

Census Tracts More Precisely Define Rural Populations and Areas

Accurate analysis of the economic and social problems currently facing urban and rural residents, as well as the implementation of programs to address them, largely depend on how settlement is measured. Counties are too big in many parts of the Nation to serve as building blocks for statistical areas used to analyze changing settlement patterns. Census tracts are used here to identify metro and nonmetro components of a five-level "rural-urban continuum." The census-tract continuum provides a more precise territorial delineation of areas and classification of population in different types of areas than does the county-level continuum.

AMONG the many ways currently used to group U.S. territory into statistical areas, the most widely used is the classification of counties as either metro or nonmetro. Much of our understanding of recent economic restructuring and demographic change within rural areas derives from further subdividing the nonmetro category according to size of city or urban population in the county and whether the county is adjacent to a metro area.

The basic concepts for defining what is rural have not changed greatly over time. However, population size, density, and accessibility have not been mapped and analyzed at a spatial scale detailed enough to fully capture increasingly complex U.S. settlement patterns. Large cities have expanded beyond traditional borders to form sprawling urban regions; economic activities have diffused into suburbs and coalesced along thriving growth corridors; advanced transportation and communications

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linkages have increased the spatial integration of rural and urban economies; and rural economies themselves have become less dependent on natural resources and more diversified.

This research lays the groundwork for devising statistical areas that reflect the diversity of rural settlement patterns by replacing counties with subcounty units as basic geographic building blocks. The need to go below the county level has become especially acute given the increasing integration of the rural economy with the urban-dominated U.S. and world economies, the employment and residential growth in suburban nodes, and the growing complexity of the rural-urban frontier. According to Alonso, a population policy expert, it is necessary

...to begin a process of rethinking the human geography of well-to-do nations... The existing censal categories are misleading because they present a vision of the United States as a territory tiled with convex, continuous, mutually exclusive types of regions, while the reality is one of a great deal of interpenetration, much of it rather fine-grained (pp. 25-26).

County geography limits the study of rural areas in different ways throughout the country depending on the region under investigation. At one extreme of rural/urban integration, the rural Northeast is intertwined economically and socially with the urban complex along the Eastern

seaboard. At the other extreme, rural territory in the Great Plains has fewer urban centers with which to be integrated, and is organized in a different way, with smaller centers of economic and social activity scattered throughout. County units are unevenly suited to measure such differences in settlement and rural/urban integration patterns. In general, the more western the State, the more territory each county encompasses. When large counties are used as the unit of measurement, metro boundaries stretch far beyond the actual urban core, obscuring the State's settlement pattern.

The essential elements of the system we designed to address these issues are (1) using data at the sub-county level; (2) holding constant the current criteria defining metro areas; and (3) incorporating that metro definition into a five-category composite of ERS' rural-urban continuum and urban influence codes. The composite categories and data sources we used are described in "The Rural-Urban Settlement Continuum and Data Sources," p. 39.

We tested our system in three States chosen to represent disparate county sizes and types of settlement. The areas defined by using sub-county geography were mapped and compared with the same five-category system using county geography. This approach isolates the effect of switching from county to subcounty building blocks. Our comparison of the two classifications includes land area encompassed, population size, and population characteristics. The results provide a solid base from which to evaluate and recommend alternative approaches to representing the U.S. settlement system.

Determining the Appropriate Subcounty Unit

After comparing the relative merits of the four geographical units smaller than counties for which census data are available—block groups, minor civil divisions, ZIP code areas, and census tracts—we chose census tracts. Census tracts are large enough to have acceptable sampling error rates (containing an average of 4,000 people); are consistently defined across the Nation; are usually subdivided as population grows to maintain geographic comparability over time; and can be aggregated to form county-level statistical areas when needed. While intercensal data from Federal agencies does not go below the county level of geography and would require the formation of county-level statistical areas, many private vendors are now producing intercensal population estimates and other demographic data at the tract level. There are about 62,000 tracts, compared with slightly more than 3,000 counties.

Regional Differences Represented by Chosen States

We chose Arizona, Minnesota, and South Carolina as initial case study areas for this project. Each State includes the full range of rural-urban settlement types, but exem-

plifies its own region's unique settlement patterns and physical county size.

