4 POPULATION BASE & ACCESS TO AIRPORTS

"Spatial Geography: Effects of Population Base and Airport Access"
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4.1 Introduction

This chapter describes findings from two related studies. One examines the impact of a county's population base on its business mix. The other examines how highway access to airports also affects business mix. These two studies differ from other studies discussed in this report in that they focus on identifying determinants of a county's business mix rather than its economic growth and well-being.

The motivation is to help identify the conditions necessary for pursuing growth paths that target various types of manufacturing, trade, services or other business sectors. In addition, these two research studies are intended to shed additional light on the role and importance of highway access in supporting economic growth.

A major element of both research studies is that they focus on examining the existence of "threshold" or other non-linear effects. In other words, it would be expected that some types of business require a minimum labor market or customer market in order to select a location for a new plant. Similarly, some types of business may require locations within a particular travel time to an airport, which must also be of a minimum size to provide sufficient scheduled service. Thus, the role of thresholds and non-linear responses becomes important.

4.2 (A) Population Base: Methodology

Measure of Business Mix. The first part of this study examines the relationship of a county's business concentration and mix to its scale of population base or market. This relationship can be particularly important in establishing how the viability of various growth strategies and target industries may differ depending on the county population base or the degree to which it is urban or rural.

For this study a dataset was used that provided year 2002 employment by 3-digit NAICS industry codes, for each of the 410 counties in the ARC region. A dataset prepared by IMPLAN was used because it provided measures of total employment including self-employed individuals and farm workers, who are not covered in County Business Patterns data. IMPLAN data are based predominantly on the REIS data, but has the advantage that it has values filled in for all industries in all counties, without the problem of missing (withheld) data which is common for many specific industries in small rural counties. Using this dataset, we define and calculate an indicator of relative business concentration:

Business Concentration (i,c) = Employment Share (i,c) * Attraction Ratio (i,c)

where:

Employment Share = Employment (i,c) / Employment (Σ i, c)

Attraction Ratio = Employment (Σ i, c) / Population (c)

and i = NAICS industry, Σ i = sum over all industries, c=county

which simplifies down to:

Business Concentration (i,c) = Employment (i,c) / Population (c)

The reason for constructing this composite measure of relative business concentration is to represent the combination of relative industry mix (represented by the Employment Share calculation) and relative industry attraction (represented by the Attraction Quotient). The Employment Share calculation is the numerator of the Location Quotient used in an earlier chapter to measure the economic base analysis of trade areas. However, instead of using the denominator of the Location Quotient (which represents national norms for industry mix), we make use of an Attraction Ratio which expresses industry employment per local population base.

The Attraction Ratio can reflect the extent to which a county has a greater level of employment in the given industry than would be expected given its population. A high ratio is generally interpreted as an indicator that the county is a business center for the given industry and has a net inflow of workers coming in from surrounding areas for that industry. On the converse side, a low Attraction Coefficient could would normally be interpreted as an indicator that the county is not a center of activity for that industry, though that may be due to many factors including a high a unemployment rate or a low labor force participation rate (e.g., a retirement area).

This per capita measure of business concentration nets out the effect of differences in county population size, so that a small county can in theory have a high concentration of a given industry just as easily as a large or populous county. By normalizing the business concentration in this way, we make it possible to analyze the role of population size in affecting the business concentration, while avoiding correlation between the two.

Alternative Travel-Time Based Definition of Population Base. An alternative definition of population base was also constructed in which we used ESRI's Geographic Information System to calculate the population base within a 30 or 40-minute drive time of the population-weighted center of each county. That concept utilizes a more sophisticated form of spatial analysis than simply measuring the population located within each county.

Unfortunately, preliminary analysis showed that this new measure actually had *less* power in predicting business concentration. The reason was that defining a county's trade area in this way fails to provide any leverage for distinguishing between (1) a county that is the center of activity in a multi-county region and (2) a fringe county that exports its workers and spending to the center of activity. In both cases, the 30 or 40-minute drive time from each county would include the others, so that they would all appear to have an equally large trade area. The simpler metric of total county population, it is actually more accurate in distinguishing counties that are a center of population and activity from those that are more rural and serve as feeders to the activity centers.

Modeling the effect of county population size. The analysis examines how the business concentration indicator for each industry differs by population level of the county (based on Year 2000 Census data). Two different techniques are used: (1) exploration of alternative regression functional forms, and (2) exploration of differences in the ratio among county population size groups.

The a priori assumption was that the ratio of employment over population for retail industries will stay generally constant as population increases. For specialized distribution and services industries, though, it would be expected that the ratio should increase with greater population base, as these industries are more sensitive to market size features. We would also expect those industries that thrive in rural areas—agriculture and mining—to be negatively affected by increases in population density.

