Airports and Economic Development

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I. Introduction

The popular press and local economic development boosters often cite hub airports as mechanisms for helping metropolitan areas grow. We will present a number of examples of such boosterism below. Moreover, there are a variety of literatures that touch on the importance of infrastructure in general, and airports in particular, to economic development, and also on the financing of such infrastructure.

Yet so far as I can tell, there have been a limited number of studies that have looked at the impact of airports on regional growth (Brueckner 2003 being the key exception). In light of the many claims that have been made about the importance of airports to economic activity, this may seem surprising. Indeed, we may draw a contrast with the sports stadium literature, which contains a large number of papers (see, e.g., Zimbalist 2001). That literature, which generally produces evidence that stadiums are not important to economic development, involves a type of infrastructure which is much less costly than airports and which has much less *direct* influence on both business and consumption than airports. In fact, one of the things that makes airports inherently interesting is that roughly two million people take a commercial flight every day (see FAA 2001), so many people can relate to the issues surrounding them.

Airports are also controversial. It seems that for every business leader who wants to see his or her local airport expand, there is a resident in the flight path of an airport who wants to see his or her local airport's traffic capped, if not reduced. Clearly airports create some negative externalities (although Tomkins and colleagues 1998 suggests that they are not as large as most people think), so it would be interesting to know whether the positive externalities they create are sufficiently large to offset their noise, pollution and aviacide.

So the question remains why airports have not been the subject of much careful study with respect to their impact on economic development. The answer lies with a difficult econometric issue: simultaneity. While there is a strong correlation between air traffic and economic growth, the direction of causation is not entirely clear. It is certainly reasonable to posit that airports lead to economic development, but it is also reasonable to posit than economic development leads to airport traffic. This paper attempts to deal with this issue by taking advantage of two things: a panel and two instruments.

The paper proceeds as follows. It begins with a review of some popular press pieces on the importance of airports. It follows with a discussion of various economic literatures involving airports. Next it turns to past econometric models of infrastructure and economic development, and includes a discussion of methods for avoiding the sorts of simultaneity problem discussed above. It then discusses model specification and data, and finally presents some regression results. It finishes with some speculations arising from the regression results.

II. The popular view of airports

Many recent newspaper stories make the case that good airport service enhances economic development—and that poor airport service discourages it. Recent stories from Cincinnati, Cleveland, New York, Dallas and Los Angeles provide useful examples. Consider the following excerpt from an October 1999 story in the Cleveland *Plain Dealer:*

"The Cincinnati/Northern Kentucky International Airport – located in Boone County in northern Kentucky, 13 miles from downtown Cincinnati – has blossomed into one of the busiest and fastest-growing in the country, now featuring daily nonstop flights to five European cities.

> Business and government leaders believe its spin-off effect on the surrounding region, in terms of economic development, has been powerful. Consider, for example, that the number of foreign-owned companies in the region has more than tripled since 1987 – from 70 to about 250 today.

> Last year, a study by the Aviation Policy Program at George Mason University found that the number of high-technology jobs in Cincinnati region had jumped from about 65,000 in 1989 to almost 80,000 in 1996. The study pegged the region's strong hub airport as an important factor in growth.
>
> 'Invariably, for new companies coming to the area, they cite air service as a critical factor,' said Joseph Kramer, vice president of economic development for the Greater Cincinnati Chamber of Commerce."

A Los Angeles Times story looks enviously at Dallas, when it notes:

"DFW, the nation's second-busiest airport, has been a catalyst for some of the most impressive employment and population growth in the U.S. since 1970, when construction of DFW got underway. Airport officials here talk about DFW as the "engine" of the region's spectacular economic growth.

> The number of jobs in the Metroplex, as the four county region surrounding the airport is known, has soared more than 148%, according to the U.S. Department of Commerce. Nationally, employment over the same period grew 67%."

The point gets made over again in other stories dealing with the capacity constrains facing New York City and Los Angeles travelers, and the relatively low level of service at Cleveland Hopkins Airport. Clearly many reporters in the popular press have a maintained hypothesis that airports matter to economic development, but they have not put the hypothesis to a systematic test. Remarkably, as we shall see below, with one exception, no one else has either.

III. Literature

There are four strands of literature relevant to the issues of airports and economic development: the public finance literature, the economic development literature, urban literature on the impact of transportation on agglomeration economies, and the "airport" literature. We briefly discuss each of these in turn.

Public Finance

A cornerstone of the public finance literature is the identification, provision and evaluation of public goods. Airports (more specifically runways)[1] could well qualify as impure public goods, because until they are congested, they are non-rival in consumption. As such they are like highways. Therefore, in determining the efficient provision of airports, we must sum individuals' willingness to pay for such services. In particular, the Samuelson rule tells us that in a world of N consumers, the optimal equilibrium relationship between a public and private good must be

$$\sum_{i=1}^{N} \frac{U_Z^i}{U_X^i} = \frac{f_Z}{f_X}$$

where i denotes the individuals, U is a standard twice differentiable concave utility function, Z is the public good, X is the private good, and f(X,Z) is the production possibilities frontier between X and Z. The community has one common Z, which in this case could be the number of runways that can handle commercial airplanes. Individuals choose their own level of Xs.

