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THE IMPACT OF HOSPITAL MARKET STRUCTURE ON PATIENT VOLUME, AVERAGE LENGTH OF STAY, AND THE COST OF CARE*

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A variety of recent proposals rely heavily on market forces as a means of controlling hospital cost inflation. Sceptics argue, however, that increased competition might lead to cost-increasing acquisitions of specialized clinical services and other forms of non-price competition as means of attracting physicians and patients. Using data from hospitals in 1972 we analyzed the impact of market structure on average hospital costs, measured in terms of both cost per patient and cost per patient day. Under the retrospective reimbursement system in place at the time, hospitals in more competitive environments exhibited significantly higher costs of production than did those in less competitive environments.

1. Introduction

Continuing high inflation rates and the only modest impact of regulatory interventions have spurred policy changes designed to increase the role of market forces in the hospital care sector. This paper analyzes how average cost per patient and cost per patient day in individual hospitals are influenced by the local market structure, both directly and indirectly via their effects on patient volume.

We begin with a brief discussion of market structure and hospital behavior, followed by a survey of empirical studies of hospital cost functions. Equations are then specified detailing the manner in which hospital market structure is hypothesized to influence key characteristics of individual facilities: inpatient admissions, outpatient visits, average length of stay, and average cost, measured in terms of cost per patient and cost per patient day.

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We then present the data to be used in the analysis. Econometric results are discussed in the fourth section, and a final section briefly summarizes the principal arguments and findings.

2. Theory and literature review

2.1. Cost-increasing competition between hospitals

The supply side of the hospital care market in the United States is characterized by the presence of two distinct but mutually dependent agents, the hospital and the community-based physician. While hospitals obtain some of their patients directly through emergency rooms and ambulatory care clinics, the majority are admitted by community-based physicians affiliated with the institution. The hospital allows its physicians to use the institution's facilities at little direct cost to the physician (although some commitment of time for committee work, etc. is expected) in return for the right to directly bill patients for the services delivered in the hospital. The hospital is dependent on its affiliated physicians for clients; conversely, the physicians are dependent on the hospital for those types of services the physicians cannot profitably or conveniently provide in their own offices.

The hospital itself is a collection of interrelated services that include hotel-type accommodations and a variety of clinical services such as blood banks, diagnostic equipment, operating rooms, etc. While all hospitals maintain the most basic of services, considerable variation exists in the availability of more specialized services. Which particular services are offered will depend in part on the relative decisionmaking power held by affiliated physicians compared to the hospital administration. In general, physicians will want more and better clinical services than will the hospital, since they reap benefits from service availability while paying little of the costs of service acquisition. Patient preferences between competing hospitals will also be influenced by the availability of various services and amenities, although these need not always be those most important to the physicians. The hospital administration, on the other hand, must weigh the benefits of a proposed service against the costs of that service.

The availability of clinical services directly influences the cost of care in the hospital. Many clinical services have high fixed costs that must be factored into daily charges. A hospital that acquires a service without having a large volume of patients to use it will manifest higher average costs than a similar hospital that decided to contract with a neighboring institution for the service. Even if utilized at full capacity, an additional clinical service may raise the cost of care at a hospital if it simply adds new procedures for given patient diagnoses rather than substituting for previously used procedures. Such new procedures may enhance the quality of care or may simply increase costs without increasing quality. Held and Pauly (1983) and Joskow

(1983) emphasize the role in non-price competition played by 'amenities' attractive to patients, which may or may not provide any clinical benefits.

The relative dominance of administration and affiliated physicians in the hospital decisionmaking structure will depend on the supply of physicians in the community and the structure of the local hospital market. In an area with many hospitals, physicians affiliated with one institution may implicitly or explicitly threaten to shift their patients elsewhere if the desired clinical services are not made available. The physicians' 'exit' threat [Hirschman (1970)] may be institutionalized through affiliations with more than one hospital, but need not be. Physician bargaining power may also be expressed through institutionalized 'voice' in the decisionmaking process, such as through membership in the hospital's board of directors. The hospital administration's bargaining power is in turn strengthened to the extent there exists a large supply of community-based physicians relative to the number of hospitals in the area.

The structures of the local physician and hospital markets thus are expected to exert an important influence over the distribution of clinical services, the volume of patients using the services of each hospital, and the average costs of providing care in those hospitals. Holding constant the supply of physicians, it is hypothesized that hospitals in more competitive hospital markets have weaker bargaining power and hence greater duplication of services, lower patient volumes per service, and higher costs. They may respond to lower patient volumes by increasing the average length of patient stay in the hospital. A study by the authors [Luft et al. (1985)] finds that the availability of 29 specialized clinical services across hospitals is strongly influenced by market structure.

Developments over the past few years have increased the level of price-consciousness on the part of consumers and insurance providers. Hospitals have in turn responded through various forms of price competition. Non-price competition continues to play a strong role, however, and it will be an interesting empirical question in the coming decade to examine the relative importance of cost-increasing and price-decreasing forms of competition. The hypothesis under examination in this paper is that, under traditional retrospective cost and charge-based forms of reimbursement, competition contributed to higher rather than lower costs of production in the hospital sector.

2.2. *Extending the analysis of hospital cost functions*

Econometric studies of hospital cost functions have proliferated over the past two decades in response to the continuing inflation in hospital costs and the changing menu of prescriptions for cost containment. Building upon a central core of explanatory variables, each new wave of studies has proceeded by adding a new group of measures designed to capture the influence of a hypothesized set of determinants of hospital costs. This study will proceed in an analogous fashion, combining variables describing the local hospital market structure with variables describing the individual hospital and demographic characteristics of its environment.

The earliest set of hospital cost studies considered the hypothesis that the substantial variation in average costs across hospitals was due to divergences from an optimal scale of production. As reviewed by Mann and Yett (1968) and Hefty (1969), these studies concluded that some returns to scale existed within the usual range of hospital size, but that occupancy rates were of crucial importance, since short-run marginal costs fall significantly below average costs.