The first technique involved using "curve estimation" to explore the relative significance and explanatory power of alternative functional forms for each industry. The slope of this regression at any given point will be the ratio of Business Concentration to population. Therefore, if a *linear model* fits the data best, then we can conclude that the Business Concentration changes directly as population increases. If a *quadratic model* is the best fit (wherein the sign of the coefficient of the quadratic term, $[\text{population}]^2$, is positive) then the Business Concentration grows faster as population increases; if the sign is negative then the ratio growth will slow down as population increases. Similarly, if the best fit is a *logarithmic model* than the Business Concentration growth will also slow down and stop growing as population increases. These sets of models were run separately for 52 industries. In addition, an analysis of *threshold effects* was conducted by breaking down this relationship by six distinct size classes.

4.3 (B) Population Base: Results

Regression Results. The results of these regressions are close to *a priori* expectations. Retail industries have linear and quadratic regressions that fit very closely. Service industries have mostly positive quadratic coefficients. Agricultural industries exhibit a logarithmic or quadratic (with a negative sign) relationship. The latter is not surprising since agricultural industries usually thrive in rural areas. Manufacturing industries exhibit results that are generally mixed and insignificant, indicating that they are less sensitive to scale of the population base than retails and service businesses.

The regressions results are shown in Exhibit 4-1 for those industries in which the model had statistically significant coefficients and an R^2 of 0.50 or better (indicating that the regression formula was explaining over 50% of the variance in the industry concentration measure.) Key findings are that:

- The business sectors with a *negative quadratic coefficient* have an aversion to counties with a larger population base. These are generally agricultural sectors.

- The business sectors with a *positive quadratic coefficient* show increasing growth of business concentration as population grows, though the point of inflection differs among industries. These are generally wholesale and retail trade sectors that have some market scale requirements.

- The business sectors that had a *logarithmic regression* fit best are those that have some minimum population size requirement but no additional growth in business concentration as population increases further. These are industries that process crops and livestock, and hence need access to a minimal labor force

- About half of all industries are *not listed* because there did not appear to be a statistically significant relationship between their concentration and county population in the regressions. They include mining, most manufacturing and freight transportation. For these industries, factors including the location of natural resources, topography and access to highway networks may be more important than just having a local population base. (Note that the role of access to highways is explored in the prior chapter, and highway access to airports is explored in a later part of this chapter.)

Exhibit 4-1 Business Concentration Regression Results for Selected Industries

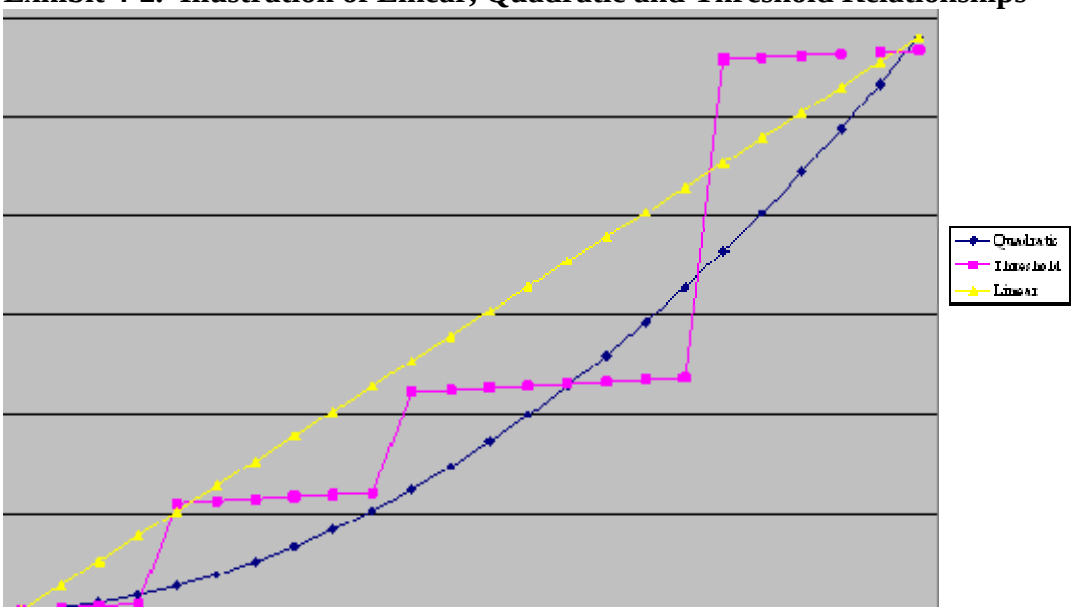
NAICS		Parameter Estimates		
		B1(Pop)*	B2(Pop^2)**	R^2
Quadratic w/ negative coefficient				
332	Fabricated metal prod	7933.4	-2200.	.66
447	Gasoline stations	5080.97	-2500.	.90
623	Nursing & residential care	12041.88	-6900.	.86
721	Accommodations	3313.56	-880.	.50
Quadratic w/ positive coefficient				
42	Wholesale Trade	7520.11	58500.	.91
92	Government & non NAICs	59961.5	34200.	.85
221	Utilities	1392.93	4150.	.53
230	Construction	25623.49	49400.	.94
323	Printing & Related	2268.82	2300.	.58
339	Miscellaneous mfg	1812.84	3560.	.63
441	Motor veh & parts dealers	7309.62	6050.	.96
442	Furniture & home furnishings	1459.61	2840.	.88
443	Electronics & appliances stores	1000.83	3450.	.87
444	Bldg materials & garden dealers	4180.55	4590.	.90
445	food & beverage stores	10155.42	5390.	.95
446	Health & personal care stores	3392.82	3140.	.95
448	Clothing & accessories stores	3156.62	9680.	.79
451	Sports- hobby- book & music stores	1819.98	4920.	.88
452	General merch stores	11004.37	4340.	.94
453	Misc retailers	4435.05	7810.	.91
454	Non-store retailers	4136.71	6150.	.62
484	Truck transportation	9186.41	2990.	.50
491	Postal service	1642.57	3830.	.79
492	Couriers & messengers	1371.51	3310.	.63
493	Warehousing & storage	1431.7	2030.	.63
511	Publishing industries	1523.2	4640.	.83
512	Motion picture & sound recording	278.92	1630.	.72
513	Broadcasting	539.11	21100.	.89
514	Internet & data process svcs	-97.03	4630.	.64
521	Monetary authorities	3367.09	13000.	.79
523	Securities & other financial	497.98	9000.	.77
524	Insurance carriers & related	907.77	35400.	.79
525	Funds- trusts & other finan	-340.7	2870.	,54
531	Real estate	6331.76	17000.	.85
532	Rental & leasing svcs	1857.06	5280.	.92
541	Professional- scientific & tech svcs	13221.38	67400.	.78
551	Management of companies	1378.15	11600.	.77
561	Admin support svcs	13487.54	67000.	.89
621	Ambulatory health care	16961.05	12000.	.89
622	Hospitals	12300.35	9430.	.67
711	Performing arts & spectator sports	1744.07	5000.	.90
713	Amusement- gambling & recreation	4060.41	1730.	.77
722	Food svcs & drinking places	32363.29	20600.	.95
811	Repair & maintenance	9138.55	15100.	.94
812	Personal & laundry svcs	4926.94	8330.	.90
Logarithmic				
111	Crop Farming	27.909197	--	.55
112	Livestock	36.6938123	--	.64