The key policy issue, then, is the determinant of the marginal utility of runways to all the individuals in the community. The sum of these will determine the point on the marginal rate of transformation curve that the community should choose. Presumably, the key elements for determining marginal utilities of airports will be the convenience given to individuals arising from air service, and the robustness of the labor market within which individuals participate. Should we find evidence that economic opportunity grows with airport activity, we will find evidence that the marginal utility of airports is greater than the marginal utility gained by those who fly.

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[1] It is important to distinguish runways from boarding gates: runways are quasi-public goods, gates are private goods.

Economic Development

The economic development literature focuses on empirical studies of the effect of government policies on economic outcomes. Bartik (1991) and Malpezzi (2002) provide excellent reviews of this literature. Specifically, they looked at the roles of taxes (income, sales, corporate and property), government services, industrial mix, and human capital and agglomeration on economic development. We will expand further on this in our discussion of model specification later in the paper. For now, suffice it to say that *ceteris paribus*, we know that the following statements are likely to be true: metropolitan areas and municipalities with lower taxes "perform better" than metropolitan areas and municipalities with higher taxes; places with higher levels of government services perform better than places with inferior government services;[2] places with industrial mixes focused in high employment growth industries perform better than places with industrial mixes in low employment growth industries (i.e., places concentrating in business services have performed better than places concentrating in manufacturing),[3] places with relatively high concentrations of college graduates perform better than places with relative low concentrations of college graduates (see Glaeser 1998), and larger places generally perform better than smaller places (although there is a size at which this advantage becomes exhausted. (see Quigley 1998)).

Generally economic performance is measured in terms of employment growth, population growth and/or income growth. We will focus on population and employment in this paper.

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[2] It is here that the ceteris paribus point is especially important—the importance of taxes can only be identified when we control for services, and vice versa. This has created problematic results for studies that look at only one or the other, because the two are correlated. For example, taxes in a regression not controlling for government services might not appear to have a significant impact on economic performance, because the unmeasured positive impact of services might offset the measured potentially negative impact of taxes.

[3] Although a new working paper by Malpezzi, Seah and Shilling (2002) shows that the competitiveness of individual corporations is even more important than industrial mix.

Deno and Eberts (1991) made a particularly important contribution when they studied the impact of infrastructure on economic development. They found that over the period of time they studied, government investments in infrastructure have produced a greater rate of return than private investment capital, and that government investment enhances return to private capital. This suggests that the opportunity cost of public capital (i.e., the use of taxes that divert resources away from private capital) has at times been lower than the benefits it has produced. The Eberts result is quite old, however, and it is quite possible that in the time since that study was published, government has developed infrastructure to the point where its returns have fallen to or below the levels produced by private capital.

Transportation and Agglomeration Economies

Classic works document the relationship between the development of transportation infrastructure and the development of cities. Douglas North's (1981) book, which discusses the relative importance of canals and rails to the development of the Midwest, and William Cronon's (1991) treatise on the development of Chicago are touchstones of this literature.

More recently, Gasper and Glaeser (1998) and Vandell and Green (2001) have looked at the effect of the Internet on agglomeration economies in general, and have suggested that the Internet could be a complement, as well as a substitute, for agglomeration. It is certainly true that the Internet can replace some meetings—emails and chat rooms enable people to communicate easily without being near one another. On the other hand, because the Internet puts more people in touch with each other, there are more possible combinations of people who might wish to meet, either for business or social purposes. Consequently, it is possible that the Internet has and will continue to generate more air traffic than would exist in its absence. This puts cities that are in a position to handle air traffic demand in a stronger position than those that are not.

Airports

The literature contains a substantial number of papers about airports. For example, there are at least 42 papers listed in *Econlit* that deal with congestion pricing issues, and a few dozen on airport finance. However, so far as I can tell, there has been only one paper that has dealt with airport locations (Brueckner 1985) and two that have looked at the impact of airports on economic development (Bennell and Prentice 1993 and Brueckner 2003). The first Brueckner paper will provide an important foundation for this one, because it suggests potential instruments for airport activity. The second Brueckner paper finds that for every 10 percent gain in passenger traffic in a metropolitan area, there is a 1 percent gain in service employment. This paper differs from Brueckner in that it uses a richer set of explanatory variables, looks at four different measures of airport activity, and uses different instruments for dealing with the simultaneity issues involving airport traffic and economic development. It also has a more specific measure of airport capacity than the Brueckner paper.

The Bennell and Prentice paper looks only at the direct employment effects of airports in Canada—it does not look at their influence on the relative competitiveness of metropolitan areas. There have been a number of consulting studies that have used regional analysis to look at the impact of individual airports on their regions, but again, these studies have tended not to perform cross-metropolitan comparisons, and have not used statistical analysis to glean the impact of airports.

IV. Modeling Issues

There can be no doubt that there is a strong correlation between the presence of an airport and economic success. Figure 1 plots boardings per capita4 in 83 metropolitan areas in 1990 against population growth in those areas between 1990 and 2000. The pattern is unmistakable, and indeed a regression of population growth on boardings alone yields an R^2 of .4.

The problem with relying on correlation is two-fold. First, the direction of causality is not *a priori* clear. While good airport service could lead to economic success, economic success could also lead to good airport service. To some extent we control for this by looking at the relationship between boardings in 1990 and growth patterns that occurred afterward. But we have not necessarily solved our problem. Suppose, for instance, a metropolitan area had companies that promised to expand once they observed adequate air service. Local government officials would have an incentive to attract hubs and build airport capacity before an expansion was actually observed. Consequently, it would be the *promise* of economic development that led to good air service, and good air service would not have been the principal cause of economic development.