A second generation of studies devoted itself to distinguishing between the contributions to hospital cost inflation of increases in factor prices versus increases in 'quality' or intensity of input utilization for any given diagnosis. The emphasis on increases in quality or intensity stems in large part from the work of Feldstein (1974a, 1977) and led to the inclusion of variables describing the extent of health insurance coverage in the local population, as well as variables for case mix that describe 'product' differences among hospitals [Feldstein (1967, 1974b), Lave and Lave (1970), Watts and Klastorin (1980)]. Ratios of community-based practitioners to area population have been included for similar purposes under the assumption that doctors are not perfect agents for patients but maintain high hospital utilization rates to achieve higher incomes [Salkever (1972), Davis (1973)]. Studies of input price changes as an explanation for hospital cost inflation have focused on wage rates and the spread of unionization in the hospital industry [Salkever (1975, 1982), Adamache and Sloan (1982)].

Economic studies of industrial organization have traditionally taken a 'black box' approach, ignoring the internal organization of production within the firm under the assumption that competition would limit variation so that the observed structures are the most efficient. In the absence of such competition, however, a wide variation in organizational structures could exist and might explain a significant proportion of the variation in hospital costs. Interest in the internal organization of hospitals also came from those who emphasize the dominance of physicians in hospital decision-making [Pauly and Redisch (1973)] or conflict between physicians and administrators [Harris (1977)], as well as from policies designed to intervene directly in hospital and physician decision-making through PSROs, certificate of need, etc. Pauly (1978) and Sloan and Becker (1981) introduce a wide variety of variables describing the internal structure of hospital organization and characteristics of affiliated physicians into hospital cost functions.

The most recent set of hospital cost studies has responded to the spurt of regulatory interventions during the late 1970s by introducing a variety of regulatory initiative measures at the state level into hospital cost functions [Salkever and Bice (1976), Sloan and Steinwald (1980, Sloan (1981)]. The finding of only meager results attributable to regulatory interventions has contributed to the growth of interest in market-oriented strategies for cost-containment.

3. Econometric specification and data sources

The foregoing discussion suggests that the variation in costs across hospitals at one point in time is due primarily to differences in market structure, institutional size and capacity utilization, case mix, input costs, the internal organization of the hospital, and regulatory programs in force. This study uses data on average cost per patient admission and average cost per patient day from 5013 U.S. community hospitals as reported in the 1972 'Annual Survey of the American Hospital Association' (AHA). The AHA survey also contains information on a wide variety of other hospital characteristics, including bed size, admissions, length of stay, outpatient visits, births, intern and resident staff, medical school affiliation, ownership, and geographic location. Characteristics of the local area such as earnings and median income levels, population density, inpatient hospital days per 1000 county residents, and physician supply are obtained from the Area Resource File. Diagnosis-specific information on case mix is obtained for a subset of 1084 hospitals from the Commission on Professional and Hospital Activities (CPHA).

3.1. Measures of market structure

Hospital neighborhoods are identified as follows. Each hospital is located in terms of latitude and longitude by matching the ZIP code of each of the short-term general hospitals in the nation to the latitude and longitude of the main post office for each ZIP code [Luft and Fox (1983)].[1] A set of variables is constructed utilizing the number of neighboring hospitals within a 15-mile radius. The underlying reasoning is that active competition between two hospitals for the allegiance of a physician requires multiple medical staff appointments and, therefore, an ability to shift admitting patterns between the two institutions. The limiting factor is not the patient's willingness to travel, but the physician's reluctance to see patients on a daily basis in distant hospitals. Physical distance is employed as a proxy for travel time. The number of hospital neighbors is used in the form of dummy variables for

[1]Obviously, few hospitals are located in the same spot as the post office for their ZIP code. A preliminary analysis comparing post office location and actual location derived from detailed maps indicates that essentially identical results are obtained using the two methods

one neighbor, two to four neighbors, five to ten neighbors, and more than ten neighbors within 15 miles, with no neighbors as the reference point.[2]

To control for physician supply, we include the number of physicians per 1000 residents in the county in which the hospital is located. Population (in 1000s) per square mile in the county is also included. Holding constant the number of physicians in the county, more densely populated areas are assumed to have shorter travel times and hence be more competitive. Population density is of course also correlated with the cost of living. Other variables are included, however, that more directly pick up the effects of urban and rural differences in both input costs and consumer demand for services.

3.2. Measures of case mix

It is very difficult to adequately control for differences between hospitals in the severity mix of their patient populations, as the difficulties encountered by prospective reimbursement programs have proven. The AHA survey includes a number of variables highly correlated with case mix, including number of beds in the hospital, number of interns and residents, annual number of births, ownership, and whether the institution is affiliated with a medical school. These characteristics are used in the form of four bed size categories (100–199 beds, 200–299 beds, 300–399 beds, 400+ beds, with the smallest size category excluded as reference point), the ratio of housestaff to hospital beds, annual births, dichotomous variables for public and for-profit ownership (with private not-for-profit status as reference category), and a dichotomous variable taking the value of one if the institution is affiliated with a medical school and zero if not.

In order to test the extent to which these AHA variables pick up all significant case mix differences, we also use diagnosis-specific case mix information for the 1084 hospitals whose patient records are abstracted by the CPHA. This information is used in the form of 17 variables giving the percentage of discharges in 1972 that were accounted for by each of 17 primary diagnoses or surgical procedures. These 17 categories plus births account for 23 percent of all admissions in 1972 for the hospitals in question. The 17 primary categories include diagnoses and procedures that cover a wide range of severity and resource intensity. They are abdominal aortic aneurysm, acute myocardial infarction, cirrhosis, fracture of the femur, peptic ulcer disease, respiratory distress syndrome, subarachnoid hemorrhage, cardiac catheterization or angiography, appendectomy, coronary artery bypass

[2]While the sample used in the regression analyses consists of only those hospitals responding to all questions on the AHA survey, hospital neighborhoods are constructed using all the nation's hospitals, and thus provide a good measure of market structure.

graft, cholecystectomy, hernia repair, hysterectomy, intestinal operations, stomach operations, total hip replacement, and transurethral prostatectomy.