Regional differences emerge based on rural population density, urban population size and structure, and differences in the geographic building blocks themselves. Counties and tracts are larger in western States where population is sparse. Arizona, a relatively large State encompassing 114,000 square miles, is divided into only 15 counties. Both because of the physical size of Arizona's metro counties and because of the sparsely settled desert areas, only 15 percent of Arizona's population is nonmetro. Minnesota is dominated by one large metro region (Minneapolis-St. Paul) with a handful of small centers located mostly near the borders of the State. The South, with smaller counties, has rural areas and larger populations combined in an evenly distributed way across the landscape. South Carolina exhibits this evenly distributed pattern with medium-sized metro centers throughout the State. Both Minnesota and South Carolina have 31 percent of their population classified in the county-based system as nonmetro.

Arizona's Large Counties Hide the Location of Metro Cores. The precise locations of the central cities of Phoenix, Tucson, and Yuma are well hidden with county-based measurement (compare the first and second maps in fig. 1), and Tucson and Yuma have no outlying components identified. Mohave County, in the northwest corner of the State, is classified as an outlying component of the Las Vegas, NV, metro area. Nonmetro nonadjacent counties without a city are confined to a narrow band in the east and one county on the western border. All of sizable Coconino County, including most of the Grand Canyon, was classified as nonadjacent with a city in 1990 since Flagstaff is located at the southern edge of the county. (Note: In June 1995, Flagstaff became a metro central city due to post-1990 population growth, making Coconino County a metro core county and Kane County, UT, a metro outlying county. For consistency across States, our analysis reflects conditions as of 1990.)

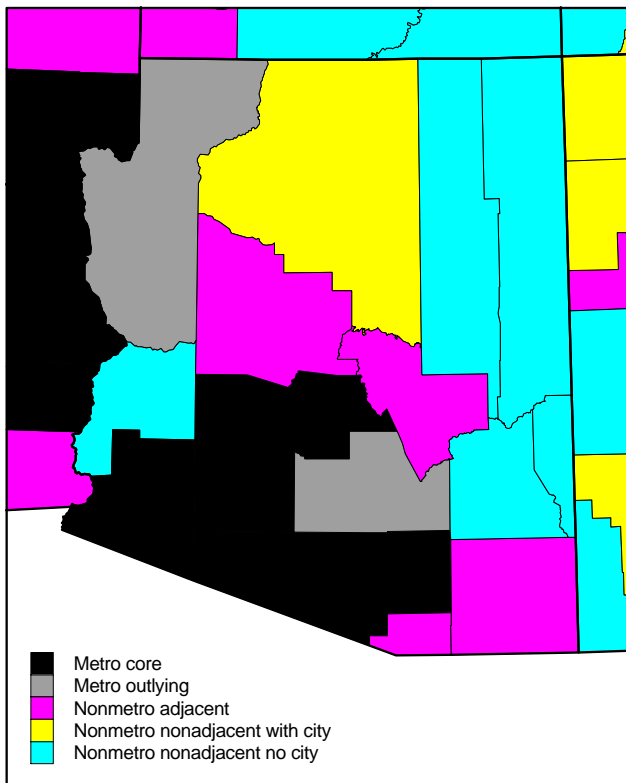
Arizona's metro areas are more constricted on the tract-based map (third map in fig. 1). The shape of the outlying components of each metro area become visible. Territory taken up by metro areas drops from 19 to 2 percent of the State's total. Central city locations become visible, as with Yuma's position on the Colorado River in a corner of its home county. Phoenix takes up less than one-sixth of its original two-county area. Tucson is almost as large at the tract level but is reshaped and in a substantially different location, taking up just a corner of its original one-county area and extending into two other counties that are not included in the county-based definition of the Tucson metro area.

