Defining Rural Hospital Markets

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Objective. The purpose of this study is to examine the geographic scope of rural hospital markets.

Data Sources. The study uses 1988 Medicare patient discharge records (MedPAR) and hospital financial information (HCRIS) for all rural hospitals participating in the Medicare Program.

Study Design. Hospital-specific market areas are compared to county-based market areas using a series of geographic and socioeconomic-demographic dimensions as well as indicators of market competitiveness. The potential impact of alternative market configurations on health services research is explored by estimating a model of rural hospital closure.

Data Collection/Extraction Methods. Hospital-specific market areas were defined using the zip code of patient origin. Zip code-level data were subsequently aggregated to the market level.

Findings. Using the county as the hospital market area results not only in the inclusion of areas from which the hospital does not draw patients but also in the exclusion of areas from which it does draw patients. The empirical estimation of a model of rural hospital closure shows that the definition of a hospital market area does not jeopardize the ability to identify major risk factors for closure.

Conclusions. Market area definition may be key to identifying and monitoring populations at risk from rural hospital decisions to downsize or close their facilities. Further research into the market areas of rural hospitals that have closed would help to develop alternative, and perhaps more relevant, definitions of the population at risk.

Keywords. Rural hospitals, market definition, hospital closure

BACKGROUND

Recent interest in rural hospital market areas has been spurred by efforts to identify rural hospitals that maintain facilities that might be the sole source of essential services to Medicare beneficiaries residing in the particular hospital's market area. One method for identifying such hospitals is to use an institution's market share as a measure of the degree to which a local community depends on that institution. In order to operationalize such a criterion, it is first necessary to define the relevant

market—both the product market and the geographic area. For this study, the product market is assumed to be the market for acute inpatient care. The purpose of this study is to examine the latter choice: a geographic area.

Studies of hospital markets generally assume that the market area coincides with an existing geographic entity. For rural hospitals, the county is usually assumed to be the appropriate geographic unit for analysis; for urban hospitals, the Metropolitan Statistical Area (MSA) is assumed to be the appropriate unit (Folland 1983; Erickson and Finkler 1985; Farley 1985; Noether 1988; Hendricks 1989; Hogan 1989). When considering some of the theoretical underpinnings of market definition, it is unlikely that hospital markets will conveniently coincide with these geographic boundaries (Garnick et al. 1987; Morrisey, Sloan, and Valvona 1988; Wright and Marlor 1990; Basu 1991). While county boundaries may be overly narrow in many situations, it can be argued that MSAs are too large to represent true geographic markets and are, by definition, not applicable to rural areas.

Hospital market areas can be defined from the perspective of either patients or hospitals (Luft et al. 1989). The patient, or the physician acting as the patient's agent, may consider only a few of the available hospitals in an area as relevant alternatives. The number of acceptable alternatives may be limited by the patient's or physician's willingness to travel. The maximum distance that patients or physicians are willing to travel has not been established empirically, possibly because of the complexity of linking data sets that would provide complete information on patient residence, hospital location, and admitting physician office location. Empirical models of patient choices of hospitals have, however, confirmed the importance of distance in the ultimate decision of where to seek hospital care (Morrill and Earickson 1968; Weiss and Greenlick 1970; Folland 1983; Cohen and Lee 1985; McGuirk and Porell 1984; Porell 1986; Adams et al. 1991; Adams and Wright 1991).

As a result, some researchers have proposed using radii around a hospital to delineate market areas (Garnick et al. 1987). This method requires assumptions about patient and physician willingness to travel.

In addition, it ignores geographic barriers to travel that may exist within the radii and assumes that hospitals are located at the center of market areas. Patient origin information, however, can be used to map existing travel patterns. Although existing travel patterns may not reflect the maximum distance that patients or physicians are willing to travel, they do reflect travel distances in the face of existing alternatives and environmental conditions.

The patient's perspective is important when we are considering many policy issues. For example, improper market definition makes it impossible to identify and monitor populations at risk from hospital decisions to downsize or close. If the incorrect populations are identified based on their residence within conveniently existing geopolitical boundaries, it will be very difficult to track changes in patterns of utilization of services or changes in travel distance using aggregate population–based measures.

