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The Role of Airports for Regional Economic Development

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Abstract:

Short on the role of airports in for regional development in earlier work, our research examines two things: (1) the likelihood for the region to have an airport in the first place and (2) the effects of airports for regional economic development. Based on multiple regression analysis for US metros, we find that airports are more likely in larger metros with higher shares of more cultural workers and warmer winters are more likely to have an airport in the first place. We also find that airports add significantly to economic output per capita, when controlling for other variables, and that the size of the airport activities matters.

Keywords: Airports, economic development

JEL classification: R00, R40

Introduction

Planes and airports are where I feel at home," the narrator of Walter Kirn's *Up in the Air* the novel that became the hit George Clooney movie—oxymoronically observes. "I love the Compass Club lounges in the terminals….I love the restaurants and snack nooks near the gates…I even enjoy the suite hotels built within sight of the runways on the ring roads, which are sometimes as close as I get to the cities that my job requires me to visit" (2001, p.6).

Airports are usually the first thing we see when we travel to a new place—and as often as not, they look exactly like where we've just been: the same shops, the same restaurant franchises, the same backlit advertisements for global brands. There is no there there, as Gertrude Stein once said of Oakland, California. Everywhere is anywhere and anywhere is nowhere.

But if airports might seem disconnected from their locations, they are critical component of the connectivity of people and places and as such they make important contributions to regional economic development. Airports are much more than places to catch planes, attend an in-transit business meeting, or do some duty-free shopping; they are a critical component of regional economic development. the terms "great city" and "port city" were synonymous until the 20th Century, as Hall (1998) points out in *Cities in Civilization.* Kasarda and Lindsay (2011) argue that airports represent a new model of regional economic development they dub "the Aerotropolis." Airports, which are among the largest investments a city and region can make, play a key role in connecting the places they serve to the global economy. They also are argued by Kasarda and Lindsay to contribute to a wide variety of business and economic activities, through the promotion of smart growth development strategies; encompassing a vast range of uses from hotels and tourism, to retail and office spaces.

The system of airports is organized as a network (Button and Stough 2000), formed around hubs and spokes (Button and Hall 1999). A host of studies document the disproportionate economic benefits that accrue to hub locations (see for example Lian and Ronnevik, 2011; Halpern and Brathen 2011; Kanafani and Abbas, 1987). They facilitate access to and form key nodes in the global economy. Airports increasingly have the vital role of facilitating connections between international cities and regions, providing both opportunities and constraints for integration into the global economy. Button and Taylor (2000, p. 220) find that "within limits, more international air transportation is likely to stimulate further growth in the economy." Airports in effect create 'favored positions' in the global economy (Bowen 2002, p. 425), providing "superior access to global flows of people, goods, money and information." This can benefit smaller second-tier cities as well as larger first tier ones. A study of air passenger movement from 1990-2000 found that second-tier cities benefitted the most from increases in passenger movement (O'Connor, 2003). Several studies document the importance of global airport investment on growth of Asian economies (see Bowen 2002; Phang, 2003).

Neal (2010; 2011a; 2011b) finds that airports are critical components of "city connectedness" linking key hubs in the global economy. He found that, "a city's economic fortunes are closely tied to its position in networks of interurban exchanges, with cities occupying more central positions experiencing relatively greater growth and stability" (p. 167). Airports play a key role here, as they are part of a series of strategic factors that enable cities to benefit from increased centrality in the urban network. Neal (2012) examines the connection between airport activity and knowledge-based and creative employment, finding an interesting pattern of association. Airport activity, specifically air passengers, follow creative jobs during

economic downturns, but the opposite is the case during economic upswings with creative jobs in turn following airport activity

The close connection between airports and regional development has been noted in several studies. A careful statistical study by Green (2007) found associations between airport passengers and both metro population and employment growth, while controlling for other factors that would be expected to shape growth. A second study Brueckner (2003) also notes a close connection between airline passengers and regional employment growth, finding that a ten percent increase in passengers in a metro generates a one percent increase in regional employment. It finds, however, that airports and airline service contribute more to knowledge and service based businesses than industrial manufacturing. Brueckerner concludes by saying: "the evidence confirms the common view that good airline service is an important factor in urban economic development." It is important to note that several studies have noted that airports create additional environmental and other costs which are not accounted for in these models (see Charles, Barnes, Ryan and Clayton, 2007; Firestone 2009; Halpern and Brathen, 2011).

