Chapter 8. Public Airport Competition and Some Potential Benefits of Private Airport Competition

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1. Introduction

Commercial airports in the United States were private enterprises until the Great Depression, when they experienced serious financial problems because of plummeting passenger demand. Government could have given airports financial assistance so they could remain in the private sector. Instead, they were put under the control of state and local governments, which had the sole authority to issue bonds to pay for airport facilities and operations. Today, almost all commercial airports are owned and operated by public authorities.

When faced with competition, private enterprises are pushed to innovate, improve product quality, and enhance operational efficiency, or be driven out of the market by more efficient firms. But when profit is not a motive, as is the case for subsidized, government-run airports, do competitive forces still improve efficiency that could reduce airline fares?

Competition between multiple airports in a metropolitan area may be limited because new airports rarely enter a market to compete with existing airports and because airports have little financial incentive to attract additional airlines and travelers.[160] In addition to federal subsidies provided by the Airport Improvement Program, airports obtain funds in a monopoly environment from automobile parking fees, retail store rents, advertising display charges, rents from terminal facilities such as counters and gates, and weight-based landing fees promulgated by US Department of Transportation policy. Long-term contracts negotiated between airlines and airports before deregulation have deterred new airline entry by containing "majority in interest"

[160] Some airports have tried to encourage Southwest Airlines to serve them and there are examples of smaller airports trying to increase the number of airlines that provide service.

clauses, which give airlines that sign long-term lease agreements the right to approve spending to construct new terminals and gates and oppose spending that could facilitate new competition (Winston (2010)).[161]

In general, public airports do not fail financially and exit the industry. During major shocks to air travel, including the period after September 11, 2001, the Great Recession, and the COVID-19 pandemic, airports have been in much better financial shape than airlines, several of which have gone into bankruptcy, and a few have been liquidated. In contrast, the Airport and Airway Trust Fund can run and (currently is running) large budget deficits. Financial analysts point out that airports tend to have high bond ratings because they have multiple revenue streams that service their debt, so they are unlikely to default on repayment obligations.

The possibility that public airports engage in competition to some extent is motivated by the hypothesis that air travelers originating from multi-airport metropolitan areas pay lower fares, all else constant, than air travelers originating from single-airport metropolitan areas.[162] The reasons are: (1) more airlines—especially low-cost and ultra-low-cost carriers—serve multi-airport metropolitan areas than serve single-airport metropolitan areas and they engage in direct competition, and (2) multiple airports facilitate effective adjacent competition (Cho, Windle, and Hofer (2012)). Adjacent competition, which was shown in the last chapter to have a measurable effect on airline fares, is possible only in multi-airport metropolitan areas.

[161] As these agreements expire, airports are increasingly replacing them with agreements that lack the "majority in interest" clauses. Airport projects also can facilitate entry. For example, Denver International Airport is building many new gates over a protracted period that will be used by its two largest incumbent carriers, United and Southwest Airlines. New entrants may possibly use the older gates that United and Southwest abandon. In addition, some airlines reshape their networks by moving their operations to different airports. For example, JetBlue shifted its West Coast service from Long Beach Airport to Los Angeles International Airport.

[162] Basso and Zhang (2007) argue that airports and airlines should not be treated separately when analyzing competition in air transportation.

Additionally, low-cost carriers are attracted to metropolitan areas with multiple airports because they can choose the airport that is best suited to their operations. For example, Southwest Airlines preferred for many years to use less-congested airports and would bypass the most congested airport in a metropolitan area. Cho, Windle, and Dresner (2015) argue that the mere presence of a low-cost carrier at an airport may attract passengers, even to competing carriers, as travelers expand their search activity.

In this chapter, we study the effects of airport competition on airline prices by exploiting exogenous variation in the number of airports serving different metropolitan origins that serve the same metropolitan destination. Airport presence is plausibly exogenous because almost all US airports currently in operation were built when airline fares were still regulated by the Civil Aeronautics Board. In fact, only one new major airport, Denver International Airport, has been built in the United States since 1973.[163]

To the best of our knowledge, ours is the first empirical analysis to examine whether travelers flying out of multi-airport metropolitan origins pay lower fares to reach their destinations than do travelers flying to those same destinations from single-airport metropolitan origins. This is an important question because the existence of airport competition suggests that travelers could potentially be made better off if: (1) additional public airports were constructed; (2) public airports were privatized and competed more vigorously for travelers and airlines than public airports currently compete for them; and (3) new private airports entered metropolitan areas that could accommodate additional airports.

[163] One small airport, Northwest Florida Beaches International Airport, was built in 2010 to replace Panama City–Bay County International Airport and San Juan International Airport has been operated and managed under a public–private partnership since 2013. In addition, some large general aviation airports, such as Orlando Sanford International Airport, have added passenger service. Finally, Paine Field, north of Seattle, resumed commercial service, currently anchored by Alaska Airlines, at a new privately operated terminal in 2019.

We find that travelers flying out of metropolitan origins with at least *three* airports pay lower fares, *ceteris paribus*, than travelers flying out of metropolitan origins with only one airport; but that fares from metropolitan origins with exactly *two* airports are higher compared with fares out of single-airport metropolitan origins. In other words, our results suggest that the presence of two airports is not sufficient to induce competitive pressures to reduce fares (and may actually be counterproductive), but that three or more airports generate sufficient competition among airlines to reduce fares.

This finding is somewhat surprising *a priori*, and we investigate possible explanations. Our preferred explanation is that three or more airports competing in a metropolitan origin facilitate more entry by low-cost and ultra-low-cost carriers and facilitate adjacent competition. In other words, the channel by which three or more airports reduces fares is by generating additional *airline* competition. We test for additional channels by which three or more airports could reduce fares, namely *airport* competition—which is affected by eliminating common ownership and by expanding airport capacity, gates, and runways that could reduce delays and airlines' operating costs—but we find no evidence that supports those channels.

In contrast, when two airports serve a metropolitan origin, they tend to differentiate their service by developing distinct business models consisting of network airlines primarily catering to international and domestic markets and point-to-point airlines primarily catering to domestic markets. The distinct business models do not reduce fares because they do not encourage additional airline competition in the same markets.

We estimate that if metropolitan areas that are currently served by two airports were served by three airports, where such an increase would be feasible based on the metropolitan areas in question having comparable populations to the metropolitan areas served by three airports,

travelers would benefit by more than $4 billion in annual fare reductions. A cost–benefit analysis that accounts for the cost of constructing new airports suggests that several large metropolitan areas would benefit from building an additional airport. Because our analysis is based on public airports, we argue that new private airports, which would have greater incentives to compete vigorously to attract and provide facilities for additional airlines, could generate even greater reductions in fares.

2. **Characterizing Airport Competition**

Airports serve the same originating market if they draw travelers from the same geographic region. Brueckner, Lee, and Singer (2014) attempt to define a multi-airport airline market by using regression analysis to correlate route-level fare changes at a metropolitan area's primary airport with the number of competing airlines at other airports in the area. But anecdotal evidence, as well as work by Shrago (2022) and McWeeny (2019), suggests that Brueckner, Lee, and Singer's (2014) market definition might be too conservative because it neglects some airports in a broad metropolitan area that travelers use.[164]

Hence, we report results based on conservative and liberal market definitions. The conservative definition is aligned with Brueckner, Lee, and Singer's (2014) definition, which includes primary and core airports.[165] The liberal definition includes primary, core, and fringe airports, as defined by Brueckner, Lee, and Singer, as well as airports that are more than 75 miles

[164] We thank John Heimlich of Airlines for America, Kenneth Strickland of Raleigh–Durham International Airport, Devon Barnett of Tampa International Airport, and Christopher Birch of San Francisco International Airport for helpful conversations regarding airline market definitions from an industry perspective.