One other variable is used to measure the effects of county-wide differences in case mix, the ratio of inpatient days in all hospitals in the county to the county population (in 1000s). To the extent high values on this variable reflect patient referrals from other counties, one would expect it to be positively associated with case mix severity and hence costs. To the extent high values on this variable reflect higher utilization of inpatient services by the resident population, it may reflect either high epidemiological need for care or the tendency of the community's physicians to hospitalize less severe cases. In this situation the variable might be positively or negatively associated with case mix severity and costs.

3.3. Institutional size and capacity utilization

The early cost function studies focused on hospital size and occupancy rates as measures of potential economies of scale. This study employs the four bed size categories discussed above as a measure of scale efficiencies. Annual admissions per year and average length of stay are used as measures of capacity utilization. Disaggregation of the occupancy rate into admissions and length of stay is important in light of the different effects these two variables are expected to have on the two central dependent variables, average cost per admission and average cost per patient day. Hospitals with long average lengths of patient stay will report high costs per admission but may achieve low costs per patient day, since the high costs incurred in the first days after admission are spread out over a greater number of subsequent inpatient days. Holding constant number of beds and average length of stay, hospitals with more admissions have higher occupancy rates. This allows fixed costs to be spread over a larger number of patients and should be negatively associated with costs per admission and per day. The available data do not allow one to separate costs associated with inpatient care from costs associated with outpatient visits. To control for differences between hospitals in ambulatory service utilization, we include the annual number of outpatient visits as an additional independent variable.

Numbers of admissions, outpatient visits, and average length of stay may not be treated as exogenous in a study of the influence of market structure on hospital costs, however. Rates of admission, outpatient visits, and length of stay are choice variables for the hospital administration to the extent the administration can influence the practice patterns of the staff physicians. Hospitals under competitive pressure from neighboring institutions may seek to extend the average length of patient stay as a means of achieving target occupancy rates. This can be done administratively by admitting patients for diagnostic tests that could be done on an outpatient basis, admitting surgical patients on Friday although operating rooms are not used over the weekend, etc. Under traditional cost- and charge-based reimbursement methods, hospitals were not penalized for such practices. Under prospective reimbursement methods such as Medicare's Diagnostic Related Groups system, hospitals are severely penalized for extra long lengths of stay. New incentives are created, however, to discharge patients early and then readmit them as new cases eligible for additional reimbursements or treat them as outpatients on a continuing basis.

In order to examine the influence of market structure on hospital utilization, the study employs annual number of admissions, annual number of outpatient visits, and average length of patient stay in days as additional dependent variables. Inclusion of these three variables on the right-hand side of the cost equations does not produce problems of simultaneity bias since the cost variables do not themselves enter as determinants of admissions, outpatient visits, and length of stay. Given the insensitivity of both patient and physician behavior to cost factors during the period under consideration, the equation system is recursive and may be consistently estimated using equation-by-equation ordinary least squares.

3.4. Input costs and other determinants

Hospital capital equipment is purchased in national markets and hence materials costs should not vary substantially between hospitals. Labor costs, however, do vary substantially between urban and rural areas and between different geographic regions. In the absence of hospital-specific information on wage rates, the study uses annual earnings of retail trade sector workers in the county where the hospital is located, plus median income per capita in the county. Annual earnings for manufacturing sector workers was also experimented with but was dropped from the final version of the analysis. Manufacturing earnings added little to the explanation of variance in hospital costs once the other two measures of input costs were included, and required that a number of hospitals be dropped from the analysis since they are located in counties with such a small manufacturing base that manufacturing payroll is not available. Three region variables (west, northeast, and north central, with southeast as reference category) are also employed as broad controls for differences in the cost of living. These variables also reflect, however, the poorly understood differences between regions in clinical practice styles, although this is to a large extent picked up by the length of stay variable.

Earlier versions of the analysis experimented with two commonly-used measures of the internal organization of the hospital: number of hospital departments and percentage of non-hospital based physicians (i.e., excluding pathologists and radiologists) on contract. Number of departments was strongly and positively associated with hospital costs, though this may be due to its association with case mix rather than bureaucratic structure. Physicians on contract was not systematically associated with costs. These variables were dropped from the final version of the analysis since the interpretation of their observed effects is ambiguous. Also, since these variables were obtained from the 1973 'Survey of Medical Staff Organization' (SMSO), to which not all AHA hospitals responded, use of organizational structure variables required the exclusion of over 2000 observations, in turn raising questions concerning the extent to which the remaining hospitals were representative of the universe. Exclusion of the SMSO variables did not materially influence the estimated coefficients on the other independent variables.

Studies of the effects of regulatory programs at the state level have found a mixed pattern of effects but it appears that the overall effect of regulatory interventions on costs has been small. These studies must be interpreted with caution, however, since the extent of regulatory intervention in a state may be in part influenced by the level of hospital costs there, in which case the measured influence of regulation on costs would probably be underestimated. Given the inherent difficulty in adequately specifying and measuring regulatory variables, and since regulatory programs in the time period being considered were rudimentary, no measures of regulation were used in this study.

