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Hospital Costs and Excess Bed Capacity: A Statistical Analysis

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ABSTRACT

The present paper develops and estimates a cost model for U.S. hospitals which enables us to analyze the cost of excess bed capacity. A new estimate is worth making for at least two reasons. First, recent changes in the economic environment in which hospitals operate has caused their utilization rates in the U.S. to fall sharply over the past decade, making previous estimates inaccurate. Second, the present paper employs econometric techniques of cost estimation not previously applied to this problem, with estimation based on all U.S. short-term community hospitals from 1979 through 1989. Our results, based on conservative estimates of the average optimal occupancy rate, indicate an annual cost of excess bed capacity (in current dollars) of $13.2 billion in 1989, $18.4 billion in 1991, and over $20 billion in 1993.

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Inefficiencies arising from excess capacity have been studied by economists and public health specialists for some time. Concerns about this potential inefficiency in hospitals have spawned both research and public policies. Of the latter, the most well-known have been certificate-of-need (CON) authorities, designed to control the growth of this capacity. Economic research dating from the 1970s and early 1980s (perhaps most importantly Joskow 1980, 1981, and Schwartz and Joskow, 1980) has led to several important conclusions regarding this excess capacity.

First, there are indeed some market incentives, related to nonprice competition, which could yield excess bed capacity in hospitals. Second, there is evidence from that period of at least modest excess bed capacity in hospitals, the cost, on an annual basis, being somewhere in the neighborhood of $800 million annually. However, Joskow (1980) also cautioned that, based on the stochastic flow demand for beds on the part of patients, an occupancy rate substantially below 100% was likely to be justified in most cases. The third conclusion from studies of this period was that certificate-of-need authorities were strikingly ineffective in preventing the development of excess capacity in hospitals: CON authorities were very good at keeping out new hospitals, but they were incapable of controlling capacity expansion by existing hospitals.

In the present paper, we revisit the issue of excess capacity in hospitals because the situation has changed dramatically since it was last investigated in detail by economists. First, many of the earlier incentives to provide excess capacity have been removed. Prospective payment, both by Medicare and by private insurers, has made service quality competition among hospitals far less attractive than before. Second, the growth of health maintenance organizations (HMOs) and preferred provider organizations (PPOs) has similarly put a premium on cost-effective, efficient services on the part of hospitals. Furthermore, they have reduced the demand for inpatient services in hospitals--HMOs are well-known for utilizing inpatient services less than in fee-for-service settings, and Medicare's Prospective Payment System (PPS) has had the same goal. Undoubtedly, service quality competition in hospitals has persisted, but it has weakened. Beyond that, it appears that medical technology itself has changed so as to favor shorter hospital visits and more outpatient treatment, which further tends to reduce demand for inpatient services.

So, many incentives to provide excess bed capacity have been eliminated or weakened. Yet these very weakened incentives have in fact reduced the demand for hospital services. Hospitals, however, are very fixed, long-lasting investments. Furthermore, when local governments authorize hospitals to be established or expanded, they often do so with the expectation that the hospital will meet certain social obligations, and will not arbitrarily discontinue meeting those obligations (Schwartz and Joskow, 1980, and Anders, 1993). As a result, because of the very distinctly increased incentives to reduce hospital capacity, occupancy rates have fallen sharply over the past decade, and regulatory policies seem increasingly geared toward preventing hospital closures, rather than preventing excess capacity. Antitrust authorities have also blocked hospital consolidations, thus increasing the problem of excess capacity, though in the name of preserving competiton (Burke, 1990).

Given the changes that have occurred over the past dozen years, we believe that the issue of excess bed capacity in U.S. hospitals needs to be reexamined in economic terms. Is there currently excess capacity in U.S. hospitals, and if so, how high is the cost? Those are the issues analyzed in the present paper.

The next section summarizes in more detail the reasons why one might expect excess capacity to exist in the industry, as well as the issues among economic analysts of the hospital industry as to the costs and desirability of that excess capacity. The second section presents the development of a model of hospital costs and excess capacity, followed by a section on the data sources and variables used to estimate the parameters of this model. The fourth section discusses the estimation results and simulations, and the final section is concerned with both the conclusions and their implications, both for the economic literature on hospitals and for public policy.