The independent variable is POP.
*actual coefficients multiplied by 1,000,000

**actual coefficients multiplied by 1,000,000,000,000

Concept of Thresholds. The strong finding that retail and service industries had non-linear relationships between industry concentration and population base indicates the likely presence of "threshold effects"—where a certain minimum population base is necessary to make a given industry viable and thus attracted to the area. Of course, the location and magnitude of this threshold effect may differ by industries. Exhibit 4-2 portrays this relationship by contrasting a linear relationship, a quadratic relationship and a threshold relationship (where multiple thresholds are shown).

Exhibit 4-2. Illustration of Linear, Quadratic and Threshold Relationships



It would be expected that threshold effects are particularly important for specialized business functions such as professional and financial services. That is, we expect the size of an area affects its ability to attract certain (generally high-skilled) sectors, either because these sectors require large numbers of potential customers or require specialized skills that are more easily found in larger labor markets.

To test this hypothesis, we calculated business concentration ratio for each 3-digit NAICS sector for the following county population sizes: <10,000, 10,000-24,999, 25,000-49,999, 50,000-99,999, 100,000-249,999, and >250,000. As shown in Exhibit 4-3, the industries that exhibit threshold effects can be categorized into two groups. In Group 1, Business Concentration (sector employment per capita) successively increases with county size, indicating that there may be increasing returns to increasing population base, and possibly also some threshold effects. In the Group 2, Business Concentration declines between county population size <10,000 and county population size 10,000-25,000, then increases with each increase in county population. This second group of industries may indicate that there are minimum requirements or scale effects at work that preclude those industries from locating in rural areas with a small population base.

Exhibit 4-3. Evaluation of Threshold Effects

% change in Business Concentration Ratio(Jobs-per-capita) from Previous (Smaller) Population Category