Figure 1
Arizona's cities, counties, and census tracts, 1990

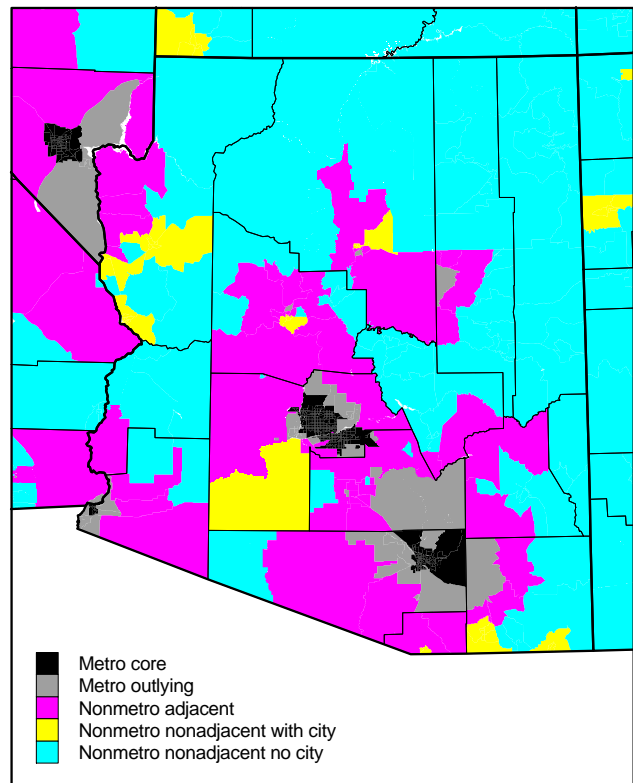
The location of cities...



...is obscured when measured by Arizona's large counties...



...but becomes clear by using tract-level measurement.



Most noticeable is the complete change in metro status for Mohave County. No part of the county has significant commuting to Las Vegas when commuting is measured at the tract-level. It is included as part of the county-based metro area because of commuting from Bullhead City, AZ, to the small city of Laughlin, NV. Laughlin is in the same county as Las Vegas and is thus part of the county-based metro core to which commuting is measured, but it is 75 miles south of Las Vegas and is not part of the metro core at the tract level. The inclusion of Mohave County as part of the Las Vegas metro area clearly demonstrates the poor fit of many large counties in the West to an area's settlement pattern.

A number of tracts located some distance from Phoenix's metro core are classified as metro outlying areas, including tracts in Prescott, Winslow, and Flagstaff, which were nonmetro areas with cities in the county-based system. The tract classifications result from a small number of workers commuting, possibly on an irregular basis, from Phoenix to these outlying tracts, not into Phoenix. Because of the metro outlying classification of these tracts, the nonmetro tracts surrounding them become metro-adjacent, a clear misnomer. Adjustments to the metro-outlying criteria that work for counties would be necessary for a tract-based system to avoid including far-flung tracts not integrated with the metro core.

Several nonmetro cities with populations above 10,000 emerge in tract-based nonadjacent territory, including Prescott and Kingman in the north and Nogales, Sierra Vista, and Douglas along the Mexican border. All had been hidden within metro outlying or nonmetro adjacent counties. Nearly three times as much territory is classified "nonadjacent with a city" in the tract-based version as in the county-based version. Nonadjacent territory without a city is found throughout the State on the tract-based map and covers twice the territory it does on the county-based map.

Tract-measurement Reveals Large Nonmetro Districts in Minnesota. In Minnesota, with medium-sized counties and a single, dominant metro region, the continuum from metro core to nonmetro nonadjacent is visible at the county level (second map in fig. 2). However, Minneapolis-St. Paul is not territorially the largest metro area at the county level; that distinction belongs to Duluth-Superior which encompasses St. Louis County in the northeast as well as Douglas County, WI. Counties also spatially misrepresent other metro centers, especially Grand Forks and Fargo-Moorhead, as well as nonmetro, nonadjacent cities such as

Bemidji, Fergus Falls, and Brainerd. No large, unbroken districts of nonmetro nonadjacent territory can be seen at the county level.

The territorial extent of tract-based metro areas in Minnesota, as in Arizona, is a fraction of that found in the county-based version (third map in fig. 2). Metro territory drops from 21 percent of the State total down to 8 percent; metro cores drop from 15 to 2 percent. Tracts more accurately depict Minneapolis-St. Paul as the State's dominant metro area, in areal extent as well as population size.

Nonmetro nonadjacent areas with cities are also much more constricted at the tract level (5 percent of the land area versus 13 percent at the county level), while nonmetro nonadjacent areas without cities nearly double in size with the switch to tracts. Nonadjacent areas without cities become territorially dominant in all parts of the State except the southeast. The remote, sparsely populated conditions found throughout the northern half of the State are much more clearly defined by tracts than by counties.

