Up in the Air:
The Role of Airports for Regional Economic Development

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Abstract:

Our research examines the role of airports in regional development. Specifically, we examine two things: (1) the factors associated with whether or not a metro will have an airport, and (2) the effect of airport activities on regional economic development. Based on multiple regression analysis for U.S. metros, our research generates four key findings. First, airports are more likely to be located in larger metros with higher shares of cultural workers and warmer winters. Second, airports add significantly to regional development measured as economic output per capita. Third, the effect of airports on regional development occurs through two channels – their capacity to move both people and cargo, with the former being somewhat more important. Fourth, the impact of airports on regional development varies with their size and scale.

Key words: *Airports, economic development*

Introduction

As the narrator of Walter Kirn's *Up in the Air* oxymoronically observes, "planes and airports are where I feel at home" (2001, p.6). Airports are usually the first thing we see when we travel to a new place—often looking exactly like where we have just been: the same shops, the same restaurant franchises, and the same backlit advertisements for global brands. But if airports might, at first glance, seem disconnected from their locations, they are a critical component of the connectivity of people and places. 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.

To probe the effects of airports on regional economic development, our research focuses on two key matters. We first examine the factors associated with whether or not a metro has an airport in the first place. Second, we then turn to the impact that airports have on regional economic development. More specifically we examine the effects of the size and scale of airports activities and also the degree to which moving people and goods matters to regional development. We develop models using multiple regression analysis as well as propensity score matching to examine each of these issues.

Our research contributes four key findings. First, airports are more likely to be located in larger metros as well as metros with higher shares of individuals in cultural occupations and with warmer winters, factors that may also reflect higher levels of tourism. Second, airports add significantly to regional economic development measured as economic output per capita when controlling for regional characteristics. Third, airports effect regional development both by moving people as well as cargo, with the effect of moving people being somewhat more important. Fourth, it is not

just having an airport, but the size and scale of airport activities that matter to regional development. Our overall findings indicate that when controlling for other factors such as population size, industry structures, human capital and high-tech, airports' effect remains positive and significant in on regional development.

The remainder of this paper proceeds as follows. The next section describes the literature on the subject followed by a discussion of our models, variables, and data before turning to our findings. Finally, we sum up our conclusions and discuss their implications.

Concepts and Theory

There is considerable literature on airports and economic development. In their book *Aertropolis,* Kasarda and Lindsay (2011) argue that airports represent a new model of regional economic development. Airports are among the largest investments a city and region can make and play a key role in connecting the places they serve to the global economy.

The connection between airports and regional development has also been noted in several studies. A statistical study by Green (2007) found associations between airport passengers and both metro population and employment growth. A study by Brueckner (2003) also notes the 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. Brueckner finds, however, that airports and airline service contribute more to knowledge and service based businesses than to industrial manufacturing. Rosenthal and Strange (2004) note that airports play a role in spurring regional productivity due to the positive externalities that stem from the agglomeration economies that develop around these

locations. Bel and Fageda (2008) find the availability of non-stop, direct international flights is a key factor in how corporate headquarters select locations in Europe.

Blonigen and Cristea (2012) examine the role of airports over two decades and the role of the 1978 Airline Deregulation Act. They conclude that airline traffic has a significant effect on regional population, income and employment growth, but that the effects differ depending on regional size and industry structure. Also Sheard (2012) finds effects from an increase in the metropolitan frequency of flights on regional employment shares, but that these differ by industry, with negative effects on manufacturing industry employment and positive effects on tradable service employment shares.

Other studies explore airports as hubs of economic activity. Button and Stough (2000), and Button and Lall (1999) advance the concept of airports as hub and spoke networks. Lian and Rønnevik's (2011) study of Norway find that passengers favor a region's large, main airport as opposed to smaller local airports due to the magnitude of services available. Kanafani and Abbas (1987) note that the success of smaller regional airports depends on finding locations that makes them independent from larger regional hub airports. Halpern and Bråthen (2011) find that the regional impact of airports depends on regional size and the demands passengers have on the airport.

Airports, especially hub airports, connect places to the global economy. Neal (2010; 2011a; 2011b) argues that airports are critical components of "city connectedness," linking key hubs in the global economy. He contends 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 can help to create 'favored positions' in the global

economy, which provide, "superior access to global flows of people, goods, money and information" (Bowen, 2002, p. 425).

