

Did Proximity to Ports Have Any Bearing on Urban Growth between 1970 and 2000?

Stanley Keil

Ball State University - USA

Abstract. The major goal of the research presented here is to test the usefulness of a different way of conceptualizing broad regions of the United States. The census regions are often used to group MSAs for various types of studies. The alternative regions are defined based on access to ocean, Great Lakes, or river ports. The usefulness of this set of regions is compared to that of the census regions using both a dummy variable approach and an index of disparity approach. This paper presents a statistical test of the hypothesis that access to port facilities could and did positively influence urban growth between 1970 and 1990. The rationale for the hypothesis is that the expansion of trade resulting from the North American Free Trade Association, various steps accomplished under GATT and the WTO, and the United States' leading role as a free trade advocate has increased the advantage of expanding economic activity in coastal regions.

1. Introduction

Studies of metropolitan growth are often cast in terms of the average growth of regional metropolitan aggregations. In economic models of growth, regional dummies provide handy exogenous variables and, if their coefficients are significantly different, lead naturally to explorations of why those differences occur. A convenient and, therefore, frequently used set of regions for these types of studies are the nine census regions. The primary goal of this note is to test the usefulness of a different way of conceptualizing the broad regions of the United States. This alternative set of regions is based on distance to a port facility. The underlying hypothesis is that the expansion of trade resulting from the North American Free Trade Association, various expansions accomplished under GATT and the WTO, and the United States' leading role as a free trade advocate has increased the advantage of expanding economic activity in coastal regions. The usefulness of any conceptual basis for grouping cities into regions is founded on the similarity of the experiences of the urban areas in each region over time. The cohesiveness of the alternative set of regions is compared to the census regions in two ways. First, the predictive power of dummy variables based on the

alternative set of regions is compared to the dummy variables based on the census regions. Second, Gordon's (1999) measure of regional dissimilarity is calculated for both sets of regions.

Section II presents a brief discussion of the notion of a region. Section III defines the alternative set of regions and provides some basic descriptive data of urban growth for metropolitan areas for both the census regions and the proposed alternative regions. Section IV presents the results of testing a simple model of population growth using regional dummies for the alternative regions and explicitly introduces distance to a coastal port in a variant of the model. Section V compares the Gordon disparity index of the census regions to that of the alternative regions. The final section discusses the results and offers some ideas for further research.

2. The notion of a region

In practice the term "region" is a chameleon, similar to "industry," taking meaning from the context of use. Extensive early discussion of the regional concept may be found in Hartshorne (1946, 1959) and James and Jones (1954). Regions have traditionally been defined as administrative, functional, or, in some sense,

homogeneous. These are clearly not mutually exclusive definitions. In his survey article Meyer (1963, page 22) argued "that all regional classifications are simply variations on the homogeneity criterion..." Homogenous regions are defined on the basis of some common internal factor. M.J. Hagood, et. al., (1941, 1943) were early pioneers in the use of factor analysis to create multidimensional indexes for measuring homogeneity. This work was advanced in the early 1960's by Almendinger (1961) and Wood (1961) in defining politically and socially homogeneous communities for the New York metropolitan region and Penn-Jersey transportation studies. Gordon's (1999) measure of regional disparity extends this work by providing a means of comparing the relative coherence of different sets of regions that add up to the same total concept, e.g., the nation.

Since 1850 the Bureau of the Census has divided the country into contiguous regions bounded by state boundaries. Except for the addition of Alaska and Hawaii to the Pacific Division in the 1950s, the composition of the nine census divisions has remained unchanged since 1910. Responding to complaints that the divisions were not sufficiently homogeneous after the 1950 census, an interagency committee within the Department of Commerce reviewed the definition of census regions and divisions in an effort to group the states according to the following principles:

1. Socioeconomic homogeneity should be the main criterion for grouping states.
2. Each group should consist of two or more adjacent states.
3. Objective statistical analysis should be the primary basis for the grouping of states.
4. The number of eventual groups should range between 6 and 12.