I. The Dilemma of Excess Capacity in Hospitals

The pressure to close hospitals is evident from the experience of recent years. Some hospitals are having difficulty justifying their bed capacities, given their inability to fill a large portion of the beds with patients. As shown in Table 1, the number of hospital beds and the occupancy rate have both been declining, and declining substantially. The number of beds has fallen from well over 1 million in 1983 to 933,000 in 1989. Meanwhile, the occupancy rate has similarly fallen, from a high of 76% in 1981 to 65-66% in the late 1980s.

The causes of this declining hospital use are not hard to find. First, technology is changing in such a way as to reduce the demand for hospital rooms. Many illnesses and procedures which once required inpatient stays now require only outpatient treatment. For even those which require inpatient treatment, there is evidence that technological change has played an important role in reducing the average length of a hospital stay (Sloan and Valvona, 1986). Second, changing economic incentives have reenforced this technological trend. Increased competition in the marketplace for health care, plus managed care, have also had the effect of reducing hospital utilization as a response to increased costs per patient day of hospitalization. These forces include PPS in Medicare, which has provided incentives for both decreased use of inpatient care and increased use of outpatient care; managed care on the part of private insurance and Medicaid, which has had equivalent effects to prospective payment for private, non-Medicare patients; and the growth of health maintenance organizations and other prepaid plans, which have strong incentives to minimize hospitalizations.

In response to all these forces, hospitals have attempted to reduce capacity, especially in parts of the nation where demand has not been growing from population increases. These attempts have met with mostly negative responses from both local governments, which charter the hospitals, and in some cases, the physicians and administrators in control of hospitals. Finally, some economists favoring competition have opposed closures necessary to eliminate this capacity. Because hospitals are more often than not chartered as nonprofit organizations, and even when they are for-profit, they are thought of as having public obligations, local governments have been highly reluctant to allow hospital closures (see, for example, Anders, 1993).

Among economists, some of the most detailed work on excess capacity in hospitals has been done by Schwartz and Joskow (1980). Their careful, thorough work concludes that there is unlikely to be a substantial cost for the years they studied. However, since that study, the average bed utilization rate for U.S. acute-care hospitals has fallen by approximately 13-14% from 1980 to the late 1980s (see Table 1). With more excess beds now, hospital overcapacity may well impose nontrivial societal costs.

Furthermore, the more current economic literature on hospital mergers and closures is incomplete and ambiguous. For example, in summarizing the available evidence, Feldstein (1993, p. 222, footnote 2) notes that while mergers and closures of hospitals may have some benefits, these benefits are difficult to observe, given that there is little or no evidence of long-run scale economies among hospitals. However, if there is excess capacity among hospitals, long-run scale economies are not necessary to justify consolidations. If there are two hospitals, both with excess capacity (i.e., are above their long-run minimum cost curve because they have too many beds to minimize costs for the outputs they are producing), then, even without long-run increasing returns to scale, they can save substantial resources by consolidating facilities.[1] (Clearly, in a complete benefit-cost test, one should also consider what extra travel costs might exist to and from nearby facilities).

One might reasonably ask whether hospital closures are necessary to eliminate excess capacity. Of course, it is possible to close some rooms or a wing of a hospital. However, if there is a significant opportunity cost to the unused capital (as there often is in high rent, urban environments), then full resources will not be saved unless the hospital capacity is converted to an alternative use, such a school or a condominium. Closing a portion of a hospital often occurs, but it seldom happens that a single wing of a hospital is converted to, say, a condominium or school: externalities make that unlikely, and that is exactly why hospitals need to be closed to reap the full benefits of eliminating excess capacity. Such closures need not be harmful to competition. By sharing the same building, two hospitals may be able to coexist with all the benefits of consolidation of bed capacity.[2]

Some would argue that closing hospitals at a substantially more rapid rate than is occurring would be too painful and too harmful to economic competition to be a viable alternative on a large scale. However, before that can be judged, it is necessary to understand just how costly it is to maintain excess capacity at current levels. Also, as some forecast, the U.S. health care industry may be moving toward "managed competition." Under such a system, to vie for patients represented by large purchasing networks, prepaid health plans such as HMOs and PPOs would aggressively compete to provide quality care at lower cost. If there is a strong move to "managed competition," that might dramatically increase the rate at which hospital utilization falls, and thus make the capacity problem all the more urgent.