In attempting to deal with this possibility, I estimate models using actual measures of airport service and instrumented measures. One idea for an instrument source comes from Brueckner (1985), whose paper looks at the determinants of hub airport location. The determinants include such things as population, whether a Metropolitan Statistical Area (MSA) is a state capital, etc. One of Brueckner's variables reflects geographic location—it simply gives the distance an airport is from a fixed point. This variable has two virtues: it is clearly exogenous, and it presumably has no impact per se on economic development. As such, the variable allows us to identify the impact of airports, because we may include it in the structural equation for airport location and exclude it from the structural equation for economic development.

Another instrument is lagged population growth. Past population growth could explain why airport traffic is heavy in a metropolitan area, but cannot be explained by future population or employment growth. Holz-Eakin, Newey and Rosen (1988) discuss the virtues of lagged values in a panel as instruments.

Finally, we add a capacity measure to explain traffic that is more explicit than Brueckner's slots measure: the number of runways of different lengths in metropolitan areas. For each area, we count the number of runways with lengths of less than 5,000

[4] I discuss the data sources for this measure below.

feet, the number with lengths of 5000-7999 feet, and the number in excess of 8,000 feet. These measure capacity for commuter planes, for non-widebody planes, and for widebody planes, respectively.

To these we add other explanatory variables for airport activity, including proximity to a city with a large or medium hub, as those terms are defined by the FAA, per capita income, and industrial structure.

Putting this together, we have a two-equation model that is

$$y_1 = y_2\gamma_1 + X_1\mathrm{B}_1 + \varepsilon_1 \quad (1)$$

and

$$y_2 = y_1\gamma_2 + X_2\mathrm{B}_2 + \varepsilon_2 \quad (2)$$

where

$y_1 \equiv \textit{airport measure}$

$y_2 \equiv \textit{economic development measure}$

$X_1 \equiv \textit{vector of explanatory variables}$

$X_2 \equiv \textit{vector of explanatory variables that excludes at least one variable in } X_1$

and

$\varepsilon_i \equiv \textit{residuals for } i = 1,2$

Estimation techniques for such a model may be found in many econometrics texts, including Goldberger (1991).

The distance instrument that I use is somewhat different from Brueckner, in that I use two distance measures: distance to Kansas City (to capture the benefit of having a hub airport in the middle of the country), and distance to the nearest coastline (to capture the asymmetry in flight patterns arising from the fact that no one lives in an ocean). Arcinfo allows me to find the nearest distance from each airport to the coastline.[5]

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[5] I owe Joe Walsh a debt of thanks for doing this for me, and for showing me how to do it.

The model specification in this paper differs from the second Brueckner paper in two other respects: he assumes the impact of airport traffic on economic development is contemporaneous, while I assume it operates with a lag; he uses one measurement of airport activity, total boardings, while I use boardings per capita, originations per capita, cargo per capita and hub status.

V. Data and Control Variables

Measuring Airport Activity

We use four measures of airport activity. The first measures we use of airport activity are boardings and passenger originations per capita in each metropolitan area. We begin with data from Federal Aviation Administration[6] on the number of passenger boardings at the 100 largest airports in the country. We stop at the arbitrary ranking of 100, because at that point we observe airports that are small enough that they likely have little economic impact, and because the airports are in locations where there would almost certainly never be a major airport.

When there is more than one airport in a metropolitan area, we combine boardings to get an MSA total. We go to the Consolidated Metropolitan Area level of aggregation, because airports within a CMSA presumably reflect a single market for air service. For example, we combine boardings at San Francisco International Airport, Oakland International Airport, and San Jose International Airport, under the assumption that they are near substitutes for one and other in a well-integrated CMSA. We then divide boardings by CMSA population in 1990[7] to get boardings per capita. This procedure produces 83 observations.

MSA boardings per capita rankings are presented in Table 1. Note that among the leading MSAs are Las Vegas, Orlando, and Atlanta, which are also places that have experienced rapid growth. The quirk is Portland, Maine, a place that has had relatively

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[6] These data come from www.transdata.bts.gov.

[7] These data are taken from the 1990 census of population and housing.

little population growth, and yet has an unusually large airport for a city of its size. Because it is such an outlier, we run sets of regressions that include and exclude Las Vegas: the impact of excluding Las Vegas is inconsequential.[8]

The interpretations of boardings and originations as variables are somewhat different. Boardings represent total airport activity, but could in principal have little spillover beyond the airport itself. Imagine an airport that was designed just to be a hub: one without any passenger originations. Presumably then its only initial economic benefit would be to create jobs at the airport. Nevertheless, the agglomeration of travelers might well ultimately create other job opportunities and cause a city to arise. On the other hand, passenger originations tell us directly how an airport creates economic activity, because it shows how many people are being directly delivered to an economic activity. As we shall see, both measures predict economic activity strongly.

The third measure of activity is whether a city has an airport that is a hub for a major carrier. It is worth examining whether bringing people to an airport to change planes spills over into economic activity for a region.

The final measure is cargo activity. This measure is analogous to boardings per capita, except that we use cargo tonnage per capita instead. The boardings measure presumably reflects the impact of airports arising from business and tourist development; the cargo measure reflects the impact of airports arising from distribution.