Several suggestions for reorganizing the census regions resulted from this study but none were implemented because of resistance by data users. There does, however, remain continuing interest in revising both the Census regions and the regions used by the Bureau of Economic Analysis. Recently Crone (1999, 2003) has explored redefining regions based on how strongly the states in each region correlate across the business cycle or, alternatively, on the index of leading indicators. Although the regions proposed in this paper are clusters of metropolitan areas rather than states, a measure similar to Gordon's is used to compare the homogeneity of growth performance of the proposed regions to that of the Census divisions.

3. Alternative regions and MSA data

The regions defined here follow Tietz's (1962) observation that, since human activity often implies some degree of movement, we might expect that a spatial variable of some kind would yield insight. The spatial variable chosen here is moving goods to port facilities. This activity is modeled two ways. One is explicit use of a variable measuring airline miles to an ocean port. The second is by forming regions grouped by distance to both ocean and other port facilities. The following rules were used to establish the alternative set of regions: 1) access to ocean ports is more important than access to Great Lakes ports which is more important than access to river ports, where importance means willingness to haul goods a greater distance to the port; 2) goods can reach ports in four or fewer hours in coastal regions and the Great Lakes region, eight or fewer hours in near coastal regions and two or fewer hours if being moved to a river port; 3) goods move at 30 miles per hour on average by truck or rail; and 4) the regions minimize the number of cities that are on or very close to regional borders. The regions described briefly are:

North Atlantic: All cities located within 125 miles of an Atlantic port from Washington D. C. north

Near North Atlantic: All cities located between 125 and 250 miles of a North Atlantic port.

South Coast: All cities located within 125 miles of an Atlantic port south of Washington D.C. or a Gulf of Mexico port.

Near South Coast: All cities located between 125 and 250 miles of a South Coast port.

Great Lake: All cities located with 100 miles of a Great Lake port and more than 50 miles from the Ohio or Mississippi Rivers

River: All cities within 50 miles of a River port on the Ohio River, Mississippi River, Arkansas River up to Tulsa, OK, or the Missouri River up to Kansas City.

Pacific: All cities located within 125 miles of a Pacific Ocean port.

Near Pacific: All cities located between 125 and 250 miles of a Pacific Ocean port.

Interior: All other cities

Listings of the cities in each region are available from the author by request. Data for 1970, 1980, and 1990 were extracted for 318 MSAs and PMSAs from the REIS databank. These data are consistent with the 1993 definitions of metropolitan areas. Metropolitan population data consistent with the 1993 definitions were constructed for the year 2000 from county and

metropolitan division data. A second set of population only data consistent with the 2003 revisions was available for 1990 and year 2000. These data define 352 metropolitan areas.¹

Average metropolitan population and employment growth rates for the period 1980 - 1990 were calculated for both the census and proposed alternative set of regions. Average population growth rates for the period 1990 - 2000 were calculated for both sets of regions using both the 1993 definitions of metropolitan areas and the 2003 definitions of metropolitan areas. These averages are presented in Tables 1a and 1b. Employment is wage and salary employment plus proprietors. For all metropolitan areas, population grew by 11.8% during the 1980s. Metropolitan population using the 1993 definitions grew 13.8% in the 1990s. As the tables make clear, this overall growth was distributed quite unevenly across geographic regions. A single factor ANOVA show the differences in both the employment data and the population data are significant at the well beyond the 0.1% level.

The picture shown by the alternative set of regions is interesting. In the 1980s the coastal and near coastal areas of the southern and pacific regions grew substantially faster than average. Even in the slow growing regions, the North Atlantic Coast region grew faster than the Near North Atlantic, Great Lakes, and River regions. This gives some credence to the hypothesis that growth was concentrated in coastal areas. The 1990s present a slightly different picture. The Near South Coast and Near Pacific cities grew faster than their adjacent coastal regions. The region labeled Interior shows an interesting pattern of growth. It grew faster than average in the 1970s (20%) and slowed to below average in the 1980s. The Interior region includes all of the metropolitan areas in the Mountain census region except Reno and Las Vegas, NV, and Yuma, AZ. The rapid growth of Nevada cities and the Front Range cities in Colorado indicate

that growth patterns in these two decades are more complex than simply being close to a coast.