		ARC County population					
NAICS	**- Industry Sector**	**10,000-24,999**	**25,000-49,999**	**50,000-99,999**	**100,000-249,999**	**over 250,000**	***TOTAL Growth***
Group 1: Positive growth across all size categories							
42	Wholesale Trade	85%	36%	38%	24%	71%	*640%*
230	Construction	26%	7%	22%	22%	27%	*153%*
441	Motor vehicle/parts dealers	54%	30%	28%	8%	5%	*190%*
442	Furniture stores	67%	35%	11%	38%	29%	*345%*
443	Electronic & appl. stores	117%	23%	35%	61%	76%	*919%*
445	food & beverage stores	21%	10%	5%	17%	4%	*70%*
446	Health & pers care stores	15%	10%	10%	14%	10%	*74%*
448	Clothing stores	77%	40%	39%	43%	56%	*670%*
451	Specialty stores	48%	30%	65%	59%	60%	*709%*
454	Non-store retailers	73%	9%	11%	9%	17%	*166%*
481	Air transportation	14%	48%	208%	223%	270%	*6108%*
485	Transit & ground passengers	88%	155%	2%	29%	18%	*647%*
511	Publishing industries	17%	9%	43%	47%	152%	*574%*
523	Securities & other financial	31%	12%	54%	125%	317%	*2031%*
524	Insurance carriers & related	19%	13%	67%	61%	139%	*767%*
541	Professional & tech. services	11%	52%	64%	31%	157%	*829%*
561	Admin support services	82%	51%	41%	36%	88%	*891%*
621	Ambulatory health care	26%	21%	23%	24%	29%	*204%*
622	Hospitals	73%	2%	33%	12%	17%	*208%*
722	Eating & drinking places	16%	36%	23%	15%	19%	*166%*
811	Repair & maintenance	40%	34%	31%	14%	30%	*265%*
812	Personal & laundry services	0%	48%	31%	27%	44%	*254%*
Group 2: Sectors with *Jobs-per-capita* growth at population levels of 25,000+							
92	Government etc.	-10%	11%	19%	15%	20%	*63%*
453	Misc retailers	-2%	16%	38%	20%	29%	*145%*
487	Sightseeing transportation	-50%	88%	31%	9%	122%	*195%*
514	Internet & data process svcs	-70%	17%	104%	208%	79%	*296%*
531	Real estate	-22%	40%	20%	41%	122%	*314%*
532	Rental & leasing svcs	-45%	39%	19%	12%	84%	*87%*
562	Waste mgmt & remediation	-3%	62%	1%	0%	28%	*102%*
711	Performing arts & sports	-62%	9%	15%	72%	113%	*76%*

The results in prior Exhibit 4-3 show that the Business Concentration Ratio in various both retail and specialized services is much higher in larger counties than in smaller counties. This may also reflect the growth of big box retailers that invest primarily in areas with some minimum population size threshold. It is particularly interesting to note some of the most dramatic threshold jumps:

- Growth in Transportation (NAICS 481) above 50,000 population,
- Growth in Financial Securities (NAICS 523) above 100,000 population,
- Growth in Publishing (NAICS 511) above 250,000 population,
- Growth in both Professional-Technical-Scientific Services (NAICS 541) as well as Insurance Offices (NAICS 524) above 250,000 population,
- Presence of Real Estate (NAICS 531) and Sightseeing Transportation (NAICS 487) starting at 25,000 population with an additional jump above 250,000

The various types of threshold relationships are shown graphically in Exhibits 4-4 through 4-6. Exhibit 4-4 illustrates the jump in professional and scientific services when the population exceeds 250,000. This finding makes sense as this kind of industry usually is found in very large population centers. This industry's functional form was quadratic with a positive coefficient which indicated that relative activity in this industry increased with population.

Exhibit 4-4. Threshold for Professional, Technical and Scientific Services

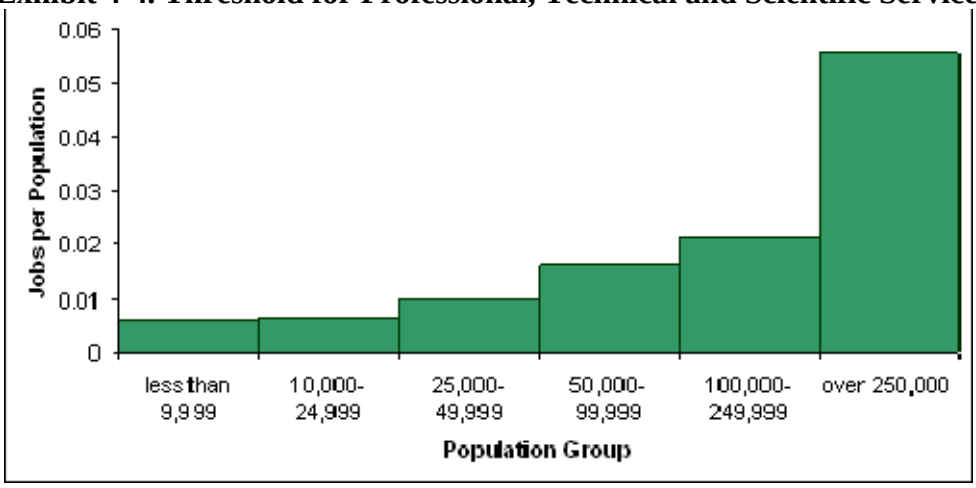


Exhibit 4-5 illustrates a pattern of continuing growth in business concentration as population increases. The functional form of the regression for this industry was quadratic with a negative coefficient which suggests that the rate of growth in activity peaks and then eventually tapers off as county population increases further.