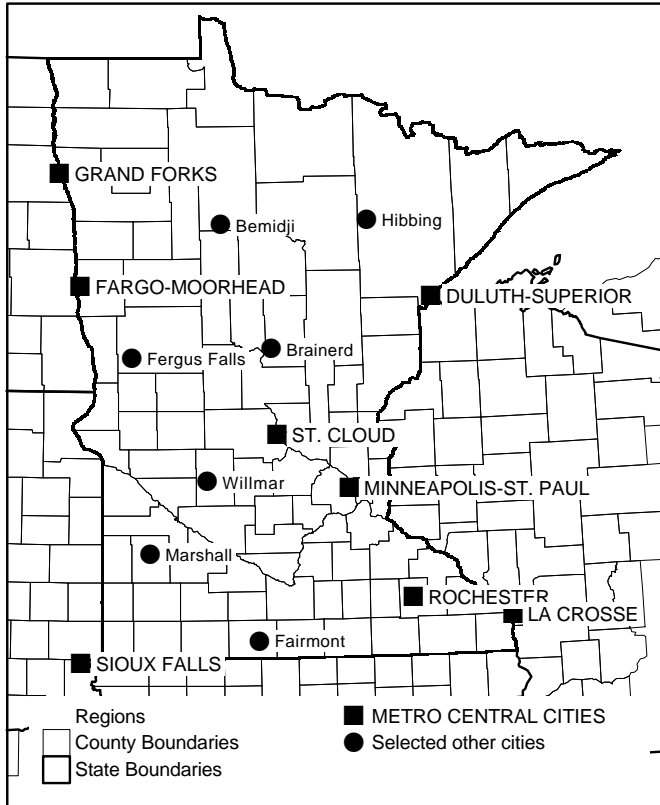
Many of Minnesota's metro areas contain some discontinuous outlying portions embedded within nonmetro adjacent areas, illustrating Alonso's rural-urban "interpenetration" concept. Unlike Arizona, most of Minnesota's metro outliers are truly integrated with metro cores. They function either as employment centers for many workers commuting from the core, or as bedroom communities surrounded by nonmetro areas less integrated with the core, or both. Most of the county-based metro areas, including Minneapolis-St. Paul, conceal a range of settlement types from metro core to nonmetro nonadjacent without a city.

Adjacent areas appear as transition zones around each metro area, in a sense anticipating their future expansion. Tract-based adjacent areas cover much less of the State than the county-based areas (17 versus 28 percent). In some areas, such as around Minneapolis-St. Paul, the adjacency band may be too narrowly defined; the requirement of physical adjacency leaves out several tracts whose commuting patterns indicate substantial levels of urban influence. Nonetheless, adjacent tracts identify the rapidly growing, intermediate space where metro areas blend into the nonmetro hinterland. Tract-based measurement enables a clearer delineation of this rapidly changing convergence zone, allowing us to track the location of emerging employment centers on the outskirts of metro areas.

