ESTIMATING THE RELATIVE RURALITY OF U.S. COUNTIES*

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In context of the phrase "Rural Development", so much a part of the current vocabulary of social scientists, the term 'rural' is often poorly defined and loosely used. Partly because of the great diversity in definitions of rural, both expressed and implied, a coherent and comprehensive rural development literature has not emerged. Obviously, rural development refers to the development of whatever is rural. The aim of this paper is to deal only with the question of what is rural, leaving the matter of what consitutes development to other writers.

PRIOR STUDIES

Two major groups of social scientists have directed their thinking and research to the matter of defining rurality, or at least to attempts to differentiate the rural from the urban.

Sociologists have distinguished rural from urban on the basis of a number of psychological, social or cultural characteristics, in addition to a more limited number of demographic attributes. A particularly good review and critique of their work was reported by Dewey [6]. Repeated failure to separate the influences of density and size of population from the influences of culture were seen by Dewey as principal weaknesses in the studies he evaluated. Taylor and Jones wrote, "Much of the history of America is concerned with rural-urban differences ... The most important are occupation, size of community, mobility, social stratification and population density" [22, pp. 63-64]. Stewart said, "The size of the small settlement is certainly less important for its participation in urban life and outlook than its location relative to large towns and cities

...The simplest but crudest distinction between urban and rural settlements is the percentage of residents whose employment is non-agricultural" [21, pp. 156 and 158]. Other significant works by sociologists dealing with the matter of rurality may be found in [1, 10, 13, 15, 27 and 28].

Most attempts by economists to define or measure rurality are of relatively recent vintage. Two articles providing summary, critique and comparison of more substantive relevant works by economists, related to the focus of this paper, should be noted. The earlier of these, by Smith and Parvin [19], is general in its characterization of the nature of the problem and its evaluation of prior research. The measure of rurality actually developed and reported was for Georgia counties only, and the validity of the measure of rurality for other states was not examined. That is, while the variables chosen may have done a good job of differentiating among levels of ruralness for Georgia counties, they may not have worked well for other states. The exploratory nature of that work was recognized. A need was asserted for further work that would be directed toward finding variables and variable specifications with both state and national applicability.

The second article summarizing attempts by economists to define rurality was by Sinclair and Manderschied [18]. These authors ranked Michigan counties using eleven different measures of specific rurality that had been proposed or used in the past. Sinclair and Manderscheid concluded that the choice of index significantly affected the relative ranking of counties, particularly those generally considered the more rural. They felt that it was not possible to con-

clude that one index is better than another, or that each worker could ligitimately have his own implicit definition of rural. This conclusion is unfortunate. The fact that each worker has had his own implicit definition of rural is one of the main reasons for current confusion about the matter. The desire to find some common ground with respect to an explicit definition of rurality was the major motivation for the initial and follow-up work by the authors of this report.

GENERAL METHODOLOGY

In all the research on the matter of defining and measuring rurality conducted by the present authors, factor analysis and correlation have been the major quantitative techniques employed. Correlation techniques are already well-known and widely used by social scientists. Factor analysis is less familiar used here to assign weights to variables thought to be related to ruralness and urbanness such that variance of the resulting index was maximized. The purpose of such an approach was to make the index of values as discriminating as possible with respect to the characteristic it purported to measure, in this case the level of rurality of counties in selected states.

A comprehensive treatment of factor analysis and related techniques is contained in Harman [12]. A concise description of the method actually used in the present study was written by F.V. Waugh and appeared as an appendix to the report by Zimmer and Manny [29]. Hagood and Price [11] and Tintner [23] also describe the methodology and application of factor analysis. Studies which focus on the application of these techniques to matters of rural or regional growth, development, and economic well-being are found in [2, 4, 5, 6, 7 and 8], and may be of interest to readers.

SELECTION OF STATES
TO BE INCLUDED IN THE STUDY

Earlier work [19] suggested that population density, total population and percent urban (census definition) were the readily available variables most closely related to popular notions of urbanness and ruralness. States were selected that would generally span the full range of values for those variables. Table 1 lists county averages for the three variables for five states. The rank of each state among all states with respect to each variable, plus five-state and U.S. averages are also provided.

