices and markups are still higher in hub markets, after we control for various determinants of prices, most importantly the new measures of barriers to entry. Second, we identify whether hub airlines charge a premium on tickets for markets out of their hub airport compared to tickets for markets into the same airport. The difference for tickets on markets out of the hub and tickets into the hub is the difference between the sum of the coefficients of the variables $HubUmbrellaOrigin_{r}$ and $HubCarrierOrigin_{jr}$ and the sum of the coefficients of the variables $HubUmbrellaDest_{r}$ and $HubCarrierDest_{jr}$. Finally, the coefficient estimate of $HubUmbrellaOrigin_{r}$ and $HubUmbrellaDest_{r}$ measure the presence of "umbrella effects," or a measure of the benefit to carriers with smaller operations in hub markets.

Should we find $HubUmbrellaOrigin_r$ to be positive and significant, we would conclude that *all* carriers can charge a premium in markets out of a hub airport.

The main objective of our paper is to identify the determinants of the hub premium. **Table 3** provides a preliminary look at the type of evidence that we are looking for. We list the airports at which one airline controls more than 30 percent of the gates, and we show how many of those airports are hubs, as well as identifying the hub airline. **Table 3** also shows how many of these airports have set limits on the sublease fees that can be charged and the maximum amount of the limit. For example, at Charlotte, USAir can sublease the gates for which USAir has preferential or exclusive use, but cannot charge a sublease fee that is more than 15 percent higher than the fee USAir pays to the airport. At Denver, United can charge any sublease fee, since the airport has not set a limit. In the empirical analysis, we will quantify the effect that each one of the three variables $OwnGates_{jr}$, $Limit_r$, and $MaxLimit_r$ has on the premium that airlines can charge on flights out of their hubs.

3.5 Control Variables

One crucial issue is whether airlines charge a premium at hubs because they provide a better, differentiated, product from their competitors, or whether they charge it because they control access to the airport facilities. We consider five measures of product differentiation.

The first measure is related to the network of an airline at an airport and is motivated by the work of Berry (1990, 1992), Brueckner, Dyer, and Spiller (1992), and Ciliberto and Tamer (2006). We compute the *percentage* of all markets served out of an airport that are served by one airline and call this variable $PctOriginMarkets_{jrt}$. This measure captures the relative attractiveness of the airlines' frequent flyer programs and other services of the airline at the airport (the number of ticket counters, customer service desks, etc).[14] Similarly, we define the variable $PctDestMarkets_{jrt}$.[15]

Airlines also differentiate their product by whether they provide non-stop or connecting service. The variable $NonStop_{jrt}$ is equal to 1 if airline j provides nonstop service on route r at time t.[16] When airlines provide connecting service, they must decide how many miles the passenger must travel in addition to the nonstop distance between two airports. We construct a variable, called $ExtraMiles_{jrt}$, which is equal to the ratio of the flown distance over the nonstop distance in miles between two airports minus one.[17] Thus, a nonstop flight will be associated with a value of $ExtraMiles_{jrt}$ equal to 0, while connecting flights will be associated with values larger than 0. The larger the number of extra miles that a passenger must travel between two airports, the less attractive it is to travel on a connecting trip than on a nonstop trip. Airlines also serve markets with different flights in a day, or frequency.[18] The more flights per day, the more likely a passenger can fly at her preferred time. The variable $Frequency_{jrt}$ measures the average number of flights per day in a quarter by an airline.[19] Finally, we also include $MarketDis\tan ce_r$ (the nonstop distance in miles between two airports) and $TouristDest_r$ (a dummy variable equal to 1 if the route has an endpoint in Florida or California) as additional market-specific controls.

Institutional characteristics of the airline industry ensure that $NonStop_{jrt}$, $ExtraMiles_{jrt}$, and

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[14] Bamberger and Carlton (2003) discuss at length why fares should be positively correlated to variables to this type of hubbing activity at an airport.

[15] In a previous version of the paper we also included the number of markets served out of an airport by a carrier. However, this measure is highly correlated (above 0.95) with the percentage presence as we defined. So we decided to keep the percentage presence, which is more naturally associated with the idea of frequent flyer benefits.

[16] For more details on the construction of the variable *NonStop*, see the Appendix.

[17] The flown distance varies across itineraries, because an airline may offer a number of alternative routings within an airport-pair. We take a passenger weighted average across itineraries.

[18] For more details on the construction of the variable *Frequency*, see the Appendix.

[19] In 4 percent of the observations the variable $Frequency_{jrt}$ is missing, and in those cases it is set to zero and the related variable $MissingFrequency_{jrt}$ is set equal to 1; otherwise $MissingFrequency_{jrt}$ is equal to zero. We did the analysis with and without $Frequency_{jrt}$ and the results are similar. We do not report the results for $Mis\sin Frequency$ for sake of brevity.

$Frequency_{jrt}$ are determined prior to the airlines' choice of prices. This is because prices can be changed at any time by an airline, while none of these variables can be changed in the same short period of time. Flight schedules, which involve crew scheduling and aircraft assignments, are developed a year prior to departure and updated every three months.[20] We will maintain that these five variables are exogenous in the empirical analysis to follow.

As far as costs are concerned, it is reasonable to think that the economic marginal cost of transporting one passenger is a function of the average operating accounting cost to carry one passenger for one mile, a concept known in the airline industry as the average cost per seat mile. We construct the average cost per seat mile using the ratio of the quarterly operating expenses available from the Air Carrier Financial Reports (Form 41 Financial Data) over the quarterly total of the product of the number of seats transported and of the number of miles flown by the airline. Data on the total number of seats and miles flown is from the Air Carrier Statistics (Form 41 Traffic). The mean of the average cost per seat mile is approximately 9 cents per seat mile, and can be as low as 4 cents and as high as 13 cents. Notice that this variable is not market specific. We multiply this average cost per seat mile by the number of miles flown by an airline to provide service between two airports and call this variable $AsmCost_{jrt}$.

3.6 Congested Airports

We expect that the control of gates is important when gates are a scarce resource, which is more likely to occur at congested airports. An important concern is that if an airline leases a large share of gates at an airport, it may reflect the existence of entry barriers but it may also reflect the efficiencies associated with hub operations or the outcome of a dynamic game where airlines differentiate

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[20] For more on this, see Ramdas and Williams (2007), and references therein.

themselves by developing their services in different locations. Because we have information on the total number of gates at an airport, we now show how to infer the importance of gate scarcity as a barrier to entry.

We propose to study the interaction of the information on gate leases with measures of airport capacity constraints. In particular, we use our new dataset to define a measure of congestion, called $CongestedOrigin_{rt}$, which is equal to the ratio of total departures performed out of an airport in a given quarter over the the total number of boarding gates. We then divide this ratio by 1000 to simplify the interpretation of the estimation results. **Table 2** shows that on average there are 350 departures per gate in a quarter. The minimum is 130 departures, and the maximum is 1007 departures.

To construct the variable $CongestedOrigin_{rt}$ we use data from the T100 database to get information on the total number of carrier-specific departures that were performed each quarter out of an airport. We do this by aggregating over carriers and months. Then, we divide this aggregate measure of departures out of an airport in one quarter by the total number of boarding gates at each airport. We define the variable $CongestedDest_{rt}$ similarly. In our analysis we will include the variables $CongestedOrigin_{rt}$ and $CongestedDest_{rt}$ to control for any price differences that is related to a change in the extent to which an airport is congested.

3.7 Potential Competition of Southwest

Another context where the control of gates is important should be at those airports where Southwest is not yet present. At these airports, controlling large enough shares of gates may allow the incumbents to prevent Southwest's entry. We construct a variable, called $WNatAirport_{rt}$, which is equal to 1 if Southwest is present at both endpoints of a market. We conjecture that the control of facilities is less valuable at an airport where Southwest is already present than at an airport where Southwest is not yet active. For 35 percent of the markets that are included in our sample, Southwest is present at both the endpoints of the market.

