Variations in Rural Hospital Costs: Effects of Market Concentration and Location

W. Bruce Vogel, Ph.D., and Michael K. Miller, Ph.D

This article explores two neglected questions: (1) Does the relationship between hospital concentration and costs vary between urban and rural markets? and (2) Do hospital costs in non-metropolitan areas vary with rurality? Covariance model results using 1992 data reveal that: (1) Although metropolitan and urban markets exhibit a negative relationship between hospital average costs and market concentration, non-metropolitan and rural markets fail to exhibit any relationship between costs and concentration; and (2) among non-metropolitan hospitals, only hospitals located in single-hospital communities have lower costs than their counterparts in multiple-hospital communities, once other factors are held constant.

INTRODUCTION

Many multivariate studies of hospital costs have included some measure of urban-rural location as a potentially important contributor to variations in hospital costs (Hendricks and Cromwell, 1989; Mick and Morlock, 1990; Carey, 1994). These studies generally show that rural hospitals are less costly than urban hospitals. In many cases, this finding appears not only in descriptive comparisons, but remains after controlling for urban-rural differences in hospital capacity, wages, scope of services, and so forth.

However, few studies have concentrated on non-metropolitan hospitals to examine variations in their costs by degree of rurality. Indeed, Moscovice (1989), as part of a research agenda concerning the economic viability of rural hospitals, asked: "Do rural hospital costs vary by the rurality of the environment? Do rural hospitals near urban areas have different costs than other rural hospitals? Do isolated rural hospitals (e.g., sole community hospitals, frontier hospitals) have different costs than other rural hospitals?"

While researchers have largely ignored cost variations among non-metropolitan hospitals, so have those examining the effects of market concentration and competition failed to differentiate between metropolitan and non-metropolitan hospital markets. Numerous studies performed during the 1980s and early 1990s (Joskow, 1980; Farley, 1985; Robinson and Luft, 1985; Mardon and Buie, 1992) have shown that as hospital market concentration increases (i.e., as the market moves from competition to monopoly), hospital costs decrease rather than increase as predicted by textbook economic theory. (However, none of these studies has examined whether the effects of market concentration on costs differ in urban versus rural markets.) This result is frequently attributed to hospitals having traditionally competed by having the latest technology and extra capacity available for their medical staffs (Joskow, 1980).

Recently, however, Melnick and Zwanziger (1988), Melnick et al. (1992), Zwanziger and Melnick (1988), and Zwanziger, Melnick, and Bamerzai (1994) have demonstrated a change in the nature of

W. Bruce Vogel is with the Department of Health Services Administration and Institute for Health Policy Research, University of Florida. Michael K. Miller is with the Department of Health Policy and Epidemiology, University of Florida. The opinions expressed are those of the authors and do not necessarily reflect those of the University of Florida or the Health Care Financing Administration (HCFA).

competition among hospitals in California. In particular, they have shown that as hospital market concentration increases, costs increase, as predicted by economic theory. The results of these studies are encouraging for those who hope to see increases in health sector efficiency through increases in price competition.

Still, to date no one has examined how market structure affects competition differently in metropolitan versus non-metropolitan hospital markets. It is widely believed that competitive market reforms may face significant obstacles in rural markets because of a dearth of providers and a consequent prevalence of highly concentrated markets. Indeed, concerns about such matters have resulted in significant skepticism about the applicability and feasibility of managed competition reform proposals in rural health care markets.

This article begins to address these shortcomings in the literature by (1) examining how the degree of rurality affects non-metropolitan hospital costs, and (2) examining how the effects of market concentration on hospital costs differ between metropolitan and non-metropolitan markets. Our findings indicate that: (1) hospitals located in the most rural counties have lower costs than other non-metropolitan counties; (2) except for single-hospital communities, these lower costs can be explained by the independent variables included in a hospital cost function; and (3) the nature of hospital competition is very different between metropolitan and non-metropolitan markets, with non-metropolitan and metropolitan markets nationally exhibiting different relationships between market concentration and costs.

MODEL

The Technical Note at the end of this article presents a utility-maximizing model of the hospital where utility depends on the quantity of services produced, the quality of those services, and profits. The comparative statics of this model predict that hospitals will increase their optimal quantity and quality of services in response to an exogenous increase in demand, and will decrease their optimal quantity and quality of services in response to an exogenous increase in costs. Furthermore, the model predicts that exogenous increases in demand will tend to increase total costs. Unfortunately, the model does not yield unambiguous predictions for how costs will change in response to exogenous increases in costs. (It may seem somewhat contradictory to say that an exogenous increase in costs will have an ambiguous effect on costs. This seeming contradiction can be better understood by recognizing that an exogenous increase in costs will (1) directly increase costs, (2) indirectly decrease costs via decreasing equilibrium quality, and (3) indirectly decrease costs via decreasing equilibrium quantity. The total effect on costs of an exogenous increase in costs is the sum of these three components, and thus is ambiguous in sign. (See the Technical Note for further discussion.)

The paucity of unambiguous empirical predictions, although unfortunate, does emphasize that the impact of most exogenous factors on hospital costs is an empirical, not a theoretical, question. Put another way, only empirical analyses of hospital cost data are likely to resolve questions about the impact of variables such as location and market structure on hospital costs.

DATA

Two main data sources were used in this research—the 1992 American Hospital Association (AHA) Annual Survey of Hospitals (American Hospital Association, 1992) and the September 1993 Area

Resource File (ARF) (Bureau of Health Professions, 1993). The AHA survey data provided detailed information on individual hospitals and was the primary source of data in this research, whereas the ARF provided information on county per capita income and county contiguity. In addition, HCFA's Medicare case-mix index was obtained from HCFA's public use data files.

There are myriad strategies that have been employed to measure the degree of rurality of a geographic location (Miller, Farmer, and Clarke, 1994). The county-based classification employed for this research includes, simultaneously, the absolute number of the county population classified as urban and the proximity of the county to a major metropolitan area. The scheme was developed by the Economic Research Service of the United States Department of Agriculture (Butler, 1990).

The classification scheme includes four categories of metropolitan counties ranging from central counties of metropolitan areas of 1,000,000 population or more to counties in metropolitan areas with populations of fewer than 250,000. There are six categories of non-metropolitan counties in the scheme. The largest is a county with at least 20,000 urban residents located adjacent to a metropolitan area. The most rural county is one that contains fewer than 2,500 urban residents and is not proximate to a metropolitan area. The intermediate non-metropolitan counties are those containing between 2,500-20,000 urban residents.