Table 1. AVERAGE COUNTY VALUES AND RANK AMONG ALL STATES FOR THREE SELECTION VARIABLES FOR THE FIVE STATES SELECTED FOR ANALYSIS

Area	Number of counties	County averages for indicated variables			State rank among 48 coterminous states[a]		
		Total population	Population density	Percent urban	Total population	Population density	Percent urban
Georgia	159	28,865	79.0	60.3	37	24	32
Michigan	83	106,929	156.2	73.8	13	11	16
Mississippi	82	27,036	46.9	44.5	39	32	45
New Jersey	21	341,341	953.1	88.9	4	1	1
Wyoming	23	14,453	3.4	60.5	45	48	31
Five States	368	62,995	86.9	72.8	–	–	–
United States[b]	3111	64,697	57.5	73.5	–	–	–

[a]Ranking is from highest to lowest values of the variable.

[b]All 50 states plus the District of Columbia.

Averages of the five states for population and percent urban are quite close to U.S. averages. The average for the density variable for the five states is not very close to the U.S. average, but when the extreme range in values among 48 coterminous states is considered, correspondence is adequate. Ranges of state rankings with respect to all three variables are close to both extremes, and there is a fairly uniform distribution of ranking between extremes for all three variables. The five states selected for analysis are therefore felt to be highly representative of the entire United States. Variables and procedures that work well for these states are likely to be applicable to all states.

SELECTION OF VARIABLES TO MEASURE RURALITY

Four principal criteria were used to select and evaluate variables for inclusion in the computation of an index of rurality. Variables first had to be related to notions of ruralness at one end of their range and to notions of urbanness at the other. One concept generally associated with rural involves openness of land or space between people, while the clustering of people and houses is associated with urban. The second selection criterion was that variables must not relate or imply effects of rurality or urbanity, they must only measure their levels. Thirdly, variables must yield essentially the same results for any given county in each state, whether the state is considered alone or in combination with other states. Finally, unnecessary duplication and redundancy among variables included should be minimized.

In the first report by Smith and Parvin [19], nine variables were included in the computation of their index. In the work done since that first report, the following additional variables have evaluated:

(1) Proportion of all workers working in county of residence, 1970, and
(2) The proximity of persons in each county of interest to persons in other counties, 1970.

Variable (1) was added to the original list because it was thought that rural counties may have a higher proportion of workers commuting to jobs beyond county borders than do urban counties. Variable (2) was brought into the

analysis because it seemed clear, that of two counties identical in every other way, the county with the larger concentrations of population nearer by would generally be more urban in orientation and outlook than the one in more distant proximity to other people.

Data for all variables except (2) above were obtained from the Census [24]. The computation of variable (2) is outlined in the appendix to this report.

As the evaluative and selective process was carried out, specification of some variables was changed. Others were totally eliminated as application of the four criteria warranted. After the first intensive evaluation and selection phase was completed, only four of the eleven original variables continued to show promise. These four, in some cases transformed from their original form, were:

a. County population density (persons per square mile).
b. Percent or numbers of persons in the county defined by the census to be living in urban areas.
c. Percent or number of employed persons in the county not employed in agriculture, forestry, or fisheries and
d. Proximity (as defined in the Appendix).

Eight indices of rurality were computed with factor analysis, using the four remaining variables in various forms and combinations. The combinations and variable forms in each run, in abbreviated designation, were:

1. density, % urban, % not open-space, proximity.
2. density, % not open-space, proximity.
3. density, no. urban, % not open-space, proximity.
4. density, no. urban, no. not open-space, proximity.
5. density, ratio of no. urban to no. in open-space, proximity.
6. density, no. not open-space, proximity.
7. density, no. urban, no. in open-space, proximity.
8. density, ratio no. not open-space to no. in open-space ,proximity.

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Index values were developed for each county in each of five states individually and for all five states combined, for each of the eight runs. Index values for each state obtained from the individual runs were correlated with those for that same state obtained when run in combination with all other states. These correlations are presented in Table 2. Also included are correlations of individual state index values and percent urban, as defined and reported by the Bureau of the Census.