The fourth column in both tables shows that the growth of employment is consistently faster than population growth. First, the increase in participation rates of some segments of the population probably counts for a substantial part of this change. Second, part of the observed change may be the result labor sheds spreading out faster than the defined boundaries of metropolitan statistical areas during these decades. The very high ratios of employment growth to population growth in the Great Lakes and River port regions suggest the importance of this latter reason.

4. Empirical results - port proximity

The value of the using distance from port facilities as the basis for explaining MSA growth was tested in three ways. First, the simplest possible association of distance with growth was tested using equation 1:

$$PG_{it} = c_1 + c_2 d_i + e_{it} \quad (1)$$

where PG_{it} is the population growth rate of the i^{th} urban area in each decade (t) and d_i is air mile distance to the nearest ocean port. The results of estimating this model for each decade were (standard errors are shown in parentheses):

$$PG_{70} = 0.2369 - 0.01513d \quad R^2 = 0.0482 \quad \rho = 0.0001 \\ (0.152) \quad (0.0037)$$

$$PG_{80} = 0.1693 - 0.01775d \quad R^2 = 0.1087 \quad \rho = 0.0000 \\ (0.012) \quad (0.0029)$$

$$PG_{90} = 0.1486 - 0.000036d \quad R^2 = 0.0077 \quad \rho = 0.1228 \\ (0.0094) \quad (0.000023)$$

The signs are as expected and in the two earlier decades the distance coefficients are significant at the 0.1% level. During the 1980s, decade long growth fell by an average of 1.78% for every one hundred miles a city was from a seaport. For MSAs beyond a distance of 954 miles from a seaport one would have expected to find negative growth rate in the 1980s, all other things equal. For the decade of the nineties growth does not have a statistically significant relationship with distance from a seaport. As shown by the R-square values, distance by itself explains little of the variance in growth rates even in the first two decades.

Second, to see if the impact of distance changed when other factors were taken into account, equation

¹. Data consistent with the 1993 definitions of urban areas are available for the censuses of 1970 through 1990. Eventually data consistent with the 2003 definitions of urban areas will be available but are not at this point. It is important to note that data in these sets will, for many urban areas, not correspond to the data reported in the respective censuses except at the county or township level. The 2003 revisions of metropolitan areas are major. The concept of PMSA has been replaced with "metropolitan divisions." Some counties that would have been considered part of metropolitan areas in the 1993 and 1999 revisions are now separated into a new category of urban counties known as "micropolitan statistical areas." New England metropolitan areas were constructed from counties in the 2003 revision and from towns in 1993. This has resulted in shifting many towns from one metropolitan division to another.

Table 1a. Growth rates for Metropolitan Areas using census groupings

	1980-1990			1990-2000	1990-2000	
	Number of MSAs	Population	Employment	1993 Definitions Population	2003 Definitions Number of MSAs Population	
New England	12	0.0789	0.2150	0.0539	15	0.0539
Middle Atlantic	38	0.0589	0.1952	0.0674	31	0.0594
South Atlantic	55	0.2153*	0.3498*	0.1955*	74	0.2001*
East South Central	25	0.0605	0.1990	0.1353	30	0.1362
West South Central	43	0.1138	0.1626	0.2074*	41	0.2088*
East North Central	53	0.0135	0.1522	0.0787	51	0.0767
West North Central	27	0.0627	0.1966	0.1129	41	0.1080
Mountain	24	0.1737*	0.2903*	0.3648*	34	0.3667*
Pacific	41	0.2357*	0.3452*	0.1501*	45	0.1510*

* For pair-wise comparisons New England was the default. Asterisks indicate differences significant at or better than $\alpha = 10\%$. All columns have F-statistics for inter-regional differences significant at better than $\alpha = 0.1\%$.