The 10 specific categories in the metropolitan-non-metropolitan classification scheme are as follows. Metropolitan counties: 0—central counties of metropolitan areas of 1,000,000 population or more; 1—fringe counties of metropolitan areas of 1,000,000 population or more; 2—counties in metropolitan areas of 250,000-1,000,000 population; 3—counties in metropolitan areas of fewer than 250,000 population. Non-metropolitan counties: 4—counties with an urban population of 20,000 or more, adjacent to a metropolitan area; 5—counties with an urban population of 20,000 or more, not adjacent to a metropolitan area; 6—counties with an urban population between 2,500-19,999, adjacent to a metropolitan area; 7—counties with an urban population between 2,500-19,999, not adjacent to a metropolitan area; 8—counties that are completely rural with fewer than 2,500 urban residents, adjacent to a metropolitan area; 9—counties that are completely rural with fewer than 2,500 urban residents, not adjacent to a metropolitan area. (Detailed information on the construction of the typology is available in Butler [1990].) We used these county codes to define three of the four locational constructs for examining non-metropolitan hospitals: urban-rural, adjacent-nonadjacent, and isolated rural-other. In addition, we used the more detailed non-metropolitan county codes to examine how hospital costs vary by degree of rurality, after controlling for other factors that influence hospital costs.

The hospital sample used in this research began with all short-term general medical and surgical hospitals in the 1992 AHA survey. All long-term and specialty hospitals were excluded from the sample. In addition, Federal hospitals and hospitals in part-year operation were omitted from the sample. The 6,730 hospitals in the AHA survey were reduced to approximately 5,400 through these edits. As seen in the empirical results presented later, basic edit checks and missing data further reduced the number of usable observations to approximately 4,350. (Edit checks were performed to detect variable values which were out-of-range. Observations which edit checks revealed to contain errors were deleted from the data used in our analyses.)

EMPIRICAL SPECIFICATION

The empirical specification of cost functions has undergone significant changes in recent years, moving from the traditional behavioral specifications of early work (Cowing, Holtmann, and Powers, 1983) to the more modern flexible functional forms (Berndt and Christensen, 1972) to the hybrid functional forms currently in use (Granneman, Brown, and Pauly, 1986; Breyer, 1987; Carey, 1994). Following Carey (1994), we use a hybrid functional form based on the work by Granneman, Brown, and Pauly (1986):

$$
\begin{aligned}
\ln AC = A &+ a^1\, DIS + a_2\, DIS^2 + a_3\, DIS^3 \\
&+ b^1\, OPV + b_2\, OPV^2 + b_3\, OPV^3 \\
&+ c^1\, LOS + c_2\, LOS^2 + c_3\, LOS^3 \\
&+ \sum d_i X_i + u
\end{aligned}
$$

where

AC	=	total costs per inpatient day equivalent,
DIS	=	number of discharges,
OPV	=	number of outpatient visits,
LOS	=	average length of stay,
X	=	a vector of other exogenous factors that affect total costs,

and

u	=	random disturbance term.

The squared and cubed output measures are consistent with U-shaped average and marginal cost curves. Discharges and outpatient visits capture important aspects of the quantity dimension of hospital output, while length of stay captures an important dimension of inpatient treatment intensity (Carey, 1994). (While Carey [1994] used the natural log of total costs as the dependent variable, we chose to use the natural log of average costs as measured by total cost per inpatient-day equivalent, where inpatient-day equivalents [also called adjusted patient days] were calculated using the AHA [1992] definition.)

We examined two types of regression models. In the first type, we estimated the above model with additive locational dummies that divided non-metropolitan hospitals into the various locational constructs discussed later. This type of model allows the level of costs to differ between locations, but constrains the independent variable coefficients to be equal across all locations. Our second type of regression (sometimes referred to as a covariance model) entered the locational dummy both (1) additively, as previously shown, and (2) multiplicatively with the other independent variables. This second model allows both the level of costs and the coefficients of the independent variables to differ among locations. The tabular results shown in Tables 3 and 4 contain only the covariance results because the covariance model is more general (i.e., less restrictive) than our first model.

Table 1 presents the definitions of the independent variables used in these analyses. In addition to hospital outputs, a variety of additional exogenous variables are included in the X vector. The number of acute and intensive beds are both included as measures of fixed assets. The various service dummies (Table 1) attempt to capture variations in hospital service mixes.

Other variables represent additional factors that could influence hospital cost performance. The pressures for reduced hospital costs associated with managed-care plans are measured by (1) the presence of at least one health maintenance organization (HMO) contract, and (2) the presence of at least one preferred provider organization (PPO) contract. A dummy variable measuring whether the hospital is managed under contract is included to account for any mission or operational differences that might be associated with that characteristic. The percent of patient days accounted for by swing beds is included as a measure of non-acute service mix.