Exhibit 4-5. Threshold for Ground Transportation

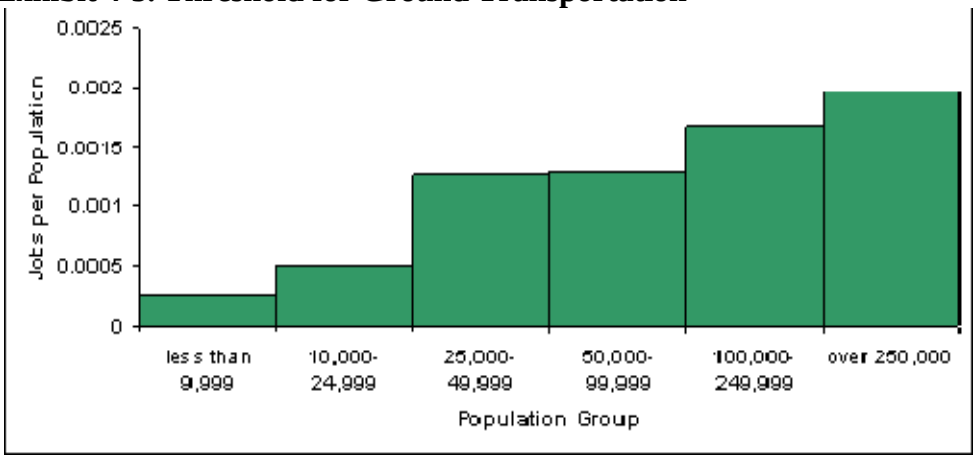
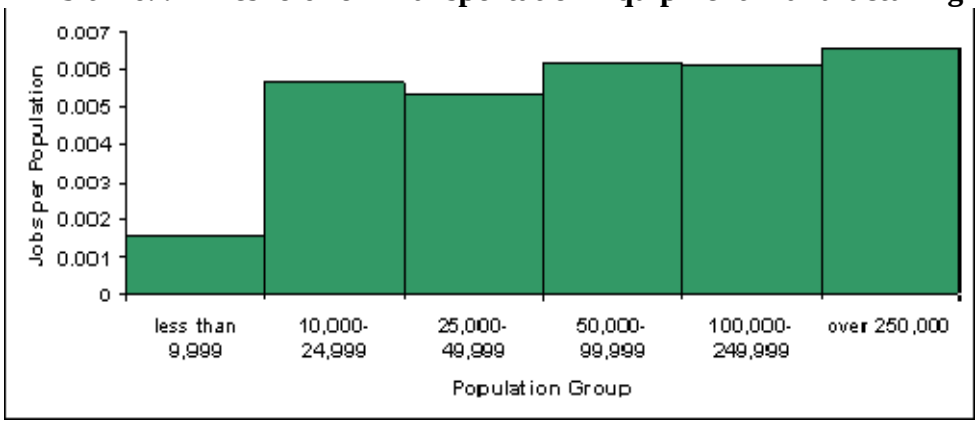


Exhibit 4-6 shows an example of the relationship for many manufacturing industries, which may require a minimum of around 10,000 population but do not appear to grow in Business Concentration as area population increases further. As previously noted, this type of business is often dispersed along supply chains and depends on transportation network connections rather than population size as a locational determinant. In fact, one of the motivations of a dispersed supply chain is that it allows use of parts suppliers located in lower cost and smaller labor markets.

Exhibit 4-6. . Threshold for Transportation Equipment Manufacturing



When comparing the regression results to the category-based threshold analysis, it was concluded that the latter form of analysis provided more precision. The regressions do give an indication of the type of relationship that employment-per-capita has for a given industry. However, they do not allow for precise identification of inflection points in a relationship that are due to minimum requirements for market or production scale economies. Further discussion of the use and limitations of this analysis, and directions for further research, are presented at the end of this chapter.

4.4 (B) Airport Access: Methodology

The second part of this study examines the relationship of a county's business mix to airport proximity, where both highway drive time to the airport and the size of airport service are considered. For some manufacturing industries that have national and international customers, airport access can be particularly important.

This analysis starts with the same dataset as the prior study of business concentration. It uses year 2002 employment by 3-digit NAICS industry codes, for each of the 410 counties in the ARC region. It was supplemented by comparable data for another 228 counties located outside of the ARC region, to enhance the coverage of outside metro centers. This data from IMPLAN represents total employment including self-employed individuals and farm workers, who are not covered in County Business Patterns. The study also used a Geographic Information System to calculate each county's population-weighted centroid, and the average drive time (in minutes) from that location to the closest airport with scheduled passenger service. Additional FAA data was used to represent the level of airport activity, represented as the number of commercial airline takeoffs and landings (known in the aviation field as "total operations").

It would be expected that industries that are more dependent on air transportation will seek locations convenient to an airport, and particularly locations convenient to an airport that is large enough to serve their needs. This may include businesses that rely on air service for incoming materials, customer visits, employee sales travel, or product delivery. In general, business sectors that are known to value air transportation include light manufacturing industries that rely on exporting and importing air cargo, and service industries that rely on employee business travel.