The prevailing market conditions that individual hospitals face can also be described using patient origin information. Researchers concerned about the level of competition facing individual hospitals focus on the level of concentration in each of the small geographic areas (generally zip code areas) from which a hospital draws its patients (Zwanziger and Melnick 1988; Melnick and Zwanziger 1988). These measures of concentration are often built into hospital cost functions to confirm the existence of cost-increasing non-price competition in the market for hospital services. In addition, measures of concentration are frequently built into other hospital behavioral models to determine the role that competition from other hospitals plays in hospital decisions to downsize or close.

The hospital's perspective is important in our analysis of hospital behavior. For example, improper market definition can result in failure to include all competing firms or failure to exclude noncompeting firms. Failure to include all competing firms will result in a market that is too narrow and will bias measures of market competitiveness downward. Failure to exclude noncompeting firms will produce markets that are too broad and will bias measures of market competitiveness upward. This can affect the estimating of parameters in empirical models of hospital behavior.

This study focuses primarily on the analytic consequences of market definition. It uses nationwide Medicare patient origin information to describe the geographic scope and the extent of competition of rural hospital markets. Two research questions are posed:

- How does using zip code patient origin information to define hospital market areas affect their characterization? How much overlap is there between market areas constructed using alternative definitions?
- How do different characterizations of the market area affect the empirical estimation of models of rural hospital closure?

The analysis is divided into two parts. In the first, hospital-specific market areas aggregated from zip code–level patient origin files are compared to the more traditional county-based market areas. Alternative configurations of the market areas are compared using a series of geographic and socioeconomic-demographic dimensions as well as indicators of market competitiveness that are frequently included in empirical models of the demand for hospital services and hospital performance.

In the second part, the potential impact of alternative configurations of rural hospital market areas on current health services research is explored by estimating a model of rural hospital closure. The model is estimated twice. In the first model, market area competition and demand variables are constructed using county-based market areas; in the second model, they are constructed using zip code–based market areas.

RESEARCH METHODOLOGY

DATA SOURCES

The Health Care Financing Administration (HCFA) in its role as administrator of the Medicare program maintains a large and complex data collection system. This study uses two HCFA files: the Medicare Provider Analysis and Review File (MedPAR) and the Hospital Cost Reporting Information System (HCRIS). The MedPAR file contains information about a beneficiary's stay in a hospital from admission through discharge. HCRIS is the national data base for Medicare hospital cost report data containing specific financial and statistical information from Medicare-certified hospitals and hospital/health care facility complexes. Hospital closures are identified from a list developed for HCFA by the Center for Health Economics Research (CHER) (Hendricks, Cromwell, Sitaram, et al. 1989). Finally, 1987 socioeconomic and demographic information at the five-digit zip code level was obtained from a file compiled from a variety of sources including the Current Population Survey and the 1980 U.S. Census of Population and Housing.

VARIABLES

To answer the research questions, two sets of market areas for rural hospitals were constructed. The first set of market areas was built assuming that the county in which a hospital is located forms its market area. The second set of market areas was constructed using a two-stage procedure. During the first stage, patient origin information was used to determine where hospitals get their patients. A baseline catchment area was defined as those zip codes (rank-ordered by numerical importance) that contribute at least 60 percent (or, alternatively, 75 percent) of a hospital's Medicare discharges. During the second stage, patient origin information was used to determine where patients went to get care. If a hospital was the majority provider (a market share of 50 percent or more) in an area, the zip code was added to the baseline catchment area.

Previous studies involving the construction of hospital markets from patient origin information have used various cutoff percentages of a hospital's discharges to determine which zip code areas should be included. Alternative cutoffs have ranged from 50 percent to 90 percent. The cutoffs of 60 percent and 75 percent were chosen for this study for three reasons. First, these two values represent the middle range of previously used cutoffs. Second, two recent studies use the 60 percent cutoff and, hence, provide a helpful frame of reference (Garnick et al. 1987; Basu 1991). Third, the 75 percent cutoff has been used by the Health Care Financing Administration in implementing the market share criteria for designating a facility as a Sole Community Hospital.