Table 1
Variable Definitions

Variable	Variable Definition
Rural Dummy	1 if county code > 7; 0 otherwise
Case-Mix Index	1992 HCFA Medicare Case-Mix Index for facility
Swing-Bed Percent	Percent of patient days accounted for by swing beds
Discharges	Total facility discharges
$Discharges^2$	Total facility discharges squared
$Discharges^3$	Total facility discharges cubed
Visits	Total outpatient visits
$Visits^2$	Total outpatient visits squared
$Visits^3$	Total outpatient visits cubed
Average Length of Stay	Average facility length of stay
Average Length of $Stay^2$	Average facility length of stay squared
Average Length of $Stay^3$	Average facility length of stay cubed
Acute Beds	Number of acute operating beds
Intensive-Care Unit Beds	Number of intensive-care beds
Percent of Medical Staff in Primary Care	Percent of medical staff in primary-care specialties
Percent of Medical Staff Board-Certified	Percent of medical staff who are board-certified
Health Maintenance Organization (HMO) Contract	1 if the hospital has a formal HMO contract; 0 otherwise
Preferred Provider Organization (PPO) Contract	1 if the hospital has a formal PPO contract; 0 otherwise
Herfindahl-Hirschmann Index (HHI)	Population-weighted average of county HHIs in hospital market area (see text); county HHI is the sum over all hospitals in the county of the hospital's squared discharge market share multiplied by 10,000 (see text).
Average Wage	Total payroll expenses divided by total FTEs
Alcohol Unit	1 if hospital offers alcohol-drug-chemical dependency outpatient services; 0 otherwise
Birthing Services	1 if hospital has birthing room-labor, delivery, recovery, postpartum room; 0 otherwise
Catheterization Laboratory	1 if hospital operates a cardiac catheterization laboratory; 0 otherwise
Emergency Department	1 if hospital operates an emergency department; 0 otherwise
Computerized Axial Tomography (CAT) Scanner	1 if hospital operates a CAT scanner (head or whole-body); 0 otherwise
Magnetic Resonance Imaging (MRI) Unit	1 if hospital operates an MRI unit; 0 otherwise
Ultrasound	1 if hospital has ultrasound capability; 0 otherwise
Outpatient Surgery	1 if hospital performs outpatient surgery; 0 otherwise
Physical Therapy Services	1 if hospital offers physical therapy services; 0 otherwise
Council of Teaching Hospitals	1 if hospital is a member of the Council of Teaching Hospitals; 0 otherwise
Medical School Affiliation	1 if hospital reports medical school affiliation to the American Medical Association; 0 otherwise
Government-Owned	1 if hospital is owned by State or county government; 0 otherwise
For-Profit	1 if hospital is investor-owned; 0 otherwise
Bed Size < 100	1 if hospital bed size is fewer than 100; 0 otherwise
Per Capita Income (Log)	Natural logarithm of 1989 county per capita income (from September 1993 Area Resource File)
Contract-Managed	1 if hospital is managed under contract; 0 otherwise
Joint Commission on Accreditation of Healthcare Organizations	1 if hospital is accredited by the Joint Commission; 0 otherwise

NOTES: HCFA is Health Care Financing Administration. FTE is full-time equivalent.

SOURCE: Vogel, W.B., and Miller, M.K., University of Florida, 1995.

Finally, a number of variables are included in the present analysis based on their widespread inclusion in prior studies of hospital costs, such as (1) average hospital wage, (2) teaching status (medical school affiliation and membership in the Council of Teaching Hospitals), (3) State or county government ownership, (4) for-profit ownership, (5) county per capita income, (6) small bed size (fewer than 100 beds), (7) accreditation status, and (8) the 1992 Medicare facility case-mix index.

A measure of hospital market concentration is provided by the Herfindahl-Hirschmann index (HHI) (Scherer, 1980). The HHI is the sum across all hospitals in a market of the squared hospital market share (expressed as the percent of total market hospital discharges accounted for by the individual hospital), and ranges from values approaching 0 (perfect competition) to 10,000 (monopoly).

Research has shown that crude definitions of the geographical boundaries of hospital markets can yield misleading results (Garnick et al., 1987; Melnick, et al., 1992; Mardon and Buie, 1992). Although analysis of ZIP Codes of patients' residences yields the most accurate hospital market areas, such data were unavailable given our broad national sample. Under such circumstances, previous research has used county boundaries as crude definitions of hospital market areas. Fortunately, we were able to develop somewhat more refined market areas through the use of data on contiguous counties contained in the ARF.[1] Specifically, for counties that were part of Metropolitan Statistical Areas (MSAs), we used the population-weighted average HHI for all counties in that MSA. For counties adjacent to one or more MSAs, we used the population-weighted average HHI for all counties in the MSA(s) adjacent to that county, plus the population-weighted HHI for that particular county. For counties that were neither part of an MSA nor adjacent to at least one MSA, we used that county's individual HHI.

RESULTS

Descriptive Results

We begin by examining the universe of non-metropolitan hospitals based on different dimensions of rurality. Following Moscovice's (1989) research agenda, we provide descriptive comparisons of non-metropolitan hospital costs by (1) an urban-rural construct—non-metropolitan urban counties (county codes 4-7) versus non-metropolitan rural counties (county codes 8 and 9); (2) an adjacency construct—non-metropolitan counties adjacent to urban areas (county codes 4, 6, and 8) versus non-metropolitan, non-adjacent counties (county codes 5, 7, and 9); (3) an isolated rural construct—non-metropolitan, rural, small, non-adjacent counties (county code 9) versus other non-metropolitan counties (county codes 4-8); and (4) a single-hospital community construct—non-metropolitan counties with a single community hospital (defined as a county HHI = 10,000) versus non-metropolitan counties with more than one community hospital.

Our descriptive results show that the 422 non-metropolitan hospitals located in rural counties have lower costs, on average, than the 1,829 non-metropolitan hospitals located in non-rural counties–averaging $406 per inpatient-day equivalent on average versus $585 per inpatient-day equivalent, respectively, or 31 percent lower (Table 2).[2] The 1,012 hospitals located in counties adjacent to metropolitan areas had higher costs on average than the 1,239 hospitals located in non-adjacent counties–averaging $583 ver-

[1] We are indebted to an anonymous referee for suggesting this method for defining markets.

[2] All comparisons discussed in the text yielded statistically significant two-tailed t-tests at $\alpha = 0.01$ unless otherwise noted.

Table 2

Descriptive Statistics for Non-Metropolitan Hospitals

Variable	Single-Hospital Communities	Multiple-Hospital Communities	Urban Hospitals	Rural Hospitals
Total Number	1,329	922	1,829	422
Expenses per Day	**526.48	**587.04	**584.87	**405.74
Case-Mix Index	**1.08	**1.12	**1.12	**1.00
Swing-Bed Percent	0.080	0.09	*0.06	*0.14
Discharges	**2,094	**2,429	**2,585	**697
Discharges²	*9,962,380	*12,942,379	**13,555,093	**901,919
Discharges³	82,270,347,435	106,961,553,163	**1.1325E+11	**1,938,693,982
Visits	*26,582	*30,089	**32,268	**9,601
Visits²	1,814,158,368	2,134,807,746	**2346,187,782	**208,843,036
Visits³	3.06E+14	2.79E+14	**3.61E+14	**9.09E+12
Average Length of Stay	13.50	12.48	**10.57	**23.96
Average Length of Stay²	704.90	595.6	**443.8	**1,597.6
Average Length of Stay³	100,989	80,655	71,369	184,940
Acute Beds	55.96	*60.41	**64.33	**29.00
Intensive-Care Unit Beds	**4.86	**5.98	**6.25	**1.20
Percent of Medical Staff in Primary Care	**0.557	**0.500	**0.509	**0.640
Percent of Medical Staff Board-Certified	0.678	0.692	**0.696	**0.630
Health Maintenance Organization Contract	**0.183	**0.265	**0.238	**0.121
Preferred Physician Organization Contract	**0.351	**0.410	**0.413	**0.211
Herfindahl-Hirschmann Index	8,097	5,046	**6,548	**8,081
Average Wage	**21,420	**23,013	**22,696	**19,371
Alcohol Unit	**0.083	**0.126	**0.118	**0.024
Birthing Services	*0.616	*0.661	**0.665	**0.498
Catheterization Laboratory	**0.062	**0.11	**0.10	**0.002
Emergency Department	0.897	0.88	0.894	0.872
Computerized Axial Tomography Scanner	0.574	0.56	**0.645	**0.235
Magnetic Resonance Imaging Unit	**0.084	**0.126	**0.121	**0.012
Ultrasound	0.731	0.706	**0.777	**0.479
Outpatient Surgery	0.881	0.888	**0.905	**0.794
Physical Therapy Services	0.708	0.743	**0.744	**0.63
Council of Teaching Hospitals	0.0008	0.003	0.002	NA
Medical School Affiliation	**0.008	**0.027	**0.019	**0.002
Government-Owned	**0.491	**0.349	**0.416	**0.505
For-Profit	0.002	0.003	0.003	NA
Bed Size < 100	0.737	0.713	**0.682	**0.919
Per Capita Income (Log)	**9.56	**9.6	**9.57	**9.59
Contract-Managed	0.208	0.189	0.2	0.199
Joint Commission on Accreditation of Healthcare Organizations	**0.550	**0.638	**0.671	**0.216