Five equations are thus estimated for each of the two data sets: the full sample of 5103 AHA respondents, and the 1084 respondents whose patient records are abstracted by the CPHA.

$$\begin{aligned} ADMISSION = {} & a_0 + a_1\, MARKET + a_2 CASEMIX + a_3\, SCALE \\ & + a_4 INPUTCOST \\ & + U1, \end{aligned} \tag{1}$$

$$\begin{aligned} VISITS = {} & b_0 + b_1\, MARKET + b_2\, CASEMIX + b_3 SCALE \\ & + b_4\, INPUTCOST \\ & + U2, \end{aligned} \tag{2}$$

$$\begin{aligned} LOS = {} & c_0 + c_1\, MARKET + c_2\, CASEMIX + c_3 SCALE \\ & + c_4\, INPUTCOST \\ & + U3, \end{aligned} \tag{3}$$

$$\begin{aligned} COSTADMISSION = {} & d_0 + d_1\, MARKET + d_2\, CASEMIX + d_3 SCALE \\ & + d_4\, INPUTCOST + d_5\, ADMISSION + d_6\, VISITS \\ & + d_7\, LOS + U4, \end{aligned} \tag{4}$$

$$COSTDAY = e_0 + e_1\,MARKET + e_2\,CASEMIX + e_3\,SCALE + e_4\,INPUTCOST + e_5 ADMISSION + e_6\,VISITS + e_7 LOS + U5. \tag{5}$$

Here *ADMISSION*, *LOS*, *COSTADMISSION*, and *COSTDAY* are in logarithmic units. *VISTS* is in natural units since many hospitals report zero outpatient visits. *MARKET*, *CASEMIX*, *SCALE*, and *INPUTCOST* are vectors of independent variables defined earlier. The error terms are assumed to be independently and normally distributed. Table 1 presents the means and standard deviations of the dependent and independent variables used in the full AHA sample analysis and in the subsample of CPHA hospitals.

4. Econometric findings

The empirical results, presented in tables 2 through 5, support the hypothesis that the structure of the local hospital market exerts a significant influence on the behavior of individual institutions. Hospitals that enjoy monopolistic positions within their local area produce their services at significantly lower costs than hospitals in more competitive environments.

4.1. Inpatient admissions, outpatient visits, and length of stay

Table 2 presents estimated coefficients and standard errors from the admissions, outpatient visits, and average length of stay regressions using the full AHA sample. Compared to hospitals in monopolistic markets, hospitals in more competitive markets report more admissions per year even after controlling for factors such as size, teaching status, and density. Compared to isolated hospitals, those with more neighboring institutions also report more outpatient visits, but the effects are small and not statistically different from zero. Hospitals in exceptionally competitive markets, i.e., those with five or more neighbors within 15 miles, report significantly higher lengths of stay than monopolistic hospitals.

Table 3 presents results from the sample of 1084 hospitals whose patient records are abstracted by the CPHA, and thus for which the 17 case mix variables are available. As neither volume of admissions nor volume of outpatient visits is hypothesized to be influenced by case mix, the table focuses on the determinants of average length of patient stay. The first column presents estimated coefficients and standard errors using the same specification as that employed with the full AHA sample, so as to facilitate comparison with the results in table 2. The second column presents analogous estimated parameters from the regression where the 17 case mix variables have been added.

As evidenced in the second column of table 3, market structure is not

Table 1
Means and standard deviations (in parentheses) for the full AHA hospital sample and the CPHA subsample.

	AHA sample ($N=5013$)	CPHA subsample ($N=1084$)
Log cost per admission	6.42 (0.44)	6.56 (0.36)
Log cost per day	4.42 (0.40)	4.52 (0.33)
Log admissions	8.14 (1.04)	8.70 (0.83)
Outpatient visits	28.9 (59.9)	41.1 (51.5)
Log length of stay	2.00 (0.34)	2.04 (0.26)
No neighbors	0.25 (0.43)	0.16 (0.36)
1 neighbor	0.18 (0.39)	0.15 (0.35)
2–4 neighbors	0.21 (0.40)	0.23 (0.42)
5–10 neighbors	0.11 (0.32)	0.19 (0.39)
11 or more neighbors	0.25 (0.43)	0.25 (0.45)
1–99 beds	0.50 (0.50)	0.26 (0.43)
100–199 beds	0.23 (0.42)	0.26 (0.44)
200–299 beds	0.12 (0.32)	0.20 (0.40)
300–399 beds	0.07 (0.25)	0.14 (0.35)
400+ beds	0.08 (0.28)	0.14 (0.34)
Annual births in hospital	567.4 (754.8)	869.2 (826.6)
Housestaff per bed	0.02 (0.07)	0.02 (0.06)
Medical school affiliation	0.08 (0.28)	0.13 (0.33)
Private not-for-profit hospital	0.61 (0.49)	0.78 (0.42)
Public hospital	0.30 (0.46)	0.19 (0.40)
For-profit hospital	0.09 (0.29)	0.03 (0.17)
Retail worker earnings (1000s)	4.64 (0.66)	4.86 (0.52)
Median per capita income (1000s)	3.46 (0.76)	3.69 (0.71)
Physicians per 100,000 population	1.24 (1.10)	1.38 (1.00)
Population per sq. mile (1000s)	1.61 (6.60)	1.67 (5.76)
Inpatient days per 1000 population	1.36 (0.70)	1.41 (0.63)
Northeast region	0.17 (0.37)	0.20 (0.40)
North central region	0.31 (0.46)	0.40 (0.49)
Western region	0.18 (0.39)	0.17 (0.38)
Southern region	0.32 (0.47)	0.22 (0.42)

Table 2
The influence of hospital market structure on inpatient admissions, outpatient visits, and average length of stay.