After the market areas were defined, variables describing market area characteristics were constructed. To keep the sources of socioeconomic and demographic data consistent, zip codes were aggregated to the county level to describe the first set of market areas. When zip codes crossed county boundaries, they were assigned to the county with the largest proportion of the zip code's population. If the variables were expressed as proportions or percentages, they were aggregated using the proportion of the county's total population in each zip code as the weight. For patient origin market areas, socioeconomic and demographic characteristics were again aggregated from zip code–level data. Where necessary, the proportion of a hospital's patients that came from the zip code was the weighting factor.

The final group of market area variables to be constructed was measures of market competitiveness. For county-based market areas, a hospital's competitors were identified as other hospitals located in the

county. For the zip code–based market areas, patient flows were used to identify any other hospitals serving residents of the market area. If two hospitals had overlapping market areas, they were identified as competitors of one another. For example, hospital X has three zip codes in its market area and hospital Y has five zip codes in its market area. If one or more zip codes are in the market area of both hospitals, then hospital X is competing with hospital Y and vice versa.

UNIVERSE OF HOSPITALS

This study is limited to short-term, acute care, rural hospitals that provide services to the general public. While the patient origin files used in this study do not include discharges from excluded hospitals — psychiatric hospitals, rehabilitation hospitals, children's hospitals, and long-term hospitals — they do include records from several types of providers that do not belong in the universe of this study. The analytic files were edited to remove records for excluded units within acute care facilities, federal hospitals (primarily Veterans Administration and Public Health facilities), emergency hospitals, and Indian Health Services (IHS) facilities. These edits resulted in a data base of 2,764 short-term rural hospitals operating in 1984 and 2,642 operating in 1988.

The population of hospitals included in the closure model was 2,638. Of the 2,764 hospitals included in the 1984 data base, 2,564 were operating continuously from 1984 to 1988, and 115 closed between 1986 and 1988. An additional 85 hospitals were deleted from the sample because they closed between 1980 and 1985. When financial information was added to the data base, the population was reduced to 2,533 hospitals in continuous operation and 105 closures between 1986 and 1988.

DESCRIPTION OF RURAL
HOSPITAL MARKETS

GEOGRAPHIC SCOPE OF MARKET AREA

Two analytical questions were answered during this phase of the research:

- How do alternative definitions of the market areas affect the geographic scope of the market area?
- How much overlap is there between market areas constructed using alternative definitions?

Three measures of scope were considered: the number of zip codes comprising the hospital market area, the square mileage in the market area, and the total population residing in the market area. Table 1 shows the means for these variables across all rural hospitals operating in 1988.

To assess the relative scope of these alternative market areas, two ratios were calculated (see Table 1 for definitions). The first is the ratio of the scope of the county-based market areas to the narrower zip code-based market areas: the second is the ratio of the scope of the medium to the narrow zip code–based market areas. A high value of the ratio would suggest a greater discrepancy in geographic scope between market areas.

The geographic scope of the market area changes dramatically when the definition of the market area is changed. In terms of both number of zip codes and square mileage, the geographic scope of a market area is, on average, approximately four times larger when the county is used to describe it than it would be if patient origin information (using the 60 percent rule) were used. Changing the cutoff criterion from 60 to 75 percent of a provider's discharges almost doubles the geographic scope of the market both in terms of number of zip codes

**Table 1:   1988 Rural Hospitals — Scope of Market Areas;
Means (Std. Errors)**

	County*	Narrow Zip Code†	Ratio 1‡	Medium Zip Code§	Ratio 2‖
Number of zip codes	10.71	3.99	3.80	5.64	1.57
	(.17)	(.06)	(.07)	(.08)	(.01)
Square mileage	1195.8	644.5	4.56	894.0	1.65
	(32.7)	(19.5)	(1.03)	(23.6)	(.04)
Total population	33,516	24,541	2.11	33,362	1.49
	(561)	(639)	(.05)	(874)	(.02)

*County in which the hospital is located.

†Narrow zip code: zip code areas that, rank-ordered by numerical importance, contribute at least 60 percent of a hospital's Medicare discharges plus any zip code in which a provider has the majority of Medicare discharges.

‡Ratio 1: number of zip codes, etc. in county-based market area/number of zip codes, etc. in narrow zip code market area.