*Significantly different from the other group at the 0.05 level

**Significantly different from the other group at the 0.01 level

NOTES: NA is not applicable. Discharges² is total facility discharges squared; Discharges³ is total facility discharges cubed.

SOURCE: Vogel, W.B., and Miller, M.K., University of Florida, 1995.

sus $525 per inpatient-day equivalent, respectively, or 11 percent higher. Similarly, the 315 non-metropolitan hospitals located in rural, small, non-adjacent counties (county code 9) exhibited lower costs on average than did the 1,936 non-metropolitan hospitals located elsewhere—averaging $398 versus $576 per inpatient-day equivalent, respectively, or 31 percent lower. Finally, the 1,329 non-metropolitan hospitals that were in single-hospital communities (defined as the only hospital in its county) had lower costs on average than did the 922 non-metropolitan hospitals that were not located in single-hospital communities–averaging $526 per inpatient-day equivalent versus $587 per inpatient-day equivalent, respectively, or 10 percent lower.

The clear pattern emerging from these descriptive results is that, among non-metropolitan hospitals, greater rurality is associated with 10-30 percent lower hospital costs per day. Of course, this is before controlling for factors other than location that influence hospital costs, and thus cannot be taken as definitive.

Table 2 presents a comparison of mean values of the independent variables for (1) urban versus rural hospitals and (2) hospitals in single-hospital communities versus hospitals in multiple-hospital communities.[3] The comparisons of the various independent variables contained in Table 2 yield differences in the expected directions. For example, non-metropolitan hospitals in urban areas are larger (more discharges, outpatient visits, and beds) than hospitals in rural areas. Similarly, non-metropolitan hospitals located in single-hospital communities are smaller (fewer discharges, visits, and beds) than those non-metropolitan hospitals located in counties with multiple facilities.

Multivariate Results

The cost comparisons in Table 2 do not control for the effects of the various independent variables, nor do the comparisons among the independent variables indicate whether the observed differences in the independent variables have an influence on observed differences in costs. To address these issues, multivariate analyses were examined.

Separate initial regression analyses using the independent variables defined in Table 1 plus an additive dummy variable representing each of our four dichotomies of non-metropolitan hospitals (urban versus rural, adjacent versus non-adjacent, isolated rural versus non-isolated, and single-hospital communities versus multiple-hospital communities) revealed that isolated rural hospitals (county code 9) had lower costs ($\alpha = 0.05$) than their non-isolated counterparts. By contrast, we were unable to detect a statistically significant difference in costs per day between non-metropolitan hospitals in (1) urban versus rural counties, (2) adjacent versus non-adjacent counties, and (3) single-hospital communities versus multiple-hospital communities.

Although dichotomous urban-rural variables are often used in health services research, such a restriction is not necessary in the present case given the 10 detailed county codes (0-9) previously defined. To determine whether finer distinctions in costs could be detected, we regressed costs per day against the independent variables defined in Table 1 plus five county dummies based on the non-metropolitan county codes previously defined. The six non-metropolitan county codes (4-9) were each assigned a dummy variable, and county code 4 (adjacent counties with 20,000 or more urban population) was omitted as a reference group.

We were unable to detect any differences in costs per day between county code 4 and county codes 5, 6, 7, and 8. However, county code 9 (completely rural, non-adjacent counties with fewer than 2,500 urban residents) did emerge as having lower costs per day ($p < 0.01$) than county code 4, after controlling for other factors that influence costs.

However, these initial results changed when we used the location dummies in a covariance analysis, i.e., when we allowed not only the regression intercepts, but also the independent variable regression coefficients to vary by location. In these more general models, only the single-hospital community-multiple-hospital community comparison yielded a significant difference in the level of costs. For the other three non-metropolitan dichotomies, we were unable to detect any differences in the levels of costs between different areas in the covariance models.

Table 3 presents the separate ordinary least squares (OLS) results for single-hospital communities and multiple-hospital communities. The difference in the intercepts is

[3] The means for the other groupings of non-metropolitan hospitals (based on adjacency and isolated rurality) are omitted from the text for reasons of brevity. These results are available from the authors upon request.