It is the aim of this paper to analyze the costs of excess bed capacity in the U.S. short-term, acute-care hospital industry, both with current health-insurance arrangements and under a "managed competition" scenario, in which hospital utilization rates are consistent with a vast majority of the U.S. population having hospitalization rates similar to those participating in health maintenance organizations.

II. Econometric Models

To determine the effect of excess capacity on hospital costs, we estimate a multiproduct cost function.[3] The long-run cost function can be written as

$$C = C(w, y, a, r, t)$$

where C represents total costs, w is a vector of factor prices, y is a vector of outputs, a is a vector of attributes, r is a vector of regulatory variables, and t is a time trend. We assume that this cost function is twice-differentiable and can be approximated by a second-order Taylor series expansion.

Among the included regulatory variables is the occupancy rate. Once the cost function is estimated, we can calculate the cost of excess bed capacity by analyzing the extent to which costs would be reduced if the occupancy rate were raised from the existing 1989 level to one closer to "optimal," based on previous studies such as that of Schwartz and Joskow (1980). Note that we do not make a distinction between excess capacity from "staffed" versus "unstaffed" beds. The reason for this is theoretically straightforward and valid: a hospital may be burdened with a particular number of beds because of the inability to close or consolidate. But it is free to vary staffing in such a way as to provide the most cost-effective service. Thus, the "staffing rate" of beds should be viewed as an endogenous one; the exogenous variable of interest is the absolute occupancy rate, because that is much more likely to be exogenously forced on the hospital. Thus, all our simulations are based on the "staffing" of beds being allowed to vary implicitly in the equations.[4]

Our econometric cost model specification is based on a flexible functional form, which imposes no a priori restrictions of the elasticities of substitution. It is behaviorally grounded in economic theory in that we assume cost minimization (with respect to everything but capacity utilization) and impose the property that cost functions must be homogeneous of degree one in factor prices. This assumption of cost minimization may seem questionable to some readers, given that many hospitals are nonprofit in nature, and, indeed, by assuming that cost-minimization with respect to capacity may be impossible, our analysis relaxes the assumption of cost-minimization more than some previous studies of hospital costs. Nevertheless, current excess capacity may be more a result of a regulatory constraint than a desire not to operate efficiently. Sloan's (1988) survey of the literature does, at least tentatively, support the assumption of cost-minimization, given that it finds nonprofit hospitals to be, overall, just as efficient as for-profit ones.

Although there are many possible choices for the functional form, we adopt the well-known translog. It is basically a second-order expansion in logarithms of the variables in the cost function. Specifically in this case, it can be written as

$$\begin{aligned}\ln C = {} & \alpha_0 + \Sigma_i\, \alpha_i \ln w_i + \Sigma_k\, \beta_k \ln y_k + \Sigma_m\, \sigma_m \ln a_m + \Sigma_p\, \mu_p\, r_p + \phi_t\, t + \\ & \tfrac{1}{2}\, \Sigma_{ij}\, \alpha_{ij} \ln w_i \ln w_j + \tfrac{1}{2}\, \Sigma_{kl}\, \beta_{kl} \ln y_k \ln y_l + \tfrac{1}{2}\, \Sigma_{mn}\, \sigma_{mn} \ln a_m \ln a_n + \\ & \tfrac{1}{2}\, \Sigma_{pq}\, \mu_{pq}\, r_p \cdot r_q + \tfrac{1}{2}\, \phi_{tt}\, t^2 + \Sigma_{ik}\, \tau_{ik} \ln w_i \ln y_k + \Sigma_{im}\, \tau_{im} \ln w_i \ln a_m + \\ & \Sigma_{ip}\, \tau_{ip} \ln w_i \cdot r_p + \Sigma_i\, \phi_{it} \ln w_i \cdot t + \Sigma_{km}\, \tau_{km} \ln y_k \ln a_m + \Sigma_{kp}\, \tau_{kp} \ln y_k \cdot r_p + \\ & \Sigma_k\, \phi_{kt} \ln y_k \cdot t + \Sigma_{mp}\, \tau_{mp} \ln a_m \cdot r_p + \Sigma_m\, \phi_{mt} \ln a_m \cdot t + \Sigma_{pt}\, \mu_{pt}\, r_p \cdot t + \epsilon \end{aligned} \qquad (1)$$