Airports move two kinds of things—goods or cargo, and people. In fact, a good deal of the argument about airports and economic development has focused on moving things and the business and industries that grow up around that. But in today's knowledge and creative economy, the ability to move people may matter even more. As Romer (1986) has shown, the principal input into the process of wealth creation is knowledge (ideas) generated, recombined and exchanged by individuals. While companies brought together key inputs in the previous industrial epoch, cities increasingly play that role in today's innovation-driven knowledge economy (Florida 2002). Increasingly, physical and social infrastructure facilitates the interaction and

concomitant sharing of ideas, which confers regional advantage in the places where these ideas are developed.

To get at this our research examines the role of airports in economic development, focusing on two key things: (1) the likelihood for the region to have an airport in the first place and (2) the effects of airports for regional economic development. We undertake multiple regression analysis of the factor associated with a metro having an airport and the effects of having one on regional economic development. We find that airports are more likely in larger metros with higher shares of more cultural workers and warmer winters are more likely to have an airport in the first place. We also find that airports add significantly to regional economic development measured as economic output per capita, when controlling for other variables, and that the size of the airport activities matters. The scale of airports' contribution of regional economic development is roughly equivalent to that of human capital which the literature identified as a major contributor to regional development and greater than that of high-technology industry.

The remainder of this paper processed as follows. The next section discusses our models, variables and data, before turning to our findings. Finally, we will sum up our conclusions and discuss their implications in the final section.

Model, Variables, and Methods

This study provides an empirical examination of the role of airports in economic development. The first model examines the factors that bear on a metro having an airport in the first place.

Model 1: Airport = Size + Technology + Education + Climate + Unemployment + Bohemians

The dependent variable in this model is a binary dummy variable for whether or not a metro has an airport. Data are from the Airports Council International, North America and cover 2010.

The second model examines the effects of having an airport on regional economic development.

Model 2: Economic Output per Capita = Airport Factor + Size + Technology + Education + Climate + Unemployment

The dependent variable in this model is the standard measure of economic performance - economic output (measured as gross regional product or GRP) per capita. These data are from US Commerce Department's Bureau of Economic Analysis (BEA) and will be used to represent the regional equivalent to the national Gross Domestic Product (GDP). In particular, this is because this is a comprehensive measure of the value of the goods and services produced within the region. The data cover the year 2010.

As our data sets cover all US metros, it is not a random sample. Hence the significance levels below refer to the actual strength of the correlations, rather than stochastic uncertainty.

Independent variables

Our models include the following independent variables.

Airport Factor: This variable is based on three standard measures of airport activity: flights (takeoff and landings), passengers (arriving, departing, and direct transit), and cargo (in metric tons). These are based on 2010 data from the Airports Council International, North America. Each is expressed in per capita terms. We combine all three to create the variable Airport Factor. It would not be feasible to include all of them (e.g., in a multiple regression model since they are partly describing the same thing which leads to estimation problems) due to multicollinearity and, even more seriously, to interpretation problems with the model. The Airport Factor variable explains 68 percent of the total variation of the three variables. Figure 1 maps the Airport Factor across US metros.

(Figure 1 about here)

Airport Dummy - We also employ an airport binary variable to control for airport effects regardless of size in our model of regional economic development (Model 2, see above).

Metro Size –This is a measure of regional population size for the year 2010 and comes from the Census American Community Survey.

High-Tech Industry – This is a measure of regional concentration of high tech industry. It is based on the Tech-Pole Index (see DeVol Wong, Catapano and Robitske 1999). It captures the percentage of the region's own total economic output that comes from high-tech industries in relation to the nationwide percentage high-tech industrial output as a percentage of total U.S. high-tech industrial output. The data is for the year 2006 and comes from the US Census County Business Patterns.

Human Capital – This variable measures the share of adults with a bachelor's degree or more. The variable is for the year 2010 and comes from the Census American Community Survey.

Unemployment Rate– The share of the population that was unemployed in July 2011, as reported by the Bureau of Labor Statistics.

Climate - This variable covers average January temperature in January. The data are from the U.S. Geological Survey and is an average for several decades of temperature measuring.

Bohemian Index – This is location quotient for arts, design and entertainment related occupations and is also based on data from the 2006 U.S. Census. It is a proxy for regional cultural activity and openness to new ideas as well as for tourism (Sinclair, 1998). This is included in Model 1 only, which examines the likelihood of having an airport.