4 Econometric Model

Because we use route-carrier fixed effects, each of the specifications that we run consists of two main steps. First we run the specifications with route-carrier fixed effects, and then we run the estimated fixed effects on the hub and barriers to entry variables, which do not change over time.[21]

We estimate the following linear specification of the (reduced form) pricing equation, where r denotes a route and t denotes a time period (year-quarter):

$$Log(itinfare_{jrt}) = W_{jrt}\pi + u_{jr} + u_{jrt}. \tag{1}$$

Here, W_{jrt} are control variables (see **Table 2** for a list of these variables); u_{jr} is a route-carrier fixed effect; and u_{jrt} is an idyiosyncratic error.

To recover estimates of the hub premia and the impact of barriers to entry on equilibrium prices, we follow Nevo's (2001) application of the minimum distance methodology of Chamberlin (1992). This entails performing a generalized least squares regression of the estimated fixed effects, $\hat{u}_{jr}$ on $HubUmbrellaOrigin_r$, $HubUmbrellaDest_r$, $HubCarrierOrigin_{jr}$, $HubCarrierDest_{jr}$, and the variables that measure limited access to airports, $\mathbf{BarriersOrigin}_{jr}$ and $\mathbf{BarriersDest}_{jr}$ such that

$$\widehat{\gamma} = (Z'_{jr}V_u^{-1}Z_{jr})^{-1}Z'_{jr}V_u^{-1}\widehat{u}_{jr} \tag{2}$$

where V_u is the variance covariance matrix of the estimated fixed effects, $\widehat{u}_{jr}$.

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[21] Berry (1990), BCS (2007), and Brueckner and Spiller (1984) estimate a structural model of demand and supply to control for product differentiation and economies of density. Here, we take a reduced form approach, given the focus of our paper on the effect of limited access to airport facilities on *equilibrium* prices.

The hub indicators are intended to capture any advantages for hub airlines out of and into their hubs as well as any of these advantages (or disadvantages) that carry over to their competitors at these airports. The $\mathbf{BarriersOrigin}_r$ and $\mathbf{BarriersDest}_r$ vectors are intended to capture the effect that concentrated rights to gates, MII agreements, slot controls, and limits on subleasing fees have on pricing decisions of firms at these airports.

In some of our specifications we also include the interaction terms of the $\mathbf{BarriersOrigin}_m$ and $\mathbf{BarriersDest}_m$ vectors with the variables $CongestedOrigin_{rt}$, $CongestedDest_{rt}$, and $WNatAirport_{rt}$.

5 Results

5.1 Unconditional Hub Premium

We start our analysis by estimating the unconditional hub premium. This is a necessary first step because the exact magnitude of the correlation between prices and airport dominance is still debated. Here, we plan to use a constructive approach and show how the hub premium changes as we introduce variables that measure the degree to which airline products are differentiated as well as the extent to which access to airport facilities is limited.

Table 4 presents the first set of results for regression (2). Notice that we do not report the results from the corresponding first stage regression (1) since we are not including any variables that vary over time and carrier. This set of results provide a useful starting point for our analysis because it illustrates how important it is to control for characteristics that differentiate the products among airlines.

Column 1 presents the results when the dependent variable is the median itinerary fare. The coefficients of the dummy variables $HubUmbrellaOrigin_r$ and $HubUmbrellaDest_r$ measure whether all carriers are able to charge a premium in hub markets. The coefficient of the dummy variables $HubCarrierOrigin_{jr}$ and $HubCarrierDest_{jr}$ measure whether the hub carrier charges an extra premium in hub markets (e.g. by American in markets originating or ending in Dallas/Fort Worth). The main result is that the premium charged by the hub carrier exists but is not of significant economic magnitude. In particular, it is equal to 6 $(-0.03 + 0.09)$ percent for tickets out of a hub, as well as for tickets into a hub. There is no evidence of "umbrella" effects, since the coefficients for $HubUmbrellaOrigin_{r}$ and $HubUmbrellaDest_{r}$ are negative.

The results in **Columns 1-4** of **Table 4** suggest that the hub premium is increasing along the fare distribution. In particular, at the 75th percentile of the distribution (**Column 3**), the premium charged by the hub carrier is equal to 10.5 percent.[22] At the 90th percentile of the distribution (**Column 4**), the premium is equal to 17 percent. Thus, the premium is increasing as the dependent variable changes from the 25th percentile (**Column 2**), to the median, to the 90th percentile of the fare distribution. The differences in the estimated coefficients in **Columns 1-4** suggest that the differences among mean and median ticket fares are important. Not surprisingly, the results are not identical when we use means or medians of the ticket fares. The premia are 11.6 (market out of a hub) and 15 (markets into a hub) percent when we use means.

We reach two main conclusions from **Table 4**. First, results based on the use of average fares must be interpreted with care, since the distribution of market fares is not symmetric around the mean. This is particularly true in hub markets. For this reason, the rest of the analysis will be carried out using the 25th percentile, the median, the 75th, and the 90th percentile. Second, the hub premia are increasing in the fare percentile. Notice that this finding is not immediately related

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[22] When discussing the meaning of the coefficients in the tables we use the correction introduced by Halvorsen and Palmquist [1980]. Our correction takes into account the comment by Kennedy [1981].

to the “fare-mix” story proposed by Morrison and Winston (1995) and Lee and Luengo-Prado (2005).[23] The “fare-mix” story says that there is a larger percentage of business travelers flying out of hubs, and this explains the higher average fares. Here, we find that the hub premium is higher for higher fares, but we can not say anything on the ”fare-mix” composition.

5.2 Control Variables

We now include additional controls for product differentiation and costs (e.g. economies of density). The results for the regression (1) are presented in **Table 5**. This first stage regression is the same for **Table 6-9**.

The results for the control variables should be interpreted with caution, since they represent the net effect of the variables on the demand and supply. Overall, nonstop flights are associated with lower prices, which is related to the fact that they imply lower costs. Longer connecting flights, captured by a higher value of $ExtraMiles$, are charged at a higher price than shorter ones. A larger number of markets served by an airline out of an airport is associated with lower prices. Notice that this is easily explained by the presence of economies of density. Higher frequency is associated to lower prices, and again this is easily explained with the presence of economies of density. Finally, the coefficient of the unit cost, $AsmCost_{jrt}$, is negative, suggesting that the effect of the average operating cost per seat mile is decreasing as the flown distance increases.[24]

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[23] Morrison and Winston (1995) argue that comparison of fares across markets also requires taking into account other demand driven control variables, in particular “traffic mix” and frequent flyer tickets. Traffic mix is the fraction of business passengers flying on a route. Using the Data Bank 1A of the Department of Transportation (DB1A), Morrison and Winston show that the premia are significantly lower, approximately 5 percent, after controlling for traffic mix and frequent flyer tickets. We discuss some limitations of the ”fare mix” data in the DB1A dataset in the Appendix.

[24] As mentioned at the top of this paragraph, the results for the control variables should be interpreted with caution since we are estimating a reduced form model. We interpret the finding that a higher average cost is associated with lower prices with the fact that a longer flown distance relative to the nonstop market distance is likely associated with lower demand.

5.3 The Hub Premium

Table 6 presents the results for the regression (2) after we have estimated the first stage (1) as discussed in Section (5.2). Notice that we do not include barriers to entry yet.

The main result is that the premium charged by the hub carrier is now of a more significant economic magnitude. In particular, it is equal to 11.9 percent for tickets out of a hub, and 12.7 percent for tickets into a hub. There is only limited evidence of "umbrella" effects, since the coefficients for $HubUmbrellaOrigin_r$ and $HubUmbrellaDest_r$ are less than or equal to 1 percent.

Again, the results in **Columns 2, 3,** and **4** suggest that the hub premium is still increasing in the ticket fare. In particular, at the 75th percentile (**Column 3**) of the distribution the premium charged by the hub carrier is equal to 13.5 percent in markets out of a hub and 17.6 percent in markets into a hub. At the 90th percentile (**Column 4**) of the distribution, the premium is equal to 16.8 percent in markets out of a hub and 26 percent in markets into a hub.