Table 3

Non-Metropolitan Regression Results: Single-Hospital Communities Versus Multiple-Hospital Communities

Variable	Single-Hospital Communities	Multiple-Hospital Communities
Intercept	**3.480870	**5.475958
	(7.764)	(8.586)
Case-Mix Index	**0.569448	**0.629855
	(6.082)	(6.211)
Swing-Bed Percent	**-0.639973	**-0.452084
	(-10.374)	(-6.215)
Discharges	**-0.000156	**-0.000196
	(-6.271)	(-6.697)
$Discharges^2$	**1.6005611E-8	**2.2406937E-8
	(5.074)	(5.638)
$Discharges^3$	**-4.74676E-13	**-8.02585E-13
	(-4.480)	(-5.019)
Visits	*0.000003927	0.000001705
	(2.401)	(1.188)
$Visits^2$	-2.52971E-11	-1.74958E-11
	(-1.245)	(-1.351)
$Visits^3$	2.752206E-17	4.590861E-17
	(0.406)	(1.509)
Average Length of Stay	**-0.059930	**-0.067126
	(-46.199)	(-36.694)
Average Length of $Stay^2$	**0.000421	**0.000547
	(30.061)	(23.214)
Average Length of $Stay^3$	**-0.000000772	**-0.000001107
	(-23.941)	(-19.672)
Acute Beds	0.000693	0.000282
	(1.268)	(0.490)
Intensive-Care Unit Beds	0.002841	*0.004391
	(1.279)	(2.395)
Percent of Medical Staff in Primary Care	*-0.083534	**-0.162999
	(-2.230)	(-3.563)
Percent of Medical Staff Board-Certified	-0.049367	**-0.140639
	(-1.442)	(-3.185)
Health Maintenance Organization Contract	0.015005	-0.012337
	(0.660)	(-0.525)
Preferred Provider Organization Contract	0.000029480	**0.071340
	(0.002)	(3.393)
Herfindahl-Hirschmann Index	-0.000001609	*0.000013967
	(-0.476)	(2.324)
Average Wage	**0.000021063	**0.000025503
	(9.991)	(13.461)

Variable	Single-Hospital Communities	Multiple-Hospital Communities
Alcohol Unit	0.001054	0.040267
	(0.035)	(1.351)
Birthing Services	0.029584	0.027655
	(1.481)	(1.176)
Catheterization Laboratory	0.058212	**0.123368
	(1.321)	(3.249)
Emergency Department	0.020609	0.027330
	(0.508)	(0.631)
Computerized Axial Tomography Scanner	-0.005822	0.006857
	(-0.251)	(0.241)
Magnetic Resonance Imaging Unit	0.039102	0.007240
	(1.224)	(0.227)
Ultrasound	0.016666	0.009539
	(0.700)	(0.344)
Outpatient Surgery	**-0.133848	**-0.201533
	(-3.502)	(-3.853)
Physical Therapy Services	-0.014380	-0.001775
	(-0.683)	(-0.066)
Council of Teaching Hospitals	1.027124	0.158464
	(0.172)	(0.696)
Medical School Affiliation	-0.179752	-0.035711
	(-1.614)	(-0.549)
Government-Owned	0.024491	0.027204
	(1.394)	(1.221)
For-Profit	**1.067090	0.036872
	(5.328)	(0.192)
Bed Size < 100	**0.118204	0.046642
	(4.060)	(1.388)
Per Capita Income (Log)	**0.241226	0.039407
	(5.157)	(0.581)
Contract-Managed	-0.012059	0.003073
	(-0.607)	(0.128)
Joint Commission on Accreditation of Healthcare Organizations	0.027033	*0.058572
	(1.178)	(2.055)
F	164	147
Total Number	1,172	1,961
Adjusted R^2	0.834	0.845

*Statistically significant at the 0.05 level.

**Statistically significant at the 0.01 level.

NOTES: Numbers in parentheses are t-statistics. $Discharges^2$ is total facility discharges squared; $Discharges^3$ is total facility discharges cubed.

SOURCE: Vogel, W.B., and Miller, M.K., University of Florida, 1995.

statistically significant at the 0.01 level and indicates that hospitals located in single-hospital communities have lower costs than hospitals in multiple-hospital communities, after controlling for the location-specific effects of the independent variables.

Moving to the impact of market concentration on hospital costs, the focus shifts from non-metropolitan hospitals exclusively to all hospitals (metropolitan and non-metropolitan) in our sample. Table 4 presents the results of OLS estimation of the empirical model using all hospitals (metropolitan and non-metropolitan). Two sets of results are presented: metropolitan-non-metropolitan (county codes ≤ 3/county codes ≥ 4) and urban-rural (county codes ≤7/county codes ≥8).[4]

In general, the metropolitan-non-metropolitan and urban-rural results show similar patterns of signs and levels of statistical significance. However, the most interesting result in Table 4 is the statistically significant difference between the metropolitan-non-metropolitan and urban-rural coefficients on the HHI. The significant negative coefficient in the metropolitan equation indicates that as market concentration increases, costs decrease. This is consistent with the notion of cost-increasing quality competition among hospitals and has been widely noted in the literature, as previously discussed. However, the non-metropolitan results fail to exhibit a significant index coefficient, indicating that we are unable to reject the null hypothesis of no effect of market concentration on hospital average costs. The urban-rural results are similar, with urban hospital markets exhibiting the classic cost-increasing competition observed previously. Once again, however, hospitals in rural markets fail to exhibit any relationship between market concentration and hospital average costs.

[4] Note that in contrast to the previous results, here metropolitan hospitals are included in our sample.

The above regressions only provide a limited test of our theoretical model. The comparative static results presented in the Technical Note are of limited usefulness in obtaining unambiguous empirical predictions for two reasons. First, there exists some unresolvable ambiguity of the impact of exogenous changes in costs on the observed level of costs. Second, and more importantly, it is typically very difficult to classify the independent variables into separate demand-shifter and cost-shifter categories. Most of the independent variables commonly used in hospital cost analyses (such as teaching status, for-profit status, and service availability) likely affect both the type of patient (and thus demand) as well as operating efficiency (and thus costs). For the present model, only those variables that are thought to influence demand directly while not influencing costs directly yield unambiguous empirical predictions. Only one variable used in our empirical work, per capita income, falls into this category, with the demand for health care being positively related to income. In a majority of the regression results presented here, per capita income exhibits a positive effect on hospital average costs, as predicted by our theoretical model.