where ϵ is a disturbance term. The estimated cost function is as above except that one of the regulatory variables cannot be squared. All variables, excluding r and t, are divided by their sample mean, which serves as the base point of approximation.

Assuming cost minimization (except with respect to the occupancy rate) allows the application of Shephard's lemma, which states that the conditional factor demand, x_i is given by

$$x_i = \partial\, C \,/\, \partial\, w_i \,.$$

It is used to obtain the following cost or factor share equations.

$$s_i = \alpha_i + \Sigma_j \alpha_{ij} \ln w_j + \Sigma_k \tau_{ik} \ln y_k + \Sigma_m \tau_{im} \ln a_m + \Sigma_p \tau_{ip} r_p + \phi_{it}\, t + \epsilon_i \qquad (2)$$

where ϵ_i is the disturbance term for the ith factor share equation.

Symmetry of relevant cross-term parameters has been assumed. In addition, cost functions must be homogeneous of degree one in factor prices, or doubling all prices doubles costs. It is imposed by normalizing total costs and all factor prices, or equivalently via the following parameter constraints.

$$\Sigma_i \alpha_i = 1, \quad \Sigma_i \alpha_{ij} = \Sigma_j \alpha_{ij} = \Sigma_{ij} \alpha_{ij} = 0, \quad \Sigma_i \tau_{ik} = \Sigma_i \tau_{im} = \Sigma_i \tau_{ip} = \Sigma_i \phi_{it} = 0 \qquad (3)$$

The cost function and factor share equations are jointly estimated by iterating Zellner's two-step procedure for estimating seemingly unrelated regressions (SUR). Since the factor shares sum to 1, one of the cost share equations is deleted to obtain a nonsingular covariance matrix. We use the factor price associated with the deleted share equation for normalization. The resulting parameter estimates are asymptotically equivalent to maximum likelihood estimates and are thus invariant to the equation deleted.

For our simulations of the effects of excess capacity under a "managed competition" scenario, we estimate several utilization equations. They take the following general form

$$U = U\,(h, a, r, t)$$

where U represents per capita utilization rates, h is a "managed competition" variable, and as before, a is a vector of attributes, r is a vector of regulatory variables, and t is a time trend.[5] In terms of functional form, we employ log-linear specifications which should provide first-order effects. These utilization equations are jointly estimated as a SUR system, although in this case, there may be no gain in efficiency since each equation has its own set of parameters.

III. Data and Variables

In contrast to many previous studies, our data set is more aggregated, at the state-level including the District of Columbia. It allows us to achieve a broader perspective on the effects of recent regulatory changes and excess capacity on hospital costs, and more specifically, it enables us to make generalizations about the prevalence and cost of excess capacity for the entire hospital system that small samples might not allow.[6] To preserve the underlying economic theory in the cost function, all relevant variables have been calculated on a per hospital basis. Most of these data on registered community hospitals are available in the Hospital Statistics, compiled annually by the American Hospital Association (AHA). Some unpublished data contained in the annual surveys have been provided to us by the AHA. The sample period is from 1979 to 1989, producing a total of 561 observations.

For total cost (TC), we use total expenses data provided by the hospitals themselves. A possible concern might be the accounting of capital costs. As a check, we have computed an alternative measure of total cost. Because gross plant and equipment assets data were not collected for 1987-88, we can only calculate capital interest expenses using the available net plant data. Applying an 8% opportunity cost on net plant and working capital, capital costs are added to total expenses minus interest. However, this alternative total cost does not perform any better than the original total expense data. This state-wide total cost is divided by the number of hospitals to represent the average total cost for a hospital in a given state.