Table 2.   CORRELATIONS BETWEEN COUNTY INDEX VALUES, INDIVIDUAL STATE AND POOLED STATE BASIS, AND BETWEEN INDIVIDUAL STATE AND CENSUS PERCENT URBAN

State	Run number[a]							
	1	2	3	4	5	6	7	8
Correlations of individual to pooled:								
Georgia	0.939	0.937	0.967	0.999	0.940	0.999	0.923	0.836
Michigan	0.995	0.996	0.997	0.999	0.999	0.999	0.999	0.999
Mississippi	0.886	0.724	0.778	0.998	0.973	0.998	0.728	0.970
New Jersey	0.942	0.959	0.972	0.994	0.999	0.994	0.997	0.999
Wyoming	0.884	0.824	0.858	0.993	0.936	0.989	0.642	0.951
Correlations of individual to Census percent urban:								
Georgia	0.712	0.527	0.541	0.528	0.595	0.524	0.549	0.558
Michigan	0.796	0.607	0.559	0.501	0.595	0.508	0.522	0.572
Mississippi	0.863	0.740	0.738	0.713	0.770	0.714	0.723	0.736
New Jersey	0.883	0.780	0.803	0.759	0.679	0.731	0.738	0.672
Wyoming	0.796	0.640	0.652	0.569	0.609	0.530	0.544	0.572

[a]The variables and their specification included in each run are listed in the text, above.

It can be seen in Table 2 that runs four and six give the best correlations between county index values obtained for states when run separately and values obtained for the same counties when all states were run in combination. That is, ranking counties within states from most rural to most urban was almost the same in both cases. This suggests that variables included in those runs may have national relevance, as they produce such consistent results for the five widely varying states selected for analysis.

Run six including proximity, density and numbers not employed in open-space industries, is preferred over run four, which also carries number of urban persons, because:

(1) the correlations between number of urban persons and number of persons not employed in open-space industries were 0.99 or more for every state — implying that number of urban persons was redundant, and

(2) ranges of index values for all states for run four seemed too great, while those for run six were smaller and appeared to be more realistic.

It is noteworthy that of the eight final runs four and six produced the lowest average correlations between index values developed in this study and percent of persons living in urban areas as defined and reported by the census (Table 2). That is, the two runs judged best (one including number of urban persons and the other not) in terms of criteria established for the present work, were the most poorly correlated with today's most popular definition and measure of urbanness and ruralness.

RESULTS AND DISCUSSION

The results of run number six are presented in Tables 3 and 4. In the first column of Table 3,

county averages for each variable are given. Individual county input data are not listed because inclusion of such detail would unduly burden this presentation. Over-all correlations of each variable to the index for each state are direct outputs of the factor analysis program. As expected, the correlations of variables to the over-all index for the five-state run are lower in every case than those for the individual state runs. The magnitude of these correlations directly reflects the relative importance of each variable in the computation of each index. Although proximity was the most important variable when all five states were combined, number and not open-space was most frequently the most important among individual states. Density, on the other hand, was least important for both combined and individual runs. It is obvious, nevertheless, that all three factors are important, and are all closely related to the index as well.

Table 3. VARIABLE AVERAGES, WEIGHTS, AND CORRELATIONS FOR THE FIVE STATES INCLUDED IN THE DEVELOPMENT OF THE INDEXES OF RURALITY

State and variable	County variable averages	Raw variable weights[a]	Correlation of variables to the index
Georgia			
Proximity	114,710	.000301	.977
Density	79.0	.121749	.963
Number not open-space	11,019	.000856	.982
Michigan			
Proximity	295,455	.000283	.992
Density	156.2	.192157	.995
Number not open-space	38,690	.000838	.997
Mississippi			
Proximity	91,638	.000286	.984
Density	46.9	.204011	.980
Number no open-space	8,393	.000741	.988
New Jersey			
Proximity	1,459,630	.000279	.985
Density	953.1	.054421	.909
Number not open-space	137,301	.001561	.925
Wyoming			
Proximity	33,959	.000259	.984
Density	3.4	.995816	.952
Number not open-space	4,972	.000781	.969
Five-states, combined			
Proximity	222,036	.000282	.975
Density	86.9	.096080	.892
Number not open-space	23,503	.001237	.910

[a]The sum of the products of these weights and the values of the corresponding variable for each county yields the individual county index values.