Figure 1 illustrates the relationship between fares and hub premia in an explicit fashion by plotting the hub premium for each quantile of the fare distribution. To draw the figure we run the first stage regression (1) and the second stage one (2) for each one of the ten deciles. As **Figure 1** demonstrates, the premium charged by a hub carrier increases by more than 60 percent from the 10th percentile to the 90th percentile of the fare distribution for both markets into and out of hubs. **Figure 1** also shows that the "umbrella" effect is only of any significance at the very high end of the fare distribution.

The main conclusion from **Table 6** is that the hub premia are larger, once we include variables that differentiate the products across airlines and that are associated with economies of density.

5.4 The Hub Premium and Institutional Barriers to Entry

Table 7 shows the results when we add the barriers to entry in the regression (2). The hub premium is now significantly smaller. The premium charged by the hub carrier is now equal to approximately 6 percent, down from 12 percent for tickets out of a hub that we reported in **Table 7**. We find that the premium for tickets into a hub is now 9.3 percent, down from 12.7 percent. The results are stronger when we look at the 75th and 90th percentile of the fare distribution. Overall, the hub premium is reduced by almost one half if we include the barriers to entry.

One variable, among those measuring the barriers to entry, plays a particularly important role: the gates leased on an exclusive basis by an airline. We estimate the coefficient of the variable $OwnGatesOrigin_{jr}$ to be equal to 0.163 and the coefficient of the variable $OwnGatesDest_{jr}$ to be equal to 0.144. This means that if the percentage of gates controlled by the carrier increases from 10 to 30 percent, the prices increase by 3 percent $(0.20 * 0.163)$.

Next, we consider the variables $LimitOrigin_r$ and $LimitDest_r$. Recall that these variables record the presence of restrictions on the fees that airlines can charge for subleasing their gates. As we would expect, the presence of restrictions on sublease fees decrease the premium that airlines can charge. For example, the coefficient of $LimitOrigin_r$ is equal to -0.02 when we look at the effects on median prices. This means that prices are 2 percent lower when limits on sublease fees are in place. Notice that the effect is equal to -6.2 percent when we consider the 90th percentile.

The coefficients of the other variables are estimated with considerable noise. The presence of limits on sublease fees is associated with an actual percentage limit. We do not find strong and consistent results for the variables $MaxLimitOrigin_r$ and $MaxLimitDest_r$, which suggests that the actual percentage limit (15 or 25 percent) is not as important as the presence of a limit.

Airports that have Majority-in-Interest agreements seem to have lower fares at the bottom of the fare distribution, but not at the 75th and 90th percentile.

Finally, the coefficients of the number of gates also vary along the fare distribution, as we find them to be negative at the bottom and positive at the top. This suggests that control of gates might be particularly important to serve business travelers, possibly because a larger fraction of gates is associated with more flexible departure times.

Overall, **Table 7** shows that access to gates is a crucial determinant of the hub premium in the airline industry. First, the higher the percentage of gates controlled at an airport, the higher the prices that airlines are able to charge. Second, the presence of a limit on sublease fees seems to play an important role in reducing the hub premium. There is only mixed evidence for the other institutional barriers to entry.

5.5 The Hub Premium at Congested Airports

We now consider how the results change when we control for the level of congestion at an airport. In practice, we add a set of interaction terms between the variable $CongestedOrigin_{rt}$ ($CongestedDest_{rt}$) and the variables that measure the availability of gates at airports. For example, we consider the interaction $LimitOrigin_{rt} * CongestedOrigin_{rt}$. The results are presented in **Table 8**.

First, we find that the hub premium is now smaller than in **Table 7**. The premium charged by the hub carrier for flights out of the hub is now less than 4 percent, down from 6 percent in **Table 7** and 12 percent in **Table 6**. The hub premium in markets into a hub is now 7.2 percent, down from 12.7 percent in **Table 6**. Again, the results are stronger when we look at the 75th and 90th percentile.

Next, we consider the interaction terms. We start with the interactions $OwnGatesOrigin_{rt} * CongestedOrigin_{rt}$ and $OwnGatesDest_{rt} * CongestedDest_{rt}$. We find their coefficients to be positive and precisely estimated. In particular, the coefficient of $OwnGatesOrigin_{rt}*CongestedOrigin_{rt}$ is equal to 0.325. Recall that $CongestedOrigin_{rt}$ is defined as the ratio of departures out of an airport over the number of gates at that airport, and that we divide it by 1000. So, a finding of 0.325 means that at an airport where there are around 600 departures per gate (e.g. Atlanta), a 30 percent difference in the gates leased would lead to a difference of 6 percent $(0.30 * 0.325 * 0.6)$ in the airline prices. At an airport where there were around 200 departures per gate (e.g. Nashville), a 30 percent difference would lead to a difference of 2 percent. Now consider the coefficients of $OwnGatesOrigin_{rt}$ and $OwnGatesDest_{rt}$. The results are striking. Controlling a large fraction of gates at airports that are not congested does not lead to higher prices. Hence, the control of gates is a crucial determinant of airline prices and hub premia only when there is a scarcity of gates relative to the number of departures out or into an airport. Interestingly, there does not seem to be a stronger effect at the higher end of the fare distribution, as we find the coefficients of the interaction terms to be essentially the same in the four columns.

Now consider the interactions $LimitOrigin_{rt}*CongestedOrigin_{rt}$ and $LimitDest_{rt}*CongestedDest_{rt}$. Both coefficients are negative and precisely estimated, and should be interpreted as follows. At an airport where there are around 600 departures per gate, the presence of a limit on the sublease fees lowers the premium by approximately 11 percent $((-0.340 + 0.158) * 0.600)$. Notice that at the airports with the smallest value of $CongestedOrigin_{rt}$, where it is equal to approximately 120, the presence of a limit would lower the premium by just 2 percent.

The interactions $MaxLimitOrigin_r * CongestedOrigin_{rt}$ and $MaxLimitDest_r * CongestedDest_{rt}$ are positive as expected. At congested airports, an increase in the limits to the sublease fee translates in higher prices. Again, to compute the magnitude of the effect, we need to take the sum of $MaxLimitOrigin_r * CongestedOrigin_{rt}$ and $MaxLimitOrigin_r$ at a given value of the variable $CongestedOrigin_{rt}$. Notice that this variable never takes a value less than 130, so the sum is never negative.

Finally, the interactions of $MIIOrigin_{rt} * CongestedOrigin_{rt}$ and $MIIDest_{rt} * CongestedDest_{rt}$ are also positive, as expected. More importantly, the sum of $MIIOrigin_{rt}$ and $MIIOrigin_{rt} * CongestedOrigin_{rt}$ is also positive (and similarly for the corresponding destination variables). Thus, airports that are more congested are more likely to see higher prices when they share the rights to decide on expansion projects with the airline controlling the majority of their operations.

Overall, these results provide strong evidence that airlines controlling a larger number of gates benefit significantly more at congested airports than at airports where gates are not a scarce resource.

5.6 The Hub Premium at Airports where Southwest is Present

We now look at the extent to which the control of gates is important at airports where Southwest is present. The idea of this section is quite simple. If Southwest is present at an airport, then it is also present in some of the routes out of that airport. Hence, the prices out of that particular airport should be, *ceteris paribus*, lower than at airports where Southwest is not yet present. In particular, we are interested in the sign and magnitude of the interaction of the variable $WNatAirport_{rt}$ with the variables that measure the access to the airport's facilities. The results are presented in **Table**

9.