Measures of Economic Development

We look at two measures of economic development: population growth from 1990 to 2000 and employment growth from 1990 to 2000. These measures are quite obvious: people tend to move to places with economic opportunity, and so places that perform well economically tend to grow. Employment growth is such a direct measure of economic performance that it requires no further comment.

[8] Results excluding Las Vegas are available upon request.

Control Variables

The regressions explaining population and employment growth contain the following variables: property, corporate and income tax rates, heating and cooling degree days, the share of the population over the age of 25 with high school diplomas, and the share with college degrees, the share of employment in the finance, insurance and real estate (FIRE) sector, the share of employment in the manufacturing sector, the population in 1990, whether the state is a right-to-work state, and average commuting time. All variables are from 1990, and, unless otherwise noted, come from the 1990 census of population and housing. We explain the reasons for their presence briefly below.

Tax Variables

After controlling for government services, taxes seem to have an impact on economic development. We therefore look at three tax variables in the regression equations: the top marginal personal state tax rate for a metropolitan area, the top marginal corporate rate for a metropolitan area~~s~~, and the average property tax rate for a metropolitan area. The state and corporate marginal tax rates were taken from the Statistical Abstract of the United States, and the property tax rate is Stephen Malpezzi's tabulation of effective average property tax rates for each Metropolitan Area from the 1990 census. When a metropolitan area lies in more than one state, we use the tax rates of the central city of the metropolitan area. For example, the marginal tax rate for Washington D.C. is that city's rate, and does not consider the rates for Maryland and Virginia. This may be a measure that we wish to revisit in later versions of the paper.

Climate Variables

As a proxy for the mildness of climate, we use average heating and cooling degree-days for each MSA as reported by the National Oceanic and Atmospheric Administration. Places that are cold have large numbers of heating degree-days; places that are warm have large numbers of cooling degree-days. Since World War II, there has of course been a major migration to the Sunbelt from the Northeast and Midwest. A likely explanation for this is that air conditioning made places such as Houston, Dallas and Phoenix tolerable in the summer. Consequently, if we wish to explain population growth across American MSAs, we must have some controls for climate.

Human Capital Variables

The importance of education to economic development is well established (Malpezzi 2002, Bartik 1999). Glaeser (1998) shows that college graduates create positive externalities for non-college graduates in the labor force. We therefore include as a control variable the percentage of the population above the age of 25 with high~~er~~ school diplomas and college degrees. The data come from the 1990 census of population and housing.

Industrial Structure

We measure the industrial structure of metropolitan areas using data from the County Business Patterns. Specifically, we look at the share of employment in manufacturing, the share of employment in the FIRE sector. We choose manufacturing employment as a variable because over the course of the 1990s, manufacturing employment grew much more slowly than overall employment; conversely, FIRE grew much more quickly.

Unionization Variables

Grimes and Ray (1988) suggest that the presence of right-to-work laws can have an impact on employer location decisions and therefore economic growth. We therefore include a dummy variable for whether an MSA is in a Right to Work State or not.

Average Commuting Time

While large cities reap the benefits of agglomeration economies, after a point they also produce negative externalities. Principal among these is congestion (see, e.g. Tabuchi and Yoshida (2000). We therefore include average commuting time as measured from the 1990 Census as an explanatory variable.

VI. Results

First stage regressions

We begin with the first stage results, which are reported in Table 2. The first column reports the results for boardings per capita; the second for originations per capita, the third for hub status and the fourth for cargo tonnage per capita.

With respect to the boardings, originations and hub first stage equations, the news is good. With other controls in place, previous decade population growth and runway capacity do a good job of explaining airport activity. On the other hand, proximity to Kansas City and the nearest coastline do not do a good job of explaining boardings or originations per capita and hub status. Airports within 100 miles of a large hub have less activity. Industrial makeup and the presence of a state capital do not seem to influence passenger activity.

The first stage cargo equation, on the other hand, works poorly—the only thing that seems to explain cargo traffic well is the presence of a long runway. But in light of the fact that moving cargo has become increasingly automated, this result should not be too surprising.

Featured Regressions

We now turn to our featured regression results, which are presented in Tables 3, 4, 5 and 6. Table 3 contains the regressions that use boardings per capita as an explanatory variable. Columns one and two give the OLS and IV regressions explaining population growth; columns three and four give the OLS and IV regressions explaining employment growth. We have complete sets of variables for 83 metropolitan areas.

We begin with population growth. Whether we use the OLS or the IV regressions, we find that boardings per capita in 1990 has a substantial impact on population growth from 1990 to 2000. Both the OLS and IV regressions have boardings per capita t-statistics that exceed 5, and the magnitude if the IV coefficient is greater than the magnitude of the OLS coefficient. The coefficient of .039 on the IV regression means that one standard deviation increase in boardings per capita would produce a 13 percent increase in decadal population growth. In the context of a country that had overall population growth of 13 percent over the course of the 1990s, this is a substantial number. Other variables which are statistically significant include the human capital variables, whether an MSA has a state capital, and heating degree days (warm places grow faster than cold places). This is consistent with past literature (Glaeser and Shapiro 2003).

Now let us turn to job growth. Note again that the coefficient on job growth in both the OLS regression and the IV regression are significant at the 99 percent level. Once again, the magnitude of the coefficient in the IV regression is higher than it is in the OLS regression. If we use the IV regression coefficient, we find that a one standard deviation increase in boardings per capita produces a 9.3 percent increase in employment growth.