	Logarithm of inpatient admissions	Number of outpatient visits (1000s)	Logarithm of average length of stay
1 neighbor	0.077[c]	2.705	0.002
	(0.023)	(2.001)	(0.013)
2–4 neighbors	0.116[c]	1.964	0.013
	(0.023)	(2.054)	(0.013)
5–10 neighbors	0.085[b]	2.318	0.030[a]
	(0.030)	(2.695)	(0.018)
11 or more neighbors	0.044	2.033	0.043[b]
	(0.031)	(2.774)	(0.018)
100–199 beds	1.02[c]	10.88[c]	0.130[c]
	(0.02)	(1.74)	(0.012)
200–299 beds	1.60[c]	27.26[c]	0.196[c]
	(0.03)	(2.35)	(0.017)
300–399 beds	1.92[c]	42.12[c]	0.269[c]
	(0.03)	(2.96)	(0.022)
400+ beds	2.31[c]	75.52[c]	0.438[c]
	(0.03)	(3.12)	(0.026)
Public hospital	−0.052[c]	7.20[c]	0.020[a]
	(0.018)	(1.58)	(0.010)
For-profit hospital	−0.075[c]	−4.60[a]	−0.091[c]
	(0.028)	(2.46)	(0.016)
Births	—	—	−0.00015[c]
			(0.00001)
Housestaff per bed	−0.063	221.25[c]	0.123
	(0.150)	(13.24)	(0.087)
Medical school affiliation	0.077[b]	18.64[c]	0.023
	(0.037)	(3.28)	(0.022)
Retail earnings (1000s)	0.266[b]	3.85[b]	−0.043[c]
	(0.017)	(1.49)	(0.010)
Income per capita (1000s)	−0.046[c]	1.66	0.013
	(0.016)	(1.43)	(0.009)
MDs per 100,000 population	0.0005	−0.024	−0.00004
	(0.0001)	(0.009)	(0.00006)
Population per sq. mile (1000s)	−0.006[c]	0.67[c]	0.0043[c]
	(0.001)	(0.13)	(0.0008)
Northeast region	−0.169[c]	11.22[c]	0.147[c]
	(0.025)	(2.20)	(0.015)
North central region	−0.156[c]	0.08	0.110[c]
	(0.020)	(1.77)	(0.012)
Western region	−0.217[c]	7.23[b]	−0.080[c]
	(0.024)	(2.12)	(0.014)
Intercept	6.39	−20.41	2.06
	(0.07)	(6.34)	(0.04)
R^2	0.76	0.42	0.21
N	5013	5013	5013

[a]Significant at 0.90 confidence level.
[b]Significant at 0.95 confidence level.
[c]Significant at 0.99 confidence level.

Table 3
Market structure and average length of stay: The sample of CPHA hospitals.

	Logarithm of average length of stay (excluding the 17 case mix variables	Logarithm of average length of stay (including the 17 case mix variables)
1 neighbor	−0.033 (0.024)	−0.032 (0.024)
2–4 neighbors	−0.026 (0.023)	−0.014 (0.023)
5–10 neighbors	−0.017 (0.026)	−0.006 (0.026)
11 or more neighbors	0.030 (0.029)	0.024 (0.029)
100–199 beds	0.098[c] (0.019)	0.089[c] (0.020)
200–299 beds	0.146[c] (0.024)	0.128[c] (0.025)
300–399 beds	0.234[c] (0.028)	0.201[c] (0.030)
400+ beds	0.366[c] (0.035)	0.324[c] (0.037)
Public hospital	0.016 (0.018)	0.009 (0.018)
For-profit hospital	−0.112[b] (0.043)	−0.106[b] (0.042)
Births	−0.00014[c] (0.00001)	−0.00011[c] (0.00001)
Housestaff per bed	0.143 (0.144)	0.070 (0.147)
Medical school affiliation	0.026 (0.026)	0.032 (0.026)
Retail earnings (1000s)	0.043[b] (0.017)	0.019 (0.020)
Income per capita (1000s)	−0.037[c] (0.019)	−0.040[b] (0.016)
MDs per 100,000 population	0.00004 (0.00010)	−0.00002 (0.00010)
Population per sq. mile (1000s)	0.004[c] (0.002)	0.004[c] (0.001)
Northeast region	0.096[c] (0.023)	0.071[c] (0.025)
North central region	0.080[c] (0.019)	0.079[c] (0.020)
Western region	−0.143[c] (0.023)	−0.130[c] (0.024)

Table 3 (continued)

	Logarithm of average length of stay (excluding the 17 case mix variables)	Logarithm of average length of stay (including the 17 case mix variables)
% Aneurysm	—	16.109 (13.518)
% Myocardial infarction	—	2.330[a] (1.181)
% Cirrhosis	—	21.877[c] (4.337)
% Fractur of femur	—	9.044 (2.837)
% Peptic ulcer	—	0.762 (0.630)
% Respiratory distress syndrome	—	−3.875 (3.160)
% Hemorrhage	—	17.954 (16.123)
% Cardiac catheterization	—	0.199 (1.564)
% Appendectomy	—	−2.773 (1.497)
% Bypass graft	—	0.931 (4.762)
% Cholecystectomy	—	−1.301 (2.004)
% Hernia repair	—	−2.059[a] (1.185)
% Hysterectomy	—	−0.370 (0.685)
% Intestinal operations	—	6.612 (4.409)
% Stomach operations	—	−1.110 (4.859)
% Hip replacement	—	−7.319[b] (0.354)
% Transurethral prostatectomy	—	−2.049 (1.328)
Intercept	1.94 (0.08)	1.96 (0.09)
R^2	0.29	0.35
N	1084	1084

[a]Significant at 0.90 confidence level.
[b]Significant at 0.95 confidence level.
[c]Significant at 0.99 confidence level.

Table 4

The influence of hospital market structure on costs: The full AHA data set.

	Logarithm of average cost per admission	Logarithm of average cost per patient day
1 neighbor	0.059[c]	0.056[c]
	(0.010)	(0.010)
2–4 neighbors	0.095[c]	0.091[c]
	(0.010)	(0.011)
5–10 neighbors	0.166[c]	0.163[c]
	(0.014)	(0.014)
11 or more neighbors	0.214[c]	0.205[c]
	(0.014)	(0.014)
Log of admissions	−0.052[c]	−0.041[c]
	(0.007)	(0.007)
Log of length of stay	0.486[c]	−0.475[c]
	(0.012)	(0.012)
Outpatients visits (1000s)	0.0007[c]	0.0007[c]
	(0.0001)	(0.0001)
100–199 beds	0.124[c]	0.114[c]
	(0.012)	(0.012)
200–299 beds	0.181[c]	0.163[c]
	(0.017)	(0.017)
300–399 beds	0.201[c]	0.179[c]
	(0.021)	(0.021)
400+ beds	0.233[c]	0.204[c]
	(0.025)	(0.025)
Public hospital	0.022[c]	0.023[c]
	(0.008)	(0.008)
For-profit hospital	−0.040[c]	−0.034[c]
	(0.013)	(0.013)
Births	−0.00005[c]	−0.000044[c]
	(0.000001)	(0.000008)
Housestaff per bed	0.933[c]	0.927[c]
	(0.070)	(0.070)
Medical school affiliation	0.100[c]	0.101[c]
	(0.017)	(0.017)
Retail earnings (1000s)	0.121[c]	0.117[c]
	(0.008)	(0.008)
Income per capita (1000s)	0.070[c]	0.071[c]
	(0.007)	(0.007)
MDs per 100,000 residents	0.00046[c]	0.00048[c]
	(0.00005)	(0.00005)
Inpatient days per 1000 population	−0.056[c]	−0.062[c]
	(0.006)	(0.006)
Population per sq. mile (1000s)	−0.0003	−0.0005
	(0.0007)	(0.0007)
Northeast region	0.104[c]	0.099[c]
	(0.012)	(0.012)
North central region	0.069[c]	0.062[c]
	(0.009)	(0.009)
Western region	0.167[c]	0.172[c]
	(0.011)	(0.011)
Intercept	4.81	4.68
	(0.07)	(0.07)
R^2	0.72	0.66
N	5013	5013