Table 1 provides the descriptive statistics for all included variables in our models.

(Table 1 about here)

FINDINGS

This section summarizes our key findings. We begin with the findings for which metros that have airports and then turn to the findings for the effects of airports on regional economic development

Which Regions Have Airports?

We begin with the findings of Model 1, the likelihood that a metro will have an airport in the first place. This dependent a binary variable (where 1 indicate the existence of one or several airports in a region) and we run a probit regression. Table 2 summarizes the key results.

(Table 2 about here)

The model generates a Pseudo R^2 of .525. Metro Size is the strongest variable in the model. The Climate variable is also positive and significant. Airports are more likely in places with warmer winter temperatures. There are several reasons this might be so. Warmer winter temperatures mean less snow and better winter flying conditions. Moreover, it is likely to reflect the broader shift in population to the South and West that has occurred over the past fifty years. Large metros in the South and West, for example Miami, Dallas and Los Angeles, are also well-positioned logistically to serve as gateways to major foreign markets. The Bohemian Index is positive and significant as well. The significant relation for bohemians may reflect three things. One, it proxies for metros that have been more open to new people and ideas. Two, it suggests metros that are more likely to have been more highly-travelled cross-roads locations to begin with, going back to ports or railroad links. Three, together with Climate, it also reflects characteristics of locations that are more attractive for tourism on weather and culture. Human Capital, High-Tech Industry, are Unemployment each insignificant in our model. This is a surprising result, as we would have thought that at least two of them (in particular, Human Capital or High-Tech Industry) would be associated with airports. We are fully aware that airport location has in many cases been fixed for decades, and that our variables are for

current dates. But while variables like high-tech industry may vary over time, metro structures particularly the relative structures of industry and education continue to be remarkably fixed over time across regions. For example, metros that have higher levels of education today, has so already a century ago (Berry and Glaeser, 2005). Taken together, airports are found in bigger metros, in bigger regions, and in regions with higher levels of openness and tourism.

Airports and Economic Development

We now turn to our findings on the effects of airports on regional economic development. Recall our dependent variable is economic output per capita and our independent variables include airports, in combination with regional size, high tech industry, education levels, and climate. Table 3 summarizes the bivariate correlations

(Table 3 about here)

The Airport Factor variable is strongly associated with a correlation coefficient of .507, which is among the highest in our analysis. It is only slightly lower than High-Tech Industry (.583) and Human Capital (.571) and stronger than Metro Size (.422). Climate (-.138) and Unemployment are both negative and significant. It is important to point out that this analysis only concerns regions with airports, and that the correlation regards the size of the airport activity and economic output per capita. This means that regions where there are more passengers, cargo and movements per capita also have higher levels of economic output.

To further sort this out the relation between airport size and economic output, we move on to the multiple regression analysis. Our model is a basic OLS regression,

explaining economic output per capita with our Airport Factor variable while controlling for regional size, high tech industry, education levels, climate and bohemian concentration. All independent variables but the airport factor are expressed in log form, and these coefficients from the Model 2 regressions can thereby be interpreted as elasticities. The Table includes five permutations of Models 2 (Eq. 1-Eq. 5), summarizing their results.

(Table 4 about here)

Equation 1 is the base model that explains economic output per capita with the Airport Factor. The regression generates an R^2 of approximately 0.25 and the Airport Factor is positive and significant.

Equation 2 adds Metro Size. We know from the results above (Table 2) that Metro Size significantly relates to the probability of having an airport in the first place. The R^2 from this regression is just slightly higher 0.259. There is a certain level of multicollinearity between size and airport (with a variance inflation factor of 4.281), but interesting enough, the Airport Factor is the stronger of the two variables. It remains positive and significant, while size in this context is insignificant.