[165] Shrago (2022) also interprets Brueckner, Lee, and Singer's (2014) definition as a conservative definition. In contrast to Brueckner, Lee, and Singer, we include Richmond International Airport (RIC) and Newport News/Williamsburg Airport (PHF) in the conservative definition. However, our findings do not change if we follow Brueckner, Lee, and Singer and do not include them in the conservative definition.

from the city center, and small airports that primarily serve low- or ultra-low-cost carriers. We also constructed definitions within the preceding extremes (for example, by not including small airports); however, we report results based only on the most conservative and liberal definitions because the main findings were not affected by small changes to the list of airports that we included in the market definitions.

As shown in the first panel of table 1, the airports that comprise multi-airport metropolitan areas in the conservative market definition are within an average radius of 17 miles from the centroid of the metropolitan area, with a maximum radius of 51 miles. Under the conservative market definition, the average farthest driving distance between any two airports serving the same metropolitan area is 46 miles, with a maximum distance of 105 miles (Manchester-Boston Regional Airport (MHT) to Providence Airport (PVD), about 1 hour and 45 minutes apart).

As shown in the second panel of table 1, airports included in the liberal market definition are within an average radius of 28 miles from the centroid of the metropolitan area, with a maximum radius of 68 miles. The average farthest driving distance between any two airports is 68 miles, with a maximum distance of 140 miles (MHT to Bradley International Airport (BDL), about 2 hours and 15 minutes apart).

Some descriptive evidence suggests that the liberal market definition is the more appropriate multi-airport airline market definition. For example, according to survey data collected by Ipsos on behalf of Airlines for America, nearly 40 percent of travelers originated their trip during 2018 from an airport that was not the closest airport to their home or office.[166] McWeeny (2019) takes a close look at the behavior of airline travelers in the San Francisco Bay Area and reports that the majority bypass airports that are closer to their homes to take advantage

[166] We thank John Heimlich for providing us access to these data.

of lower fares out of San Francisco International Airport (SFO), and that, on average, leisure travelers are willing to drive up to 2 hours to save $100 on fares.[167] A significant share of travelers drives from as far as Sacramento, bypassing Sacramento International Airport (SMF), while Sonoma County Airport (STS) even provides a trip calculator that includes parking fees at and travel costs to SFO to discourage travelers from taking long drives that bypass the flights it offers.[168] Although public airports are not profit-maximizing enterprises, they do have an interest in attracting passengers to generate revenues from the ancillary services they offer and to justify government subsidies.

Figure 1 shows the multi-airport metropolitan areas in our sample. The light blue dots correspond to the conservative market definition, and the dark blue dots plus the light blue dots correspond to the liberal definition, which are encompassed by circles. The 15 largest single-airport metropolitan areas are represented by yellow dots.

Table 2 presents descriptive evidence of the difference between fares on flights from metropolitan areas served by a different number of airports. Specifically, the table reports average yields (passenger-revenue per passenger-mile) for markets served by one, two, and three or more airports and shows that they are lower for markets served by three or more airports compared with those served by fewer airports, a finding that is robust to the alternative market definitions. In contrast, yields for markets served by two airports are slightly lower than yields for markets served by one airport under the conservative definition, while they are notably higher under the liberal

[167] Generally, the tradeoff is affected by gasoline prices. Higher gasoline prices would reduce the amount of time leisure travelers would be willing to spend driving to save money on lower fares.

[168] According to data collected at Tampa International Airport (TPA), a nonnegligible number of international passengers flying out of TPA drive from Orlando, which is roughly 90 miles away. We thank Kenneth Strickland and Devon Barnett for sharing this insight with us.

definition. Recal, that the liberal definition includes several more metropolitan areas served by two airports than are included under the conservative definition.

Table 3, which disaggregates yields by the number of airports in a metropolitan area and by the hub classification (or size) of the airports, shows that differences in yields are more pronounced.[169] Yields for metropolitan areas with three or more airports are much lower than yields for metropolitan areas with a smaller number of airports when the metropolitan area in question contains a large hub airport. Yields for medium hubs show an interesting pattern where they are lowest for metropolitan areas with one airport and highest for metropolitan areas with two airports. Yields for small hubs and nonhubs are much higher for metropolitan areas with one airport than for metropolitan areas served by multiple airports.

In sum, the lower yields for metropolitan areas with three or more airports may be driven by their lower yields at large hubs that reflect intense competition or lower costs from economies of distance and aircraft size. Metropolitan areas with one airport have lower yields than metropolitan areas with two airports for large and medium hubs, but not for small hubs and nonhubs, likely because those markets may be quite isolated and able to charge high fares or less able to benefit from economies of distance and aircraft size. Because the descriptive comparisons do not hold other important influences on fares constant, we turn to a formal econometric analysis to estimate causal effects.

[169] A large hub handles at least 1 percent of national enplanements, a medium hub from 0.25 to 1.0 percent of enplanements, a small hub from 0.05 to 0.25 percent of enplanements, and a nonhub has less than 0.05 percent of enplanements but more than 10,000 annual enplanements.

3. **Estimating the Effect of Airport Competition on Fares**

We estimate an airline fare regression to determine the causal effect of airport competition on fares. In its basic reduced form, airline fare regressions specify the (log) yield in a market as a function of airline competition, route characteristics such as distance to capture costs and intermodal competition, distance squared to capture economies of length of haul, and population and income to capture exogenous measures of demand (Morrison and Winston (1995)).[170] It also is common to include route (airport-pair or city-pair) fixed effects to control for any time-invariant route characteristics (Brueckner, Lee, and Singer (2014)).

As we discussed in our analysis in chapter 3 of the effect of bus and rail transit competition on bus costs, it is important to carefully consider which variables should and should not be held constant so that we are able to identify the causal effect of the number of airports on fares. We specify the number of airports serving a metropolitan area as dummy variables for two or three-or-more airports with one airport as the base. Given that this variable is time-invariant and specific to the origin market, we cannot include route fixed effects or origin fixed effects because the origin component of the route fixed effect will be perfectly collinear with the multi-airport dummy variables. Thus, instead of specifying route fixed effects, we include destination fixed effects to control for unmeasured time-invariant influences on fares at the destination.

[170] As an additional demand variable, a greater share of business travelers could lead to higher fares, but it would be an endogenous variable in a fare regression. Income at the origin is an exogenous variable that can capture travelers' willingness to pay. As pointed out below, we also restrict the sample to include only destinations that are served by both single- and multi-airport metropolitan origins to help control for different characteristics across routes. As an additional cost variable, airports that have higher costs per enplanement could lead to higher fares. However, the relevant issue is how airport costs affect airlines' costs, whose airport operations are subsidized because aircraft are charged only for their takeoff but not landing operations. A representative landing fee per passenger for typical passenger loads is less than three dollars (Morrison and Winston (2007)) and any variation would have only a small effect on fares. Importantly, aircraft also are not charged for their contribution to congestion and delays during takeoffs and landings.