DISCUSSION AND CONCLUSION

Several interesting results emerge from the analyses presented in this article:

- Among non-metropolitan hospitals, cost differences by degree of rurality are largely explained by the effects of the independent variables in the cost regression. Only in the case of single-hospital communities versus multiple-hospital communities does there remain a difference in costs after adjusting for the effects of the independent variables, with hospitals located in single-hospital

Table 4

Total Cost Regression Results: All Hospitals, Metropolitan-Non-Metropolitan, and Urban-Rural Comparisons

Variable	Metropolitan	Non-Metropolitan	Urban	Rural
Intercept	**4.960006 (19.595)	**3.996555 (11.212)	**4.206226 (19.725)	**4.735329 (6.341)
Rural Dummy	—	-0.021837 (-1.171)	—	—
Case-Mix Index	**0.532538 (18.054)	**0.581012 (8.631)	**0.577143 (19.715)	*0.346166 (2.106)
Swing-Bed Percent	**-0.574961 (-3.991)	**-0.555603 (-12.027)	**-0.533349 (-11.447)	**-0.591609 (-7.183)
Discharges	**-0.000032689 (-7.632)	**-0.000153 (-8.590)	**-0.0000339 (-7.939)	**-0.001170 (-7.314)
Discharges^2	**8.700075E-10 (4.594)	**1.5512322E-8 (6.999)	**8.31E-10 (4.304)	**.000000542 (5.890)
Discharges^3	**-6.94973E-15 (-2.769)	**-4.86785E-13 (-6.148)	*-6.7382E-15 (-2.552)	**-7.159E-11 (-5.206)
Visits	7.385761E-8 (0.557)	*0.000001797 (2.241)	0.000000215 (1.557)	0.000004540 (0.737)
Visits^2	8.345143E-15 (0.035)	-9.93657E-12 (-1.719)	-2.10528E-13 (-0.836)	-1.26608E-10 (-0.664)
Visits^3	6.531137E-21 (0.075)	1.177497E-17 (1.350)	8.07605E-20 (0.851)	1.206588E-15 (0.876)
Average Length of Stay	**-0.056223 (-43.092)	**-0.061268 (-59.672)	**-0.061191 (-70.289)	**-0.062691 (-30.715)
Average Length of Stay^2	**0.000334 (27.864)	**0.000448 (38.259)	**0.000404 (42.427)	**0.000518 (18.746)
Average Length of Stay^3	**-0.000000520 (-21.385)	**-0.000000848 (-31.035)	**.000000689 (-33.062)	**-.00000123 (-14.355)
Acute Beds	0.000023551 (0.252)	0.000525 (1.363)	0.000107 (1.059)	0.002854 (1.809)
Intensive-Care Unit Beds	**0.000967 (4.223)	*0.002996 (2.164)	**0.001179 (4.687)	0.006433 (0.594)
Percent of Medical Staff in Primary Care	**-0.196080 (-4.847)	**-0.110967 (-3.901)	**-0.149151 (-6.027)	-0.069043 (-1.306)
Percent of Medical Staff Board-Certified	-0.005472 (-0.154)	**-0.081505 (-3.065)	-0.025376 (-1.085)	-0.068769 (-1.435)
Health Maintenance Organization Contract	**-0.033277 (-2.706)	-0.003033 (-0.189)	0.000453 (0.045)	-0.040039 (-0.860)
Preferred Provider Organization Contract	**0.067675 (5.322)	*0.033012 (2.396)	**0.045471 (4.715)	0.048321 (1.292)
Herfindahl-Hirschmann Index	**-0.000013557 (-5.215)	-0.000000140 (-0.057)	**-0.0000078 (-4.460)	0.000002886 (0.460)
Average Wage	**0.000014574 (23.323)	**0.000023348 (16.840)	**.0000163 (25.861)	**.000028079 (11.039)
Alcohol Unit	*-0.020408 (-2.029)	0.016127 (0.772)	-0.010418 (-1.067)	0.072248 (0.808)
Birthing Services	0.010888 (0.987)	0.022510 (1.509)	0.001234 (0.132)	-0.033435 (-1.039)
Catheterization Laboratory	**0.079903 (6.373)	**0.109051 (3.871)	**0.096273 (7.902)	-0.188794 (-0.682)
Emergency Department	**-0.090530 (-3.950)	0.009513 (0.327)	**-0.062967 (-3.292)	*0.133445 (2.048)
Computerized Axial Tomagraphy Scanner	0.005775 (0.309)	-0.002550 (-0.144)	-0.021579 (-1.641)	0.003788 (0.092)

See source at end of table.

Table 4—Continued

Total Cost Regression Results: All Hospitals, Metropolitan-Non-Metropolitan, and Urban-Rural Comparisons

Variable	Metropolitan	Non-Metropolitan	Urban	Rural
Magnetic Resonance Imaging Unit	**0.047145 (4.524)	0.031221 (1.415)	**0.045106 (4.467)	-0.228458 (-1.636)
Ultrasound	*-0.050188 (-2.159)	0.010946 (0.613)	-0.000743 (-0.049)	0.014738 (0.433)
Outpatient Surgery	**0.134750 (2.887)	**-0.160205 (-5.261)	*-0.067861 (-2.307)	*-0.101281 (-2.107)
Physical Therapy Services	-0.013302 (-0.816)	-0.005849 (-0.360)	-0.015644 (-1.281)	*0.080766 (2.314)
Council of Teaching Hospitals	**0.094230 (4.846)	0.330354 (1.666)	**0.081476 (3.769)	NA
Medical School Affiliation	**0.059614 (4.585)	-0.051954 (-0.948)	**0.054674 (3.908)	NA
Government-Owned	**0.046385 (3.537)	0.024481 (1.798)	**0.033187 (3.379)	-0.009530 (-0.293)
For-Profit	**0.097470 (2.788)	**0.522949 (3.819)	**0.153297 (4.086)	NA
Bed Size < 100	*0.040583 (2.422)	**0.095583 (4.414)	**0.071395 (5.290)	-0.003602 (-0.056)
Per Capita Income (Log)	**0.114051 (4.542)	**0.192669 (5.137)	**0.189463 (8.680)	0.141346 (1.880)
Contract-Managed	-0.013838 (-0.809)	-0.006286 (-0.417)	-0.007787 (-0.659)	0.021894 (0.622)
Joint Commission on Accreditation of Healthcare Organizations	-0.013730 (-0.769)	*0.037425 (2.139)	0.009755 (0.776)	*0.091778 (2.111)
F	176	278	460	87
Total Number	2,389	1,962	3,987	364
Adjusted R^2	0.725	0.840	0.810	0.887

*Statistically significant at the 0.05 level.
**Statistically significant at the 0.01 level.

NOTE: NA is not applicable.

SOURCE: Vogel, W.B., and Miller, M.K., University of Florida, 1995.

communities having lower costs than other non-metropolitan hospitals.