§Medium zip code: zip code areas that, rank-ordered by numerical importance, contribute at least 75 percent of a hospital's Medicare discharges plus any zip code in which a provider has the majority of Medicare discharges.

‖Ratio 2: number of zip codes etc. in medium zip code market area/number of zip codes etc. in narrow zip code market area.

and square mileage. In the case of rural hospitals, it would appear that the majority of a hospital's patients originate from a geographic area considerably smaller than the county in which the hospital is located.

The ratios were also calculated for the population residing in the market area. Based on these ratios, the county-based market area is just over twice the size of the narrower zip code-based market area. Changing the cutoff criterion from 60 to 75 percent less than doubles the scope of the market area. Although the county-based market areas represent a much larger geographic area than the zip code-based market areas, the discrepancy is significantly reduced when considering the total population. The narrower patient origin market areas appear to capture the more populated areas in the immediate vicinity of the hospital. Other market definitions, whether based on county or patient origin, add more sparsely populated areas.

In addition to zip code-based market areas being much smaller than the county-based areas, the zip codes included in these market areas are not necessarily located in the same county as the hospital. To assess the overlap between alternative market areas, zip codes that were contained in both zip code-based and county-based market areas were identified. On average, only 2.95 zip codes (or an average of 34.3 percent of the zip codes located in the county) are included in both the county and narrow zip code market area. Using the broader definition of the zip code market area, the overlap increases to 3.70 zip codes (42.6 percent). The picture improves slightly when looking at square mileage. For the narrower zip code markets, 479 square miles (or an average of 40.1 percent of square mileage of the county) are located in both the county and narrow zip code market area. For the medium zip code markets, the overlap increases to 566 square miles (47.3 percent).

Because the narrow zip code markets capture the more populated areas in the immediate vicinity of the hospital, the overlap between markets is greater when total population is considered. On average, 18,394 people (or an average of 61.2 percent of the population in the hospital's county) are included in both the county and the narrower zip code market area: 21,172 people (or an average of 69.4 percent of the population in the hospital's county) are included in both the county and the medium zip code market area.

The concept of overlap between areas can also be used to confirm that some zip codes (square mileage) included in zip code-based markets are excluded from county-based markets. For the narrower zip code markets, 82.1 percent of the zip codes and 82.3 percent of the square mileage were included in the county markets: for the medium

zip code markets, this overlap was reduced to 73.7 percent of the zip codes and 73.2 percent of the square miles. Considering total population yields similar results. Using the county to describe the market area of rural hospitals may result not only in the inclusion of areas from which the hospital does not draw patients but also in the exclusion of areas from which it does draw patients.

SOCIOECONOMIC-DEMOGRAPHIC CHARACTERISTICS OF MARKET AREA

Because not much overlap exists between market areas defined using alternative criteria, the composite socioeconomic and demographic characteristics of the market area could be affected. To answer the question of whether or not the market definition alters its characterization, a series of zip code–level socioeconomic and demographic variables were aggregated to the market level. Table 2 contains the population means for some of these variables across all rural hospitals operating in 1988.

For most of these variables, the definition of the market area does not affect the population means. The high correlation between most of the variables calculated using the county as the market area and the variables calculated using the narrow zip code–based market area suggests that changing the definition of the market area may not affect the estimation of empirical models of hospital behavior. For three variables—population density, number of households, and total population—a relatively low correlation exists between the variables. As a result, the estimation of models that include these three variables could be affected.

MARKET COMPETITIVENESS

As discussed earlier, changing the geographic scope of the market area can change measures of market competitiveness as different firms are identified as competitors. This phase of the analysis focused on two variables: the number of competitors and a hospital's market share. Table 3 presents the results of the analysis.