The raw variable weights of Table 3 are scalars of the weights actually generated by the factor analysis program. Each weight was multiplied by a different constant for each individual state and for the five combined. Weights for the combined run were first multiplied by the constant that would yield an index value of 100 (when the variables for the five states combined were at their mean values). The mean values for each state were then observed, and constants were developed which, when applied to variable weights for each individual state, would yield state means equal to those obtained in the combined run. Thus, the mean values of the index for each state were determined by the combined run, individual county values within each state being determined by each individual run.

Key county index values resulting from the application of raw variable weights to county data are shown in Table 4. Again, limitations on space prohibit publishing index values for all the 368 counties included in the study. A complete listing of values for Georgia counties is published in [20], for Mississippi counties in [14], and for Michigan counties in [18]. It should be emphasized that all index values are considered relative, not absolute measures of rurality. Thus, although one may wish to say that (among the five states studied) Keweenaw County in Michigan and Sublette County in Wyoming are 100 percent rural and/or Wayne County, Michigan is 100 percent urban, that is qualitative judgement that goes beyond the scope of this article. Likewise, whether all counties with index values above the mean or median (or any other specific value) ought to be designated urban and those below rural, is a matter that other researchers or users of the index may want to consider.

Table 4. MEAN, MEDIAN, AND FIVE LOWEST AND HIGHEST COUNTY RURALITY INDEX VALUES WHEN THE OVERALL FIVE STATE MEAN IS 100

State, item, and county	Index value	Item and county	Index value
Georgia			
Mean for all counties	53.6	Median for all counties	28.9
Five most rural counties:		Five most urban counties:	
Echols	9.9	Fulton	576.8
Long	11.3	DeKalb	508.5
Baker	13.2	Cobb	232.5
Charlton	13.3	Muscogee	221.0
Brantley	13.3	Richmond	183.0
Michigan			
Mean for all counties	146.1	Median for all counties	39.0
Five most rural counties:		Five most urban counties:	
Keweenaw	3.2	Wayne	2,483.8
Luce	6.2	Oakland	807.0
Schoolcraft	7.4	Macomb	694.6
Montmorency	7.8	Genesse	435.1
Alger	8.0	Kent	374.6
Mississippi			
Mean for all counties	42.0	Median for all counties	26.9
Five most rural counties:		Five most urban counties:	
Issaquena	10.7	Hinds	178.6
Sharkey	16.2	Harrison	135.2
Kemper	16.3	Jackson	82.0
Choctaw	16.7	Forrest	67.8
Jefferson	17.6	Lauderdale	64.1

Table 4. continued

State, item, and county	Index value	Item and county	Index value
New Jersey			
Mean for all counties	673.4	Median for all counties	478.0
Five most rural counties:		Five most urban counties:	
Cape May	126.9	Hudson	1,788.8
Salem	178.4	Essex	1,614.6
Warren	216.0	Bergen	1,400.8
Sussex	218.6	Union	1,304.2
Cumberland	229.0	Middlesex	831.8
Wyoming			
Mean for all counties	16.1	Median for all counties	9.0
Five most rural counties:		Five most urban counties:	
Sublette	3.2	Laramie	57.3
Niobrara	3.5	Natrona	38.7
Crook	4.4	Albany	25.0
Johnson	4.7	Fremont	17.8
Teton	4.7	Sheridan	16.8

It is notable that the most urban and one of the two most rural counties among the five states studied are both found in Michigan. Keweenaw County is the northermost county in Michigan and includes Isle Royale in Lake Superior. On the other hand, Wayne County includes Detroit, Dearborn and Livonia, and is in close proximity to several other large cities. The other most rural county is Sublette County, Wyoming, in the midst of the High Rockies. The most urban county in New Jersey, Hudson County, is also the second most urban among all five states. Jersey City is located inside Hudson County, large cities such as Elizabeth, Newark and New York as well as many smaller cities being in close proximity.