[a]Significant at 0.90 confidence level.
[b]Significant at 0.95 confidence level.
[c]Significant at 0.99 confidence level.

Table 5
Market structure and average costs: The sample of CPHA hospitals.

	Log of cost per admission (excluding case mix variables)	Log of cost per day (excluding case mix variables)	Log of cost per admission (including case mix variables)	Log of cost per day (including case mix variables)
1 neighbor	0.063[c]	0.065[c]	0.048[c]	0.050[c]
	(0.021)	(0.021)	(0.020)	(0.020)
2–4 neighbors	0.084[c]	0.084[c]	0.067[c]	0.066[c]
	(0.020)	(0.020)	(0.019)	(0.019)
5–10 neighbors	0.166[c]	0.167[c]	0.162[c]	0.163[c]
	(0.023)	(0.023)	(0.022)	(0.022)
11 or more neighbors	0.208[c]	0.206[c]	0.197[c]	0.194[c]
	(0.025)	(0.025)	(0.025)	(0.025)
Log of admissions	−0.032[a]	−0.032[c]	−0.062[c]	−0.061[c]
	(0.020)	(0.021)	(0.021)	(0.021)
Log of length of stay	0.472[c]	−0.524[c]	0.425[c]	−0.571[c]
	(0.031)	(0.031)	(0.031)	(0.031)
Outpatients visits (1000s)	0.0009[c]	0.0008[c]	0.0009[c]	0.0009[c]
	(0.0002)	(0.0002)	(0.0001)	(0.0001)
100–199 beds	0.084[c]	0.082[c]	0.063[c]	0.061[c]
	(0.024)	(0.024)	(0.023)	(0.023)
200–299 beds	0.137[c]	0.134[c]	0.101[c]	0.098[c]
	(0.034)	(0.034)	(0.033)	(0.033)
300–399 beds	0.157[c]	0.155[c]	0.116[c]	0.113[c]
	(0.041)	(0.041)	(0.040)	(0.040)
400+ beds	0.194[c]	0.192[c]	0.144[c]	0.142[c]
	(0.049)	(0.049)	(0.048)	(0.048)
Public hospital	0.013	0.016	0.017	0.019
	(0.016)	(0.016)	(0.015)	(0.015)
For-profit hospital	−0.086[b]	−0.083[b]	−0.078[b]	−0.076[c]
	(0.037)	(0.037)	(0.036)	(0.036)
Births	−0.00006[c]	−0.00006[c]	−0.00006[c]	−0.00006[c]
	(0.00001)	(0.00001)	(0.00001)	(0.00001)
Housestaff per bed	0.945[c]	0.949[c]	0.717[c]	0.720[c]
	(0.129)	(0.129)	(0.128)	(0.128)
Medical school affiliation	0.091[c]	0.093[c]	0.060[c]	0.063[c]
	(0.023)	(0.023)	(0.022)	(0.022)
Retail earnings (1000s)	0.112[c]	0.112[c]	0.094[c]	0.095[c]
	(0.017)	(0.017)	(0.017)	(0.017)
Income per capita (1000s)	0.041[c]	0.042[c]	0.035[c]	0.036[c]
	(0.014)	(0.014)	(0.014)	(0.014)
MDs per 100,000 population	0.0005[c]	0.0005[c]	0.0003[c]	0.0003[c]
	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Inpatient days per 1000	−0.050[c]	−0.049[c]	−0.046[c]	−0.045[c]
	(0.013)	(0.013)	(0.012)	(0.012)
Population per sq. mile (1000s)	−0.0021	−0.0022	−0.0003	−0.0004
	(0.0013)	(0.0013)	(0.0013)	(0.0013)
Northeast region	0.115[c]	0.115[c]	0.078[c]	0.080[c]
	(0.021)	(0.021)	(0.022)	(0.022)
North central region	0.110[c]	0.110[c]	0.091[c]	0.092[c]
	(0.017)	(0.017)	(0.017)	(0.017)
Western region	0.184[c]	0.184[c]	0.109[c]	0.110[c]
	(0.019)	(0.021)	(0.021)	(0.021)

Table 5 (continued)