First, consider the coefficients of $OwnGatesOrigin_{rt}$ and $OwnGatesDest_{rt}$. They are positive and slightly larger than in **Table 7**. Recall that this means that the control of a larger share of airport gates is associated with higher prices. Now, consider the interactions $WNatAirport_{rt} * OwnGatesOrigin_{rt}$ and $WNatAirport_{rt} * OwnGatesDest_{rt}$. We find that these interactions have a negative effect on prices. This means the following. In markets between two airports where Southwest is present ($WNatAirport_{rt} = 1$) controlling 10 percent more of the gates would increase the prices by a negligible amount (0.25 percent at the origin). These results suggest that control of gates is an important determinant of higher airline prices only where Southwest is not already present at the airport.

Interestingly, the presence of Southwest has a 'policing' effect only with regard to the control of gates. The effect of the other variables measuring access to airport facilities ($Limit$, $MaxLimit$, MII) are essentially unchanged.

5.7 "Airport Dominance" and Limited Access to Airport Facilities

Finally, we check the robustness of our results when we include in the first stage regression (1) the measure of "airport dominance" used by Borenstein (1989). For each market, we define a measure of airport dominance for the origin and destination as $DominanceOrigin_{jrt}$ and $DominanceDest_{jrt}$, respectively. Similar to Borenstein (1989), these variables are constructed as the sum of passengers transported out (or into) an airport by a carrier over the total number of passengers traveling out (or into) an airport in a quarter. A subtle point is worth being made here. Because the number of passengers transported is a function of the fare charged by the carrier, the first stage regression

(1) is no longer a reduced form regression. However, we believe that this approach still provides a useful robustness check for our findings.

We also define two additional variables.$MeanDo\min anceOrigin_{jr}$ and $MeanDo\min anceDest_{jrt}$. These are route-carrier specific averages of $DominanceOrigin_{jrt}$ and $DominanceDest_{jrt}$, respectively. These averages are not used in the first stage, but are used in the second stage, to pick up any effect of "airport dominance" presence that can be measured cross-sectionally.

The results from these regressions are presented in **Table 10**.[25] By comparing the respective columns of **Table 7** and **Table 10**, it is clear that the addition of these controls have a negligble effect on our estimates of the hub premium and the impact of the barriers to entry. This is true for each quantile of the fare distribution that we consider. Notice that the coefficients of the variables $MeanDo\min anceOrigin_{jr}$ and $MeanDo\min anceDest_{jrt}$ have the expected positive sign.

Thus, these additional and potentially endogenous controls that are commonly used in the literature do not change our results or our conclusions made above regarding the magnitude of the hub premium. In addition, the impact of the respective barriers to entry are nearly identical with or without these measures of airport dominance. We still consistently find that concentrated control of boarding gates results in significantly higher fares. Again, the impact of the size of the limit on subleasing fees ($MaxLimitOrigin_r$ and $MaxLimitDest_r$) and the presence of Majority-in-Interest ($MiiOrigin_r$ and $MiiDest_r$) agreements are estimated imprecisely and no definitive conclusions should be drawn from the results.

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[25] We do not report the results from the first stage regression for sake of brevity. They are available from the authors.

6 Conclusions

Following deregulation of the US airline industry in 1978, there was a great deal of optimism that airline markets would become more competitive and fares would decline substantially. The theoretical framework justifying this optimism was the "theory of contestable markets" developed by Baumol, Panzar, and Willig (1992). Their basic insight was that airlines do not incur large sunk costs to enter into markets, and thus they can easily enter when prices are high and exit as soon as prices fall too much.

In this paper we show that airlines can still charge a large premium in markets into and out of their hubs. In particular, we find that the hub premium is influenced by gate ownership, particularly when gate utilization is high at an airport, and the the hub premium is larger at the high end of the fare distribution. Future research should focus on the role that barriers to entry have on the entry decisions, as that is also an important determinant of long run competition in airline markets.[26]

Finally, we want to highlight that our research can explain approximately 50 percent of the hub premium. The other 50 percent is still to be explained. It could be a function of what Borenstein (1989) calls marketing barriers to entry: frequent-flyer programs (FFPs) and volume incentives to travel agents that might allow airlines to raise their prices above their marginal cost. Unfortunately, data on FFPs are not available. The remainder of the premium may also be explained as a function of the strategic behavior of airlines.[27]

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[26] Williams (2008) finds that that improved access to boarding gates at hub airports is the most significant determinant of the sunk cost of entry, particularly for *LCC*s.

[27] For example, Miller (2009) studies the US Department of Justice's suit against eight major domestic airlines and the Airline Tariff Publishing Company. The purpose of the suit was to reduce opportunities for collusion in the industry. The lawsuit ended with consent decrees limiting the ability of airlines to communicate surreptitiously through the shared fare database. Direct data on these practices remains unavailable.

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7 Appendix

7.1 Data Construction: Fare and Passenger Data

Fare and passenger information are from the Origin and Destination Survey (DB1B), which is a 10 percent sample of airline tickets from reporting carriers. The data from the DB1B are merged with data from the T-100 Domestic Segment Dataset by the operating carrier. The T-100 Domestic Segment Dataset contains domestic market data by air carriers, origin and destination airports for passengers enplaned. The T-100 is not a sample: it reports all flights occurred in the United States in a given month of the year. Data are from every quarter from the first quarter in 1993 to the third quarter in 2005. A market is defined as a unidirectional trip from one airport to another airport, with or without connections. The unit of observation is a market-carrier-year-quarter data point.

We drop: tickets that are neither one-way nor round-trip travel, such as open-jaw trip tickets; tickets involving a US-nonreporting carrier flying within North America and foreign carrier flying between two US points; tickets that are part of international travel; tickets including travel on more than one airline on a directional trip (known as interline tickets); tickets involving non-contiguous domestic travel (Hawaii, Alaska, and Territories); tickets with fares less than 20 dollars or larger than 9999 dollars; and tickets whose fares were in the bottom and top 5 percentile percentile in their year; tickets with more than 6 coupons. We then merge this dataset with the T-100 Domestic Segment (U.S. Carriers) and drop tickets for flights that have less than 12 departures over a quarter in *one* direction (this means less than 1 departure every week in one direction).

We code a round-trip ticket as *one* directional trip ticket, which costs half the full round-trip ticket fare. This avoids overcounting the lower fares associated with round-trip tickets relative to the higher fares associated with purchasing two one-way tickets. In this way, it is possible to make the comparisons between one-way and round-trip fares meaningful, by comparing what two passengers would pay for traveling the same distance. Each passenger is only counted once when constructing the market and airport market shares.[28]

We construct the *NonStop* variable using the following procedure. For each ticket we know the number of segments flown by the passenger. If the passenger used one coupon for one-way travel and the airline provided nonstop service on that route, then we code this ticket as a non-stop ticket. If the passenger used two coupons for a round-trip ticket and the airline provided nonstop service on the two routes, then we code this ticket as a non-stop ticket. Otherwise, the ticket is for a connecting or direct (connecting but using only one coupon) flight. In principle, an airline can provide both non-stop and connecting service between two airports. It turns out that in our sample in 63 percent of the observations (year-quarter-route-carrier), a carrier only provided connecting service. Among the remaining 37 percent of the observations, a carrier might provide both non-stop and connecting service. However, it turns out that carriers sell a non-negligible number (at least 30 percent of the tickets on a route in a quarter) of connecting tickets when they also provide nonstop service *in less than* 2 *percent of the observations*. Because the price variable is constructed as a median, the median price is the price of the nonstop service in all but a very negligible number of markets. Thus, we coded $NonStop = 1$ if the carrier provided nonstop service between two airports.

We construct the *Frequency* variable using the following procedure. If an airline provide nonstop service on a route, then *Frequency* is simply the number of departures in a quarter divided by 91, and this provide the average number of flights per day. If an airline provides connecting

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[28] To check that this coding did not affect the result, we re-run our regressions considering only data from roundtrip tickets. The results were almost identical.

service on a route, then the variable *Frequency* is equal to the *minimum* number of daily flights among those in each segment that the airline flew on the route. This is the same approach as in Borenstein (1989). In some cases, airlines issue a coupon for two segments of flight. Then, data on frequency is missing. When this happens, we let the variable *MissingFrequency* be equal to 1.