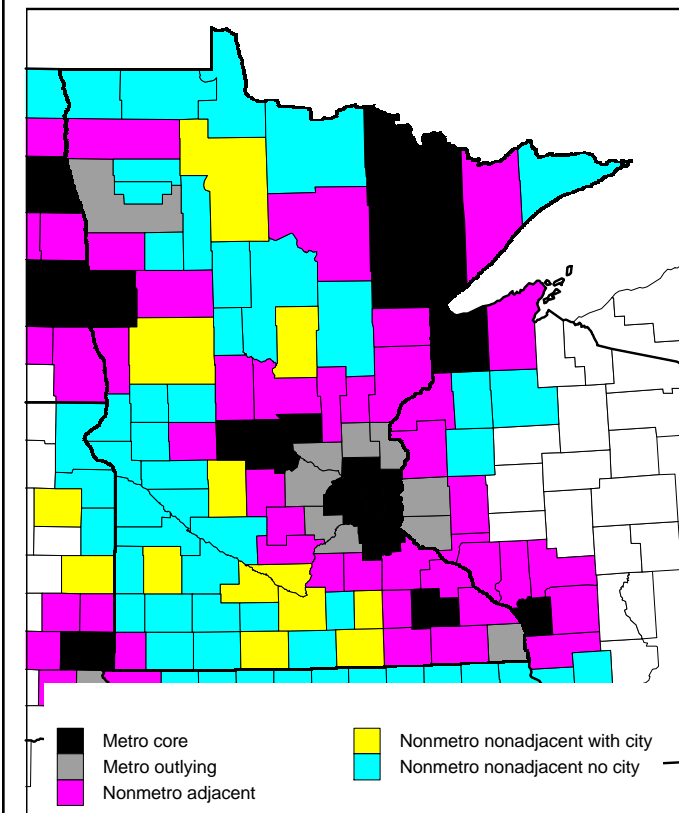
Figure 2

Minnesota's cities, counties, and tracts, 1990

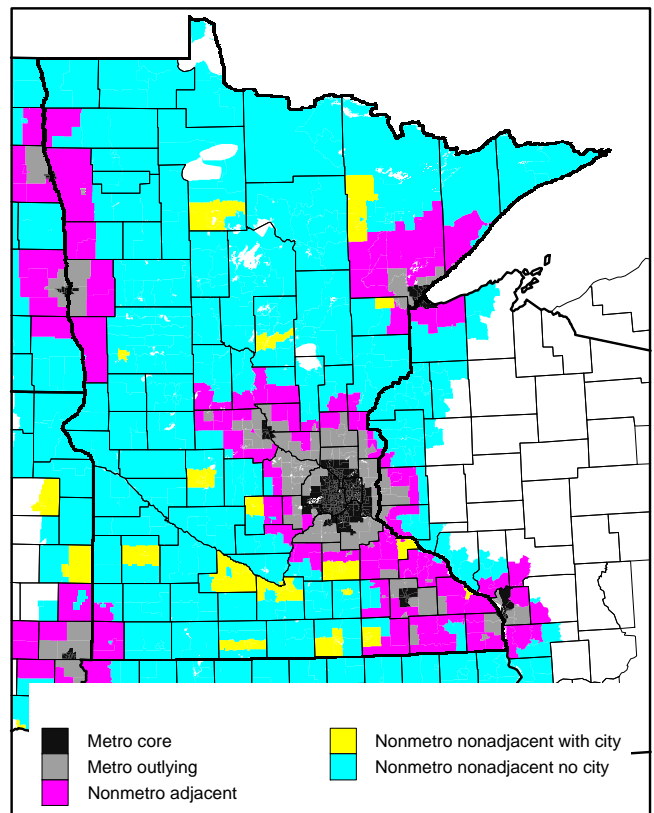
Minneapolis-St. Paul's dominance and Minnesota's large nonmetro, nonadjacent districts...



...are not visible with county measurement...



...while tracts clearly show that settlement pattern.



South Carolina Tracts Exemplify Metro/Nonmetro Interpenetration. South Carolina's evenly distributed urban structure—several medium-sized metro areas found throughout the State with no one dominant center—results in a classification of all but six of the State's nonmetro counties as adjacent (first and second maps in fig. 3). Even with South Carolina's smaller counties, the county-based scheme gives little sense of the location of central cities and their relationship with outlying areas, both of which come into focus at the tract level (third map in fig. 3). The entire rural-urban continuum looks remarkably different on the county and tract maps. South Carolina's tract-based map shows extensive areas not adjacent to metro regions, making up 30 percent of the State's territory, compared with only 10 percent in the county-based version.