Equation 3 adds Human Capital and High Tech Industry to the base model: These are both factors that the broad literature identifies as key drivers of economic development (e.g. Solow, 1956; Romer, 1986; Glaeser, 1998; Glaeser, Kolko, Saiz, 2001; Florida, Mellander, Stolarick, 2008). It adds Unemployment as well. The R^2 increases substantially to 0.597. The Airport Factor variable remains positive and significant. Human Capital is positive and significant as well, which is line with the extant literature. The relative strength of two - the Airport Factor and the Human Capital variable - are relatively similar, suggesting that airports are closely associated

with regional economic development. Unemployment is more strongly related to economic output per capita, and it negative as expected. Metros with high levels of uemployment by definition are experiencing problems with economic performance. Several studies note the connection between contemporary unemployment and metros with high levels of housing and construction activity and manufacturing based economies, which have been vulnerable to globalization and the economic crisis (e.g. Gabe and Florida, 2011; Martin, 2011; Coile and Levine, 2011; Chai, Maurer, Mitchell and Rogalla, 2011). The resutlt for High-Tech Industry likely reflects the correlation between it, Metro Size and airports. The VIF values for these variables range from 5.1 to 7.8, indicating that they at least partly include the same type of information: The Airport Factor is one of three that remains significantly related to economic output per capita in this. Equation 4 adds Climate (measured as winter temperature) to the model, but the variable is insignificant in this context.

Equation 5 substitutes the Airport Dummy variable for the Airport Factor to examine if the size and scale of the airport activities really matter, or if it just an effect from having an airport *at all*. Uusing the Airport Dummy also increases the sample significantly, which may have an effect on the overall results. The R^2 for this model is .509. The Airport Dummy is significant, although it is weaker than the Airport Factor variable. This makes intuitive sense; just having an airport adds significantly to economic output per capita, but having an airport with a lot of activity given the metro size adds even more. Moreover, High-Tech Industry becomes significant in this model, alongside Metro Size. However, in this model, Human Capital becomes somewhat weaker than it was in Model 3.

Taken together, our findings indicate that airports matter when it comes to regional economic development. Their effect is considerable and is even comparable

to the effect of Human Capital (measured as the share of adults with a college degree) – a factor that has been confirmed to be a key driver of economic development in a wide range of studies. Moreover, our models indicate that airports are more important than Metro Size or High-Tech Industry, while still noting that the airport variable clearly picks up information associated with both of them.

Conclusion

In this paper, we have examined the role of airports in regional economic development across two dimensions: (1) likelihood of having an airport, and (2) the extent to which airports effect regional development. Based on our probit regression analysis, we find that Metro size is the most important factor in having an airport. Regions with airports also have warmer winter climates and higher levels of artistic and culturally creative bohemians. Interestingly, we find no statistically significant association between having an airport and Human Capital, High-Tech Industry or Unemployment. Having said this, it is important to reiterate the fact most airports were established decades ago, and would not be affected by today's levels of technology, human capital and unemployment; even though these structures tend to be fairly consistent over time.

Furthermore, we find that airports play a significant role in regional economic development. The scale of their effect is similar to that of Human Capital, a factor which the literature identifies as a key contributor to regional development, and greater than High-Tech Industry, which many also think of as an important driver of regional development. We also find that it is not just having an airport but that its size and scale of activities matter to regional development.

Overall, our findings suggest that airports play a substantial role in economic development; beyond many of the traditional usual suspects of human capital, high-tech clusters etc. Our findings thus support the aerotropolis model of economic development (Kasarda and Lindsay, 2011) to some degree. We also tend to agree with Green (2007) that the most precious cargo on-board is likely to be people, as well as Bowen (2002) argues that airports help create 'favored positions' for locations in the global economy. Airports play a key role in especially in moving people and ideas as well as goods in our ever more connected and spiky global economy.

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TABLES AND FIGURES

Table 1: Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
Airport Factor	125	-2.064	2.290	0	1
Economic Output	359	14855	94852	41584	12295
Size	359	55226	18919983	71714 1	1596336
High Tech Industry	320	.0002	8.5273	.2376	.847
Human Capital	362	.1135	.5688	.2518	.077
Unemployment	359	3.00	30.80	9.105	2.912
Climate	341	3.95	66.50	36.05 0	12.204
Bohemians	322	.000	2.195	.512	.371
Valid N (listwise)	316				

Table 2: Probit Regression for the Likelihood of Having an Airport

Variable	**Coefficient**
Constant	-18.7719***
	(5.93)
Size	1.229***
	(5.11)
High-Tech Industry	-0.014
	(-0.11)
Human Capital	0.508
	(-0.508)
Unemployment	-0.283
	(-0.57)
Climate	0.948***
	(2.68)
Bohemians	1.121***
	(3.78)
N	290
Pseudo R^2	0.525

Notes: z-values within parentheses.
*** Significant at the 1 percent level, ** at the 5 percent level