Following Borenstein (1989), the mean, median, 25th percentile, and 75 percentile fares are from the distribution of fares weighted by the number of passengers paying each fare, not from a distribution that gives equal weight to each fare listed by the airline. We do not use data on fare class from Data Bank 1B because of the following reasons. First, in private communication with the National Transportation Library in the Bureau of Transportation Statistics, it came to our attention that it is possible that one airline may classify a ticket as falling into class X while another airline may classify the same ticket as falling into class Y. The reason for this is that there are no rules as to the standardization of what X and Y means. Second, Southwest codes all tickets under one fare class, despite selling tickets with different fare restrictions. As a result, it is questionable whether or not the information on fare classes contained in the US Department of Transportation O&D Survey can be used to build a reliable traffic mix variable. Finally, the number of frequent flyer tickets (and traffic mix) are endogenous, in the sense that prices, the number of frequent flyer tickets, and the fare mix are determined simultaneously.

One important issue is how to treat regional airlines that operate through code-sharing agreements with national airlines. As long as the regional airline sells tickets independently, we treat it separately from the national airline.[29] Another issue is that there are airlines that transport

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[29] The D1B1 dataset provides information on the "operating" and "ticketing" carrier, which might differ in the case of code share agreements. In their institutional analysis of airline alliances, Bamberger, Carlton, and Neumann [forthcoming] discuss how code-share agreements allow a carrier to independently set price and sell service between cities that it otherwise would not be able to serve. Code share agreements can involve different financial agreements

very few passengers in a quarter. In particular, consider an airline using a small plane that has 20 seats to serve a regional market. One flight per week over a quarter tells us that the airline will transport 240 passengers at full capacity. A 10 percent sample should give the airline reporting 24 passengers in the dataset. If an airline reports less than 20 passengers in a quarter, we assume that the airline does not have an *active* presence in this market. Berry (1992) drops airlines which report less than 90 passengers in a quarter. We relax this condition to account for the progressive adoption of smaller regional jets by the US airlines.

7.2 Data Construction: AIR 21 Data

The data from the competition plans is a cross-section. Airports included: Albuquerque (ABQ), Atlanta (ATL),Austin (AUS), Baltimore (BWI), Burbank (BUR), Charlotte (CLT), Chicago O'Hare (ORD), Cincinnati (CVG), Dallas Fort-Worth (DFW), Denver (DEN), Detroit (DTW), Houston (IAH), Washington Dulles (IAD), Washington Reagan (DCA), Tucson (TUS), Miami (MIA), Milwaukee (MKE), Minneapolis (MSP), Newark (EWR), Philadelphia (PHL), Phoenix (PHX), Pittsburgh (PIT), St. Louis (STL), Salt Lake City (SLC), San Francisco (SFO), Chicago Midway (MDW), Cleveland (CLE), Dallas Love (DAL), El Paso (ELP), Houston Hobby (HOU), Jacksonville (JAX), Memphis (MEM), Nashville (BNA), Oakland (OAK), Providence (PVD), Reno (RNO), Sacramento (SMF), San Antonio (SAT), San Jose' (SJC), West Palm Beach (PBI).

We merge it with the fare and passenger data, which is a panel data set. During this process of merging the two data set, we need to clean the AIR 21 data set as follows. At JAX, American uses

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between the operating carrier and its alliance partner. In some alliances ("free sale" agreement), the operating carrier determines seat availability and the ticketing carrier sets prices for its service. In other alliances ("blocked space" agreement), the ticketing carrier buys a block of seats on each code-share flight from the operating carrier. Since fares are set by the ticketing carrier in both cases, we use the ticketing carrier to assign a ticket to a specific airline. Notice that this approach addresses the issue of how to treat regional carriers that operate for major airlines.

a gate that is for common use. We code that gate as for common use rather than as of American. The same is true for Southwest, who also uses a common-use gate. At SMF, the gates of AA include the activity of TWA. The gates of CO include the activity of HP. We have three competition plans for SMF. The number of gates and assignment change very little. Instead, the limit on sublease fees changed from not existing in 2000 to being 15% in 2001. At ATL, Atlantic Southwest Airlines is counted as Delta. At SLC, Skywest controls the gates and serves DL: we coded these gates as controlled by DL. At IAD, Atlantic Coast Airlines gates assigned to UA. At SLC, it says that an entrant was charged above 15% and airport helped negotiation but does not tell how lower the fee was charged. It says they are introducing a limit, but with new agreement. At PHL they were constructing 13 gates, which are included. We do no include 4 gates and 38 regional gates expected to be added after the period of interest. At DTW, 5 gates are assigned to both HP and CO, but we used the number of departures to split 4 to Continental and 1 to America West. At DAL, 25 gates were available but only 18 operational. At CLE, USair sublets one gate to Midwest; Continental sublets one to America West; also, Continental has 4 gates that can serve 6 regional planes each. We coded them as counting for 4. At BUR, airlines cannot sublease gates. There are three overflow gates which we interpret as common use. At MIA, all gates are for common use, no subleasing necessary. At DFW, 37 are non-bridge positions. We do not count them. The TWA gates went to AA when TWA was acquired by AA. MKE converted one gate of TWA to common use. AA serves the airport through AA Eagle since 1996. Data for ORD, MDW, OAK, BWI was collected from the airport websites, their competition plans, direct contact with the airports, and from the publication "Airport Business Practices and their Impact on Airline Competition," published by the FAA/OST Task Force Study in October 1999.

Table 1: Limited Access to Airport Facilities

Variable	Description	Mean	Std. Dev.	Min	Max
OwnGates (%)	Fraction of Gates Leased on an Exclusive or Preferential Basis to an Airline	0.14	0.20	0	0.79
Limit (0/1)	There is a Limit on Sublease Fees	0.50	0.50	0	1
MaxLimit (%)	Magnitude of the Maximum Sublease Fee Conditional on the Presence of a Limit on Sublease Fees	0.15	0.06	0	0.25
MII	Majority in Interest Agreement	0.69	0.46	0	1
Number Gates (00)	Number of Gates Available at an Airport	0.75	0.44	0	1.72

SOURCE.- Data collected from the airports' competition plans that airports must compile in compliance to the Wendell H. Ford Aviation Investment and Reform Act for the 21st Century (AIR 21).

NOTE.-The "Fraction of Gates Leased" to an airline is computed as the ratio of the gates leased with exclusive or preferential use to an airline over the total number of gates at an airport. Summary statistics use the origin airport: the variables at the destination airports are the same as those for origin airports up to second decimal digit. Number of observations is 42,269.