Including multi-airport dummy variables in the specification to capture airport competition raises the question of whether *airline* competition should be held constant because it is one of the mechanisms by which *airport* competition—through its ability to attract low-cost competitors and to facilitate adjacent competition—could affect fares. Thus, *airport* competition may be prevented from affecting fares if *airline* competition is held constant. Additionally, airline presence is likely to be endogenous because carriers' entry will be influenced by revenue and average fares on a route, while airport presence is arguably exogenous because, as noted, most US airports were built during the period when fares were regulated.

Thus, we do not include airline competition variables in the specification and estimate fare regressions of the following form:

$$\ln \text{yield}_{ijyq} = \alpha + \beta_1 \text{two}_i + \beta_2 \text{three}_i + \gamma_1 \ln \text{inc}_{iyq} + \gamma_2 \ln \text{pop}_{iyq} + \delta_1 \ln \text{dist}_{ij} + \delta_2 \ln \text{dist}_{ij}^2 + \boldsymbol{\xi}_j + \boldsymbol{\xi}_y + \boldsymbol{\xi}_q + \varepsilon_{ijyq},$$

where $\ln \text{yield}_{ijyq}$ is the log of the yield from origin airport i to destination airport j in year y and quarter q. The key variables of interest are two_i and three_i, dummy variables that equal 1 if origin airport i is part of a two- or three-or-more-airport metropolitan origin, respectively; 0 otherwise. The base metropolitan origin is served by a single airport. The remaining control variables in the specification include log of income at the origin, $\ln \text{inc}_{iyq}$; log of population at the origin, $\ln \text{pop}_{iyq}$; log of distance and log of distance squared between the origin and destination, dist_{ij} and dist_{ij}^2; destination fixed effects, $\boldsymbol{\xi}_j$; and year and quarter fixed effects, $\boldsymbol{\xi}_y$ and $\boldsymbol{\xi}_q$.[171] We

[171] One could argue that population should be divided by the number of airports at the origin. However, population is a measure here of potential airport demand throughout the metropolitan area. We have made the point that it is reasonable to assume that travelers consider all airports in a metropolitan area because they frequently use airports that are not closest to their residence or place of business. In addition, dividing population by the number of airports would impose a restriction where the effect of the number of airports on fares is affected by metropolitan area population, which has no theoretical justification.

also specified slot-control dummy variables for JFK, LGA, and DCA airports, but they were statistically insignificant. We discuss the possible effect of airport capacity on fares later.

We estimate the model using data on fares and flight distances from the US Department of Transportation's Airline Origin and Destination Survey (DB1B), a 10% quarterly sample of domestic itineraries. Data on population and income are from the US Census Bureau and Bureau of Economic Analysis, and data for the number of airports in the metropolitan area are from the Bureau of Transportation Statistics. Our sample covers the period from 1993 to 2019 and consists of approximately 3,400 routes and 149,000 observations, depending on the market definition used. The year fixed effects control for national-level structural changes in the airline industry that occurred during our sample period, such as the September 11, 2001, terrorist attacks and the Great Recession.[172] Finally, to partly control for different characteristics across routes, we restrict the sample to include only destinations that are served by both single- and multi-airport metropolitan origins, and we include only round-trip direct flights.[173]

We present parameter estimates from ordinary least squares regressions in table 4. The results for the airport dummy variables based on the conservative market definition, shown in the first column, lack statistical significance, possibly because there are only 14 multi-airport markets (9 two-airport markets and 5 three-airport markets, as shown on the left side of table 1).

The second column shows results for the airport dummy variables based on the liberal market definition, which results in 22 multi-airport markets. The parameter estimates are statistically significant, and the signs are consistent with the descriptive differences in yields

[172] We performed tests of whether our parameters of interest—the effect of multi-airport presence on yields—were affected by the September 11, 2001, terrorist attacks and the Great Recession, but we could not reject the null hypothesis that the parameters are equal before and after those shocks to the industry, so the pooled estimation is appropriate.

[173] We also exclude lightly travelled routes with fewer than 300 passengers per quarter.

shown in table 2. The estimates indicate that the presence of exactly two airports in a market *increases* yields by 8.9% relative to yields in single-airport markets, while the presence of three or more airports in a market *decreases* yields by 10.1% relative to single-airport markets. The estimated decrease in yields is plausible given that multiple airports should facilitate both direct and adjacent competitive pressures on fares. As shown in chapter 7, direct competition from Southwest can reduce fares by as much as 30%; the presence of other carriers in a market has a smaller but not negligible effect on fares. Chapter 7 also found that Southwest can reduce fares by as much as 5% in the long run when it provides adjacent competition.

The finding that two airports do not lower fares, but in fact *increase* fares, relative to single-airport metropolitan areas, is surprising given that we expect that fares should decrease with the number of airports serving a market, or at least not increase with the number of airports serving a market. In the next section, we disaggregate the data further to provide possible explanations for this finding.

4. **Explaining the Differential Effects of Airport Competition**

The preceding estimates imply that airport competition has differential effects: two airports in a market do not generate sufficient competition to reduce fares and, in fact, their presence increases fares, while three or more airports in a market do generate sufficient competition to reduce fares. We argue that if airport competition affects fares, it does so by affecting competition among airlines serving the metropolitan area. For example, the "Southwest effect"—the observation that originating air travel tends to increase considerably after Southwest's entry into a market—has been well established (Dresner, Lin, and Windle (1996) and Morrison and Winston (2000)). We therefore explore the source of airport competition's differential effects on yields and

the justification for excluding airline competition from the specification by re-estimating our model with measures of airline competition and seeing how they affect our estimates of the airport competition dummy variables.

We measure airline competition as the number of traditional, low-cost, and ultra-low-cost carriers serving the market. Table 5 shows the specific airlines in each carrier classification.[174] Data on the airports served by each airline come from the US Department of Transportation's Air Carrier Statistics database (T-100).

Table 6 presents ordinary least squares estimation results showing how the previous estimates of airport competition, reproduced in column (1), are affected by including airline competition in the model. Column (2) shows that the number of low-cost carriers reduces yields, and the effect is statistically significant, although the parameter estimate is likely to be biased because the number of low-cost carriers is endogenous. The important finding is that the coefficient for the two-airport dummy increases and it is still statistically significant while the quantitative effect of the three-airport dummy is virtually eliminated, and it becomes statistically insignificant. Thus, the effect of three or more airports on yields appears to be capturing the effect of the number of low-cost carriers on fares, as direct or adjacent competitors, which indicates a specific mechanism by which airport competition reduces fares. At the same time, the effect of two airports is hardly affected by controlling for low-cost carrier competition, which suggests that a different mechanism explains how that form of airport presence affects fares.

[174] As Southwest and JetBlue expand into international service and into more (congested) US airports, the distinction between their operations and traditional carriers' operations is not as stark as it used to be. We do not consider private aviation as a distinct carrier classification because the difference between its cost and commercial carriers' first or business class fares is too great to suggest that private aviation and commercial airline service are plausible substitutes for more than a tiny share of travelers.

Column (3) shows that the preceding findings are not affected when we add the number of traditional and ultra-low-cost carriers to the specification. So, it appears that airport competition in metropolitan areas with three or more airports reduces fares by facilitating additional low-cost carrier competition. However, we need to probe more deeply to understand why the presence of two airports in a metropolitan area increases fares relative to one airport.