It is important to also consider what is being transported through airports. Airports move two kinds of things: people and goods or cargo. A good deal of the literature on airports and economic development has focused on moving goods. For example, the benefits that an airport provides to a region and firm have also been demonstrated to influence the exporters in locational decisions, specifically on where to locate their business (Lovely et al, 2005). In today's knowledge and creative economy, the ability to move people may matter even more than moving goods. As Romer (1986) has shown, the principal input into the process of wealth creation is knowledge (ideas) generated, recombined and exchanged among individuals. While companies bring 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. Airports can shrink distance and facilitate interaction across longer distances. Audretsch and Feldman (1996) note the importance of face-to-face interactions, which air travel can spur, to innovation and the generation of new ideas. Gaspar and Glaeser (1998) document the importance of face-to-face interactions, even in light of growing information technology services and electronic communication mediums. Airports can increase face-to-face interaction by bringing people together from different cities and regions. Venture capitalists often say they will consider investments that are in a relatively short direct flight radius of their office – so they can interact with principals and monitor these investments. In fact,

Green (2007) notes that the most precious cargo on-board airplanes is likely to be people.

It is difficult to precisely disentangle causality between airports and economic development. On the one hand, airports can add to economic development by their movements of goods and people along with other factors identified above. However, airports are also more likely to be located in larger regions with higher levels of economic development, more people, larger industries and so on which increases demand for their services.

The lack of time series data leaves us unable to fully test for causality. In the analysis we conduct a propensity score matching, by matching what are essentially "twin" metros with similar economic and social structures where some have airports while others do not. We compare across these metros to identify whether or not airports have a positive effect on economic performance.

Model, Variables, and Methods

Our research draws from this literature to examine the effects of airports on regional development. This section introduces our statistical approach, variables, and methods. We undertake two separate models. The first examines whether or not a metro has an airport in the first place. The second then considers the effects of airport activities on economic development. The first model is structured as follows.

Model 1: Airport = Size + Technology + Human Capital + Climate + Unemployment + Bohemians

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

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

Model 2: Economic Output per Capita = Airport Effects + Size + Technology + Human Capital + Climate + Unemployment

We use four separate variables for airport activities, as described below. 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). The data are for the year 2010. Our data set covers all U.S. metros.

Independent variables

Our models include the following independent variables.

Airport Variables: Four separate variables are used for airports and airport activity.

Airport Factor: The base variable is a common factor based on three standard measures of the size of the airport activity: flights (takeoff and landings), passengers (arriving, departing, and direct transit), and goods or cargo (in metric tons). Each is expressed in per capita terms, and the factor score variable is scale-independent. Their combination into a single variable facilitates parameter estimation and interpretation. It is not feasible to include all of them in a multiple regression model since they partly describe the same thing. This can generate estimation problems due to

multicollinearity and, even more seriously, it could lead to interpretation problems with the model. We use factor analysis to combine the three measures into a single variable (see Srivastava, 2002). A factor generated from a factor analysis will always have a mean value equal to 0 and a standard deviation equal to 1. In other words, all regions will values below 0 have an airport activity per capita below the national average, while all metros with an airport factor value above 0 are above the national average. 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 Cargo: In order to look at the effects of moving people versus goods, we also separate airport cargo and passengers in our models. Airport Cargo is measured as loaded and unloaded freight, and mail in metric tons per capita. The data also include transit freight...

Airport Passengers: Airport Passengers is measured as the number of arriving and departing passengers per capita (transit passengers are only counted once)..

Airport Dummy: We also employ an airport binary variable to control for airport effects regardless of size in our model for regional economic development.

All airport data comes from the Airports Council International, North America for 2010.

Based on this, there were 198 airports in the US and in Canada in the year 2010. The top 50 (in terms of passenger traffic) accounted for 84.7 percent of all passengers, the top 100 for 96.5 percent, and the top 150 for 99.4 percent of all passengers. The 198

airports accounted in total for 100 percent of all passenger traffic. The distribution for cargo traffic was somewhat more skewed, where already the top 50 airports (in terms of cargo) accounted for 91.6 percent of the total cargo traffic. Only 164 out of the 198 airports handled cargo in the year of 2010. It is in other words important to notice that the list of airports that handled passengers not is identical with the list of airports that handled cargo. The lists were overlapping to a very large extent, but there were especially a number of airports that only handled passengers and not cargo.
All airports located in Canada were excluded from our sample. We aggregated airports over metropolitan regions, and based that 120 metropolitan regions had access to an airport within the metropolitan region. In most cases, the airport(s) handled both passengers and cargo, but in certain cases just one of the two.