Table 2: Summary Statistics

Variable	Description	Mean	Std. Dev.	Min	Max
Ticket Fares					
Median Ticket Fare ($100)	Median of the fares charged by an airlines in a quarter in each market	1.22	0.33	0.44	2.36
25th Percentile Ticket Fare ($100)	25th Percentile of the fares charged by an airlines in a quarter in each market	0.97	0.23	0.42	2.16
75th Percentile Ticket Fare ($100)	75th Percentile of the fares charged by an airlines in a quarter in each	1.67	0.52	0.44	5.25
90th Percentile Ticket Fare ($100)	90th Percentile of the fares charged by an airlines in a quarter in each	2.24	0.52	0.44	7.35
Average Ticket Fare ($100)	Average of the fares charged by an airlines in a quarter in each market	1.41	0.34	0.45	3.35
Hub Dummies					
HubOrigin (0/1)	Equal to 1 if origin airport is a hub of any of the national carriers	0.42	0.49	0	1
HubCarrier (0/1)	Equal to 1 whenever the observation is for a carrier in a market out of an airport where carrier is hub airline	0.13	0.34	0	1
Congestion Measures					
Congested (00)	Ratio of total departures performed out of an airport in a given quarter over the total number of boarding gates.	0.50	0.16	0.13	1.07
CongestedDummy (0/1)	Equal to 1 if the variable Congested is larger than its 75th percentile value (550)	0.34	0.47	0	1
WN is a Potential Entrant					
PotentialWN (0/1)	Equal to 1 if Southwest is present at both the endpoints of a market.	0.35	0.48	0	1
Firm Specific Variables					
PctOriginMarkets (%)	Network Extent at the Airport: *Percentage* of markets served out of an airport by one airline out of the total number of markets served out of that airport by any airline	0.44	0.23	0.01	1
Nonstop (0/1)	Dummy Equal to 1 for Tickets for Nonstop Flight	0.37	0.48	0	1
Frequency (00s)	Average Daily Frequency	0.04	0.02	0	0.28
Missing Frequency (%)	If data on Frequency is missing	0.05	0.14	0	0.28
ExtraMiles	Ratio of Distance Flown by an Airline over NonStop Distance	0.09	0.14	0	1.60
Accounting Cost	Average Cost per Seat Mile (ASM Cost, cents) * Flown Miles (00s)	0.87	0.81	0	4.06
Market Specific Variables					
Tourist Destination (0/1)	Equal to 1 if destination airport is in either California, Florida, or Nevada	0.22	0.41	0	1
Market Distance (1000 miles)	Non Stop Distance	1.21	0.59	0.10	2.68

SOURCE.-Data collected from DB1B Origin and Destination Survey (2002-2004)

NOTE.-Summary statistics use the origin airport: the variables at the destination airports are the same as those for originthey are not airports up to second decimal digit, hence reported for sake of brevity. The fares presented and the cost data are in 1993 dollars. Details on the construction of the variables Non-Stop and Frequency are provided in the Appendix. Number of observations is 42,269.

Table 3: Control of Gates at Hubs and other Large Airports

Airport, Carrier	HubCarrier (0/1)	OwnGates (%)	Limit (0/1)	MaxLimit (%)
St. Louis, American	1	0.22	1	0.15
Washington Reagan, USAir	0	0.32	0	.
Chicago O'Hare, American	1	0.35	0	.
Chicago O'Hare, United	1	0.35	0	.
San Jose, American	0	0.36	0	.
Cincinnati, Delta	1	0.42	0	.
Charlotte, USAir	1	0.43	1	0.15
Atlanta, Delta	1	0.55	1	0
Philadelphia, USAir	1	0.50	0	.
Phoenix, America West	1	0.40	1	0.15
Baltimore, USAir	0	0.52	0	.
Newark, Continental	1	0.58	0	.
Denver, United	1	0.60	0	.
Cleveland, Continental	1	0.60	1	0.1
Detroit, Northwest	1	0.68	1	0.15
Dallas/Fort Worth, American	1	0.64	0	.
Salt Lake City, Delta	0	0.67	0	.
Minneapolis, Northwest	1	0.72	1	0.15
Houston (IAH), Continental	1	0.75	0	.

SOURCE.-Data collected from the airports' competition plans that airports must compile in compliance to the Wendell H. Ford Aviation Investment and Reform Act for the 21st Century (AIR 21).

NOTE.- The airports included in this table are either the hubs of a legacy carrier or airports where one carrier controls more than 30 percent of the gates. OwnGates indicates the percentage of gates leased to the airline with the largest share at an airport (e.g. American at St. Louis). Limit is a categorical variable equal to 1 if the airport has a limit on sublease fees. If the airport has a limit, then MaxLimit reports its magnitude.

Table 4: Unconditional Hub Premia

	(1) 50th% Fare	(2) 25th% Fare	(3) 75th% Fare	(4) 90th% Fare	(5) Mean Fare
Hub Dummies					
HubUmbrellaOrigin	-0.03*** (0.01)	-0.03*** (0.01)	-0.02*** (0.01)	0.02*** (0.01)	-0.01 (0.01)
HubUmbrellaDest	-0.02*** (0.01)	-0.03*** (0.01)	0.00 (0.01)	0.03*** (0.01)	0.00 (0.01)
HubCarrierOrigin	0.09*** (0.01)	0.07*** (0.01)	0.12*** (0.01)	0.14*** (0.01)	0.11*** (0.01)
HubCarrierDest	0.08*** (0.01)	0.06*** (0.01)	0.14*** (0.01)	0.21*** (0.01)	0.14*** (0.01)
Controls					
Tourist	-0.05*** (0.01)	-0.05*** (0.01)	-0.07*** (0.01)	-0.08*** (0.01)	-0.06*** (0.01)
Distance	0.15*** (0.01)	0.18*** (0.00)	0.13*** (0.01)	0.17*** (0.01)	0.16*** (0.00)
Constant	4.60*** (0.01)	4.34*** (0.01)	4.89*** (0.01)	5.09*** (0.01)	4.71*** (0.01)
R-Squared	0.15	0.26	0.12	0.17	0.2
# Observations	42,269	42,269	42,269	42,269	42,269

* p<0.10
** p<0.05
*** p<0.01

Table 5: First Stage Regressions

	(1) 50th% Fare	(2) 25th% Fare	(3) 75th% Fare	(4) 90th% Fare	(5) Mean Fare
NonStop	-0.37*** (0.07)	-0.43*** (0.05)	-0.28*** (0.06)	-0.31*** (0.08)	-0.44*** (0.05)
ExtraMiles	0.24*** (0.03)	0.23*** (0.03)	0.18*** (0.03)	0.14*** (0.04)	0.18*** (0.02)
PctOriginMarkets	-0.16*** (0.02)	-0.14*** (0.02)	-0.21*** (0.02)	-0.20*** (0.03)	-0.18*** (0.02)
PctDestMarkets	-0.17*** (0.02)	-0.14*** (0.02)	-0.21*** (0.02)	-0.19*** (0.03)	-0.17*** (0.02)
Frequency	-0.76*** (0.15)	-0.56*** (0.11)	-0.76*** (0.13)	-0.94*** (0.16)	-0.91*** (0.11)
AsmCost	-0.05*** (0.01)	-0.06*** (0.01)	-0.03*** (0.01)	-0.04*** (0.01)	-0.06*** (0.01)
Adjusted R-Squared	0.664	0.693	0.673	0.683	0.745
# Observations	42,269	42,269	42,269	42,269	42,269

* $p<0.10$
** $p<0.05$
*** $p<0.01$

Table 6: Hub Premia

	(1) 50th% Fare	(2) 25th% Fare	(3) 75th% Fare	(4) 90th% Fare	(5) Mean Fare
Hub Dummies					
HubUmbrellaOrigin	0.00 (0.01)	-0.01** (0.01)	0.03*** (0.01)	0.05*** (0.01)	0.02*** (0.01)
HubUmbrellaDest	0.01 (0.01)	-0.01* (0.01)	0.04*** (0.01)	0.06*** (0.01)	0.03*** (0.01)
HubCarrierOrigin	0.11*** (0.02)	0.12*** (0.01)	0.10*** (0.01)	0.11*** (0.02)	0.11*** (0.01)
HubCarrierDest	0.11*** (0.02)	0.11*** (0.01)	0.12*** (0.01)	0.15*** (0.02)	0.13*** (0.01)
Controls					
Tourist	-0.06*** (0.01)	-0.05*** (0.01)	-0.07*** (0.01)	-0.07*** (0.01)	-0.06*** (0.01)
Distance	0.16*** (0.01)	0.17*** (0.01)	0.09*** (0.01)	-0.04*** (0.01)	0.06*** (0.01)
Constant	4.75*** (0.04)	4.44*** (0.03)	4.72*** (0.04)	4.24*** (0.05)	4.37*** (0.03)
R-Squared	0.15	0.26	0.16	0.29	0.30
# Observations	42,269	42,269	42,269	42,269	42,269