To estimate this relationship, each industry's share of total county-wide employment was calculated, and non-linear regression analysis was used to predict the roles of explanatory variables representing airport access time, airport size and the interaction of the two. There are several salient considerations that guided this specification:

- The measure of Employment Share was used to represent the relative portion of countywide employment each industry. This measure was used in order to focus on how airport access affects the *economic specialization* of counties. This measure was used instead of employment size or business concentration measures to avoid correlation with population size of the county, which is another factor analyzed separately in the preceding part of this chapter.

- The analysis of explanatory factors focused on interactions between airport size and airport distance or travel time in order to illuminate the role of highway connections in improving access for air-dependent industries.

- Various forms of "curve fitting" regression formulations were used to calculate the relationships and shape of curves. But unlike the preceding study of population base, there was no separate analysis of threshold effects for airport distance because many types of business value airport proximity but few if any would find additional value in being some minimum distance away.

The statistical analysis tested various linear, quadratic and logarithmic curve forms to explain the roles of airport size and ground access travel time on industry employment shares. They all generally involved three explanatory variables: size of airport(number of operations), distance to airport (access time), and the interaction between the two (number of operations*access time). The functional form for the linear model was:

$$\text{Employment Share } (i,c) = B_1 * time(c) + B_2 * Size(c) + B_3 * [time(c) * size(c)$$

$$\text{where } i = \text{NAICS industry and } c = \text{county}$$

The statistical analysis also tested a "gravity model" formulation that represented the interaction between a positive weighting factor of airport size and a negative factor of airport access time (squared).

$$\text{Employment Share } (i,c) = B_1 * time(c) \ / \ size^2(c)$$

4.5 (B) Airport Access: Results

Roles of Airport Access Time and Size. Results of the regressions can best be illustrated by showing how various industries respond differently to the effect of airport access time (holding airport size constant), and to the effect of airport size (holding airport access time constant). Accordingly, we present a pair of graphics for a typical county.

Exhibit 4-7 illustrates how the predicted number of jobs in a typical county would differ as *ground access time* to a typical size airport increases. It shows a steep drop-off of jobs in professional and technical services as airport access time increases from 1 to 80 minutes, with lesser impact beyond that point. The role of access time is significant but less dramatic for transportation equipment manufacturing and essentially non-existent for logging industries (which seldom use air travel).

Exhibit 4-8 illustrates how the predicted number of jobs would differ as *airport scale* (annual operations) increases. It shows a steep rise of jobs in professional and technical services as airport size rises above 50,000 annual commercial operations, tapering off as annual commercial operations increase beyond 100,000. The role of airport scale is significant but less dramatic for transportation equipment manufacturing (increasing most steeply as annual commercial operations rise to at least 10,000). Again, the role of airport size is essentially non-existent for logging

industries (which seldom use air travel).

Exhibit 4-7. Effect of Ground Access Time to Airport

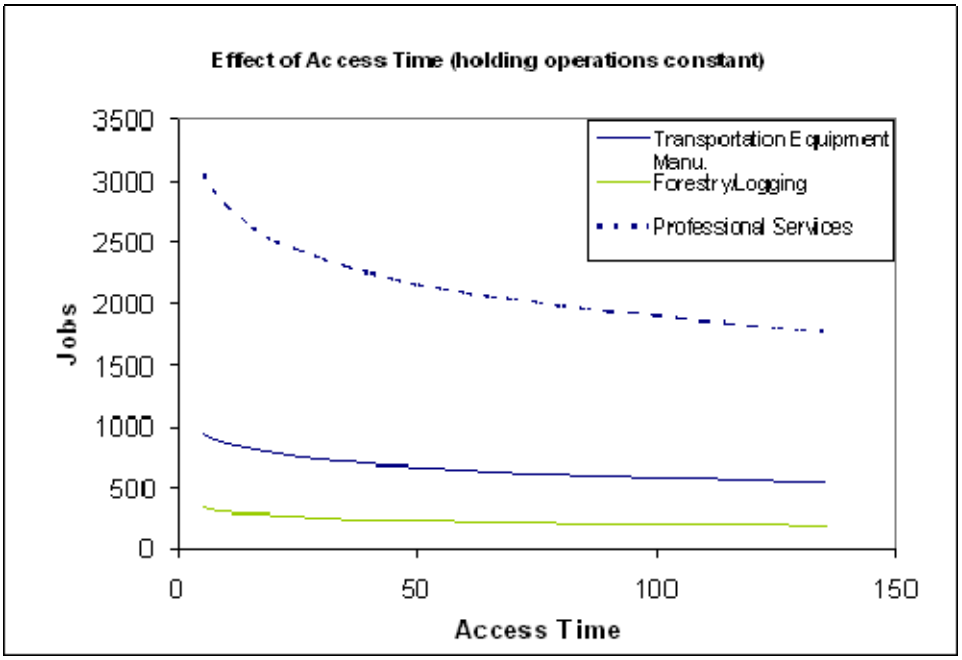
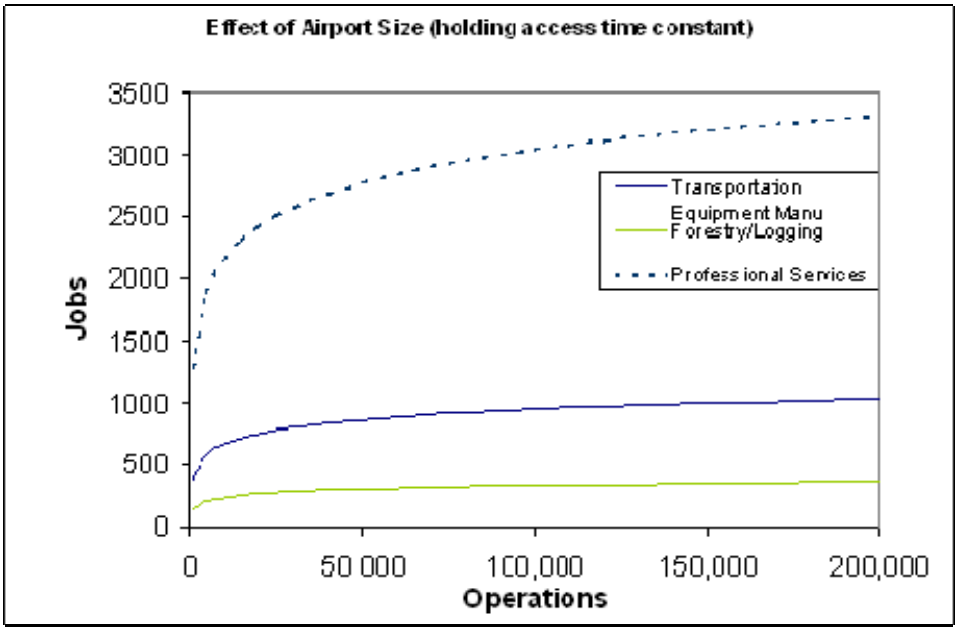