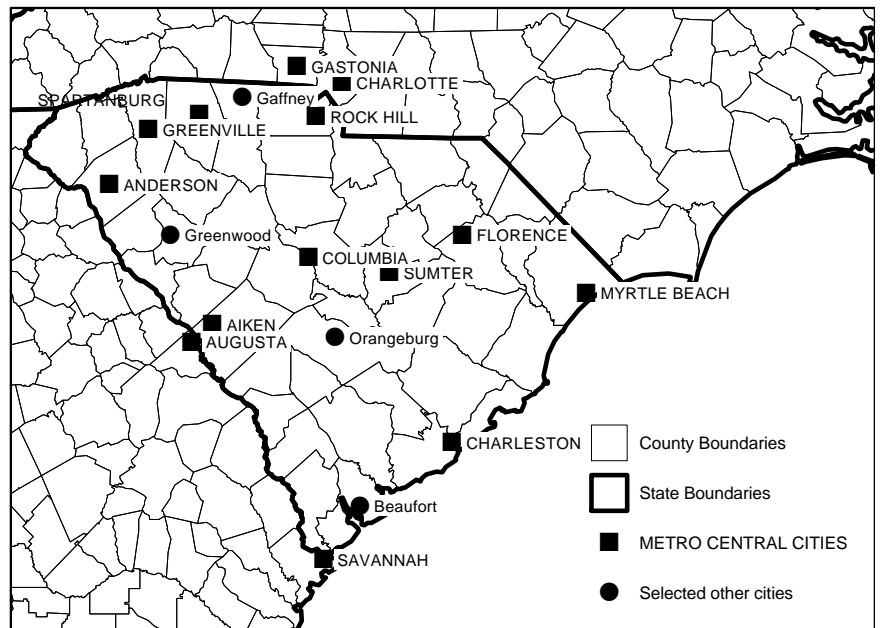
In all nine metro areas shown, segments of the tract-based metro area reach beyond the county-based configurations into nonmetro territory. Some of these metro segments are noncontiguous and indicate metro-nonmetro interpenetration. Only in Columbia and Florence do all segments of the county-based metro area remain metro at the tract level. County-based metro areas are significantly overbounded in Augusta-Aiken, Charleston, and Myrtle Beach; the shape of the Myrtle Beach core changes completely to better represent its mostly coastal location.

Shifts Toward Rural End of Continuum Affect Nonmetro Population

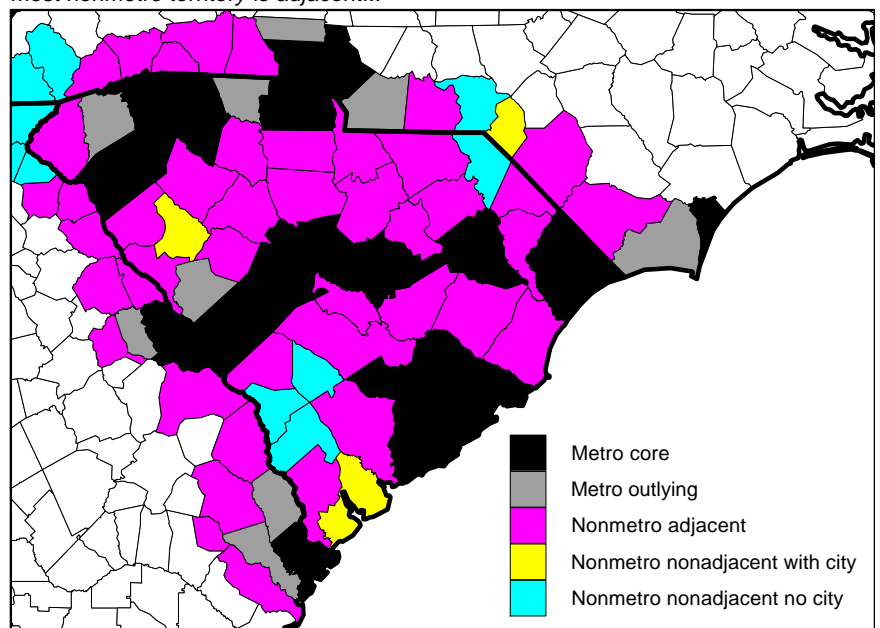
When tracts are substituted for counties in creating the rural-urban continuum, the most commonly occurring change is for territory to shift by one category toward the rural end of the continuum. The loss of lower density territory makes proportionally little difference in the total population of metro areas. The metro territorial changes brought about by switching from counties to tracts are thus not paralleled by similarly large metro population changes. Switching from counties to tracts tightens the territorial boundaries that surround essentially the same metro populations.