Table 4, which features passenger originations per capita instead of boardings, looks remarkably similar to Table 3: the coefficients on airport activity are of similar magnitude and of similar significance. Thus the result is robust to whatever measure we use of passenger activity.

Finally, Table 5 contains the regressions that use hub status as an explanatory variable. MSAs are deemed to have hubs if they were designated hubs by one of the nine major airlines (United, American, Delta, Northwest,-Continental, US Air, Southwest, TWA and American West) in 1990.

Once again we begin with population growth. Whether we use the OLS or the IV regressions, we find that hub status in 1990 has a substantial impact on population growth from 1990 to 2000. Astonishingly, the results imply that hub cities grew between 9 and 16 percentage points faster than non hub cities.

Job growth in hub cities was similarly impressive. Again, the coefficient on hub status is significant, whether we look at the OLS or the 2SLS result, and once again, the magnitude is large, implying that hub cities saw employment grow between 8.4 and 13.2 percent faster than in non-hub cities.

But when we turn to the cargo regressions, we find that we get no action at all. A look at the raw data shows that this is not surprising: the two large cargo hubs are Memphis (the home of Federal Express) and Louisville (the home of UPS), and neither of these places are fast-growth MSAs. To trot out a cliché, airports that serve business travelers are serving “knowledge based businesses,” while those that ship cargo are not. While there is anecdotal evidence that companies have located warehouses near Memphis and Louisville, warehouses have become increasingly automated, and warehouse and distribution jobs tend not to be at the top end of the pay scale. It is therefore perhaps not surprising that cargo has little predictive power for economic development.

VII. Conclusions

This paper sought to find a relationship between airport activity and economic development, and it found one. Passenger boardings per capita and passenger originations per capita in the nation's largest metropolitan areas are powerful predictors of population growth and employment growth. This is the case after a number of controls are put in place, and survives after an attempt to control for simultaneity issues. Beyond statistical significance, the magnitude of the coefficient on boardings per capita indicates that the magnitude of the effect of passenger boardings on these two measures of economic development could be rather large. It might particularly suggest that where airports are constrained by capacity (such as they are in Chicago, Boston, New York and Los Angeles), adding to capacity might well have an important economic development impact. That said, these results do not suggest that every small city should run out and build a large airport.

Of course the results presented here are far from conclusive: they are, perhaps, among the first of their kind (this paper was written contemporaneously with Brueckner 2003), and are therefore subject to far more scrutiny. Nevertheless, their statistical significance is sufficiently strong that it survives a large variety of alternative specifications. The results are also consistent with the findings in Brueckner.

The policy implications of this finding are therefore quite important. The political economy of airports is very much a function of their governance structure. The cost (at least the perceived cost) of airports to members of a community is highly concentrated geographically, while the benefits tend to be diffused throughout the community. Airports are sometimes under the control of local units of government, such as city councils or county boards. When this is the case, representatives whose districts include an airport have a strong incentive to become members of the airport authority. Consequently, decisions about airports can be based on parochial interests, even if the total benefits of the airport to the economy exceed the cost. Should air traffic be a large determinant of economic success, it is entirely possible that the benefits of new or expanded airports exceed costs.

Yet we have observed that in many places (San Francisco, Boston, Milwaukee), interest groups have worked to inhibit runway expansion, while in other places (Chicago), local political squabbles have prevented any number of potentially reasonable plans for expanding airport capacity from going forward in a timely manner. All this suggests that airport policy might best be made regionally, rather than locally. Of course, the regional policy would have to include a scheme for compensating those injured by airport expansion. But if the regional benefits of airport development are large, the costs of fair compensation should be easy to finance.

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Table 1
Boardings per Capita in 1990 ranked by MSA

1	Las Vegas, NV - AZ MSA	16.76
2	Portland, ME MSA	13.71
3	Atlanta, GA MSA	10.64
4	Orlando, FL MSA	8.42
5	Dallas - Fort Worth, TX CMSA	8.26
6	Denver - Boulder - Greeley, CO CMSA	7.88
7	Charlotte - Gastonia - Rock Hill, NC - SC MSA	7.86
8	Raleigh - Durham - Chapel Hill, NC MSA	7.05
9	Reno, NV MSA	7.03
10	Phoenix - Mesa, AZ MSA	6.96
11	Fort Myers - Cape Coral, FL MSA	6.72
12	Salt Lake City - Ogden, UT MSA	6.25
13	Miami - Fort Lauderdale, FL CMSA	4.98
14	Albuquerque, NM MSA	4.90
15	Memphis, TN - AR - MS MSA	4.35
16	Nashville, TN MSA	4.32
17	Minneapolis - St. Paul, MN - WI MSA	4.07
18	West Palm Beach - Boca Raton, FL MSA	3.96
19	Chicago - Gary - Kenosha, IL, IN, WI CMSA	3.94
20	St. Louis, MO - IL MSA	3.91
21	Houston - Galveston - Brazoria, TX CMSA	3.87
22	Austin - San Marcos, TX MSA	3.59
23	San Francisco - Oakland - San Jose, CA CMSA	3.46
24	Pittsburgh, PA MSA	3.25
25	El Paso, TX MSA	3.25
26	Seattle - Tacoma - Bremerton, WA CMSA	2.98
27	New Orleans, LA MSA	2.72
28	Tampa - St. Petersburg - Clearwater, FL MSA	2.68
29	Washington - Baltimore, DC - MD - VA-WV CMSA	2.67
30	Boise City, ID MSA	2.59
31	Sarasota - Bradenton, FL MSA	2.44
32	Tucson, AZ MSA	2.40
33	Spokane, WA MSA	2.39
34	Kansas City, MO - KS MSA	2.38
35	San Diego, CA MSA	2.37
36	Tulsa, OK MSA	2.37
37	San Antonio, TX MSA	2.35
38	Cincinnati - Hamilton, OH - KY – IN CMSA	2.34