What are the policy implications of this finding? Our results demonstrate that urban-rural and adjacent-non-adjacent distinctions are not significant explanatory factors for variations in non-metropolitan hospital costs. Consequently, policymakers can be confident that the other factors that determine hospital costs adequately account for variations in hospital average costs between urban-rural and adjacent-non-adjacent locations. However, it does appear that hospitals located in single-hospital communities have lower costs per day than other non-metropolitan hospitals, even after accounting for numerous factors that influence hospital costs. As a result, hospital payment mechanisms that seek to tie reimbursement levels to cost levels should be cognizant of the lower costs found in hospitals located in single-hospital communities.[5]

- The effects of market concentration on costs differ across metropolitan-non-metropolitan and urban-rural markets. Hospitals in metropolitan markets

[5] Although our results indicate that urban-rural and adjacent-non-adjacent constructs do not influence costs once other variables are included, they say nothing about whether such constructs could be used as proxies for other factors that create differences in hospital costs. This interesting question is beyond the scope of this article.

demonstrate the negative relationship between costs and concentration found in previous studies (Farley, 1985; Robinson and Luft, 1985; Mardon and Buie, 1992). As market concentration increases, costs decrease, suggesting that hospitals compete against one another by cost-increasing means rather than cost-decreasing means. By contrast, non-metropolitan hospitals fail to exhibit any relationship between concentration and costs.

Based on these results, it is clear that hospitals in urban and metropolitan markets are responsible for the negative relationship between market concentration and hospital costs observed in previous studies. By contrast, hospitals in rural and non-metropolitan markets fail to exhibit cost-increasing competition. This finding suggests that policies designed to promote competition among hospitals run less risk of perverse effects in rural and non-metropolitan locations. Although there remain numerous barriers to pro-competitive policies in rural areas (inadequate provider numbers, long travel distances, and so forth), our results indicate that rural and non-metropolitan hospitals will be less likely to engage in the kind of "technological arms race" that many believe is at the heart of the cost-increasing competition observed in urban and metropolitan markets. What causes this difference between metropolitan and non-metropolitan markets? It seems doubtful that the difference is related to extensive price competition among rural and non-metropolitan hospitals. Rather, the difference may be related to reduced cost-increasing competition among rural and non-metropolitan hospitals. Differences in the organizational culture between metropolitan-non-metropolitan and urban-rural hospitals may contribute to the finding as well. In particular, hospitals in non-metropolitan and rural areas may focus more on their communities, whereas metropolitan and urban hospitals focus on their rivals, leading to the kind of technological rivalry long observed in metropolitan markets. Also, the existence of single-hospital communities in non-metropolitan areas probably reduces the incidence of such competition.

The implications of these findings for health care reform are not straightforward. An absence of cost-increasing competition in non-metropolitan markets does not necessarily imply that vigorous price competition will flourish. In our opinion, concerns about the lack of a critical competitive mass of providers in rural areas are warranted, despite our findings. Further research in an effort to identify the causes of the observed difference in the concentration-cost relationship is clearly warranted.

TECHNICAL NOTE

Consider a utility-maximizing hospital where utility, U, is a function of the quantity of services produced, q, the quality of those services, Q, and profits, π:[6]

$$\max.\ U(q,Q,\pi)$$

$$\frac{\partial U}{\partial q},\frac{\partial U}{\partial Q},\frac{\partial U}{\partial \pi}>0;\ \frac{\partial^2 U}{\partial q^2},\frac{\partial^2 U}{\partial Q^2},\frac{\partial^2 U}{\partial \pi^2}<0;\frac{\partial^2 U}{\partial q\partial \pi},\frac{\partial^2 U}{\partial q\partial Q},\frac{\partial^2 U}{\partial Q\partial \pi}>0$$

The hospital faces an inverse demand curve, P, that depends upon q, Q, and M, an exogenous shift variable:

$$P = P(q,Q;M) \quad P_q < 0,\ P_Q > 0,\ P_M > 0$$

The hospital incurs costs, C, that depend upon q, Q, and N, an exogenous shift variable:

$$C = C(q,Q;N) \quad C_q > 0,\ C_Q > 0,\ C_N > 0$$

Profits are defined as the difference between revenues and costs:

$$\pi = P(q,Q;M)q - C(q,Q;N)$$

[6] This model is quite similar to the model developed by Sloan and Steinwald (1980).

Substituting the expression for profits into the utility function and differentiating with respect to q and Q yields the following first-order conditions:

$$U_q = \frac{\partial U}{\partial q} + \frac{\partial U}{\partial \pi} \pi_q = 0$$

$$U_Q = \frac{\partial U}{\partial Q} + \frac{\partial U}{\partial \pi} \pi_Q = 0$$

These first-order conditions show that the sum of the direct marginal contribution of quantity (quality) to utility and the indirect marginal contribution of quantity (quality) to utility must equal zero.[7]

Satisfaction of the second-order conditions requires that the second principal minor of the Hessian determinant be greater than zero:

$$\begin{vmatrix} U_{qq} & U_{qQ} \\ U_{Qq} & U_{QQ} \end{vmatrix} = U_{qq}U_{QQ} - U^2_{qQ} > 0$$

Totally differentiating the first-order conditions yields:

$$U_{qq}dq + U_{qQ}dQ + U_{qM}dM + U_{qN}dN = 0$$

$$U_{Qq}dq + U_{QQ}dQ + U_{QM}dM + U_{QN}dN = 0$$

Letting $dN = 0$ and solving for dq/dM yields:

$$\frac{dq}{dM} = \frac{-U_{qM}U_{QQ} + U_{qQ}U_{QM}}{U_{qq}U_{QQ} - U^2_{qQ}} > 0$$

Similarly, the effect of a change in M on Q is:

$$\frac{dQ}{dM} = \frac{-U_{QM}U_{qq} + U_{qM}U_{Qq}}{U_{qq}U_{QQ} - U^2_{qQ}} > 0$$

Letting $dM = 0$ and solving for dq/dN and dQ/dN, we obtain:[8]

$$\frac{dq}{dN} = \frac{-U_{qN}U_{QQ} + U_{qQ}U_{QN}}{U_{qq}U_{QQ} - U^2_{qQ}} < 0$$

$$\frac{dQ}{dN} = \frac{-U_{QN}U_{qq} + U_{qN}U_{Qq}}{U_{qq}U_{QQ} - U^2_{qQ}} < 0$$

Summarizing the results previously shown, we see that dq/dM and dQ/dM are both positive, while dq/dN and dQ/dN are both negative. In other words, this model predicts that hospitals will increase their optimal quantity and quality of services in response to an exogenous increase in demand, and will decrease their optimal quantity and quality of services in response to an exogenous increase in costs.