* p<0.10
** p<0.05
*** p<0.01

Table 7: Hub Premia with Gates

	(1) 50th% Fare	(2) 25th% Fare	(3) 75th% Fare	(4) 90th% Fare
Hub Dummies				
HubUmbrellaOrigin	0.01 (0.01)	0.01 (0.01)	0.02** (0.01)	0.04*** (0.01)
HubUmbrellaDest	0.02*** (0.01)	0.01* (0.01)	0.05*** (0.01)	0.07*** (0.01)
HubCarrierOrigin	0.06*** (0.02)	0.07*** (0.01)	0.05*** (0.02)	0.04** (0.02)
HubCarrierDest	0.07*** (0.02)	0.07*** (0.01)	0.07*** (0.02)	0.06*** (0.02)
Barriers				
OwnGatesOrigin	0.16*** (0.02)	0.16*** (0.02)	0.15*** (0.03)	0.19*** (0.03)
OwnGatesDest	0.14*** (0.03)	0.14*** (0.02)	0.15*** (0.03)	0.27*** (0.03)
LimitOrigin	-0.02* (0.01)	-0.02* (0.01)	-0.03** (0.01)	-0.06*** (0.01)
MaxLimitOrigin	-0.04 (0.08)	-0.06 (0.06)	0.01 (0.09)	0.19** (0.09)
LimitDest	-0.01 (0.01)	-0.00 (0.01)	-0.02 (0.01)	-0.05*** (0.02)
MaxLimitDest	-0.07 (0.08)	-0.11* (0.07)	-0.08 (0.09)	0.09 (0.10)
MiiOrigin	-0.03*** (0.01)	-0.04*** (0.01)	-0.01** (0.01)	-0.01 (0.01)
MiiDest	-0.01* (0.01)	-0.02*** (0.01)	0.01 (0.01)	0.01** (0.01)
NumberGatesOrigin	0.01 (0.01)	-0.02** (0.01)	0.03*** (0.01)	0.06*** (0.01)
NumberGatesDest	-0.01 (0.01)	-0.03*** (0.01)	0.00 (0.01)	0.02* (0.01)
R-Squared	0.20	0.29	0.18	0.32
# Observations	42,269	42,269	42,269	42,269

NOTE.- Controls for market distance as well as tourist market dummies are included in each regression.

* $p<0.10$

** $p<0.05$

*** $p<0.01$

Table 8: Hub Premia with Gates and Congestion

	(1) 50th% Fare	(2) 25th% Fare	(3) 75th% Fare	(4) 90th% Fare
Hub Dummies				
HubUmbrellaOrigin	0.00 (0.01)	0.00 (0.01)	0.02 (0.01) **	0.04 (0.01) ***
HubUmbrellaDest	0.03 (0.01) ***	0.01 (0.01) **	0.04 (0.01) ***	0.06 (0.01) ***
HubCarrierOrigin	0.04 (0.02) ***	0.06 (0.01) ***	0.03 (0.02) *	0.02 (0.02)
HubCarrierDest	0.05 (0.02) ***	0.05 (0.01) ***	0.06 (0.02) ***	0.06 (0.06) ***
Barriers				
CongestedOrigin*NumberGatesOrigin	0.33 (0.10) ***	0.20 (0.08) ***	0.41 (0.12) ***	0.29 (0.12) ***
CongestedDest*NumberGatesDest	0.26 (0.11) ***	0.25 (0.09) ***	0.20 (0.13) *	0.02 (0.13)
OwnGatesOrigin	0.01 (0.05)	0.07 (0.04) **	-0.04 (0.06)	0.06 (0.06)
OwnGatesDest	0.04 (0.05)	0.04 (0.05)	0.07 (0.07)	0.26 (0.07) ***
CongestedOrigin*LimitOrigin	-0.34 (0.09) ***	-0.21 (0.08) ***	-0.38 (0.11) ***	-0.48 (0.11) ***
CongestedDest*LimitDest	-0.26 (0.09) ***	-0.10 (0.07)*	-0.38 (0.11) ***	-0.62 (0.11) ***
LimitOrigin	0.16 (0.05) ***	0.09 (0.04) **	0.17 (0.06) ***	0.19 (0.06) ***
LimitDest	0.12 (0.05) ***	0.04 (0.04)	0.19 (0.06) ***	0.28 (0.06) ***
CongestedOrigin*MaxLimitOrigin	1.73 (0.48) ***	1.12 (0.41)***	2.07 (0.58) ***	2.75 (0.59) ***
CongestedDest*MaxLimitDest	1.76 (0.46) ***	0.77 (0.39) **	2.44 (0.55) ***	3.68 (0.57) ***
MaxLimitOrigin	-0.88 (0.26) ***	-0.54 (0.22) ***	-1.00 (0.32) ***	-1.13 (0.33) ***
MaxLimitDest	-0.88 (0.25) ***	-0.37 (0.21) **	-1.28 (0.30) ***	-1.76 (0.31) ***
CongestedOrigin*MiiOrigin	0.21 (0.05) ***	0.26 (0.04) ***	0.21 (0.06) ***	0.35 (0.06) ***
CongestedDest*MiiDest	0.26 (0.05) ***	0.28 (0.04) ***	0.16 (0.06) ***	0.22 (0.06) ***
MiiOrigin	-0.12 (0.02) ***	-0.16 (0.02) ***	-0.11 (0.03) ***	-0.16 (0.03) ***
MiiDest	-0.12 (0.02) ***	-0.15 (0.02) ***	-0.06 (0.03) **	-0.08 (0.03) ***
CongestedOrigin	-0.17 (0.05) ***	-0.20 (0.04) ***	-0.19 (0.06)***	-0.30 (0.06) ***
CongestedDest	-0.25 (0.05) ***	-0.26 (0.04) ***	-0.12 (0.06) **	-0.16 (0.06) ***
NumberGatesOrigin	0.01 (0.01)	-0.01 (0.01) *	0.04 (0.01) ***	0.06 (0.01) ***
NumberGatesDest	-0.01 (0.01)	-0.03 (0.01) ***	0.02 (0.01)	0.04 (0.01) ***
R-Squared	0.21	0.34	0.19	0.33
# Observations	42,269	42,269	42,269	42,269

NOTE.- Controls for market distance as well as tourist market dummies are included in each regression.