Table 7 presents descriptive evidence on yields, airport size (based on hub classification), and the share of international traffic for each airport in markets with two airports (first panel) and with three or more airports (second and third panels) to assess the extent that airports within those markets compete with each other. For example, consider two airports in the same metropolitan area with only one of the airports offering international flights. Those airports may be less likely to be served by airlines with overlapping domestic route networks that compete intensely with each other. The reason is that airlines offering international service tend to be major network carriers that align their domestic and international routes accordingly, while airlines that do not offer international service tend to be smaller point-to-point carriers with route networks that have a small overlap with larger carriers' route networks. In contrast, a third airport in a metropolitan area is likely to increase airline competition because it will be served by major network carriers or point-to-point carriers or both.

Recall that air travelers often bypass airports closest to their homes and use airports farther away to obtain lower fares, better service, or both. We presented McWeeny's (2019) evidence for the San Francisco multi-airport market to illustrate that travelers with the option to use three or more airports may drive to a farther airport to obtain lower fares to their metropolitan destination, which may be served by different carriers operating out of different origin airports. In addition, those travelers may drive to a farther airport to fly on their preferred carrier based on frequent flier

mileage accumulation. In contrast, travelers in two-airport markets are less likely to have the option to use an alternative airport to obtain lower fares, although they might drive to a farther airport to take international or domestic flights that are not offered at the airport that is closest to their home or workplace.[175]

Evidence from Airlines for America's 2019 "Air Travelers in America" survey is consistent with the conjecture that travelers from metropolitan areas with three or more airports are more likely than travelers from metropolitan areas with two airports to use an airport that is farther from their home or workplace. Specifically, 39.7% of travelers flying from metropolitan origins served by three or more airports used an airport that was not the closest airport to their home or office, while 28.7% of travelers flying from metropolitan origins served by two airports used an airport that was not the closest airport to their home or office.[176]

The first panel of table 7 shows that in two-airport metropolitan areas, one of the airports is often served by airlines that provide international service and is either a large or medium hub airport while the other airport is often a small or non-hub airport that is not served by airlines providing international service. For example, in the Detroit area, Detroit Metropolitan Airport (DTW) is a large hub that provides international flights and is served by almost all the major carriers, while Flint Bishop Airport (FNT) is a small hub that provides few, if any, international flights and its only major carrier is Delta Air Lines. Note that yields at FNT are 15% lower than yields at DTW, likely because international flights tend to be more expensive than domestic flights

[175] Canadians living close to the US border often drive to US airports because airfares and airport fees are lower in the US. The main instances of substitute airports along the US–Canada border are those near Toronto (Niagara Falls International Airport and Buffalo Niagara International Airport), Montreal (Plattsburgh International Airport), Ottawa (Ogdensburg International Airport), and Vancouver (Bellingham International Airport).

[176] It is more likely that the survey results capture the effect of exogenous characteristics of airports, including airlines with low fares, better service, and the like, on travelers' airport choice behavior rather than those airport characteristics being caused by travelers' airport choice behavior.

and because more passengers flying out of DTW are likely to be paying more expensive business and first-class fares on longer flights.[177]

In sum, the airlines providing service in two-airport metropolitan areas appear to segregate and specialize their operations such that they provide different services at each airport in accordance with their different business models and they cater to different types of travelers to a significant extent. It is thus plausible that airlines that serve a single-airport metropolitan origin, which includes both network and point-to-point carriers, could generate more competition that reduces yields than airlines that serve a two-airport metropolitan origin.

Regulatory restrictions on international airline competition also may contribute to different airports pursuing different airline business models because burdensome regulations often make it difficult for carriers to provide international service from specific airports. Such restrictions include entry barriers in international markets that are not governed by open skies agreements and entry barriers such as slot and gate restrictions at domestic and foreign airports that comprise US international routes.

The second and third panels of table 7 show that in three-airport markets, at least two of the airports are often served by carriers that provide some international service and are large or medium hubs. For example, the Washington market is served by three large hub airports, all of which provide some international service and one of which, Baltimore/Washington International Airport (BWI), has long been served by Southwest Airlines, which, in addition to providing direct competition, has helped to reduce yields by providing adjacent competition for airlines flying out

[177] FNT's lower fares in recent years also could be explained by service provided by low-cost and ultra-low-cost carriers.

of Reagan National Airport (DCA) and Dulles International Airport (IAD) (Cho, Windle, and Dresner (2015)).[178]

Table 8 presents descriptive evidence that a greater number of low-cost and ultra-low-cost carriers serve markets with three or more airports compared with markets with only one or two airports. Ultra-low-cost carriers serve a greater number of large hub single-airport markets than they serve two-airport markets, and low-cost carriers serve a comparable number of single-airport markets and two-airport markets. Medium hub single-airport markets are served by fewer low-cost and ultra-low-cost carriers than are served at two-airport markets. In contrast, metropolitan origins with three or more airports are more likely than single- and two-airport metropolitan origins to be served by low-cost and ultra-low-cost carriers, and, on average, have more low-cost, ultra-low-cost, and total carriers offering flights than single- and two-airport metropolitan origins have.

5. **Considering Additional Channels that Enable Airport Competition to Reduce Fares**

We have found evidence that we interpret as indicating airport competition reduces fares by facilitating direct and adjacent airline competition, especially involving low-cost carriers. However, there are additional channels by which the presence of multiple airports in a metropolitan area could reduce fares, including true airport competition and capacity expansion.

In true airport competition, airports would take certain actions that reduce airlines' operating costs to attract additional airlines to serve their airports. Airlines that are induced to serve airports that provide such incentives would have lower costs and possibly lower fares. We have pointed out that most (subsidized) public airports do not aggressively seek to attract additional airlines. However, if such an incentive existed, airports operating in the same

[178] BWI was a hub for US Airways, but Southwest Airlines essentially drove them out of BWI. Of course, other low-cost and ultra-low-cost carriers operate in the three Washington metropolitan area airports.

metropolitan area would be more likely to take actions to attract additional airlines if they were operated by different airport authorities instead of by a monopoly authority that has little incentive to encourage competition among the airports that it operates.

Metropolitan areas that are served by three or more airports and where at least two of the airports are operated under the same airport authority include the Chicago (ORD, MDW), New York (LGA, JFK, EWR, SWF), and Washington (DCA, IAD) metropolitan areas. Thus, as an empirical test of the possible effect of true airport competition on fares, we added a new variable to our specification where we specified a same-airport-authority dummy variable, interacted it with the three-or-more-airports dummy variable, and re-estimated the fare model. We found that its coefficient was statistically insignificant and that its inclusion had little effect on the magnitude and statistical significance of the three-or-more-airports dummy variable, which indicates that pure airport competition is unlikely to be a channel that reduces fares.

The capacity expansion channel suggests that the presence of multiple airports results in more runways and more gate and terminal capacity that could, for example, reduce takeoff and landing delays, and reduce operating costs and fares. We tested for the effect of additional capacity directly by interacting the three-or-more-airports dummy with the total number of airport runways in the metropolitan area.[179] Including this interaction term in our regression did not change the magnitude of the coefficient on the three-or-more-airports dummy, and the coefficient on the interaction term was small and statistically insignificant.