Table 3: Bivariate Correlations for Gross Regional Product (GRP) per Capita

Variable	Economic Output per Capita
Airport Factor	.507**
High-Tech Industry	.583**
Human Capital	.571**
Metro Size	.422**
Unemployment	-.446**
Climate	-.138*

** Significance at the 1 percent level, * at the 5 percent level

Table 4: OLS Regression Results for Airports and Regional Economic Development

Variable	Eq (1)	Eq (2)	Eq (3)	Eq (4)	Eq (5)
Constant	10.758***	11.559***	12.340***	12.089***	11.043***
	(543.013)	(22.032)	(22.901)	(20.882)	(38.707)
Airport Factor	0.129***	0.184***	0.119***	0.098***	-
	(6.500)	(4.497)	(3.641)	(2.781)	
Size		-0.059	-0.032	-0.012	0.043**
		(-1.528)	(-0.134)	(-0.287)	(1.986)
High-Tech			0.017	0.017	0.030**
Industry			(0.880)	(0.848)	(2.517)
Human Capital			0.366***	0.368***	0.131**
			(3.235)	(3.209)	(2.318)
Unemployment			-0.300***	-0.278***	-0.354***
			(-4.841)	(-3.970)	(-7.276)
Climate				-0.021	0.011
				(0.446)	(0.349)
Airport Dummy	-	-	-		0.071**
					(2.287)
N	123	123	115	114	315
R^2 Adj.	0.251	0.259	0.597	0.590	0.504

Notes: t-values within parentheses.
*** Significant the 1 percent level, ** at the 5 percent level

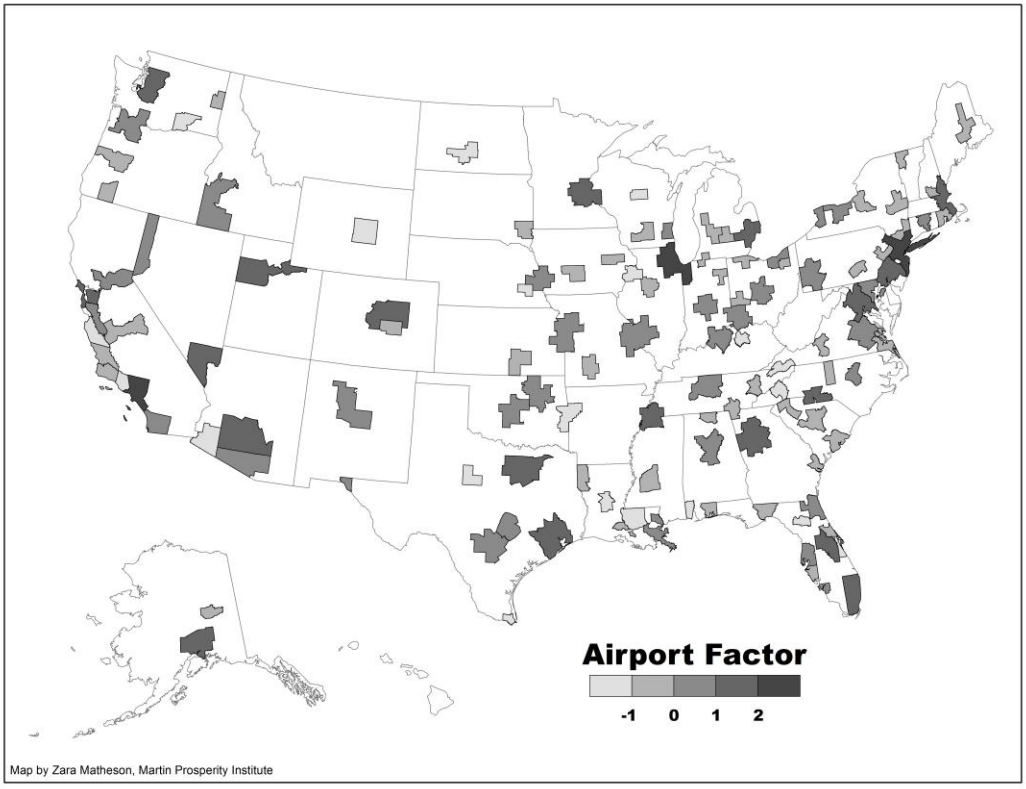

Figure 1: Airport Factor for Flights, Passengers and Cargo per Capita