Exhibit 4-8. Effect of Airport Size



The regression coefficient estimates, shown in Exhibits 4-9 and 4-10, also show how some industries have a negative (or positive, diminishing) reaction to airport access and size. For instance, in Exhibit 4-9 the effects in agricultural industries have a positive coefficient for *time*. This means that they benefit from being further away from an airport. Other industries that have a significant positive coefficient for time include: mining, apparel manufacturing, and furniture manufacturing.

Some of those industries in Exhibit 4-9 that have a negative, significant coefficient for time (indicating that they value a reduction in airport travel time) are: wholesale trade, paper manufacturing, insurance, and professional services. These are the types of industries that we would expect to situate near airports, since they all rely on worker air travel for meetings with either clients or other office locations of their business. Exhibit 4-10 shows industries that have a positive but diminishing effect as airport access time decreases or operations increase. Some of these industries showed a negative effect in Exhibit 4-9 (i.e. crop production); this is due to the use of a different functional form. The estimates obtained for Exhibit 4-10 used a logarithmic model which gave many significant parameters estimates yet was not the best fit across all industries.

Testing of Urbanization Effect. We might expect these coefficients to also be affected by the degree of urbanization of a county. While the measure of Employment Share is standardized so that it is not affected directly by population size, it is known that some technology and service industries congregate in high population areas, as demonstrated in the preceding Population Base analysis. To see if this has an effect on the airport analysis, we tested whether the core model coefficients changed sign or significance when adding the "*urban effect.*" This effect was incorporated by adding a dummy variable for counties with population of 200,000 or more (Urban dummy = 1). All other counties were assigned a value of 0" representing non-urban areas.

The implications of adding a test of urbanization to Model #1 are embedded in Exhibit 4-9. The urban effect is categorized in the columns to the right of each independent variable: (A) represents cases where the urban dummy variable stays significant and has the same sign as the original variable, (B) represents cases where the original variable is insignificant but the urban variable is significant, and (C) represents cases where there is no significant urban effect; i.e., where the urban variable is not significant even though the original variable was significant.

The results show most of the effects lie in the "C" category. For the time variable, there is either no urban effect or adding the urban variable only makes the time variable insignificant—the exception being the wood products industry. For the size and interaction variables, there are several industries where the effect of these variables is reinforced in urban counties. These industries include: insurance, real estate, professional services, administrative services, and publishing. However, for most industries there seems to be no urban effect.

Exhibit 4-9. Regression Results for Airport Access Model #1
(shown for selected industries with statistically significant coefficients)