Table 1 (cont.) Boardings per Capita ranked by MSA

39	Cedar Rapids, IA MSA	2.30
40	Savannah, GA MSA	2.29
41	Indianapolis, IN MSA	2.19
42	Portland - Salem, OR - WA CMSA	2.13
43	Little Rock – North Little Rock, AR MSA	2.11
44	Hartford, CT MSA	2.10
45	Detroit - Ann Arbor - Flint, MI CMSA	2.08
46	Sioux Falls, SD MSA	2.01
47	Des Moines, IA MSA	1.95
48	Dayton - Springfield, OH MSA	1.94
49	Boston - Worcester - Lawrence, MA-NH-ME-CT CMSA	1.84
50	Los Angeles - Riverside - Orange County, CA CMSA	1.81
51	Colorado Springs, CO MSA	1.81
52	Oklahoma City, OK MSA	1.79
53	Omaha, NE - IA MSA	1.74
54	New York – Northern New Jersey - Long Island, NY-NJ-CT-PA CMSA	1.71
55	Jacksonville, FL MSA	1.70
56	Syracuse, NY MSA	1.55
57	Huntsville, AL MSA	1.52
58	Columbus, OH MSA	1.43
59	Sacramento - Yolo, CA CMSA	1.42
60	Cleveland – Akron, OH CMSA	1.38
61	Buffalo - Niagra Falls, NY MSA	1.35
62	Charleston – North Charleston, SC MSA	1.35
63	Madison, WI MSA	1.35
64	Columbia, SC MSA	1.34
65	Birmingham, AL MSA	1.31
66	Milwaukee - Racine, WI CMSA	1.25
67	Wichita, KS MSA	1.25
68	Philadelphia - Wilmington - Atlantic City, PA-NJ-DE-MD CMSA	1.24
69	Providence - Fall River - Warwick, RI - MA MSA	1.21
70	Richmond - Petersburg, VA MSA	1.15
71	Rochester, NY MSA	1.12
72	Jackson, MS MSA	1.10
73	Louisville, KY – IN MSA	1.07
74	Albany - Schenectady – Troy, NY MSA	1.04
75	Greensboro -- Winston - Salem -- High Point, NC MSA	1.01
76	Knoxville, TN MSA	0.96
77	Norfolk - Virginia Beach - Newport News, VA – NC MSA	0.94
78	Harrisburg – Lebanon - Carlisle, PA MSA	0.80

Table 1 (cont.) Boardings per Capita ranked by MSA

79	Grand Rapids - Muskegon - Holland, MI MSA	0.76
80	Shreveport – Bossier City, LA MSA	0.71
81	Greenville - Spartanburg - Anderson, SC MSA	0.70
82	Fresno, CA MSA	0.64
83	Fort Wayne, IN MSA	0.58

Table 2
First Stage Regressions

Intercept	-1.94	-1.17	-0.831	0.046
	(2.52)	(2.08)	0.509	(0.090)
Distance to Kansas City	0.0005	0.00003	-0.0002	-0.00004
	(0.0011)	(0.00086)	(0.0002)	(0.00004)
Distance to the Ocean	0.0009	0.0008	-0.0002	-0.00005
	(0.0014)	(0.0011)	(0.0003)	(0.00005)
Population growth 1980-1990	10.20	10.0	0.785	-0.015
	(2.13)	(1.70)	(0.430)	(0.076)
% of Workforce in Manufacturing	-5.94	-4.05	0.492	-0.097
	(5.47)	(4.35)	(1.10)	(0.195)
% of Workforce in FIRE Jobs	5.73	-5.22	-0.104	-0.010
	(15.2)	(12.1)	(3.08)	(0.543)
State Capital located within CMSA/MSA	0.038	0.428	0.133	-0.008
	(0.623)	(0.495)	(0.126)	(0.022)
Military Base located within CMSA/MSA	-0.489	-0.275	-0.075	-0.022
	(0.603)	(0.480)	(0.122)	(0.022)
CMSA/MSA within 100 Miles of Large Hub Airport	-0.854	-1.38	-0.214	-0.012
	(0.637)	(0.507)	(0.129)	(0.023)
CMSA/MSA within 100 Miles of Medium Hub Airport	-0.806	-0.49	-0.136	-0.008
	(0.670)	(0.533)	(0.135)	(0.024)
Runway length 1000-4999 ft	-1.07	-0.751	-0.144	-0.019
	(0.655)	(0.521)	(0.132)	(0.023)
Runway length 5000-7999 ft	0.279	0.140	0.213	-0.003
	(0.228)	(0.181)	(0.046)	(0.008)
Runway length 8000+ ft	0.476	0.556	0.284	0.017
	(0.192)	(0.153)	(0.039)	(0.007)
Per Capita Income	0.0001	0.0001	0.00002	0.000002
	(0.0001)	(0.0001)	(0.00002)	(0.000004)
N	83	83	83	83
R^2	0.47	0.57	0.63	0.12