The vector of factor prices consists of prices for capital (PK), labor (PL), and purchased professional services (PP). We assume a relatively homogeneous price of capital and use a general capital price deflator which varies only yearly. In particular, the capital price is the U.S. Department of Commerce fixed-weight price index for nonresidential equipment and structures, available from a number of sources, including the Economic Report of the President. The price of labor is calculated as total labor expenses (payroll and benefits) per full-time equivalent (FTE) personnel. Because professional fees paid for medical, dental, legal, auditing, consulting and other services are considered nonpayroll expenses, we include a purchased services price, given by professional fees per hospital bed. Similarly, trainees used in hospitals are not accounted for in labor expenses. While not a price variable, total FTE trainees as a percentage of total FTE personnel (TR) has been incorporated in the model. It reflects to some extent the degree to which hospitals in a state engage in teaching, which might raise costs. Because hospitals in some states occasionally do not employ trainees, some observations with zeroes (14) have been converted to a small value (0.00001) before taking logs.

The basic outputs in the cost function are inpatient days (IP) and total outpatient visits (OP). Both outputs have been computed on a per hospital basis. Clearly, differences in hospital outputs across states cannot be easily captured by these highly aggregated variables. Because case mix data are not available, we attempt to control for some aspects of heterogeneity in outputs with a vector of attributes. For example, the average length of stay (ST) is inpatient days divided by admissions, while utilization (UT) is given by inpatient days as a percentage of bed-days. All else equal, longer lengths of stay and greater utilization should lower costs.

Another output attribute is newborn births as a percentage of admissions (BR). A larger fraction of births can be expected to raise costs. At the other extreme, serving a much older population has a similar effect. To capture this influence, we include the percentage of a state's population which is 65 years of age or older (SR). Data on resident population by age are taken from various issues of the Statistical Abstract of the United States.

Recent regulatory attempts to curb hospital costs have received much national attention. To capture their possible effect, we include two variables. The all-payer regulation variable (AP) is a dummy variable equal to 1 for those states which controlled hospital rates over the 1979-89 period, and 0 otherwise. Although there are some discrepancies across sources, we use the seven all-payer states listed in Feldstein (1988). They are Connecticut, Maryland, Massachusetts, New Jersey, New York, Washington, and Wisconsin. Another important regulatory change has been the adoption of the Prospective Payment System (PPS) by the Medicare program beginning in 1984. Under PPS, hospital are paid a fixed price per case type or diagnosis-related group (DRG). To smooth the transition, Medicare gradually phased in PPS over 4 years, with additional 25% increments of payments using the PPS system each year. Thus, the PPS variable has the value 0 in 1979-83, 0.25 in 1984, 0.50 in 1985, 0.75 in 1986, and 1 in 1987-89.

The last variable in the cost function is a time trend (T), equal to 1 in 1979, 2 in 1980, and so forth. Inclusion of a time trend is meant to control for unmeasured dynamic changes in costs. Typically, such changes result from technological progress. However, the time trend can proxy for any number of time-varying factors.

In the three utilization equations, the specific dependent variables are inpatient days per capita (IPPC), outpatient visits per capita (OPPC), and average length of stay (ST). The vector of attributes consists of births as a percentage of admissions (BR) and percentage population of age 65 or older (SR). Regulatory variables for all-payer states and PPS are also inserted, along with a time trend.

Perhaps the best indicator of a "managed competition" scenario is the prevalence of health maintenance organizations. Pure HMO enrollment as a percentage of population by state from 1980-1989 has been taken from Managed Care: A Decade in Review 1980-1990, by Interstudy. Data for the District of Columbia (DC) are not provided and perhaps for good reasons--when calculated, the percentages are extremely high, reflecting the single-city nature of DC. To avoid any perverse results because of the DC data, we have eliminated them from the utilization equations for a total of 500 observations. A number of errors in the data source have also been corrected.