Since the geographic scope of the zip code–based market areas is smaller than the geographic scope of the county-based markets, it would be expected that the former areas would identify fewer competitors located in the market. However, since patient origin information was used to identify other hospitals serving residents of the market area, rather than hospitals located within the market area, the impact

Table 2:   1988 Rural Hospitals — Socioeconomic/Demographic
Characteristics of Market Area; Means (Std. Errors)

	County*	Narrow Zip Code*	Medium Zip Code*	Corr. Coef.†
Median age	33.53	34.00	34.03	.89188
	(.08)	(.08)	(.08)	
Percent African American	7.74	7.85	7.80	.97956
	(.27)	(.28)	(.28)	
Density	51.34	133.29	134.40	.28446
	(2.40)	(5.78)	(5.89)	
Median education	11.94	11.96	11.94	.91913
	(.02)	(.02)	(.02)	
Number of households	12,428	9,192	12,513	.43340
	(209)	(244)	(335)	
Household income	20,819	20,621	20,538	.92251
	(78)	(80)	(79)	
Population	33,516	24,540	33,362	.43827
	(561)	(639)	(874)	
Percent senior	14.92	15.66	15.65	.89334
	(.08)	(.08)	(.08)	
Unemployment rate	6.97	6.91	6.96	.92451
	(.07)	(.07)	(.07)	
Recent movers	36.73	36.97	37.18	.90249
	(.15)	(.15)	(.15)	

*See footnote in Table 1 for definitions.

†Correlation coefficient between variable calculated using the county as the market area and variable calculated using narrow zip code-based market area.

Table 3:   1988 Rural Hospitals — Market Competitiveness;
Means (Std. Errors)

	County*	Narrow Zip Code*	Medium Zip Code*
Number of competitors	.77	.77	1.82
	(.02)	(.03)	(.05)
Number of competitor beds	63.7	148.2	310.9
	(2.1)	(6.4)	(11.6)
Market share	37.0%	47.9%	41.2%
	(.4)	(.3)	(.3)

*See footnote in Table 1 for definitions.

that redefining both the market area and competitors would have on the number of identified competitors is unclear.

Using the county as the market identifies, on average, the same number of competitor hospitals as using the narrow zip code market areas does. These markets do not appear, however, to identify the same competitors. Only 15 percent of the competitor hospitals identified using patient origin information are located in the same county as the hospital. Since the narrow zip code markets have more competitor beds than the county market areas, it appears that patient origin information identifies larger competitors, possibly rural referral centers or urban facilities, outside the immediate vicinity of the hospital. As expected, the medium zip code markets identify more than twice as many competitor hospitals and beds as the narrow zip code markets.

Since the previous analysis of the geographic scope of markets found that using the county to describe the market area of rural hospitals results in the inclusion of areas from which the hospital does not draw patients, the market share calculated using the county would be lowered by these zip code areas in which the hospital has low market penetration. As expected, hospital market shares calculated using the county are lower than the market shares calculated using either zip code market area.

RURAL HOSPITAL CLOSURE

EMPIRICAL MODEL

In the final phase of the analysis, a model of rural hospital closures was estimated. The primary purpose of this model was to compare the results of a closure model estimated using county level market variables to the results of a closure model estimated using zip code level market variables. As a result, it replicates several recently estimated models that seek to evaluate operating and environmental characteristics associated with a high risk of closure (Mullner and Whiteis 1988; Hadley 1989; General Accounting Office 1990, 1991).

The estimated empirical model is:

$$Yi = a^* + b_1{}^*X_{1i} + b_2{}^*X_{2i} + b_3{}^*X_{3i} + b_4{}^*X_{4i} + e_i$$

where,

Y_i = 1 if the ith hospital closed between 1986 and 1988;

X_{1i} = the vector of financial and operating characteristics of ith hospital;

X_{2i} = the vector of market area demand factors;

X_{3i} = the vector of market structure variables; and

X_{4i} = the vector of other exogenous environmental factors.

Table 4 contains a complete list of the independent variables included in the model and the expected sign on the coefficients, consistent with the findings of previous studies of hospital closure.

Hospital closure is a gradual process with declines in discharges occurring for a period of time preceding the date on which the hospital's license is surrendered. Previous research has found that declines in hospital activity are most pronounced in the last two or three years before closure (Hendricks, Cromwell, Sitaram, et al. 1989). Because the closures being modeled in this study occurred between 1986 and 1988, hospital market areas were constructed using 1984 patient origin information in order to characterize the market prior to the start of the closure process.