Because capacity expansion also may encompass more gates and terminals, we used hub size as a broader measure of capacity. Generally, larger airports and greater airport capacity are

[179] We included only runways that were longer than 5,000 feet, which is an adequate length for most commercial aircraft to take off and land. Data on runway length are from the Federal Aviation Administration's National Flight Data Center. We are grateful to Jan Brueckner and Alberto Gaggero for sharing the data with us.

associated with larger hub sizes, which are associated with larger metropolitan areas. We again created a new variable where we interacted the dummy variable for three or more airports with dummy variables that identified metropolitan areas with either two large hub airports or with one large hub airport and two medium hub airports and we re-estimated the fare model. We found that the coefficient for the new (capacity expansion) variable was statistically insignificant and that its inclusion had little effect on the magnitude and statistical significance of the three-or-more-airports dummy variable. In sum, the statistically insignificant effects of the number of runways and hub sizes suggest that capacity expansion is unlikely to be a channel that reduces fares in multi-airport metropolitan areas.[180]

6. **The Potential Gains from Additional Airport Competition**

Given that our analysis suggests airport competition in metropolitan areas with three or more airports can help to reduce fares, it is of interest to calculate the potential benefits of increasing the number of airports in metropolitan areas served by fewer than three airports. The left panel of table 9 lists the markets, as defined by metropolitan area, served by three or more airports, alongside their populations. The right panel identifies markets served by one or two airports that could plausibly sustain three airports, given that their populations are comparable to markets currently served by three or more airports. We have simply identified those markets as candidates for a cost–benefit assessment; we do not assert that they could sustain more airports with certainty.

[180] In theory, there could be a "delay" channel where airports take actions to reduce delays, which increases effective competition and reduces fares, although, conversely, such action may increase airport demand and raise fares. Regardless, fewer delays would increase consumers' surplus and benefit travelers. However, in practice, airports do not set congestion fees to reduce delays and only a few airports limit flights with slot controls, which raise fares. Efforts to reduce delays by building more runways is likely to generate induced demand—as in the case of highway expansions—and may not have very much effect on delays.

In addition to raw population comparisons, other factors make those markets reasonable candidates for additional airports. For example, Dallas and Houston are large metropolitan areas with millions of passengers flying through their airports annually, while land prices in Texas are relatively low compared with land prices in the rest of the US. The Detroit metropolitan area *did* at one point have three functioning airports—DTW, FNT, and Coleman A. Young International Airport (DET)—but following Detroit's declaration of bankruptcy in 2013, DET was listed as an asset of the city that could be sold to cover debts and it currently does not serve any commercial passengers. Charlotte is currently served by a hub for American Airlines, Charlotte Douglas International Airport (CLT), and could plausibly sustain a third airport in addition to Concord Regional Airport (JQF). St. Louis, which currently has a larger population than Charlotte, also could possibly sustain a third airport in addition to Lambert International Airport (STL) and MidAmerica Airport (BLV). In addition, several large single-airport metropolitan areas could possibly sustain two additional airports, including Atlanta (home to the busiest airport in the world), Seattle, Minneapolis, San Diego, and Denver.

Benefits of Additional Public Airports

We calculate the annual fare savings from adding additional public airports using our parameter estimates from table 4. For the two-airport markets, we calculate the reduction in yields caused by the addition of a third airport, which is the difference between the coefficient estimates for the three-airport dummy and the two-airport dummy: –0.101 – 0.089 = –0.190. This figure represents the percentage change in fares per passenger-mile. We then multiply –0.190 by the annual passenger-miles for the markets. This calculation assumes that the total volume of passenger-miles is unchanged with the addition of a third airport, which provides a

lower bound on total benefits. We estimate that the annual fare savings from adding an additional airport to the five two-airport metropolitan areas shown in Table 9 is roughly $4.1 billion.

Considering the benefits from fare reductions alone is not enough to justify building a new airport because the construction and capital costs may exceed the benefits. Setting the annual savings on fares equal to the annualized capital cost of building an airport allows us to solve for the maximum airport construction cost that would still result in net benefits.[181] The results of this cost–benefit analysis also are reported in Table 9. We estimate that the addition of a third airport in Dallas, for example, would provide net benefits if the cost to build the airport were less than $31.43 billion. We do not know what the cost of a new airport in Dallas would be, but it would likely be far less than $31.43 billion, given that Denver International Airport (DEN) was completed in 1995 at a cost of about $8.2 billion in 2020 dollars.[182] Taking DEN as the baseline, new airports in Houston, Detroit, and Charlotte would almost certainly provide positive net benefits from fare reductions alone.

Table 9 also presents the results of similar calculations for the five largest single-airport markets. The annual savings from adding two additional airports are calculated analogously to the two-airport case, except that we need only the coefficient estimate for the three-airport dummy from Table 4: –0.101. Multiplying –0.101 by the annual passenger-miles for the one-airport markets yields the annual savings on domestic fares. We report the maximum cost *per airport* that would provide net benefits. Building two new airports in Atlanta, for example, would provide net benefits from fare reductions alone if the construction cost for *each airport* were less than $8.56 billion. Given the construction cost of DEN, it is possible that building two new airports in Atlanta

[181] The calculation assumes a 30-year lifetime for the airport and a 3% discount rate.
[182] The costs of building new airports today are likely to be inflated by a modest amount by increasingly higher capital costs and higher costs of environmental review, legal services, and the like.

would provide net benefits, while the cost to build two new airports in Seattle, Minneapolis, San Diego, and Denver would have to be much lower than the cost to build DEN to provide net benefits.

As noted, our estimates of the benefits from fare reductions are conservative because we hold annual passenger-miles constant. Importantly, the *total* benefits from building a new airport include much more than the benefits from fare reductions. Additional airports would attract more airline service and more flights and possibly increase a metropolitan area's economic development (Green (2007)), which would generate significant benefits to travelers and residents and strengthen the case for building additional airports.

A possible argument against the potential benefits of additional airports, associated with Delta Air Lines' operations in Atlanta Hartsfield–Jackson Airport (ATL), a monopoly airport, is that Delta's dominant position has enabled it to develop an extensive network that provides a large choice of nonstop destinations and more frequent service. Delta also has been able to consolidate flow-through traffic to achieve economies of density that reduce its operating costs and fares to some extent. However, there is no reason why Delta's alleged benefits to travelers cannot be subjected to a market test. If an additional airport or airports were built in Atlanta and other airlines entered those airports and provided service, then travelers would reveal their preferred combinations of airline fares, service quality, and airlines. In the process, Delta's market share would be affected in accordance with travelers' preferences, which would leave travelers at least as well off as before the additional airport or airports were built.[183]

[183] If the additional airport or airports were public, the taxpayers would bear the cost if those airports could not overcome Delta's advantage and attracted few carriers and passengers. Airport investors would bear the cost if the additional airport or airports were private, and they would have the incentive to give careful thought to whether a new airport entrant could compete successfully and to vigorously explore alternative strategies following entry to overcome any advantage for Delta that existed.

Another consideration when assessing the potential benefits of new airports is whether air traffic control is significantly disrupted by multiple airports in the same region and whether it is appreciably more difficult with multiple airports to create flight paths that would avoid generating noise over heavily populated areas. We are not aware of evidence that travel in metropolitan areas with multiple airports is compromised by air traffic problems that are more common in such areas or that residents in those metropolitan areas experience more noise than residents in single airport metropolitan areas. In any case, those issues should be addressed efficiently by improving air traffic control services and government airplane noise policies (Morrison, Winston, and Watson (1999)).