Table 1b. Growth rates for Metropolitan Areas using the alternative groupings

	1980-1990			1990-2000	1990-2000	
	Number of MSAs	Population	Employment	1993 Definitions Population	2003 Definitions Number of MSAs Population	
North Atlantic	36	0.0781	0.2132	0.0795	35	0.0797
Near North Atlantic	6	0.0360	0.2081	0.0175	9	0.0307
South Coast	53	0.2391*	0.3397*	0.2027*	57	0.2014*
Near South Coast	30	0.1179	0.2337	0.2431*	38	0.2292*
Great Lakes	40	0.0091*	0.1454	0.0662	49	0.0652
River	34	0.0195*	0.1395*	0.0760	35	0.0795
Interior	75	0.0896	0.2108	0.2107*	91	0.2233*
Near Pacific	5	0.2418*	0.3183*	0.5390*	8	0.5288*
Pacific	38	0.2471*	0.3577*	0.1484*	40	0.1496*

* Using the North Atlantic Region as the default, asterisks indicate pair-wise differences significant at or better than $\alpha = 10\%$. All columns have F-statistics for inter-regional differences significant at better than $\alpha = 0.1\%$.

(2) was estimated for both decades under study. Third, the proposed alternative regions, represented by dummy variables, were used in place of distance (equation 3).

$$PG_{it} = b_1 + b_2 d_i + b_3 PE_{it} + b_4 WD_{it} + e_{it} \quad (2)$$

$$PG_{it} = a_1 + \sum_{j=2}^9 a_j R_j + a_8 PE_{it} + a_9 WD_{it} + e_{it} \quad (3)$$

where the R_j 's are regional dummies, PE_{it} is the ratio of population to employment at the beginning of each decade and WD_{it} is the ratio of the local payroll compensation per employee to the average for all MSAs at

the beginning of each decade. Equation 3 is based on a simple one-equation model that attempts to capture the same influences on growth as described in Mill and Sende (1995). The constant term represents the region (North Atlantic) omitted from the set of regional dummies. The coefficients for the remaining dummy variables pick up difference between regional effects in that region and the North Atlantic. WD is a surrogate for relative wages. High wages would attract potential employees and their families but would tend to repel both potential and current employers unless compensated by differences in productivity. However, if job opening are more important in attracting workers than high wages, per se, then the expected

sign of the coefficient for WD is negative, *cet. par.*, as the repelling of new entrants or the exit of existing firms would dominate. The expected sign of the coefficient of PE is positive. A positive coefficient is consistent with the hypothesis that “jobs follow people.” A high ratio of population to employment suggests room for expansion of retail and other service oriented activities created out of an increase in the local labor force participation rate. The results of estimating these two equations are presented in Table 2. When the influence of PE and WD are taken into account distance ceases to be a significant variable in the 1980s, but becomes statistically significant with the correct sign in the 1990s.

For the decades of the 1970s and 1980s the regressions signs are as expected. The ratio of population to employment (PE) plays a significant role in all forms of the regressions for these decades but not for the 1990s. The deviation of local labor compensation from the national average plays a significant explanatory roll only for the decade of the 1970s. Labor compensation is significantly below the national average in the South Atlantic and Near South Atlantic states in 1980 and in the South Atlantic, Near South Atlantic, and Interior regions in 1990. This may help explain the population growth (via employment growth) of these regions. R-squared increases for both equations for the decade of the 1980s but the number of significant variables decrease motivating a check for multicollinearity. This check indicated it was present, but did not suggest that it was severe. PE and WD are more strongly inversely correlated in the 1980s than in the 1970s ($\rho = -0.37$). PE is also weakly negatively correlated with distance (d) but the multiple correlation coefficient of WD and d with PE is less than 0.30. The multiple correlation coefficient for wage deviations and the regional dummies are significant but with r-squares of only 0.1753 and 0.2121 for 1980 and 1990 respectively.

How did the distance-based variables do? In the 1970s and again in the 1990s distance from a seaport negatively and significantly affected population growth. All other things equal, each 100 miles of distance is associated with a reduction in decade long growth of 1.25% in the 1970s and 0.0066% in the 1990s. The coefficients of distance based regional dummies also all have the expected sign in the 1970s and 1990s. The sign of the Interior region reverses in the 19980s but is not significant. The slow growth in the North Atlantic, Great Lakes and the River regions indicated in Table 1 is confirmed by negative coefficients for their regional dummies for both decades. Just how bad the 1980s were for the Great Lakes region is indicated by the fact that its coefficient is significantly be-

low an already significantly negative coefficient for the North Atlantic States. In the 1990s, the dummies for the coastal and near coastal regions of both the south and pacific are significantly positive, again providing evidence that proximity to coasts was an significant factor in population growth, other things equal, and despite the fact that the Near Pacific and Pacific regions were relatively high wage states.