Table 4:   Rural Hospital Closure Model — Independent Variables

Category/Variable Name	Expected Sign
Hospital Operating and Financial Characteristics	
Bed size	–
For-profit ownership	+
Public hospital	–
Occupancy rate	–
Percent Medicare days	+
Percent Medicaid days	+
Area wage index	+
Medicare case-mix index	–
Market Area Demand	
Population density	+
Per capita income	–
Median education	–
Recent movers	+
Population	–
Percent population > 65 years old	–
Unemployment rate	+
Market Structure	
Market share	–
Number of competitors	+
Other Environmental Factors	
Census division	?

STATISTICAL METHODS

Hospital closure is a limited dependent variable—it can take on only two values, open or closed. In this situation, a logit model is appropriate. A logit model assumes that the underlying continuous probability function can be modeled from the observed binary outcome. The dependent variable of the estimated model is the logarithm of the odds that a closure will occur. When using the logit model with individual observations, maximum likelihood estimation is the most suitable estimation technique. The estimates in this study were performed using the SAS logistic procedure.

RESULTS

Table 5 presents a comparison of market area characteristics for open and closed rural hospitals. These bivariate comparisons of population means have the expected signs, with the exception of percent senior, for both zip code- and county-based market areas. Three variables—percent senior, population density, and number of competitors—show significant differences using county-based areas but no significant differences using zip code–based areas.

As discussed before, the correlation between the market area variables calculated using different market definitions is very strong and, as a result, the definition of the market area is unlikely to have an effect on the estimate of the coefficients for the closure model. For four variables—total population, population density, market share, and the number of competitors operating in the market area—the low correlation would suggest that the market area definition could affect the coefficient estimates for these variables.

As is shown in Table 6, the two closure models yielded similar results. The model using zip code–based market areas has only slightly greater explanatory power than the model using county-based market areas (pseudo *r*-squared: 29.1 percent versus 26.6 percent). All of the hospital characteristics included in the model, with the exception of percent Medicaid days and the wage index, were statistically significant in both models. For market area demand factors, the two models were slightly different. Both identified the unemployment rate as a factor associated with closure. In the county-based model, the percent senior is also significant: in the zip code–based model, three additional variables—recent movers, total population, and population density—are significant. For market competitiveness and regional variables, the models yielded comparable results. Only the hospital market share is statistically significant.

The identification of many of the same risk factors associated with closure does not mean that both models would necessarily predict closures with equal accuracy. The fact that the predicted probabilities from the models are highly correlated (.8345) suggests that this may, however, be the case. To assess the level of accuracy the respective models showed in predicting closure, the cut-off point was set at the 95th percentile: that is, if a hospital's predicted closure probability was at or above the 95th percentile of the distribution, it was predicted to close. Compared to actual closures, the zip code-based model performed only slightly better than the county-based model. (The former identified 47.6 percent of actual closures versus 43.8 percent.)

Table 5:   Rural Hospital Closures, 1986-1988 — Comparison of Market Area Characteristics

	Zip Code[†]			County[†]			Corr. Coef.[‡]
	Open	Closed		Open	Closed		
Unemployment rate	6.88	7.03	$	6.94	7.08	$	.9282
	(0.07)	(0.38)		(0.07)	(0.36)		
Household income	20,623	18,738	*	20,855	19,177	*	.9226
	(81)	(394)		(80)	(369)		
Recently moved	36.96	39.73	*	36.69	38.71	*	.9018
	(0.15)	(0.57)		(0.15)	(0.68)		
Percent senior	15.66	16.29	$	14.94	15.78	*	.9007
	(0.08)	(0.45)		(0.08)	(0.40)		
Population	25,128	17,763	*	33,525	28,550	*	.4062
	(706)	(3,441)		(572)	(2,378)		
Median Years of	11.96	11.57	*	11.98	11.62	*	.9205
Education	(0.02)	(0.10)		(0.02)	(0.09)		
Density	129.32	131.67	$	53.46	39.42	*	.3642
	(5.46)	(26.79)		(2.51)	(3.23)		
Market share	51.28	34.24	*	39.95	21.92	*	.5766
	(0.31)	(1.67)		(0.39)	(1.50)		
Competitors	0.83	0.89	$	0.83	1.11	*	.1452
	(0.03)	(0.13)		(0.02)	(0.10)		

*$p < .05$.

[†]Standard error of the mean in parentheses beneath population mean.