* $p<0.10$
** $p<0.05$
*** $p<0.01$

Table 9: Hub Premia with Gates and WN Potential Competition

	(1) 50th% Fare	(2) 25th% Fare	(3) 75th% Fare	(4) 90th% Fare
Hub Dummies				
HubUmbrellaOrigin	0.01 (0.01) *	0.01 (0.01)	0.03 (0.01) ***	0.04 (0.01) ***
HubUmbrellaDest	0.03 (0.01) ***	0.01 (0.01) **	0.06 (0.01) ***	0.07 (0.01) ***
HubCarrierOrigin	0.07 (0.01) ***	0.08 (0.01) ***	0.07 (0.02) ***	0.06 (0.02) ***
HubCarrierDest	0.07 (0.01) ***	0.08 (0.01) ***	0.08 (0.02) ***	0.08 (0.02) ***
Barriers				
OwnGatesOrigin*WNatBothAirports	-0.16 (0.03) ***	-0.11 (0.03)***	-0.24 (0.04) ***	-0.15 (0.04) ***
OwnGatesDest*WNatBothAirports	-0.14 (0.03) ***	-0.09 (0.03) ***	-0.24 (0.04) ***	-0.20 (0.04) ***
OwnGatesOrigin	0.18 (0.03) ***	0.17 (0.02) ***	0.19 (0.03) ***	0.21 (0.03) ***
OwnGatesDest	0.16 (0.03) ***	0.14 (0.02) ***	0.20 (0.03) ***	0.29 (0.03) ***
LimitOrigin*WNatBothAirports	-0.03 (0.03) *	-0.03 (0.02) *	-0.06 (0.03) **	-0.03 (0.03)
LimitDest*WNatBothAirports	-0.03 (0.03)	-0.03 (0.02)	-0.06 (0.03) **	-0.03 (0.03)
LimitOrigin	0.01 (0.01)	0.01 (0.01)	0.00 (0.02)	-0.03 (0.02) **
LimitDest	0.01 (0.01)	0.02 (0.01)	0.01 (0.02)	-0.02 (0.02) *
MaxLimitOrigin*WNatBothAirports	0.05 (0.15)	0.03 (0.12)	0.19 (0.18)	0.05 (0.18)
MaxLimitDest*WNatBothAirports	-0.06 (0.14)	-0.01 (0.12)	0.10 (0.18)	0.01 (0.18)
MaxLimitOrigin	-0.06 (0.09)	-0.07 (0.08)	-0.06 (0.12)	0.17 (0.12) *
MaxLimitDest	-0.01 (0.09)	-0.06 (0.08)	-0.07 (0.12)	0.13 (0.12)
MiiOrigin*WNatBothAirports	0.01 (0.01)	0.02 (0.01) **	-0.01 (0.02)	0.01 (0.02)
MiiDest*WNatBothAirports	0.01 (0.01)	0.02 (0.01) **	-0.02 (0.02) *	-0.02 (0.02)
MiiOrigin	-0.05 (0.01) ***	-0.06 (0.01) ***	-0.03 (0.01) ***	-0.03 (0.01) ***
MiiDest	-0.03 (0.01) ***	-0.05 (0.01) ***	-0.01 (0.01)	-0.00 (0.01)
WNatBothAirports	-0.07 (0.02) ***	-0.10 (0.02) ***	-0.02 (0.02)	-0.10 (0.02) ***
NumberGatesOrigin	-0.03 (0.01) ***	-0.05 (0.01) ***	-0.01 (0.01)	0.01 (0.01)
NumberGatesDest	-0.05 (0.01) ***	-0.06 (0.01) ***	-0.04 (0.01) ***	-0.03 (0.01) **
R-Squared	0.25	0.35	0.23	0.37
# Observations	42,269	42,269	42,269	42,269

NOTE.- Controls for market distance as well as tourist market dummies are included in each regression.

* $p<0.10$
** $p<0.05$
*** $p<0.01$

Table 10: Hub Premia with Airport Share

	(1) 50th% Fare	(2) 25th% Fare	(3) 75th% Fare	(4) 90th% Fare
Hub Dummies				
HubUmbrellaOrigin	0.01 (0.01)	0.01 (0.01)	0.03*** (0.01)	0.04*** (0.01)
HubUmbrellaDest	0.03*** (0.01)	0.01* (0.01)	0.06*** (0.01)	0.07*** (0.01)
HubCarrierOrigin	0.05*** (0.02)	0.06*** (0.01)	0.04** (0.02)	0.04** (0.02)
HubCarrierDest	0.05*** (0.02)	0.06*** (0.01)	0.05*** (0.02)	0.06*** (0.02)
Barriers				
OwnGatesOrigin	0.17*** (0.03)	0.16*** (0.02)	0.15*** (0.03)	0.19*** (0.03)
OwnGatesDest	0.15*** (0.03)	0.15*** (0.02)	0.17*** (0.03)	0.27*** (0.03)
NumberGatesOrigin	0.01 (0.01)	-0.01* (0.01)	0.04*** (0.01)	0.06*** (0.01)
NumberGatesDest	-0.01 (0.01)	-0.02*** (0.01)	0.01 (0.01)	0.02 (0.01)
MiiOrigin	-0.02*** (0.01)	-0.04*** (0.01)	-0.01 (0.01)	-0.01 (0.01)
MiiDest	-0.01 (0.01)	-0.02*** (0.01)	0.01 (0.01)	0.01* (0.01)
LimitOrigin	-0.02* (0.01)	-0.02 (0.01)	-0.03*** (0.01)	-0.06*** (0.01)
MaxLimitOrigin	-0.03 (0.07)	-0.06 (0.06)	0.03 (0.09)	0.19** (0.09)
LimitDest	-0.01 (0.01)	-0.01 (0.01)	-0.02 (0.01)	-0.05*** (0.01)
MaxLimitDest	-0.05 (0.08)	-0.10 (0.07)	-0.05 (0.09)	0.09 (0.10)
AirportPresenceOrigin	0.22* (0.13)	0.15 (0.11)	0.25 (0.16)	0.25 (0.16)
AirportPresenceDest	0.36*** (0.14)	0.21* (0.12)	0.33** (0.16)	0.07 (0.17)
R-Squared	0.21	0.29	0.18	0.31
# Observations	42,269	42,269	42,269	42,269

NOTE.- Controls for market distance as well as tourist market dummies are included in each regression.

* p<0.10

** p<0.05

*** p<0.01

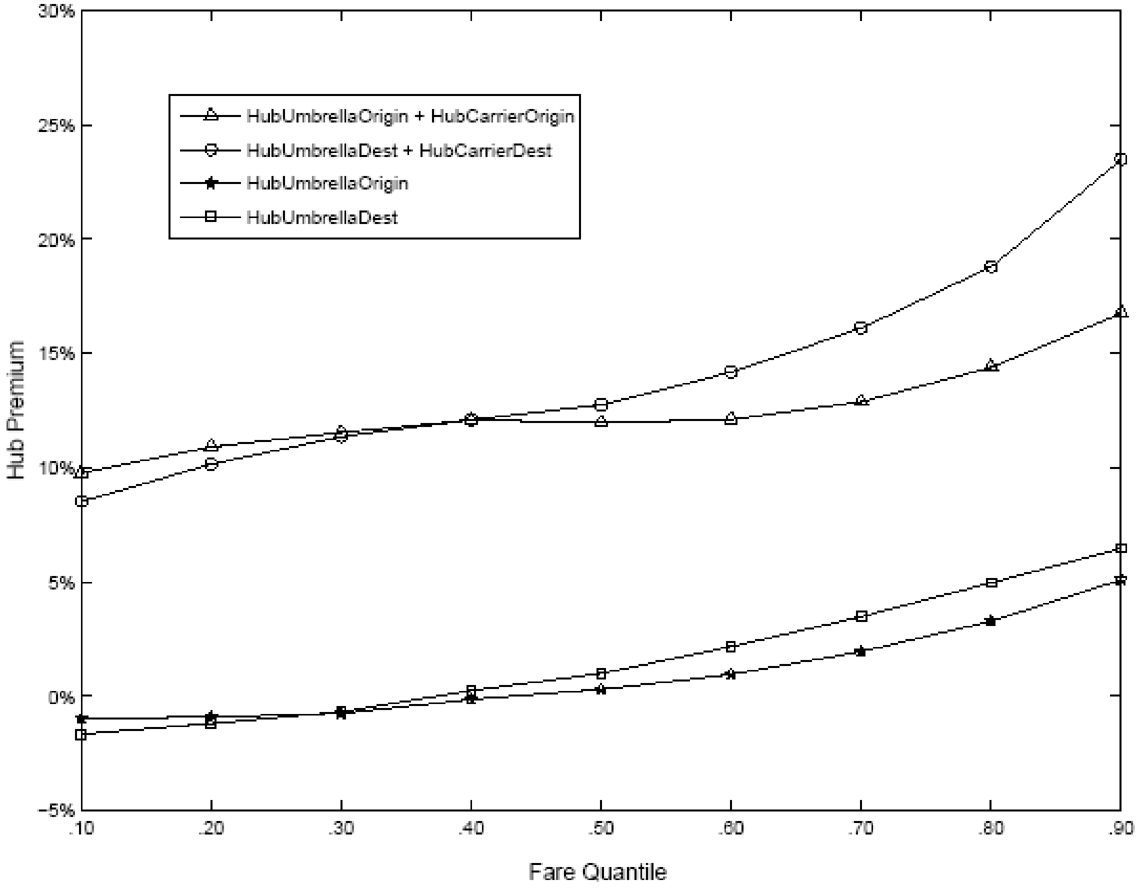

Figure 1: Distribution of Hub Premium by Ticket Fare