Equation 3 was also estimated using the census regions. Population growth was estimated for both sets of regions using only regional dummies. The r-squares for these regressions are presented for comparison in Table 3. The census regions with significant regression coefficients (using New England as the default region) are the same as those asterisked in Table 1a. Similar regressions with similar results were also performed for employment growth. Details for these regressions are available from the author by request. The results in Table 3 suggest that neither set of regions have an advantage in explanatory power. In the 1970s and 1980s PE and WD added significant information about population growth but this is not the case for the 1990s.

5. Regional dissimilarity

One means of comparing a set of clusters of metropolitan areas to alternative sets of clusters is to measure their dissimilarity on a particular characteristic. In this case the characteristic is the rate of population growth (or, alternatively, employment growth). The measure used in this paper was proposed by Gordon (1999). A region's dissimilarity is measured by the squared distance of each element of the cluster from the cluster's center. In this case the elements of the clusters are simply the population growth rates of each MSA in the region and the distance is the difference between each MSAs growth rate and the mean growth rate for its region. Let X_{ij} be the i^{th} MSA in the j^{th} region, N_j be the number of MSAs in the j^{th} region. The index of dissimilarity is calculated using equation 4 as follows:

$$\sum_j \sum_{i=1}^{N_j} (X_{ij} - \bar{X}_j)^2 \quad (4)$$

The higher the value of equation 4 the more dissimilar the elements of the clusters are from each other. Equation 4 was applied to both the census clusters and to the proposed alternative set of clusters. Table 4 shows these calculations.

Table 2. Regression results: alternative region population growth.

Alternate Region Estimation	1970-1980 Distance only	1970-1980 Region Dummies	1980-1990 Distance only	1980-1990 Region Dummies	1990-2000 Distance only	1990-2000 Region Dummies
Constant	0.3104*** (0.1182)	-0.0183 (0.1195)	-0.3578*** (0.0638)	-0.3598*** (0.0631)	0.4292*** (0.0898)	0.1829** (0.0861)
Near North Atlantic		-0.0431 (0.0665)		-0.0403 (0.0393)		-0.0632 (0.0452)
South Coast		0.2263*** (0.0349)		0.0661*** (0.0201)		0.1102*** (0.0237)
Near South Coast		0.0986** (0.0401)		0.0294 (0.0225)		0.0748*** (0.0270)
Great Lakes		-0.0366 (0.0354)		-0.0472** (0.0209)		-0.0248 (0.0240)
Rivers		-0.0103 (0.0365)		-0.0287 (0.0215)		-0.0165 (0.0255)
Interior		0.1045*** (0.0319)		-0.0266 (0.0184)		0.0657*** (0.0232)
Near Pacific		0.4608*** (0.0718)		0.1337*** (0.0426)		0.3352*** (0.0490)
Pacific		0.2052*** (0.0357)		0.0846*** (0.0217)		0.0879*** (0.0242)
Distance (d)	-0.0125*** (0.0035)		-0.000025 (0.000021)		- 0.000066*** (0.000025)	
PE70 or PE80	0.1550*** (0.0387)	0.1548*** (0.0341)	0.2429*** (0.0135)	0.2151*** (0.0130)	-0.0604 (0.0285)	-0.0309 (0.0254)
WD70 or WD80	-0.4324*** (0.0725)	-0.2377*** (0.0756)	-0.0636 (0.0443)	-0.0294 (0.0444)	-0.1618*** (0.0516)	-0.0147 (0.0485)
R-Squared	0.1880	0.4303	0.6014	0.6733	0.0404	0.2889
Adj. R-Squared	0.1802	0.4117	0.5977	0.6626	0.0312	0.2658
F-Statistic	24.2336***	23.185***	157.938***	63.264***	4.4001***	12.474***
DW Statistic	1.7590	1.8810	1.9514	1.9649	1.7792	1.7785

Significance denoted * 10% level, ** 5% level, and *** 1% level

Table 3. R-square comparisons for census regions and alternative region - equation 3