[‡]Correlation coefficient between variable calculated using county as a market area and variable calculated using zip code-based market areas.

$Not significant.

Table 6: Rural Hospital Closure Model

	County	Zip Code
Intercept	7.904991*	8.811937*
Hospital Characteristics		
Bed size	-0.013814*	-0.015922*
Case-mix index	-6.275235*	-5.168463*
Medicaid days	0.659125	-0.359527
Medicare days	-1.915987*	-1.605843*
Ownership†		
Nonprofit	-0.733012*	-0.538790**
Public	-0.674444*	-0.938749*
Occupancy	-2.825259*	-2.739772*
Wage index	-0.767356	-2.010589
Market Area Demand Factors		
Income	-0.000022	-0.000031
Median education	-0.208041	-0.151328
Recent movers	0.034965	0.069136*
Population	0.000003	-0.000011*
Percent senior	0.077896*	0.004413
Population density	0.000942	0.000912*
Unemployment rate	0.072605**	0.070620**
Market Competitiveness		
Number of competitors	-0.181338	0.088092
Market share	-4.903670*	-5.074422*
Census Divisions‡		
New England	0.098303	0.402361
Middle Atlantic	0.726110	0.382526
South Atlantic	0.358174	-0.745748
East North Central	0.581516	0.117333
East South Central	-0.075732	-1.154198
West North Central	-0.237559	-0.701224
West South Central	1.271831	0.687114
Mountain	0.675524	0.208013

*$p < .05$.

**$p < .10$.

†Omitted category is for-profit ownership.

‡Omitted category is Pacific Census Division.

DISCUSSION

One of the limitations often cited in studies of hospital behavior is that county level data are imperfect measures of the characteristics of a hospital's market. This study shows that, in the case of rural hospitals, the hospital market area is generally much smaller than the county and usually crosses county boundaries. Using the county to describe a

hospital's market area appears to result in the inclusion of areas from which the hospital does not draw its patients and the exclusion of areas from which it does draw patients.

The use of Medicare discharge information by itself to determine market areas undoubtedly introduces bias into the study. Unfortunately, the extent of this bias is hard to assess. Discharge data on the non-Medicare population are not readily available with the exceptions of a few states. The results of three recent studies found that age is a deterrent to travel (Hogan 1988; Adams and Wright 1991; Adams et al. 1991). This would suggest that market areas built using Medicare-only discharges are likely to be smaller and more concentrated than market areas built using all-payer information. This hypothesis is confirmed by another recent study, which examined California data and found that Medicare market shares were generally higher than total patient market shares in the same geographic area (Lewin/ICF 1991).

From an analytical perspective, the empirical estimation of a model of rural hospital closures has shown that the definition of a hospital's market area does not jeopardize the ability to identify hospitals' major risk factors for closure. In estimating empirical models of hospital behavior, the construction of hospital markets based on patient origin information may not yield results sufficiently different from county-based markets to justify undertaking the time-consuming process.

Three reasons are possible for this somewhat disappointing, although potentially comforting, result. First, areas within rural counties and contiguous rural counties may have relatively homogeneous socioeconomic and demographic characteristics. Second, if any heterogeneity exists in these characteristics within rural areas, the development of zip code level data bases may not be refined enough to capture it, or such heterogeneity may require geographic units smaller than the zip code level. Finally, neither model predicts closure very well. It is possible that variables that are important predictors of closure and able to show important differences between the two markets are omitted.

From a policy perspective, this article shows that market definition may be key to identifying and monitoring populations at risk from rural hospital decisions to downsize or close their facilities. While the market areas defined in this study may need to be refined to identify patient populations at risk from a hospital's decisions, the results of this study suggest that the county is unlikely to be an appropriate proxy.

Changes in county-based measures of mortality and service utilization are often used to assess the impact of rural hospital closure. As a result, changes in access to inpatient services among the hospital's

patient population may be masked by the inclusion of large numbers of county residents who are not likely to be among the hospital's patients. Unless careful consideration is given to the unit of analysis, conclusions reached using population-based measures should not be used to make claims that these closures do not have an impact on access to hospital services. Further research into the market areas of rural hospitals that have closed would help to develop alternative and perhaps more relevant definitions of the populations at risk.

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