Figure 3
South Carolina's cities, counties, and census tracts, 1990

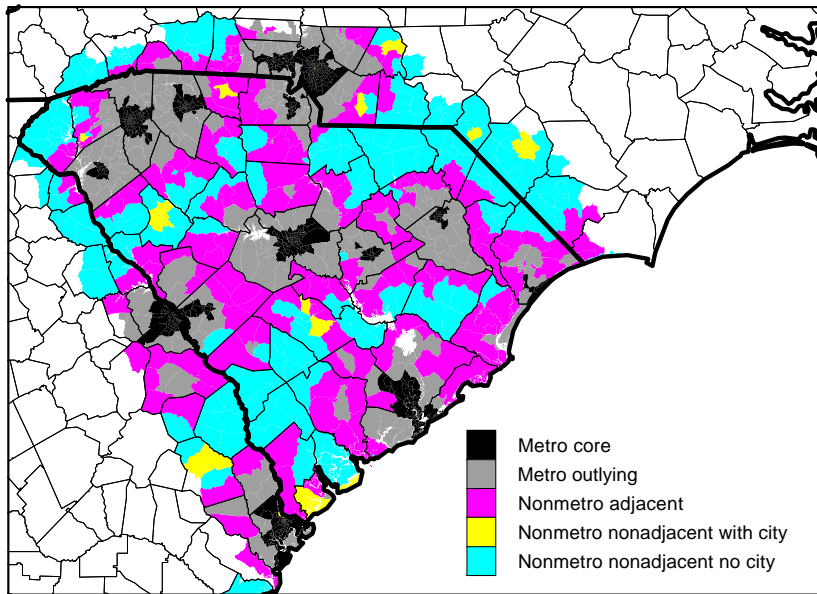
The scattering of mid-size metro areas across South Carolina...



...makes it appear with county measurement that most nonmetro territory is adjacent...



...but tracts show that much of the nonmetro population is not commuting to metro areas.



For the sparsely populated nonmetro categories, the addition and loss of territory can make a sizable percentage change in their populations. The rearrangement of nonmetro population toward the rural end of the continuum is substantial (table 1). In South Carolina, for instance, the population living in the most remote and rural category, nonadjacent nonmetro without a city, jumps from 76,000 with county measurement to over 500,000 with tract measurement. Similarly, population in this category more than doubles in Minnesota. Arizona saw a doubling in the population of nonadjacent areas with a city. This is because cities such as Kingman, Prescott, and the border cities of Nogales, Sierra Vista, and Douglas were hidden in metro or adjacent counties but became separate entities with tract-level classification. In all three States, the population living in nonmetro territory adjacent to a metro area declines—in Minnesota it drops by over half.

Comparison of County- and Tract-Based Population Characteristics

Metro and nonmetro populations defined at the county level differ along important socioeconomic lines. For instance, nonmetro people are less likely to hold a college degree, are less likely to be in managerial or professional occupations, and are more likely to be poor. For most of the socioeconomic measures we investigated, the metro-

nonmetro gaps widen with tract-level measurement in all three States, indicating increased accuracy in classifying the population by residence type (table 2). For the most part, people who were shifted into the metro category in the tract-based measurement were more similar to people in the county-based metro category than they were to the people in the county-based nonmetro category. Those shifting into the nonmetro category were also more like people in the county-based nonmetro category.

Conclusions

To understand the complete system of U.S. settlement, a rural-urban continuum is crucial. Existing ERS continuums provide a reliable base on which to build. The choice of geographic units affects both the accuracy of the continuum and the ability to implement the system with a diverse set of data. Applying currently used criteria to census tract data more accurately reflects the territorial divisions along the continuum from the largest cities to open country. The shortcomings of the current system seem to be largely a function of the use of counties as the units of analysis, causing misclassification of much of the nonmetro part of the spectrum.

A tract-based measurement system brings to light the diversity of population and settlement patterns within nonmetro territories. The geographical gradations from one end of the rural-urban continuum to the other are brought into focus with the use of tracts, especially the role of metro-adjacent areas as transition zones between settlement types. If trends of the last few decades continue, metro-adjacent territory will be among the fastest growing in the near future, both in employment and residential population.

Programs designed to target residents of specific types of settlement areas can be more accurately implemented with tract delineation. Patterns of emerging centers and specific areas of loss, both in and around metro areas and in small cities and towns, can be identified. For researchers and policymakers who work with the entire range of settlement types, a rural-urban continuum is crucial and the choice of geographic units affects both the accuracy of the continuum and the ability to apply the system to a diverse set of problems.