	Log of cost per admission (excluding case mix variables)	Log of cost per day (excluding case mix variables)	Log of cost per admission (including case mix variables)	Log of cost per day (including case mix variables)
% Aneurysm	—	—	22.264[b]	22.787[b]
			(11.444)	(11.461)
% Myocardial infarction	—	—	−0.564	−0.482
			(1.011)	(1.012)
% Cirrhosis	—	—	14.263[c]	14.367[c]
			(3.717)	(3.723)
% Fracture of femur	—	—	1.453	1.350[b]
			(2.410)	(2.414)
% Peptic ulcer	—	—	−3.265[c]	−3.231[c]
			(0.534)	(0.535)
% Respiratory distress	—	—	7.553[c]	7.762[c]
			(2.682)	(2.686)
% Hemorrhage	—	—	26.862[b]	27.225[c]
			(13.719)	(13.739)
% Cardiac catheterization	—	—	3.959[c]	4.036[c]
			(1.324)	(1.325)
% Appendectomy	—	—	−2.452[a]	−2.317[a]
			(1.278)	(1.280)
% Bypass graft	—	—	−1.853	−1.948
			(4.028)	(4.034)
% Cholecystectomy	—	—	0.536	0.580
			(1.708)	(1.711)
% Hernia repair	—	—	−2.466[b]	−2.470[b]
			(1.008)	(1.009)
% Hysterectomy	—	—	−0.295	−0.263
			(0.582)	(0.583)
% Intestinal operations	—	—	7.652[b]	7.099[a]
			(3.734)	(3.740)
% Stomach operations	—	—	7.762[a]	7.520[a]
			(4.124)	(4.131)
% Hip replacement	—	—	2.992	3.237
			(2.850)	(2.854)
% Transurethral prostatectomy	—	—	0.967	1.025
			(1.132)	(1.134)
Intercept	4.86	4.84	5.39	5.37
	(0.19)	(0.19)	(0.20)	(0.20)
R^2	0.72	0.67	0.75	0.71
N	1084	1084	1084	1084

[a]Significant at 0.90 confidence level.
[b]Significant at 0.95 confidence level.
[c]Significant at 0.99 confidence level.

significantly associated with average length of stay when the 17 case mix variables are included in the analysis. It is not clear, however, that this difference from the results observed with the full AHA sample is due to the inclusion of the case mix variables. As is evident from the first column of table 3, length of stay is not associated with market structure in the CPHA sample even in the absence of the case mix variables. It is only possible to conclude that the relationship between market structure and average length of stay observed in table 2 is suggestive but requires further research.

Hospital characteristics influence admissions, outpatient visits, and length of stay in different ways. Affiliation with a medical school is positively associated with outpatient visits, but not with admissions or length of stay. The ratio of housestaff to beds is positively associated with outpatient visits and length of stay but not with admissions. Bed size is strongly associated with volume of admissions and outpatient visits, as one would expect, but also with average length of stay. Hospitals with a greater volume of births have shorter average lengths of patient stay. Public hospitals have fewer admissions per year than comparable voluntary hospitals, but have higher volumes of outpatient visits and longer average lengths of stay. Compared to voluntary hospitals, for-profit institutions have fewer outpatient visits and shorter average lengths of stay.

The demographic characteristics of the hospital's environment also exert strong influences on patient volume and length of stay. Population density is negatively associated with inpatient admissions but positively associated with outpatient visits and length of stay. This probably reflects lower occupancy in rural areas, controlling for hospital size. Number of physicians per 1000 county residents is negatively associated with number of outpatient visits, but the effect is small and not statistically significant. Average annual earnings for retail sector workers is positively associated with admissions and outpatient visits but negatively associated with average length of stay. Median per capita income is negatively associated with admissions and is not strongly correlated with outpatient visits and length of stay. Strong regional differences in admissions, outpatient visits, and average length of stay are observed.

4.2. Average costs per admission and per day

Coefficients and standard errors from the cost regressions are presented in table 4 for the full AHA sample. Contrary to the standard predictions of microeconomic theory, hospitals in more competitive local markets manifest significantly higher average costs per case and per day than do hospitals in less competitive areas. Other determinants of hospital costs held equal, hospitals with one neighbor report costs six percent higher than hospitals with no neighbors; those with two to four neighbors report costs nine percent higher; those with five to ten neighbors report costs 16–17 percent higher; and those with more than ten neighbors report costs 20–21 percent higher. Cost differences by market structure are very similar for both measures, cost per admission and cost per patient day.

Number of patient admissions and average length of patient stay influence costs as hypothesized. Hospitals with longer lengths of stay report higher costs per admission but lower costs per day than hospitals with shorter lengths of patient stay. Holding constant length of stay, hospitals with higher number of admissions enjoy higher occupancy rates and thus take advantage of the difference between marginal and average costs of producing hospital services. Higher numbers of annual admissions is negatively and significantly associated with both cost measures.

Hospitals with more outpatient visits have higher total costs and hence higher costs per admission and per inpatient day, since volume of outpatient services delivered is not included in the denominator of either cost measure. This coefficient does not imply that hospitals with active outpatient departments have high inpatient costs; they may in fact operate at lower average costs due to the ability to spread the fixed costs of their clinical services over a larger volume of patients. This variable was included solely to reduce the bias in the coefficients on the other independent variables resulting from the fact that the AHA hospital data do not separate out costs associated with inpatient services from those associated with outpatient services.

Large hospitals, public hospitals, those affiliated with medical schools, and those with strong teaching functions as measured by the ratio of housestaff to hospital beds have high costs per admission and per day. For-profit hospitals and those with active obstetrical departments, as measured by the annual number of births, have lower costs.

Hospitals operating in areas with high per capita income and high annual earnings for workers in retail trade report significantly higher costs than hospitals in areas with lower incomes and earnings. These coefficients reflect both higher input costs in high wage areas and higher demand in wealthy areas for technologically sophisticated and expensive clinical medicine. Holding constant the two earnings variables, population density is negatively correlated with costs.

Hospitals in areas with high physician to population ratios report significantly higher costs than hospitals in areas with fewer physicians. Under the supplier-induced demand hypothesis, one would expect areas with large numbers of physicians to have higher rates of admissions and longer lengths of stay for any given level of true epidemiological need for care. This would in turn result in higher total costs but perhaps lower costs per admission and per day, since the marginal patients are likely to be less ill and in less need of care than the average patients. Consistent with this hypothesis, hospitals in areas with high ratios of inpatient days to county population report lower costs than hospitals in areas with fewer inpatient days per 1000 population. Holding constant the inpatient days per population variable, the coefficient on physician per 1000 population probably reflects underlying income and taste factors favorable to expensive clinical medicine, factors that attract physicians to the area. The data do not support the hypothesis suggested earlier, that higher physician/population ratios would indicate weaker physician bargaining power vis-à-vis the hospital and hence a weaker imperative to accumulate unneeded clinical services. It may be the case that this variable largely reflects expansion in the number of subspecialties in an area, rather than increasing competition among subspecialists. The negative coefficient on the inpatient days per 1000 county residents does not support the hypothesis that this variable picks up a 'medical Mecca' effect of referrals of complex and costly cases from rural to urban areas. Instead, high values of this variable may be primarily due to clinical styles relying heavily on hospital admissions, and consequently be associated with a less sick case mix.