Sector		B_1(Time)		B_2(Size)		B_3(Time*Size)	
111	Crop Production	**181.38**	C	**-2981**	C	23.731	-
112	Animal Production	**210.41**	C	**-5443**	C	**69.797**	C
113	Forestry & Logging	**68.704**	C	-317.7	-	-2.519	-
115	Support for Agriculture & Forestry	-25.778	-	**-1649**	C	**34.547**	C
212-213	Mining & Support Activities	**281.68**	-	886.9	-	-25	-
230	Construction	-53.341	-	**3171.5**	C	-4.689	-
313	Textile Mills	1.162	-	-1654	-	**24.611**	C
315	Apparel Manufacturing	**60.604**	-	-959.2	-	11.457	-
321	Wood Products	120.15	B	**-1509**	-	10.069	-
322	Paper Manufacturing	**-38.529**	C	-601.9	-	4.229	-
324	Petroleum & Coal Products	**-6.944**	C	-45.09	-	0.262	-
325	Chemical Manufacturing	**-44.866**	C	-577.6	-	3.71	-
336	Transportation Equipment	-1.818	-	**-1558**	-	16.915	-
337	Furniture & Related Products	**104.76**	-	-929.2	-	8.37	-
420	Wholesale Trade	**-85.13**	C	**3051.8**	C	**-32.57**	C
441-454	Retail Trade	-53.926	-	-348.1	-	0.209	-
491-493	Mail, package delivery & warehousing	**-51.904**	C	636.49	-	-8.7	-
511	Publishing Industries (except Internet)	-7.676	-	**595.39**	A	**-7.997**	A
512	Motion Picture & Sound Recording	**-4.165**	C	**248.7**	C	**-2.874**	C
513	Broadcasting	-1.182	-	**1345.2**	C	**-18.366**	C
514	Internet & data process svcs	-3.325	-	**595.67**	C	**-8.048**	C
524	Insurance Carriers & Related Activities	**-39.451**	C	**1145.7**	A	**-15.307**	A
525	Funds, Trusts, & Financial	1.755	-	**335.42**	A	**-4.53**	C
531	Real Estate	-28.396	-	**2846.1**	A	**-31.769**	A
532	Rental & Leasing Services	4.199	-	**449.11**	A	**-6.451**	C
541-551	Prof. Scientific, Technical, Services	**-176.12**	C	**7735.9**	A	**-93.673**	A
561	Administrative & Support Services	**-147.74**	C	**4584**	A	**-46.247**	A
711-713	Amusement & Recreation	**-49.522**	C	**1569.8**	C	**-17.369**	C
721-722	Accommodations, Eating & Drinking	**-124.69**	C	**1887.8**	C	-18.107	-
811-812	Repair, Maint, Personal Services	**-84.957**	C	**1428.1**	C	**-11.626**	C
814	Government	58.482	-	**-2413**	-	**37.496**	C

bold *indicates that coefficient is statistically significant*
A*=urban variable reinforces effect*
B*=only an urban effect*
C*=no urban effect when variable is already significant*
"-"=no significant effect in either case or incorrect sign

Exhibit 4-10. Regression Results for Airport Access Model #2
(shown for selected industries with statistically significant coefficients)

NAICS	Industry	Parameter Estimates b1(ln(oper/time))
111	Crop Production	**0.003992**
112	Animal Production	**0.004882**
113	Forestry & Logging	**0.00068**
115	Support for Agriculture & Forestry	**0.000756**
212-213	Mining & Support Activities	**0.001431**
230	Construction	**0.010472**
313	Textile Mills	**0.001388**
315	Apparel Manufacturing	**0.001057**
321	Wood Products	**0.001964**
322	Paper Manufacturing	**0.000789**
325	Chemical Manufacturing	**0.00091**
336	Transportation Equipment	**0.001901**
337	Furniture & Related Products	**0.001897**
420	Wholesale Trade	**0.004073**
441-454	Retail Trade	0.018785
491-493	Mail, package delivery & warehousing	**0.001503**
511	Publishing Industries (except Internet)	**0.000559**
512	Motion Picture & Sound Recording	**0.000142**
513	Broadcasting	**0.001072**
514	Internet & data process svcs	**0.000224**
524	Insurance Carriers & Related Activities	**0.001345**
531	Real Estate	**0.00256**
532	Rental & Leasing Services	**0.000731**
541-551	Professional Scientific, Technical, Services	**0.006102**
561	Administrative & Support Services	**0.004967**
711-713	Amusement & Recreation	**0.002314**
721-722	Accommodations, Eating & Drinking	**0.010516**
814	Government & non NAICs	**0.00226**

*Note: **bold** coefficients are statistically significant*

4.6 Uses and Limitations of the Findings

The findings shown in this chapter can be directly embedded in the Local Economic Assessment Package which ARC provides to its Local Development Districts. The findings on threshold effects associated with local population base can be used to identify likelihood of attracting various industries to a local area. The findings on the role of access time and facility service level factors on business attraction can be incorporated in the diagnosis of barriers associated with insufficient access to airport services. At the time of this publication, these improvements have already been made to the LEAP model.

There are, however, clear ways in which this line of analysis can be improved. There is a need to explore whether or not a measure of trade center strength, such as the spatial multiplier used in the Chapter 2 study, may be as good or better than the current population base as a predictor of market area strength for attracting retail, wholesale and related service businesses. There is also need for further analysis of the business attraction relationship to airport access – separating improvements in access time, distance, type of highway access and/or airport service levels. Finally, there is a need to further explore the ways in which the impacts of market scale and airport access features may be better measured in terms of industry employment shares, concentration ratios or total size of the industries.