Potential Benefits When Airports Are Private

It is important to bear in mind that our estimates of the effects of airport competition are based on an analysis of *public* airports, which have vast pricing, investment, and operating inefficiencies (Winston (2013)). As we have indicated, public airports do not have strong incentives to compete for airlines and travelers, and we have found that those incentives are not increased in the case of pure airport competition even when each airport operates under different airport authorities. In practice, public airports may face opposition from incumbent airlines to build additional terminal space and gates that would enable new carriers to provide service (Winston (2010)).[184] Morrison and Winston (2000) estimated that the restriction on available gates cost travelers $4 billion in higher fares. In addition, Delta is an example of an airline that has made

[184] A few public airports have attempted to overcome that opposition. For example, in 2018, Miami International Airport changed its gate fees policy from per-use to flat monthly fees, which opened the door for Frontier and other low-cost carriers (including Southwest) to enter an airport that had been too costly to use. Passenger Facility Charges (PFCs) have enabled some airports to more easily finance terminal expansions that would have been much harder to do when most airports were locked into long-term leases with legacy carriers that gave them veto power over terminal expansions.

aggressive efforts through lobbying to protect its strong competitive position at ATL by preventing Atlanta-area general aviation airports from adding commercial airline service.

In contrast to US cities, many cities throughout the world, including London, New Delhi, Rome, Sydney, and Tokyo, have privatized their airports subject to varying degrees of regulation. Winston (2013) reports that case studies find that privatization has improved airport efficiency in some countries, and Oum, Yan, and Yu (2008) find in a worldwide comparison of airports that airport privatization has promoted competition and reduced costs. Howell et al. (2022) also finds in their study of airports in more than 200 countries that airport competition leads to efficiency improvements, especially for private airports owned by infrastructure funds.

Suggestive evidence that private airport competition could reduce fares and improve service is provided by the experience of the UK and other European countries. Starkie (2009) concludes that private airport competition in the UK has been an effective regulator of what an airport can charge an airline. Of particular interest to the US is that, like contract rate negotiations that have enabled railroad shippers to obtain lower rates by playing one railroad off against another, UK airports have had to compete for airlines by offering beneficial long-term contracts that stipulate the charge and service quality that an airline can expect from an airport.

Another benefit of UK airport privatization is that the local airport at Luton renamed itself as London Luton Airport and allowed the emerging low-cost carrier Ryanair into the Dublin–London route, which was at a vital stage in its development.[185] Chapter 7 contained an estimate that Ryanair has reduced fares 20% in the European Union markets that it serves. The implication of the UK's experience for the US is that some existing general aviation airports could expand

[185] Luton's local government did not actually sell the assets of the airport, but it granted a long-term operating lease to a private company.

their operations to provide commercial service and generate airport competition in a privatized environment without requiring substantial capital investments.

Still another potential benefit that has emerged from airport privatization abroad is that larger airports are likely to try to attract low-cost carriers with low airport charges to generate large volumes of passengers for their facilities with spare capacity. Smaller airports have anticipated this competition and have attracted low-cost carriers by building special facilities and providing fast turnaround times.

Because private commercial airports in the United States would seek to maximize the return on their investments, they would have stronger incentives than public airports to compete for all types of airlines and to increase passengers by accommodating airlines that wish to serve their airport and that are willing to pay the (marginal) cost of the facilities.[186] United Airlines, for example, recently decided to suspend service at New York's JFK airport because it was unable to obtain sufficient takeoff and landing slots, administered by the Federal Aviation Administration, to offer a schedule of flight frequencies and departure times that would be competitive with the larger flight schedules offered by JetBlue Airways and American Airlines. If JFK were a private airport, it would have an incentive to increase United's operations and its revenues by requesting the FAA to increase United's slots so United could expand its operations and compete more effectively with other carriers serving JFK.[187]

Yan and Winston (2014) simulated the effect of airport privatization on the welfare of airports, carriers, and travelers by developing a model where privatized airports in the San

[186] In 1997, Congress established the Airport Investment Partnership Program, but only a handful of small airports have taken part.

[187] If airports were private, they would be free to set takeoff and landing charges that vary with traffic volumes, which would possibly eliminate the FAA's justification for intervening in certain airports' operations by instituting slots to limit flights at those airports.

Francisco Bay Area with separate owners compete for airline operations by setting profit-maximizing runway charges that reduce delays while airlines compete for passengers. Runway charges are determined through separate negotiations between airlines organized as a bargaining unit and each of the three Bay Area airports, Oakland, San Jose, and San Francisco.

The authors find that by setting different charges for different classifications of airport users (scheduled commercial carriers and general aviation), the Bay Area airports would gain from privatization, as would commercial travelers and carriers. Commercial air travelers would pay higher fares because airport charges to airlines would increase, but the time savings from less-congested air travel would more than offset that additional cost. General aviation would face higher charges, but their losses would be softened if policymakers expanded airport privatization to encourage (smaller) private airports to compete for (smaller) aircraft operations.

It also is possible that some private airports would convert their operations and compete for commercial airline traffic by taking advantage of advances in GPS technology that have improved access to smaller airports, by upgrading runways and gates, and by offering van and rental car service to improve travelers' access to the central city and other parts of the metropolitan area. By having more flight alternatives, travelers in low-density markets could especially benefit if private airports nationwide offered commercial service.

In the context of this analysis, private airport competition could reverse the positive sign of the effect of competition on fares in markets with two airports because private airports are likely to encourage all types of airlines to serve them—that is, carriers that serve domestic short-haul and long-haul markets and international markets—and to compete with other airlines serving the two-airport metropolitan area.

Private airports also could enhance competition by constructing additional terminals for low-cost carriers that were willing to pay for the capacity.[188] This would be a less expensive and more feasible alternative than a new entrant incurring the huge expense of building an entirely new airport. Recall that incumbent airlines could possibly block investments such as new terminals by public airports, but private airports' financial arrangement with airlines would not allow an incumbent airline to prevent a private airport from expanding its capacity to accommodate new airline entrants that were willing to pay the cost of the expanded capacity.

Finally, as private airports shed the inefficiencies that have accumulated in public airports for decades and introduce new policies and operations, pure private airport competition in metropolitan areas with less than three airports may become a channel that reduces airfares and challenges our conclusion based on public airports that such competition has not benefited air travelers. In sum, private airport competition that results in the construction of new airports is likely to generate greater benefits from lower fares and additional service than the estimated benefits that we reported based on public airports.

7. **Final Comments**

Although US airlines have been deregulated for decades, airports are still largely owned and operated by public authorities. We investigated whether public airports compete in the sense of causing fares to decline in metropolitan areas as the number of airports increase. We found that fares are lower when three or more airports serve a metropolitan origin, because those airports facilitate more direct and adjacent competition from low-cost carriers, and they are not segregated to serve different carriers that have different business models.

[188] Some airports, such as Austin–Bergstrom International Airport, have opened new terminals or concourses for ultra-low-cost carriers in recent years.

We estimate that the construction of additional public airports in metropolitan areas served by two and possibly by one airport would benefit travelers by generating billions of dollars in fare reductions and would produce large benefits from additional service. We argue that those benefits are likely to be even greater if airports were privatized and if international airline markets were fully deregulated because US metropolitan areas would be served by more domestic and international carriers that would face fewer barriers from serving airports in those areas. Airline competition in such an environment could result in efficiency gains, technological innovations, and benefits to travelers that we have yet to envision.