Compared to the southeast, average costs are significantly higher in the north central, northeast, and, especially, western regions. The high average cost per day in the west is understated by the inclusion of the length of stay measure as an independent variable, since hospitals in the west have particularly short lengths of stay.

4.3. Cost differences controlling for diagnostic mix

The strong and remarkable associations between market structure and average costs observed in table 4 are based on regressions that include a number of control variables correlated with case mix complexity, including bed size, ownership, teaching mission, length of stay, and number of births. Nevertheless, the suspicion remains that unmeasured differences in case mix may be causing at least part of the association ascribed to market structure. Hospitals in more competitive environments are generally in urban areas and may serve as referral centers for sicker patients in ways not picked up by the case mix proxy variables included in the analysis. In order to test this hypothesis, table 5 presents coefficients and standard errors from regressions analogous to those in table 4 but using the subsample of 1084 hospitals whose patient records are abstracted by the CPHA and hence for which case mix information is directly available. Since the CPHA hospitals are not a random sample of the universe of AHA hospitals (as evidenced in the descriptive statistics in table 1), the first two columns in table 4 present for comparison's sake cost per admission and per patient day regressions specified exactly as are those in table 4, i.e., without diagnostic mix variables. Columns three and four present regressions that do include the 17 case mix variables.

Contrary to the hypothesis that the observed correlation between market structure and average costs is due to case mix differences, the coefficients on the market structure variables from the CPHA hospitals in table 5 are very similar regardless of whether the diagnostic mix variables are included. They are also almost identical to those in table 4. Average costs per admission and per patient day increase monotonically with the number of neighboring institutions within a 15-mile radius.

The coefficients on the other independent variables that were, in table 4, hypothesized to pick up case mix differences are influenced by the addition of the diagnostic mix variables. Bed size, medical school affiliation, and the ratio of housestaff to hospital beds all play smaller roles in explaining differences in hospital costs once case mix is directly controlled for. The cost-reducing influence of high numbers of admissions increases substantially once case mix is explicitly controlled for, indicating that hospitals with high numbers of admissions also have more complex and costly case mixes.

5. Discussion and conclusions

The continuing high rate of inflation in the cost of hospital care has nourished a variety of policy options. The standard economic diagnosis of wasteful modes of production due to the weakness of market forces has made many economists hostile to the regulatory strategies attempted over the past two decades, since they are often attempts to erect barriers to entry into hospital markets. This perspective underlies the new menu of policy proposals that rely upon increased competition between hospitals to reduce costs.

An alternative perspective, which in the economic literature dates back to Arrow (1963), emphasizes the unique features of the markets for health and hospital care, particularly the role of the physician as the patient's agent, and is more cautious about prescribing standard competitive remedies. This alternative is particularly emphatic when discussing hospital care, since most admissions are heavily influenced by physicians and since price elasticities of demand for hospital service are smaller than are those for ambulatory care. This is certainly the case given the higher levels of insurance coverage for hospital services, but even with equivalent coverage, the greater uncertainty associated with hospital treatment is likely to result in a lower price elasticity. It has been argued that increased competition among hospitals for patients will take the form of inflationary increases in the technological intensity of hospital services or a 'medical arms race', rather than the form of price reductions aimed at patients.

This paper has utilized data on the characteristics of the local hospital market structure to analyze the effect of competition, or the potential for competition, on the average costs of producing care. The findings support the hypothesis that the hospital care market with a cost-based mode of reimbursement functions in a manner different from many other markets, and in particular, that greater competition is associated with higher rather than lower costs.

In analyzing policy proposals to reduce hospital cost inflation, the relevant criteria appear to be the extent to which a proposal maintains the open ended fee-for-service mode of reimbursement or replaces it with a form of capitation or other overall budget constraint, in contrast to whether it relies upon regulation or market forces. Under a fee-for-service approach, regulation appears to be ineffectual and competition counterproductive. Both may have a positive role to play under a capitation approach.

There are a wide variety of policy proposals that are often grouped together under the rubric of competition or market strategies. Some of these proposals focus on increased copayments by consumers in order to enhance their sensitivity to price [Feldstein (1971)]. Such plans would have their greatest impact on the use of ambulatory services, and perhaps the decision to hospitalize, but there would be little impact on hospital costs once patients were admitted, since the price elasticity of demand for inpatient services is small [Newhouse et al. (1981)]. Other proposals anticipate competition among organized delivery systems that would constrain the utilization of hospital care and bargain with hospitals for the efficient delivery of services [Enthoven (1978), McClure (1978)]. Such systems actually represent bilateral oligopolies and need to be studied within the context of bargaining models as well as atomistic competition theory.

A third type of competition proposal focuses on vigorous antitrust enforcement to prevent hospitals from colluding and excluding potential competitors [Havighurst (1980)]. While not a direct test of this last policy, our findings suggest that some cooperation among hospitals to avoid duplication of specialized clinical services may be socially desirable. In particular, it may be appropriate to classify hospital markets for most types of admissions as natural monopolies or oligopolies. In 1982, for example, 24 percent of hospitals had no neighboring hospitals within a 15-mile radius (700 square miles), while 62 percent of hospitals had fewer than five neighbors within that radius. This may require a hybrid of regulatory efforts to discourage predatory behavior and encourage joint ventures, and financing systems to encourage cost conscious production methods. Furthermore, the differences in hospital performance across various market areas observed in this paper suggest that the effects of any new reimbursement or regulatory scheme will depend upon local market structure.

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