Table 1

Nonmetro population by tract- and county-based classifications, 1990*Nonmetro population shifts toward the rural end of the continuum with tract measurement*

Rural-urban continuum categories	Classification		Population in the category under both classifications
	County-based	Tract-based	
		Thousands	
Arizona:			
Adjacent	275	216	65
Nonadjacent, with city	97	213	31
Nonadjacent, without city	188	336	167
Minnesota:			
Adjacent	583	266	167
Nonadjacent, with city	389	364	232
Nonadjacent, without city	393	877	391
South Carolina:			
Adjacent	842	521	361
Nonadjacent, with city	146	96	65
Nonadjacent, without city	76	501	74

Note: See "The Rural-Urban Settlement Continuum and Data Sources," p. 39, for category definitions.

Source: ERS analysis of 1990 Decennial Census data, U.S. Bureau of the Census.

Table 2

Change in metro-nonmetro differences in population characteristics when tracts are substituted for counties, 1990*Most differences between metro and nonmetro people widen when tracts are the unit of analysis*

Characteristic	Arizona	Minnesota	South Carolina
		Metro-nonmetro differences larger (+) or smaller (-) at the tract level	
Percentage of the population:			
Nonwhite	-	+	-
Living below the poverty level	-	+	+
Percentage of population 25 or older:			
Without a high school diploma	+	+	+
With a college degree	+	+	+
Percentage of employed population:			
In farming, forestry, and fishing	+	+	+
In manufacturing	-	+	+
In finance, insurance, and real estate	+	+	+
In professional and managerial occupations	+	+	+

Note: Contact the authors for supporting statistics.

Source: ERS analysis of 1990 Decennial Census data, U.S. Bureau of the Census.

For Further Reading

W. Alonso, "The Interpenetration of Rural and Urban America," in *Population Change and the Future of Rural America: A Conference Proceedings*, L. Swanson and D. Brown, eds., AGES- 9324, USDA-ERS, 1993, pp. 23-28.

M. Butler and C. Beale, *Rural-Urban Continuum Codes for Metro and Nonmetro Counties, 1993*, AGES-9425, USDA-ERS, 1994.

D. Dahmann and J. Fitzsimmons, eds., *Metropolitan and Nonmetropolitan Areas: New Approaches to Geographical Definition*. Working Paper No. 12, U.S. Dept. of Commerce, Bureau of the Census, Population Division, 1995.

L. M. Ghelfi and T. Parker, "A New County-level Measure of Urban Influence," paper presented at the annual meeting of the Rural Sociological Society, Arlington, VA, Aug. 17-20, 1995.

U.S. Department of Commerce, Bureau of the Census, Geography Division, *Geographic Areas Reference Manual*, 1994.

The Rural-Urban Settlement Continuum and Data Sources

We created an abridged, five-level composite of two ERS residential area coding schemes (see Butler and Beale; Ghelfi and Parker) to form the rural-urban settlement continuum used in our analysis:

(1) **Metro core.** Every metro area begins with an urbanized area, a statistically derived area that describes the extent of the built-up area. To be part of the metro core, 50 percent or more of the county or tract population must be within the urbanized area.

(2) **Metro outlying.** Once the metro core is established, nearby counties or tracts are examined to determine whether a "high degree of economic and social integration" exists with the core. Commuting flows to and from the core (the number commuting in either direction as a percentage of resident workers) are used to measure integration. Units must also show "metropolitan character" as measured by population density, percent urban, and population growth during the previous decade.

(3) **Nonmetro adjacent.** Adjacent counties or tracts are those physically adjacent to a metro area with at least 2 percent of their employed labor force commuting to metro cores.

(4) **Nonmetro nonadjacent with city.** Counties or tracts not adjacent to metro areas, but which contain all or part of a city of 10,000 or more residents are included.

(5) **Nonmetro nonadjacent without city.** Counties or tracts not adjacent to a metro area, nor containing any part of a city of 10,000 or more residents are included.

Data Sources. All data except commuting flows were taken from STF1A and STF3A machine-readable files, 1990 Census. Place-of-work data from the 1990 Census was used by the Census Bureau to construct a special tabulation for this project, consisting of a tract-to-tract matrix of commuting flows covering the entire Nation. The tract-level commuting flows matrix can be obtained from the Census under the file name STP154. Because commuting data were processed before all street address ranges were coded into the Census Bureau's digital cartographic database, many tracts, particularly those in nonmetro areas, have a high proportion of allocated journey-to-work data. This analysis is based on commuting in and around metro areas, where allocation rates are relatively low.