Population: This is a measure of regional population size for the year 2010 and aims at capturing market size. It comes from the Census American Community Survey.

High-Tech Industry: This is a measure of regional concentration of high-tech industry. It is a location quotient that compares the regional high-tech employment compared to the national share of the same group. High-tech industries are defined as industries that spend above the average amount of the revenue on R&D, and that employ above the average share of technology using occupations (e.g. scientists and engineers). The data are for the year 2006 and come 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: This variable measures the share of the population that were unemployed in July 2010 as reported by the Bureau of Labor Statistics.

Climate: This variable reflects average temperature in January for several decades and comes from e from the U.S. Geological Survey.

Bohemian Index: This is location quotient for arts, design and entertainment related occupations and is also based on data from the 2006 American Community Survey. 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 because it examines the likelihood of having an airport.

Industry structures: We include industrial employment share for 11 different industries as control variables in order to explain GRP per Capita. The industries we include are: agriculture and mining; construction; manufacturing; wholesale; retail; transportation and warehouse; information; finance and insurance; professional science and management; health and education ('med and eds'); and public administration. All variables are from American Community Survey for the year 2010.

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 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 by discussing the factors that affect the likelihood that a metro will have an airport (Model 1). The dependent variable is a binary variable (where Model 1 indicates the existence of one or several airports in a region). We ran a logit regression on these data. Table 2 is summarizing the key results.

(Table 2 about here)

The model generates a Pseudo R^2 of 0.525. Population is the strongest variable in the model. Climate is also positive and significant as airports are more likely in places with warmer winter temperatures. There are several reasons why this might be the case. Warmer winter temperatures mean less snow and better winter flying conditions. It also likely reflects 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 significantly associated with the presence of airports. This may reflect two kinds of demand-driven mechanisms. First, metros with higher levels of bohemians are more likely to be open to new people and ideas, which would imply that individuals living in these places have a demand for travelling to other places[1]. Second, metros with higher levels of cultural creatives are also likely to be more attractive to tourists and business travelers looking for entertainment,

[1] We acknowledge that there may be that bohemians are drawn to places where airports are already located. However, while this would decrease the bohemians' demand to fly out, this may instead increase the "flying in" effect, due to higher shares of entertainment and tourism.

which suggest demand to fly in from other places. In general, we would assume such places to have been more highly travelled even before the advent of air travel.

It is surprising that both human capital and high-tech industry are both insignificant. In the case of high-tech industry, it may simply reflect the fact that airport location has been fixed for decades, while high-tech industry location has changed over time. Human capital levels also tend to be fixed over time across regions (see Berry and Glaeser, 2005). Unemployment is also insignificant.

Our findings indicate that airports are more likely in: bigger metros, those with warmer climates, and regions with higher levels of openness and/or tourism.

Airports and Economic Development

Regression Analysis

We now turn to our findings on the effects of airports on regional economic development (Model 2). Recall our dependent variable is economic output per capita and our independent variables include airports, in combination with population, high-tech industry, human capital, and climate. Table 3 summarizes the bivariate correlations which show the marginal relationships between variables. These can be compared to the regression coefficients in Table 4. Conflicting signs or significances may reflect multicollinearity, which bears upon our interpretation of the regression coefficients.

(Table 3 about here)

We begin with the simple bivariate correlations (Table 3). The Airport Factor variable is strongly correlated with regional economic development with a correlation coefficient of 0.507, among the highest in our analysis. The variable Passengers per Capita is also strongly related with a correlation of 0.506. The correlation for Cargo per Capita is slightly weaker (0.478). Moving people, as well as goods, is significantly associated with regional development. These correlations are only slightly lower than for High-Tech Industry (0.583) and Human Capital (0.571) two factors that have been very closely tied to economic development according to the research literature. The correlation between the airport variable and regional development is stronger than that for airports and regional size measured by Population (0.422). Climate (-0.138) and Unemployment (-0.430) are both negative and significant. We should note that these correlations only concern metros with airports and account for the relationship between the overall size of airport activity and economic output per capita. It points to an association between metros where airports move passengers and cargo, and economic output, but does not specify the direction of causality.