IV. Estimation Results and Simulations

Cost function results

The results of the translog cost function estimation are given in Table 2. Since most of the variables have been measured as logged deviations from their mean, evaluating a cost elasticity at the sample mean is equivalent to examining just the first-order coefficient. Thus, the discussion will focus on these terms. However, because the time trend and two regulatory variables enter without logs, interpretations involving these variables require a bit more care.

In general, the first-order parameters are plausible and revealing. The cost elasticities for the input prices, labor and capital, are of the correct sign, of credible magnitude, and statistically significant. Representing also factor shares, these estimates show that labor and capital comprise approximately 59% and 35% of total cost, respectively. Over time, labor share has fallen slightly while capital share has increased slightly. Following PPS, there seems to have been a small shift towards more capitalization.

The effects of output on costs are of substantial interest. As expected, inpatient days (IP) have a considerably larger effect than outpatient visits (OP) on costs. An 1% increase in IP raises costs by 1.08%, over 6 times more than a similar increase in OP. In states with all-payer regulation, the cost elasticity with respect to inpatient days is lower, while the elasticity with respect to outpatient visits is higher, both in a statistically significant manner. Taken together, the estimate of overall scale economies, which is the sum of the elasticities of IP and OP, is 1.24, indicating decreasing returns to scale at the mean hospital size in the sample. Although large hospitals undoubtedly do face some organizational problems which can cause scale diseconomies, it is also likely that large hospitals face severer cases (i.e., sicker patients) than small ones, and some of this observed decreasing returns to scale is likely due to that effect.[7]

For the attribute variables, the estimated coefficients are again plausible. The effect of average length of stay on cost per patient day is just what one would expect: the cost per patient day is less, the longer the stay, reflecting some "fixed" cost with admissions. At the sample mean, a 10% increase in the average length of stay would decrease costs by over 4%. Those hospitals with more trainees, or teaching hospitals, have higher costs than others, all other things equal. Over time, this cost disadvantage has decreased, perhaps to the point where it no longer exists.

The demographic variables, childbirths as a fraction of admissions and senior citizens as a fraction of population in the relevant state, have the expected effects on costs. Both a higher percentage of births and a larger fraction of senior citizens raise costs. The positive coefficients reflect the relatively high cost of deliveries and the more serious illnesses afflicting the elderly. The passage of time itself also raises costs. To those not familiar with the hospital industry, this result might seem anomalous, suggesting a decrease in productivity over time. However, this result is all to familiar to those studying hospital costs, and indeed, what to do about it has been the subject of books (see, for example, Joskow, 1981). In this industry, technological advances often improve the quality of care, rather than provide cost innovations.

Of particular interest are the effects of the regulatory variables and the utilization rate on total hospital costs. The first-order coefficient for Medicare's Prospective Payment System seems to indicate it has indeed reduced the cost of a patient day, all other things equal. However, after properly taking account of the interaction term with the time trend, the results show that PPS has instead increased costs. Some previous studies have established that PPS reduced costs by reducing the length of hospital stay. Our results may be due to the fact that we control for and thus hold average length of stay, as well as other factors such as inpatient days and outpatient visits, constant.

The estimated cost function indicates that all-payer regulation (AP) reduces costs, although its negative first-order parameter is not significant. The significance of interaction terms with AP shows that all-payer regulation may affect costs more indirectly through other variables. Furthermore, as we shall see below, all-payer regulation seems to have increased hospital utilization per patient, so our results do not necessarily imply that patients gain from it unambiguously in terms of costs or resource use.

Effect of excess capacity

the per capita number of inpatient days in a state as a function of, among other things, the percentage of the population participating in HMOs. The results of this estimation are shown in Table 3.

Before simulating the "managed competition" scenario, consider the effects of the other variables in the utilization equations. Because the time trend is not significant in any of the estimated equations, it has been dropped from the specification. A higher percentage of births (BR) tends to decrease per capita inpatient days (IPPC) as well as the average length of stay (ST), perhaps reflecting incentives arising from the high costs associated with childbirth. On the other hand, more senior citizens (SR) has the opposite effect on IPPC and ST, which might result from differences in the degree of substitutability between care options. Neither BR nor SR have a significant effect on per capita outpatient visits.