What about the impact of changes in M and N on the level of hospital costs? The total differential of costs is:

$$dC = C_q dq + C_Q dQ + C_N dN$$

Letting $dN = 0$ and solving for dC/dM yields:

$$\frac{dC}{dM} = C_q \frac{dq}{dM} + C_Q \frac{dQ}{dM} > 0$$

Letting $dM = 0$ and solving for dC/dN yields:

$$\frac{dC}{dN} = C_q \frac{dq}{dN} + C_Q \frac{dQ}{dN} + C_N \lesseqgtr 0$$

For dC/dN, the ambiguous sign stems from the last term in the expression, C_N. For dC/dN, C_N is positive while the remainder of the expression is negative (since C_q and $C_Q > 0$, while dq/dN and $dQ/dN < 0$). This ambiguity can be resolved somewhat by recognizing that the relative contribution of C_N to dC/dN depends upon the time period under consideration. In the very short-run, q and Q can be considered fixed, leaving C_N to determine the sign of dC/dN. As we move to the short-run, q and Q may be somewhat variable, thereby increasing the ambiguity of the sign of dC/dN. Finally, in the long-run, q and

[7] Here, the indirect effect of quantity (quality) on utility is the product of the marginal contributions of: (1) quantity (quality) to profits, and (2) profits to utility. Also, satisfaction of the first-order conditions requires that the marginal profitability of both quantity and quality be less than or equal to zero.

[8] Here, $U_{qN} < 0$ and $U_{QN} < 0$. This flows from our previous assumptions and the fact that $\pi_N < 0$.

Q would be fully variable, introducing greater ambiguity into the sign of dC/dN.

For purposes of empirical prediction, however, the greater source of ambiguity lies in classifying independent variables as components of M or N, or both. Many of the independent variables in most hospital cost analyses arguably belong in both M and N, yielding unavoidable ambiguity in determining the net effect of the variable on costs. As a result, the effects of the various elements of M and N on costs are more empirical than theoretical questions.

REFERENCES

American Hospital Association: *Documentation for 1992 Data: Annual Survey of Hospitals Database.* Chicago. 1992.

Berndt, E.R, and Christensen, L.: The Translog Function and the Substitution of Equipment, Structures, and Labor in U.S. Manufacturing. *Journal of Econometrics* 1:81-114, 1972.

Breyer, F.: The Specification of a Hospital Cost Function: A Comment on the Recent Literature. *Journal of Health Economics* 6:147-157, 1987.

Bureau of Health Professions: *User Documentation for the Area Resource File.* Health Resources and Services Administration. Rockville, MD. 1993.

Butler, M.A.: *Rural-Urban Continuum Codes for Metro and Nonmetro Counties.* AGES 9028. Washington. U.S. Department of Agriculture, April 1990.

Carey, K.: Cost Allocation Patterns Between Hospital Inpatient and Outpatient Departments. *Health Services Research* 29(3):275-291, 1994.

Cowing, T.G., Holtmann, A.G., and Powers, S.: Hospital Cost Analysis: A Survey and Evaluation of Recent Studies. In Scheffler, R., and Rossiter, L., eds.: *Advances in Health Economics and Health Services Research* 4:257-303, 1983.

Farley, D.E.: *Competition Among Hospitals: Market Structure and Its Relation to Utilization, Costs and Financial Position.* Research Note 7, Hospital Studies Program. DHHS Pub. No. (PHS)85-3353. National Center for Health Services Research and Health Care Technology Assessment, U.S. Department of Health and Human Services. Washington. U.S. Government Printing Office, 1985.

Garnick, D.W., Luft, H.S., Robinson, J.C., and Tetrault, J.: Appropriate Measures of Hospital Market Areas. *Health Services Research* 22(1):69-89, 1987.

Granneman, T.W., Brown, R.S., and Pauly, M.V.: Estimating Hospital Costs: A Multiple-Output Approach. *Journal of Health Economics* 5:107-127, 1986.

Hendricks, A., and Cromwell, J.: Are Rural Referral Centers as Costly as Urban Hospitals? *Health Services Research* 24(3):289-309, 1989.

Joskow, P.L.: The Effects of Competition and Regulation on Hospital Bed Supply and the Reservation Quality of the Hospital. *Bell Journal of Economics* 11(2):421-447, 1980.

Mardon, R., and Buie, F.: *Dimensions of Local Competition in Florida 1984-1990.* Tallahassee, FL: Agency for Health Care Administration, 1992.

Melnick, G.A., and Zwanziger, J.: Hospital Behavior Under Competition and Cost-Containment Policies, The California Experience, 1980 to 1985. *Journal of the American Medical Association* 260(18):2669-2675, 1988.

Melnick, G.A., Zwanziger, J., Bamezai, A., and Pattison, R.: The Effects of Market Structure and Bargaining Position on Hospital Prices. *Journal of Health Economics* 11(3):217-234, 1992.

Mick, S.S., and Morlock, L.: America's Rural Hospitals: A Selective Review of 1980s Research. *The Journal of Rural Health* 6(4):437-466, 1990.

Miller, M.K., Farmer, F.L., and Clarke, L.L.: Rural Populations and Their Health. In Beaulieu, J.E., and Berry, D.E., eds.: *Rural Health Services: A Management Perspective.* Ann Arbor. AUPHA Press/Health Administration Press, 1994.

Moscovice, I.S.: Rural Hospitals: A Literature Synthesis and Health Services Research Agenda. *Health Services Research* 23(6):891-930, 1989.

Robinson, J.C., and Luft, H.S.: The Impact of Hospital Market Structure on Patient Volume, Average Length of Stay, and the Cost of Care. *Journal of Health Economics* 4:333-356, 1985.

Scherer, F.M.: *Industrial Market Structure and Economic Performance.* 2nd edition. Chicago. Rand-McNally College Publishing, 1980.

Sloan, F., and Steinwald, B.: *Insurance, Regulation, and Hospital Costs.* Lexington, MA. Lexington Books, 1980.

Zwanziger, J., and Melnick, G.A.: The Effects of Hospital Competition and the Medicare PPS Program on Hospital Cost Behavior in California. *Journal of Health Economics* 7:301-320, 1988.

Zwanziger, J., Melnick, G.A., and Bamerzai, A.: Costs and Price Competition in California Hospitals, 1980-1990. *Health Affairs* 13(4):118-126, 1994.

Reprint Requests: W. Bruce Vogel, Ph.D., University of Florida, College of Health Related Professions, P.O. Box 100195, Gainesville, Florida 32610-0195.