To further sort out the associations between airports and economic development, a multiple regression analysis is included. The model is a basic OLS regression, using economic output per capita as dependent variable. The independent variables include the four Airport variables - Airport Factor, Passengers, Cargo, and Airport Dummy - as well as Population, High-Tech Industry, Human Capital, Unemployment, Climate, and the Bohemian Index. We employ the four different Airport variables one at a time to sort out their relative effects on economic output. With the exception of the Airport Factor and Airport Dummy, all independent variables are expressed in log form. The coefficients from these regressions can thereby be interpreted as elasticities.

For each regression, we conduct a Breusch-Pagan test to check for heteroscedacticity issues (all with *p*-values around 0.9, which indicates absence of heteroscedacticity). Table 4 includes three permutations of Model 2a (Eq. 1-Eq. 3) as well as Model 2b (Eq. 4), summarizing their results.

(Table 4 about here)

Equation 1 explains economic output per capita with the Airport Factor, which is positive and significant, and stronger than the Population and High-Tech variables, which are both insignificant. The relatively high VIF values indicate that a certain degree of multicollinearity is present in the model but out of these variables, the Airport Factor comes out the strongest. Human Capital and Unemployment are both significantly related to GRP per Capita, while Climate is insignificant. While Climate significantly adds to the likelihood of having an airport in the first place (as per above), it does not add to economic output in this multivariate regression context.

Equation 2 substitutes the Airport Factor with a variable for the "moving people" aspect of airports – Passengers per Capita. This variable is positive and significant. The R2 Adjusted value decreases slightly when we only consider this aspect of airport activities. The coefficient suggests that economic output per capita increases by 0.055 percent when passengers per capita increase by 1 percent. Unemployment is still the strongest variable in the regression, but Passengers per Capita is approximately equally as strong as Human Capital, one of the key drivers of economic development based on prior studies (e.g. Romer, 1986; Glaeser, 1998; Glaeser, Kolko, and Saiz, 2001; Florida, Mellander, and Stolarick, 2008).

Equation 3 substitutes the "moving things" variable – Cargo per Capita. This variable is also positive and significant. Its inclusion generates an R2 Adjusted of 0.599, slightly more than for the Passengers per Capita regression. However, the coefficient suggests that a 1 percent change in Cargo per Capita will increase economic output by 0.023 percent – approximately half the effect of a 1 percent change in Passengers per Capita.

Equation 4 includes the Airport Dummy to probe whether the size and scale of the airport activities really matter, or if it just an effect from having an airport *at all*. Using the Airport Dummy also increases the sample significantly which may affect the overall results. The R^2 for this model is 0.509. The Airport Dummy is significant, although it is weaker than the size variables. Just having an airport adds significantly to Economic Output per Capita, but having an airport with a lot of activity adds even more. High-Tech Industry becomes significant in this model, alongside Population. Human Capital now becomes somewhat weaker than in Equations 1 and 2.

Since work by e.g. Blonigen and Cristea (2012) as well as Sheard (2012) suggests that industry structure matter besides airports, we re-ran all four regressions controlling for metropolitan employment share in within agriculture and mining; construction; manufacturing; wholesale; retail; transportation and warehouse; information; finance, insurance and real estate; professional, scientific, and management, and administrative and waste management services; educational services, healthcare and social assistance; and public administration. Even after the inclusion of these seven control variables, our airport variables (the Airport Factor, Passengers per Capita, Cargo per Capita, and the Airport Dummy) remained positive and significant at the 1 percent level (See the Appendix).

Matching Similar Metros

We use a propensity score matching to better identify the effect of airports on metro economic development. Propensity score matching allows to identify essentially "matched pairs" of metros with similar economic and demographic characteristics. We then compare metros with and without airports on our key indicator of economic performance, GRP per capita. Table 5 shows the key results of this analysis.