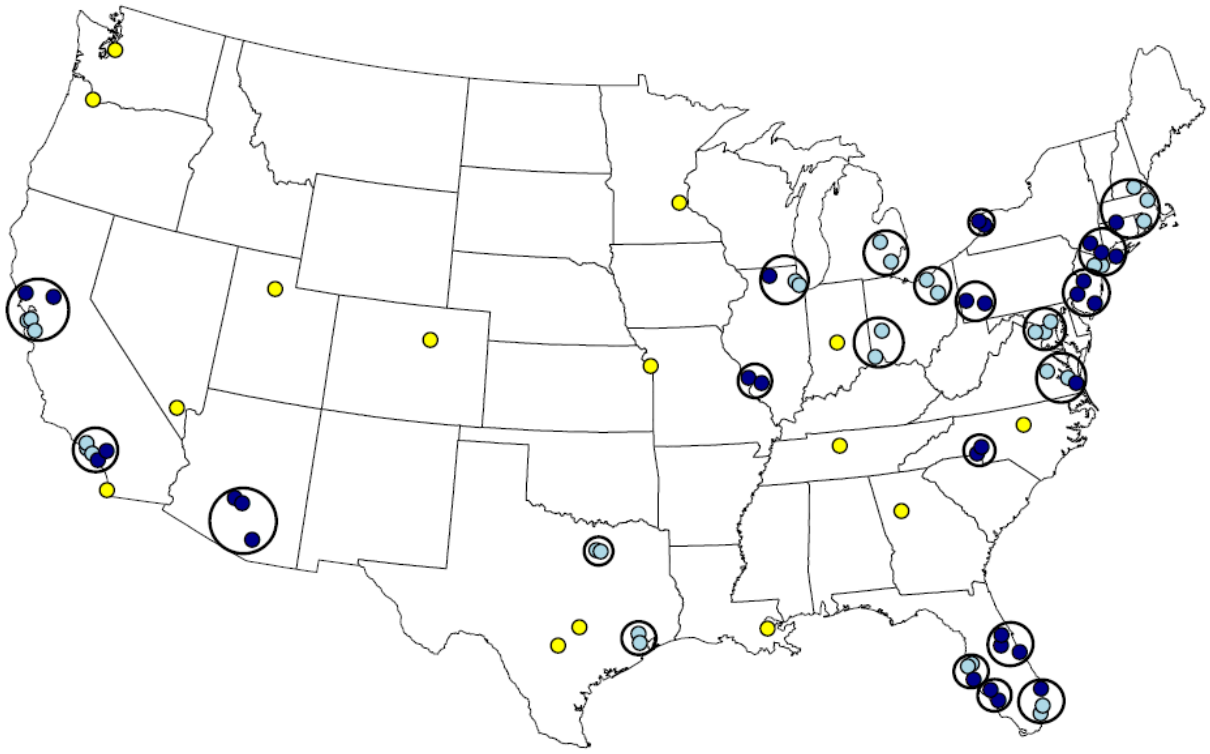
Table 1. Market Definitions

Conservative Market Definition				Liberal Market Definition			
Market	Airports	Radius from Centroid (miles)	Maximum Driving Distance (miles)	Market	Airports	Radius from Centroid (miles)	Maximum Driving Distance (miles)
Chicago	ORD:MDW	5	25	Buffalo	BUF:IAG	10	19
Cincinnati	CVG:DAY	34	78	Charlotte	CLT:JQF	7	22
Cleveland	CLE:CAK	14	51	Chicago	ORD:MDW:RFD	68	95
Dallas	DFW:DAL	5	18	Cincinnati	CVG:DAY	34	78
Detroit	DTW:FNT	13	74	Cleveland	CLE:CAK	16	51
Houston	IAH:HOU	25	30	Dallas	DFW:DAL	5	18
Los Angeles	LAX:BUR:LGB	10	41	Detroit	DTW:FNT	13	74
Miami	MIA:FLL	9	29	Fort Myers	RSW:PGD	8	37
New England	BOS:MHT:PVD	51	105	Houston	IAH:HOU	25	30
New York	LGA:JFK:EWR	8	29	Los Angeles	LAX:BUR:LGB:SNA:ONT	21	58
San Francisco	SFO:OAK:SJC	21	35	Miami	MIA:FLL:PBI	48	72
Tampa	TPA:PIE	6	14	New England	BOS:MHT:PVD:BDL	46	140
Virginia Beach	RIC:PHF	12	62	New York	LGA:JKF:EWR:HNP:ISP:SWF	22	108
Washington	DCA:IAD:BWI	31	58	Orlando	MCO:SFB:MLB	23	75
Maximum		51	105	Philadelphia	PHL:TTN:ACY	32	80
Mean		17	46	Phoenix	PHX:TUS:AZA	48	117
				Pittsburgh	PIT:LBE	54	63
				San Francisco	SFO:OAK:SJC:STS:SMF	55	119
				St. Louis	STL:BLV	22	38
				Tampa	TPA:PIE:SRQ	19	53
				Virginia Beach	RIC:PHF:ORF	24	90
				Washington	DCA:IAD:BWI	31	58
				Maximum		68	140
				Mean		28	68

Sources: Brueckner, Lee, and Singer (2014); Google Maps; authors' calculations.

Notes: Radius from centroid measures the distance in miles as the crow flies from the centroid of the metro area. Maximum driving distance measures the distance in miles via road between the farthest two airports in the market.

Figure 1. Airport Locations and Market Definitions



Notes: The yellow dots are single-airport metropolitan areas. The light blue dots correspond to the conservative definition of multi-airport metropolitan areas. The dark blue dots plus the light blue dots correspond to the liberal definition of multi-airport metropolitan areas, which are encompassed by circles.

Table 2. Mean Yields in Dollars by Number of Airports in the Market, 1993–2019

Number of Airports in the Market	Conservative Market Definition	Liberal Market Definition
One	0.187	0.190
Two	0.185	0.209
Three or more	0.156	0.157
All	0.176	0.176

Sources: Bureau of Transportation Statistics; airportcodes.us; authors' calculations.

Table 3. Cross-Tabulations of Mean Yields in Dollars by Number of Airports in the Market and Hub Classification, 1993–2019

Hub Classification	Three or More Airports	Two Airports	One Airport
Large	0.144	0.208	0.176
	(18)	(7)	(10)
Medium	0.196	0.205	0.189
	(10)	(5)	(20)
Small and nonhub	0.189	0.198	0.251
	(17)	(8)	(266)

Sources: Bureau of Transportation Statistics; airportcodes.us; authors' calculations.
Notes: Statistics are for the liberal market definition. The number of airports in each cross-tabulation is in parentheses.

Table 4. The Effect of Multi-Airport Markets on Yields, 1993–2019

Log Yield (dollars)	Conservative Market Definition	Liberal Market Definition
Two airports	–0.004	0.089**
	(0.049)	(0.039)
Three or more airports	–0.062	–0.101***
	(0.049)	(0.038)
No. of observations	149,320	149,600
R^2	0.729	0.741

Sources: Bureau of Transportation Statistics; Bureau of Economic Analysis; Census Bureau; authors' calculations.

Notes: Regressions include controls for log population at the origin, log income at the origin, distance and distance squared between the origin and destination, destination fixed effects, year fixed effects, and quarter fixed effects. Robust standard errors clustered at the origin metropolitan statistical area are shown in parentheses. Statistical significance is indicated at the ***1 percent, **5 percent, and *10 percent levels.

Table 5. List of Carriers

Name	Notes
Traditional Carriers	
Alaska Airlines	
America West Airlines	Acquired by US Airways in 2005
American Airlines	
Continental Airlines	Acquired by United in 2010
Delta Air Lines	
Hawaiian Airlines	
Northwest Airlines	Acquired by Delta in 2008
Trans World Airways	Acquired by American in 2001
US Airways	Acquired by American in 2015
United Airlines	
Low-Cost Carriers	
ATA Airlines	Acquired by Southwest in 2008
AirTran Airways	Acquired by Southwest in 2014
JetBlue Airways	
Southwest Airlines	
Virgin America	Acquired by Alaska in 2018, which remains a traditional carrier
Ultra-Low-Cost Carriers	
Allegiant Air	
Frontier Airlines	
Spirit Airlines	
Sun Country Airlines	

Source: Bureau of Transportation Statistics.