Table 3
Boardings per Capita Regressions

	Population Growth 1990-2000		Employment Growth 1990-2000	
	OLS	2sls	OLS	2sls
Intercept	-0.265 0.179	-0.157 (0.180)	-0.363 (0.223)	-0.313 (0.205)
Boardings per capita	0.025 (0.004)	0.039 (0.005)	0.021 (0.004)	0.028 (0.006)
% of Workforce in Manufacturing	0.293 (0.206)	0.508 (0.210)	0.329 (0.257)	0.424 (0.242)
% of Workforce in FIRE Jobs	-0.787 (0.594)	-0.902 (0.586)	-1.04 (0.740)	-1.090 (0.671)
State Capital located within CMSA/MSA	0.091 (0.026)	0.099 (0.026)	0.095 (0.032)	0.099 (0.029)
% of Population with high school degree and above	0.796 (0.205)	0.753 (0.201)	1.12 (0.255)	1.11 (0.231)
% of Population with college degree	-0.473 (0.242)	-0.514 (0.238)	-0.426 (0.302)	-0.449 (0.273)
Cooling Degree Days	-0.000003 (0.000024)	-0.00002 (0.00003)	0.00002 (0.00013)	0.000008 (0.00003)
Top Corp. Income Tax Rate State Level	-0.580 (0.479)	-0.276 (0.479)	-0.587 (0.597)	-0.453 (0.549)
Top Personal Income Tax Rate State Level	-0.529 (0.534)	-0.628 (0.524)	-0.846 (0.664)	-0.9 (0.602)
Top Corp. Income Tax Rate - City Level	0.026 (0.012)	0.035 (0.016)	0.023 (0.020)	0.027 (0.018)
Top Personal Income Tax Rate - City Level	-0.025 (0.022)	-0.027 (0.021)	-0.012 (0.027)	-0.012 (0.025)
MSA/PMSA Property Tax Rates per $1,000	0.00004 (0.00213)	0.0003 (0.0021)	-0.0009 (0.0027)	-0.0008 (0.0024)
Right to Work State	0.024 (0.026)	0.018 (0.026)	0.036 (0.033)	0.032 (0.030)
Failures vs Business Starts	0.010 (0.014)	0.015 (0.014)	0.013 (0.017)	0.016 (0.016)
Heating Degree Days	-0.00002 (0.00001)	-0.00003 (0.00001)	-0.00001 (0.00001)	-0.00002 (0.00001)
Average Commute Time	-0.00003 (0.00381)	-0.0039 (0.0039)	-0.004 (0.005)	-0.006 (0.004)
N	83	83	83	83
R^2	0.72		0.69	

(Note: heteroskedacticity corrected standard errors in parenthesis)

Table 4
Originations per Capita Regressions

	Population Growth 1990-2000		Employment Growth 1990-2000	
	OLS	2sls	OLS	2sls
Intercept	-0.157 (0.165)	-0.141 (0.147)	-0.273 (0.218)	-0.251 (0.195)
Originations per Capita	0.033 (0.004)	0.035 (0.004)	0.028 (0.005)	0.030 (0.005)
% of Workforce in Manufacturing	0.228 (0.185)	0.254 (0.164)	0.269 (0.244)	0.291 (0.219)
% of Workforce in FIRE Jobs	-0.415 (0.540)	-0.388 (0.478)	-0.718 (0.713)	-0.706 (0.636)
State Capital located within CMSA/MSA	0.067 (0.023)	-0.067 (0.021)	0.075 (0.031)	0.074 (0.028)
% of Population with High School Degree and Above	0.678 (0.188)	0.606 (0.166)	0.981 (0.248)	0.964 (0.222)
% of Population with College Degree	-0.307 (0.220)	-0.291 (0.194)	-0.284 (0.291)	-0.278 (0.259)
Cooling Degree Days	-0.000003 (0.000022)	-0.000005 (0.000020)	0.00002 (0.00003)	0.00002 (0.00003)
Top Corp. Income Tax Rate - State Level	-0.475 (0.437)	-0.422 (0.388)	-0.503 (0.577)	-0.457 (0.516)
Top Personal Income Tax Rate - State Level	-0.297 (0.485)	-0.270 (0.426)	-0.647 (0.640)	-0.644 (0.571)
Top Corp. Income Tax Rate - City Level	0.032 (0.014)	0.032 (0.013)	0.027 (0.019)	0.029 (0.017)
Top Personal Income Tax Rate - City Level	-0.030 (0.120)	-0.029 (0.018)	-0.015 (0.026)	-0.016 (0.023)
MSA/PMSA Property Tax Rates per $1,000	0.001 (0.002)	0.002 (0.002)	0.0002 (0.0026)	0.0003 (0.0020)
Right to Work State	0.011 (0.024)	0.010 (0.021)	0.025 (0.032)	0.023 (0.028)
Failures vs Business Starts	0.011 (0.012)	0.012 (0.011)	0.014 (0.016)	0.015 (0.0150)
Heating Degree Days	-0.00002 (0.00001)	-0.00002 (0.00001)	-0.00001 (0.00001)	-0.00002 (0.00001)
Average Commute Time	-0.004 -0.004	-0.005 -0.003	-0.007 -0.005	-0.008 -0.004
	83	83	83	83
R^2	0.77		0.71	