The value of the index for the median county is much lower than the index's mean value in every state studied. A conventional interpretation of this finding leads to the conclusion that there are more relatively rural counties in each state than there are urban. In fact, 81 percent of Georgia's counties have index values below the state mean, Michigan similarly has 81 percent, Mississippi 79 percent, New Jersey 67 percent and Wyoming 78 percent. For the five states collectively, 315 of 368 counties (86 percent) have index values below the five-state mean of 100.

Although Michigan has the most urban county, New Jersey is clearly the most urban of the five states over-all. The mean value of the index for New Jersey is 4.6 times that of Michigan and 41.8 times that of Wyoming, the most rural state. The ranking of the five states with respect to over-all levels of rurality; Wyoming, Mississippi, Georgia, Michigan and New Jersey, from most rural to most urban, respectively, is entirely consistent with initial expectations of the authors.

APPLICATIONS AND FURTHER RESEARCH

The procedures followed for developing indexes of rurality reported in this article seem to do a good job of differentiating between the most rural and the most urban counties both within and among the five states studied. Although it would be stretching the credibility of the index to make much of small differences in index values, there are several important advantages to having a continuous measure of rurality.

Such a measure may be used as an explanatory variable for, or a correlate of, any of several traditional social, economic or cultural factors thought to be affected by or considered characteristic of level of rurality. How incomes, employment or fertility rates, for example, are related to rurality may be tested statistically. Other relationships of interest might be prox-

imity to medical and dental care, pupil-teacher ratios, quality of housing, moral traditionalism, family structure and divorce rates. The list of such possible factors is limited only by the imagination and industry of interested researchers.

Another advantage of a nationally valid, continuous measure of rurality is that the ruralness of counties may be directly compared among states, as well as within states. All counties in any of the five states included in the analysis with similar index values may be considered to be of the same level of rurality. Other definitions of rurality do not lend themselves to such comparisons, and a county that may be classified urban in one state might actually be more rural than some counties classified rural in others. This is particularly true of the Bureau of Census definitions of urban and rural. In 1970 Wyoming was listed as 60.5 percent urban while Mississippi was indicated to be only 44.5 percent urban. At the same time, Nevada, with a population of 488,738 and a density of 4.4 people per square mile, was listed at 80.9 percent urban and Pennsylvania, with a population of 11,793,909 and a density of 262.3 was listed at only 71.5 percent urban. Surely with respect to each state overall, Mississippi is more urban than Wyoming and Pennsylvania is more urban than Nevada.

Although the study on which this report is based advances an earlier one reported in this journal by the same authors, it must still be considered exploratory and developmental. It is still not assured that the combination and specification of variables used for constructing indexes of rurality for the five states included in this study will also work best for all other states in the United States. That the results seemed so good for the widely varying states that were selected, however, argues well for using the variables and procedures on which this study is based as the starting point for the development of indexes of rurality for all U.S. counties.

Rural development is a point of focus for public policy and funding that is likely to persist for some time. The more precisely rural areas are defined and identified, the more pointed our efforts to develop resources in rural America will be. When those characteristics that are critical to rural well-being are related to a definitive measure of the level or degree of rurality, priorities can more effectively be drawn where time, talents and funds are limited.

APPENDIX
Computation of the Proximity Variable

The value of the proximity variable for any county i is:

$$\text{Proximity}_i = \sum_j \left(\frac{1970 \text{ population of } j}{\text{distance } i \text{ to } j} \right) + (1970 \text{ population of } i)$$

where i = any reference county, and
    j = all counties regardless of state
        borders, whose
county seats are within 125 miles of the county seat of the reference county, and

$$\text{distance} = \sqrt{[(N-S_i - N-S_j)^2 + (E-W_i - E-W_j)^2]},$$

where N−S and E−W are the North-South and East-West coordinates, respectively, of the "Picadad Key Point" representing the county seat in each county of interest. The "Picadad" system for computing straight-line distances between 37,000 places (including all the county seats) in the 48 coterminous states is described in [25].

The 125 mile limit placed on the distance that the proximity of persons is considered to be relevant is somewhat arbitrary. It is generally felt however, that persons beyond that distance are for the most part out of daily commuting, television, radio and newspaper range. There is, therefore, little physical interchange of persons on any sort of sustained or regular basis, and whatever influences on life styles that television, radio and newspapers might have is of national origin and effect, rather than local.

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