(Table 5 about here)

A standard logistic regression was used to calculate the probability of a region to have an airport given the set of covariates. The "nearest neighbor" method was then used to form a sample of 35 regions with an airport and 35 others without airport. The same logistic regression was conducted on the matched data, which shows that there are no significant beta parameters after matching and hence no statistical differences between the two groups with respect to the covariates.[2]. We ran two versions of the logistics model; (Eq. 1) based on the same explanatory variables as used in Table 2, (Eq. 2) based on the same explanatory variables as used in Table 2 but also with employment shares in construction and employment shares in 'meds and eds' – two of the industries with the strongest relation to GRP per Capita as per our regression analysis which includes controls for industry shares (see the Appendix).

As Table 5 shows, when the matching is based on Equation 1, the mean and median GRP per capita for regions with and without airport are 10.65 and 10.55 versus. 10.68 and 10.51 (logged values) respectively – a considerable difference in terms of percentiles of the distribution (Appendix 2). The mean value difference is

[2] The results from the logistic regression procedures are available in the Appendix, together with the mean value difference t-test results.

slightly lower but yet significant on the 10%-level. Also in the case where we add construction employment shares and 'meds and eds' employment share in the matching process (Equation 2) we still find a significant difference in the mean (10.62 to be compared to 10.50) and median (10.67 compared to 10.51). This suggests that regions with similar preconditions can be expected to perform significantly better economically if they have an airport.

Taken together, our findings indicate that airports matter when it comes to regional economic development. Also after we have controlled for regional size, unemployment, industrial and educational structures as well as climate, the airport effect remains strong and significant. Our research also finds that airports contribute to regional development both by moving people as well as moving goods.

Conclusion

Our research has examined the role of airports in regional economic development across two dimensions. We first examined the factors associated with whether or not a metro has an airport. Next we probed the effects of airports on regional development. Priority was placed on examining how the size and scale of airport activities and the moving of people or goods matter to regional development. We examined these questions through a series of multiple regression models, and also examined the effects of metros with and without airport on economic development based on a propensity score matching procedure.

Our research generates four key findings. First, we find that population size is the most important factor in explaining which metros have an airport in the first place. Larger metros with more people will generate more demand for airports. Having an airport is also associated with warmer winter climates and higher levels of artistic and

culturally creative bohemians, which may also reflect higher levels of tourism. Interestingly, there is 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 that most airports were established long ago and would not be affected by today's levels of technology, human capital, or unemployment, even though these structures tend to be fairly consistent over time[3]. Overall, our findings here suggest that having an airport is a function of being a larger, more developed region.

Second, the analysis also examined the effects of airports on regional development. Here, we find substantial evidence that airports play an important role in regional economic development controlling for a wide range of factors.

Third and related to this, it is not just having an airport, but the size and scale of airport activities matter according to our analysis, with larger airports having a bigger positive effect on regional development. This makes intuitive sense. Larger airports will move more passengers and goods into and out of metros having a bigger effect on their output. This in turn helps to shed light on the complex issue of causality. While airports tend to be concentrated in larger more developed metros (as per above), the fact that larger airports have a bigger effect on regional development suggests that airport activities matter above and beyond the effects of regional size.

Fourth, we find that airports affect regional development through two primary channels – "moving people" and "moving goods." Here, our analysis finds that moving people has a relatively larger effect than moving goods - a one percent change in passengers per capita has roughly twice the effect on economic output as a one percent change in moving goods. This suggests that airports may play a slightly

[3] Work by Berry and Glaeser (2005) suggests a strong path dependency for shares of highly educated in U.S. metros. The authors find that cities with higher shares of highly educated also experienced relatively higher shares of this group already in the 1980s.

greater role in the knowledge economy which is in line with Green's (2007) contention that the most precious cargo being moved by and through airports is people.

This brings us to the issue of causality which in the case of airports, as with many aspects of economic development, is a complex, cumulative process. On the one hand, airports are more likely to be located in bigger regions with more passengers and more demand, which is what we find. On the other, airports also bring development to regions. Our results suggest that airports are significantly related to regional development and also that larger airports bring higher levels of regional development, controlling for other factors including population size. The effect of airports is similar to that of human capital and greater than high-tech industry, two key factors in regional development.

Our propensity score matching analysis of metros with and without airports suggests that metros which have airports perform significantly better economically than metros with similar preconditions and structures which do not have an airport. Of course, this still do not enable us to tease out the precise historical causality between airports and economic development, but this is also true of many other factors that shape economic development, which is an ongoing, evolutionary, path-dependent, and cumulative process. We encourage future research based on longer-time series data on this important issue.