		1970-1980	1980-1990	1990-2000
Dummy variables only	Census Regions	0.3476	0.2806	0.2847
	Alternate Regions	0.3663	0.3337	0.2843
Dummies with PE and WD	Census Regions	0.4256	0.6804	0.2883
	Alternate Regions	0.4303	0.6733	0.2889

Table 4. Indices of dissimilarity

Period	Population Growth		Employment Growth	
	Census Clusters	Alternate Clusters	Census Clusters	Alternate Clusters
1970 -80	9.0164	7.5989	13.4365	13.6475
1980-90	5.3033	4.9127	7.9446	7.6495
1990-2000	3.0749	3.0913	NA	NA

At least in terms of population growth the alternative set of regions shows less dissimilarity in the two earlier decades than the census regions. Both sets of regions show more dissimilarity in their employment growth than in their population growth, but there is very little difference in employment growth dissimilarity of the two sets. For the 1990s there is no significant difference in the dissimilarity indices for the two sets of regions. It is also of interest to note that dissimilarity of population growth diminishes over this 30 year period for both sets of regions. That is, growth of individual cities in each region is closer to the mean growth in that region in each successive decade.

6. Policy implications and conclusions.

Fisher (1955) emphasizes the policy importance of administrative unity for economic development regions as that provides coherence between the area being studied and the political institutions available for effectuating policy. Clearly neither set of regions studied here have this sort of coherence. One major source of metropolitan area problems, especially for those MSAs that cross state lines, is that this coherence is often missing. Nonetheless, the discovery of individual or groups of socioeconomic variables that can be used to explain differences in metropolitan growth can yield policy insights regarding viable paths for development or redevelopment investments. If these variables allow grouping metropolitan areas into aggregations with highly similar growth experiences, policy makers can gain insight from policies that have worked or failed in similar regions.

The objectives of this paper were twofold. The first objective was to determine if distance, per se, from a seaport could be a significant factor in explaining population and employment growth for the nation's metropolitan areas. While transportation costs

have declined in importance as a location factor, for some activities they are still important. It turns out that distance from a seaport is significantly, but weakly, negatively associated with population growth. The peak explanatory power of distance to ocean ports alone (equation 2) is reached in the 1980s. While the results for equation 2 show a negative and statistically significant association between distance and growth for the 1990s, it does not appear to be economically significant.

The second objective was to compare an alternative set of regions to the census regions in terms of helping explain differences in economic growth of clusters of metropolitan areas. In developing the alternative set of regions three of the four Department of Commerce principles set forth in 1950 for census regions were followed. The only principle not followed was that the regions be made up of contiguous states. The alternative set of regions, stylistically based on distance from port facilities, are theoretically more appealing than the census regions in that they can be related to an economic cost concept. The set of dummy variables representing these regions explain slightly more of the variance in MSA population growth rates than the set of dummies for the census regions for the first two of the decades studied. The data show that Near North Atlantic Coast and Near South Coast grew significantly slower in the earlier decades studied than their coastal counter parts, but this was not true for the Near Pacific region or for any of these regions in the 1990s.

For the first two decades of the study the alternative regions appear to be less dissimilar than the census regions. This advantage in cohesion disappears in the 1990s. In particular, the region designated as "Interior" does not appear to be a coherent region during the 1990s. It alone adds nearly 2 points to the dissimilarity index in the 1990s. NAFTA has increased the locational advantage of certain interstate

highway corridors. Rapid growth along the Interstate Highway 25 corridor is mixed with stagnation in the rest of the Interior. Amenity oriented population growth followed by employment growth filling in the service sector needs of Mountain states MSAs may also account for the dissimilarity in the Interior region.

Clearly the proposed alternative regions can be refined. The South Atlantic region could be further subdivided to create a gulf coast region. A similar division could be made of the Near South Atlantic region. Similarly, the high amenity parts of the Interior region could be separated if a meaningful measure of amenity can be created. These are all reserved for future research. Finally, a useful direction for future research would be attempting to replace the regional dummies with sets of social economic variables that have significant variations between regions and great cohesion within regions. This could lead to more economically meaningful functional regions.

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