Table 5
Hub Regressions

	Population Growth 1990-2000		Employment Growth 1990-2000	
	OLS	2sls	OLS	2sls
Intercept	-0.097 (0.226)	0.177 (0.235)	-0.193 (0.257)	-0.001 (0.255)
Hub	0.090 (0.022)	0.162 (0.031)	0.084 (0.025)	0.132 (0.034)
% of Workforce in Manufacturing	-0.105 (0.234)	-0.110 (0.224)	-0.016 (0.267)	-0.036 (0.244)
% of Workforce in FIRE Jobs	-0.709 (0.697)	-0.763 (0.667)	-0.978 (0.794)	-1.05 (0.727)
State Capital located within CMSA/MSA	0.078 (0.030)	0.078 (0.029)	0.084 (0.034)	0.084 (0.031)
% of Population with High School Degree and Above	0.950 (0.241)	0.997 (0.231)	1.26 (0.274)	1.31 (0.252)
% of Population with College Degree	-0.572 (0.287)	-0.681 (0.277)	-0.524 (0.327)	-0.621 (0.304)
Cooling Degree Days	0.000008 (0.000028)	0.00001 (0.00003)	0.00003 (0.00003)	0.00001 (0.00003)
Top Corp. Income Tax Rate - State Level	-0.849 (0.559)	-0.613 (0.538)	-0.801 (0.637)	-0.673 (0.586)
Top Personal Income Tax Rate - State Level	-0.465 (0.626)	-0.492 (0.596)	-0.801 (0.713)	-0.875 (0.653)
Top Corp. Income Tax Rate - City Level	0.029 (0.019)	0.043 (0.019)	0.027 (0.021)	0.037 (0.020)
Top Personal Income Tax Rate - City Level	-0.039 (0.026)	-0.050 (0.025)	-0.025 (0.029)	-0.034 (0.027)
MSA/PMSA Property Tax Rates per $1,000	-0.00001 (0.00250)	-0.0005 (0.0024)	-0.0009 (0.0029)	-0.0007 (0.0026)
Right to Work State	0.017 (0.031)	0.004 (0.030)	0.028 (0.035)	0.017 (0.033)
Failures vs Business Starts	0.012 (0.016)	0.021 (0.016)	0.016 (0.018)	0.022 (0.017)
Heating Degree Days	-0.00002 (0.00001)	-0.00003 (0.00001)	-0.00001 (0.00002)	-0.00002 (0.00002)
Average Commute Time	-0.009 (0.006)	-0.021 (0.007)	-0.013 (0.007)	-0.021 (0.007)
N	83	83	83	82
R^2	0.61		0.65	

Table 6
Cargo per Capita Regressions

	Population Growth 1990-2000		Employment Growth 1990-2000	
	OLS	2sls	OLS	2sls
Intercept	-0.453 (0.234)	-0.390 (0.233)	-0.515 (0.256)	-0.473 (0.238)
Cargo per Capita	0.024 (0.149)	0.608 (0.317)	0.098 (0.164)	0.419 (0.322)
% of Workforce in Manufacturing	-0.065 (0.263)	0.037 (0.261)	0.031 (0.289)	0.074 (0.267)
% of Workforce in FIRE Jobs	-0.568 (0.780)	-0.472 (0.768)	-0.842 (0.855)	-0.820 (0.784)
State Capital located within CMSA/MSA	0.077 (0.034)	0.087 (0.034)	0.085 (0.037)	0.090 (0.034)
% of Population with High School Degree and Above	0.863 (0.269)	0.857 (0.264)	1.18 (0.295)	1.19 (0.270)
% of Population with College Degree	-0.389 (0.318)	-0.354 (0.311)	-0.354 (0.349)	-0.355 (0.320)
Cooling Degree Days	0.00003 (0.00003)	0.00003 (0.00003)	0.00005 (0.00003)	0.00004 (0.00003)
Top Corp. Income Tax Rate - State Level	-1.09 (0.623)	-0.974 (0.614)	-1.01 (0.683)	-0.98 (0.627)
Top Personal Income Tax Rate - State Level	-0.337 (0.703)	-0.498 (0.697)	-0.713 (0.771)	-0.847 (0.716)
Top Corp. Income Tax Rate - City Level	0.010 (0.020)	0.013 (0.120)	0.010 (0.022)	0.012 (0.021)
Top Personal Income Tax Rate - City Level	-0.022 (0.029)	-0.015 (0.028)	-0.008 (0.031)	-0.006 (0.029)
MSA/PMSA Property Tax Rates per $1,000	-0.0003 (0.0028)	-0.0002 (0.0028)	-0.001 (0.003)	-0.001 (0.003)
Right to Work State	0.036 (0.035)	0.022 (0.035)	0.044 (0.038)	0.034 (0.036)
Failures vs Business Starts	0.0008 (0.0179)	0.005 (0.018)	0.006 (0.020)	0.009 (0.018)
Heating Degree Days	0.000002 (0.000015)	-0.00001 (0.00002000)	0.00000008 (0.00001661)	-0.000004 (0.00002)
Average Commute Time	0.007 (0.005)	0.003 (0.005)	0.001 (0.005)	-0.0001 (0.0053)
N	83	83	83	82
R^2	0.51		0.59	

Figure 1
Boardings per Capita in 1990 and Population Growth from 1990-2000.