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TABLES AND FIGURES

	Minimum	Maximum	Mean	Std. Deviation
Airport Factor	-2.064	2.290	0	1
Passengers per Capita	0.17	100.5	30.93	25.10
Cargo Tonnes per Capita	0	6.91	0.15	0.685
Economic Output	14855	94852	41584	12295
Population	55226	18919983	717141	1596336
High-Tech Industry	.0002	8.5273	.2376	.847
Human Capital	.1135	.5688	.2518	.077
Unemployment	3.40	32.20	9.540	3.014
Climate	3.95	66.50	36.050	12.204
Bohemians	.000	2.195	.512	.371
Industry employment shares:				
Agriculture & Mining	.10	22.00	2.4240	3.0309
Construction	2.50	10.70	6.1930	1.3475
Manufacturing	2.00	38.00	11.0398	5.4802
Wholesale	.40	8.00	2.6766	.92571
Retail	7.20	18.10	12.1914	1.6644
Transportation & Warehouse	2.00	12.30	4.5925	1.2851
Information	.10	4.60	1.7774	.66359
Finance & Insurance	1.70	21.10	5.7524	1.9885
Prof. Science & Management	3.20	20.20	8.9657	2.5617
Meds & Eds	14.20	48.70	24.5437	4.4615
Public Administration	1.40	22.40	5.5036	3.0436

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

Variable	Coefficient
Constant	-34.688***
	(-5.55)
Population	2.344***
	(4.85)
High-Tech Industry	-0.018
	(-0.08)
Human Capital	-0.959
	(-0.89)
Unemployment	-0.622
	(-0.70)
Climate	1.568**
	(2.56)
Bohemians	1.944***
	(3.69)
N	290
Pseudo R^2	0.529

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***
Passengers per Capita	.506***
Cargo per Capita	.478***
High-Tech Industry	.583***
Human Capital	.571***
Population	.422***
Unemployment	-.430***
Climate	-.138**

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

Table 4: OLS Regression Results for Airports and Regional Economic Development (Dependent variable: Log GRP per Capita)

Variable	Eq (1)	VIF	Eq (2)	VIF	Eq (3)	VIF	Eq (4)	VIF
Constant	12.155***		11532***		11.380***		11.130***	
	(21.077)		(26.882)		(27.355)		(39.017)	
Airport Factor	0.098***	5.938	-		-		-	
	(2.797)							
Passengers per Capita	-		0.055***	2.335	-		-	
			(2.617)					
Cargo per Capita	-		-		0.023***	1.439	-	
					(3.093)			
Airport Dummy	-		-		-		0.078**	2.029
							(2.490)	
Population	-0.011	6.687	0.017	5.438	0.015*	4.174	0.042*	4.522
	(-0.273)		(0.498)		(1.714)		(1.932)	
High-Tech Industry	0.015	5.811	0.030	5.991	0.015	5.806	0.029**	5.231
	(0.783)		(1.503)		(0.784)		(2.438)	
Human Capital	0.380***	2.704	0.287**	2.706	0.386***	2.684	0.142**	2.414
	(3.359)		(2.525)		(3.443)		(2.527)	
Unemployment	-0.275***	1.546	-0.263***	1.531	-0.285***	1.561	-0.328***	1.502
	(-4.086)		(-3.792)		(-4.241)		(-7.133)	
Climate	-0.036	1.399	-0.048	1.430	-0.021	1.442	-0.018	1.217
	(-0.794)		(-1.025)		(-0.455)		(-0.591)	
N	114		120		114		315	
R^2 Adj.	0.593		0.567		0.599		0.501	

Notes: t-values within parentheses.

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

Table 5: Mean and Median Values for Propensity Score Matched Data:

	Airport	Mean	Median	Standard Dev.	N
Equation 1	**Yes**	10.6555	10.6848	0.2685	35
	No	10.5472	10.5119	0.2600	35
Equation 2	**Yes**	10.622	10.672	0.2802	35
	No	10.496	10.506	0.2827	35