Table 6. Yields, Multi-Airport Markets, and Number of Carriers by Classification, 1993–2019

Log Yield (dollars)	(1)	(2)	(3)
Two airports	0.089**	0.109***	0.104***
	(0.039)	(0.035)	(0.034)
Three or more airports	–0.101***	–0.035	–0.029
	(0.038)	(0.032)	(0.031)
Number of traditional carriers			–0.009
			(0.006)
Number of low-cost carriers		–0.061***	–0.050***
		(0.010)	(0.010)
Number of ultra-low-cost carriers			–0.026***
			(0.008)
No. of observations	149,600	149,600	149,600
R^2	0.741	0.746	0.748

Sources: Bureau of Transportation Statistics; Bureau of Economic Analysis; Census Bureau; authors' calculations.

Notes: Results are for the liberal market definition. Regressions include controls for log population at the origin, log income at the origin, log of distance and distance squared between the origin and destination, destination fixed effects, year fixed effects, and quarter fixed effects. Robust standard errors clustered at the origin metropolitan statistical area are shown in parentheses. Statistical significance is indicated at the ***1 percent, **5 percent, and *10 percent levels.

Table 7. Yields in Dollars, Hub Classification, and International Market Penetration, 1993–2019

Market	Hub Class	Yield	% Int'l
Buffalo			
BUF	Medium	0.222	0.0
IAG	Non-Hub	0.082	0.3
Charlotte			
CLT	Large	0.284	4.5
JQF	Non-Hub	0.111	0.0
Cincinnati			
CVG	Large	0.251	3.2
DAY	Small	0.304	0.0
Cleveland			
CLE	Large	0.191	0.6
CAK	Small	0.193	0.0
Dallas			
DFW	Large	0.203	4.3
DAL	Medium	0.228	0.0
Detroit			
DTW	Large	0.190	7.5
FNT	Small	0.163	0.0
Fort Myers			
RSW	Medium	0.141	1.0
PGD	Non-Hub	0.086	0.0
Houston			
IAH	Large	0.196	10.7
HOU	Medium	0.216	0.5
Pittsburgh			
PIT	Large	0.223	1.3
LBE	Non-Hub	0.075	0.1
St. Louis			
STL	Large	0.201	0.6
BLV	Non-Hub	0.091	0.3
Chicago			
ORD	Large	0.181	9.8
MDW	Large	0.151	0.3
RFD	Non-Hub	0.100	0.0
Los Angeles			
LAX	Large	0.120	19.2
BUR	Medium	0.260	0.0
LGB	Small	0.153	0.0
SNA	Medium	0.201	0.0
ONT	Non-Hub	0.198	0.1
Miami			
MIA	Large	0.146	43.7
FLL	Large	0.117	10.3
PBI	Medium	0.148	0.7
New England			
BOS	Large	0.173	12.5
MHT	Medium	0.237	0.0
PVD	Medium	0.206	0.4
BDL	Medium	0.190	0.5
New York			
LGA	Large	0.219	0.5
JFK	Large	0.110	49.1
EWR	Large	0.162	22.8
HPN	Small	0.303	0.3
ISP	Small	0.145	0.0
SWF	Non-Hub	0.193	3.6
Orlando			
MCO	Large	0.139	7.1
SFB	Small	0.093	36.2
MLB	Non-Hub	0.242	0.2
Philadelphia			
PHL	Large	0.178	9.0
TTN	Non-Hub	0.110	0.0
ACY	Small	0.097	0.1
Phoenix			
PHX	Large	0.155	0.5
TUS	Medium	0.200	0.0
AZA	Non-Hub	0.092	1.6
San Francisco			
SFO	Large	0.136	16.8
OAK	Large	0.172	0.7
SJC	Medium	0.177	1.1
STS	Non-Hub	0.274	0.0
SMF	Medium	0.197	0.0
Tampa			
TPA	Large	0.159	1.7
PIE	Small	0.095	0.1
SRQ	Small	0.191	0.0
Virginia Beach			
RIC	Small	0.370	0.5
PHF	Small	0.224	0.0
ORF	Medium	0.302	0.0
Washington			
DCA	Large	0.259	0.3
IAD	Large	0.170	25.0
BWI	Large	0.166	2.4

Source: Bureau of Transportation Statistics. *Note:* Percent international is the percentage of passengers with destinations outside of North America.

Table 8. Share of Markets Served by and Number of Low-Cost Carriers, 1993–2019

	Share of Markets Served		Number of Carriers Serving			
Number of Airports in the Market	Low-Cost Carriers	Ultra-Low-Cost Carriers	All Carriers	Traditional Carriers	Low-Cost Carriers	Ultra-Low-Cost Carriers
One						
Large hubs	0.870	0.814	10.93	7.00	1.85	2.08
	(0.336)	(0.390)	(2.57)	(1.72)	(1.17)	(1.41)
Medium hubs	0.899	0.643	8.46	5.64	1.45	1.37
	(0.301)	(0.479)	(1.83)	(1.63)	(0.84)	(1.26)
Two	0.920	0.749	9.55	5.78	1.92	1.85
	(0.271)	(0.434)	(1.89)	(1.62)	(0.97)	(1.42)
Three or more	0.973	0.906	12.25	6.87	2.79	2.59
	(0.162)	(0.292)	(2.31)	(1.76)	(1.07)	(1.41)

Sources: Bureau of Transportation Statistics; authors' calculations.
Note: Statistics are for the liberal market definition. Standard deviations are shown in parentheses.

Table 9. Aggregate Consumer Savings from Expanding to Three Airports

Three-Airport Markets		Two-Airport Markets			
Market	Population (million)	Market	Population (million)	Annual Savings on Fares ($ bil.)	Breakeven Airport Construction Cost ($ bil.)
New York	19.22	Dallas	7.57	1.604	31.43
Los Angeles	13.21	Houston	7.07	0.837	16.41
Chicago	9.46	Detroit	4.32	0.605	11.85
New England	7.70	St. Louis	2.80	0.262	5.13
Washington	6.28	Charlotte	2.64	0.790	15.49
Miami	6.17	Total	24.40	4.098	
Philadelphia	6.10	One-Airport Markets			
Phoenix	6.00	Atlanta	6.02	0.874	8.56
San Francisco	4.73	Seattle	3.98	0.594	5.82
Tampa	3.19	Minneapolis	3.64	0.393	3.86
Virginia Beach	3.06	San Diego	3.34	0.276	2.70
Orlando	2.61	Denver	2.97	0.708	6.94
Total	87.73	Total	19.95	2.844	

Sources: Bureau of Transportation Statistics; Census Bureau; authors' calculations.
Notes: Results are for the liberal market definition. Annual savings on fares measures the total annual reduction in fares for all domestic flights from the market. Breakeven airport construction cost is per airport and is found by setting the annualized capital cost of building an airport equal to the annual savings, assuming a 30-year lifetime and a 3 percent discount rate. Populations are for 2019 metropolitan statistical areas. The New England market includes Boston, Manchester, Providence, and Hartford. The Phoenix market includes Tucson. The Virginia Beach market includes Richmond.