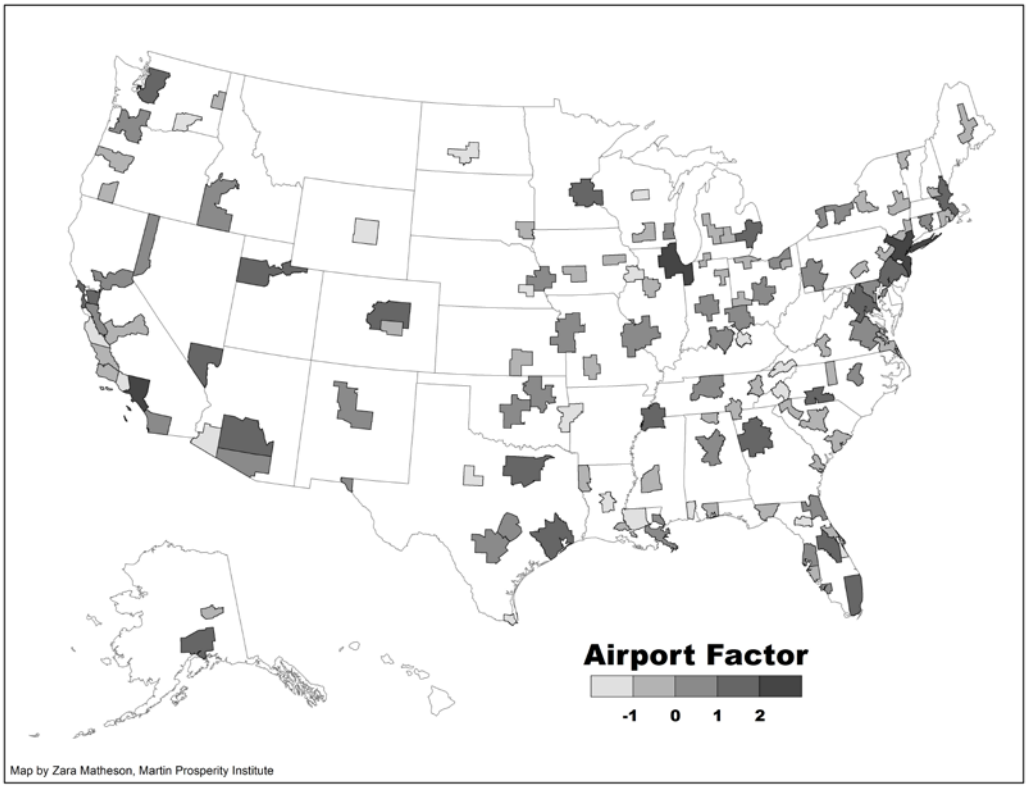

Figure 1: Airport Factor for Flights, Passengers and Cargo per Capita

Appendix: Propensity Score Matching Results

Logit Regression for the Likelihood of Having an Airport
Before and After the Propensity Score Matching

Variable	Original Coefficients	Coefficients after Propensity Score Matching	Original Coefficients	Coefficients after Propensity Score Matching
	Equation 1		Equation 2	
Constant	-34.688***	2.253	-28.710***	4.272
	(6.250)	(7.947)	(7.824)	(10.510)
Population	2.344***	-.233	2.441	-0.386
	(0.483)	(0.594)	(0.500)	(0.678)
High-Tech Industry	-0.018	-0.074	-0.056	-0.080
	(0.228)	(0.272)	(0.234)	(0.347)
Human Capital	-0.959	0.729	-0.657	-0.691
	(1.078)	(1.456)	(1.159)	(1.734)
Unemployment	-0.622	-0.566	-1.030	0.319
	(0.895)	(1.080)	(0.956)	(1.149)
Climate	1.568**	0.837	1.774**	-0.334
	(0.613)	(0.899)	(0.695)	(1.036)
Bohemians	1.944***	0.333	1.782***	0.945
	(0.526)	(0.715)	(0.539)	(1.807)
Meds and Eds			-1.570	-0.163
			(1.362)	(1.930)
Construction			-1.052	0.618
			(1.087)	(1.449)
N	290	70	290	70
Pseudo R^2	0.690	0.046	0.534	0.049

Notes: standard error values within parentheses.
*** Significant at the 1 percent level, ** at the 5 percent level

Log GRP per capita, matched and original data.

Percentiles	Equation 1	Equation 2	Original Data
10	10.2711	10.1969	10.2512
20	10.3605	10.3517	10.3555
30	10.4433	10.4237	10.4351
40	10.5092	10.4985	10.5180
50	10.5989	10.5667	10.5979
60	10.6322	10.6073	10.6626
70	10.7701	10.6851	10.7466
80	10.8080	10.7861	10.8233
90	10.9375	10.8855	10.9448
	N=70	N=70	N=359

T-test of Mean Value Difference of GRP per Capita for Matched Data

		Coefficients	Significance (2-tailed)	Mean Difference
Equation 1	Equal variation assumed	-1.714	0.091	-.10830
	Equal variation not assumed	-1.714	0.091	-.10830
Equation 2	Equal variation assumed	-1.862	0.067	-.12531
	Equal variation not assumed	-1.862	0.067	-.12531

OLS Regression Results for Airports and Regional Economic Development *with Industry Control Variables* (Dep. variable: Log GRP per Cap.)

Variable	Eq (1)	VIF	Eq (2)	VIF	Eq (3)	VIF	Eq (4)	VIF
Constant	15.703***	-	16.397***	-	15.119***	-	14.682***	
	(17.126)		(20.984)		(16.824)		(26.318)	
Airport Factor	0.086***	8.57	-	-	-		-	
	(2.727)							
Passengers per Capita	-	-	.063***	2.746	-		-	
			(3.785)					
Cargo per Capita	-	-	-	-	0.017***	1.790	-	
					(2.813)			
Airport Dummy	-	-	-	-	-		0.072***	2.122
							(2.603)	
Population	0.013	11.688	0.008	8.105	0.074***	6.688	0.027	5.826
	(0.342)		(0.264)		(2.691)		(1.272)	
High-Tech Industry	-0.011	10.924	0.011	10.642	-0.013	10.919	0.024**	6.476
	(-0.538)		(0.593)		(-0.669)		(2.018)	
Human Capital	0.569***	5.203	0.452***	5.494	0.593***	5.099	0.278**	4.614
	(4.843)		(3.862)		(5.110)		(4.132)	
Unemployment	-0.383***	3.195	-0.378***	3.205	-0.405***	3.268	-0.338***	1.867
	(-5.284)		(-5.215)		(-5.547)		(-7.601)	
Climate	0.096	2.390	0.099*	2.539	0.088**	2.345	0.044	1.744
	(0.119)		(2.215)		(2.013)		(1.358)	
Industry Structure								
Agriculture & Mining	.033	2.313	0.026	2.115	0.030	2.272	0.012	1.989
	(1.754)		(1.489)		(1.605)		(0.843)	
Construction	-.268***	2.114	-0.332***	2.180	-0.260***	2.118	-0.120**	1.451
	(-2.990)		(-3.664)		(-2.908)		(-2.349)	
Manufacturing	.057	3.292	-0.013	2.658	0.024	2.905	-0.010	2.423
	(1.228)		(-0.323)		(0.559)		(-0.336)	
Wholesale	.065	1.738	0.067	1.823	0.056	1.763	-0.032	1.502
	(1.070)		(1.156)		(0.917)		(-1.101)	
Retail	-.422***	1.565	-0.498***	1.587	-0.344***	1.625	-0.448***	1.278
	(-3.121)		(-3.875)		(-2.503)		(-5.740)	
Transportation & Warehouse	.035	2.069	0.038	1.951	0.028	2.099	0.049	1.522
	(0.530)		(0.556)		(0.418)		(1.167)	
Information	-.041	1.694	-0.018	1.736	-0.062	1.737	0.020	1.461
	(-0.905)		(-0.395)		(-1.340)		(0.718)	
Finance & Insurance	-.009	2.484	-0.001	2.437	-0.035	2.464	0.047	1.839
	(-0.156)		(-0.001)		(-0.578)		(1.135)	
Prof. Science & Management	-.145	5.487	-0.219**	4.809	-0.124	5.484	-0.165***	3.336
	(-1.266)		(-2.125)		(-1.090)		(-2.668)	
Meds & Eds	-.698***	2.399	-0.803***	2.176	-0.744***	2.297	-0.538***	1.874
	(-5.874)		(-7.080)		(-6.416)		(-7.295)	
Public Administration	-.042	2.322	-0.051	2.200	-0.069*	2.169	-0.063**	1.631
	(-0.972)		(-1.245)		(-1.671)		(-2.412)	
N	114		120		114		315	
R^2 Adj.	0.772		0.774		0.773		0.625	

Notes: t-values within parentheses.

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