Our estimates suggest that the Prospective Payment System has led to decreased use of inpatient treatments and increased use of outpatient care. If so, this shift should help to alleviate rising health care costs. PPS does not appear to have had much of an impact on the average length of stay. In all-payer states, that form of rate-setting has produced more outpatient visits per capita and interestingly, lengthened average stays. All-payer regulation has not had a significant effect on per capita inpatient days.

As expected, HMO participation is negative in its effect on per capita inpatient days, after controlling for other variables expected to affect hospital utilization. While the coefficient is reasonably significant (at the 7% level), its size suggests that the magnitude of its effect is relatively small. Health maintenance organizations also tend to use outpatient services more. But, their average lengths of stay are not significantly different.

Evaluated over all sample years, the mean HMO participation rate is about 5.9%. If under "managed competition," two-thirds of the population were enrolled in HMOs or similar managed care, the HMO participation rate would raise substantially, by over 1000%. However, this increase would in turn reduce per capita inpatient days by about only 3%. For some given state population, inpatient days would fall 3%, and for some existing hospital capacity, utilization would decrease by the same amount. This reduction in the utilization rate would raise the costs of excess capacity by 1.6%, or another $3 billion per year as of 1989. Although this is not a trivial sum, it does suggest that the reduced utilization likely to stem from increased HMO participation will not result in substantially more excess capacity. It also means that, to explain the recent reduction in capacity utilization, one must look further than the growth of managed care, at least in the form of HMOs.

V. Conclusions

Excess capacity in hospitals is costly, the annual costs for the U.S. being approximately $13.2 billion as of 1989 and substantially higher (probably over $20 billion) as of 1993. The results of this study have at least one important implication for public policy: a policy of preventing closures and mergers of hospitals, while politically appealing and appealing to some economists because it preserves the appearance of competition, is a costly policy. It may be justified, but if it is, it requires balancing the needs of competition and accessibility that keeping hospitals open affords, against the substantial savings of waste from closing hospitals and eliminating bed capacity.

One conclusion regarding regulation, however, must be emphasized here: our results do not in any way support the use of regulatory agencies (such as CON authorities) to eliminate excess capacity. Rather, we believe that currently, the regulatory problem is one of state and local government agencies which prevent elimination of excess capacity in hospitals, rather than encouraging it. Since the 1980s, powerful market forces of competition and managed care have given hospitals strong incentives to eliminate excess capacity. Given the poor record of CON authorities in managing excess capacity, it is our strong belief that the main goal of government policies should be to step out of the way of hospital closures and consolidations, rather than either blocking them through lawsuits or legislation, or encouraging them through the seemingly inefficient policies of CON authorities.

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Endnotes

1. It is an interesting fact that, in the 1960s and 1970s, the same ambiguity existed in the literature between short-run economies of utilization and long-run economies of scale in the discussion of railroad mergers and abandonments. Keeler (1974) aimed to clarify those issues in railroads as the present piece does in hospitals.

2. Although this might seem an unusual arrangement, it is common for other facilities, such as airports, and, for that matter, shopping malls.

3. There have been many excellent studies of hospital costs over the years, but few which have addressed the issue of excess capacity. One early study which did (albeit to answer different questions from the present one) is Lave and Lave (1970). Other, more recent studies include Grannemann, Brown, and Pauly (1986), Vitaliano (1987), Hadley and Swartz (1989), and Vita (1990). See also the survey by Breyer (1987).

4. This might seem an unusual assumption to someone analyzing costs on an accounting basis, but it makes sense from the viewpoint of economic theory, because the "staffing" rate is neither an exogenous variable, nor is it of interest from the viewpoint of this study, so there is no good reason for including it. Admittedly, of course, the occupancy rate itself may not be totally exogenous, but, for reasons discussed in this paper, it is far more likely to be exogenous than any sort of "staffed" or "unstaffed" bed utilization rate.

5. This utilization equation bears some relationship to utilization equations estimated in various other places in the health economics literature (see, for example, equation "k" in Joskow, 1980). But its purpose is somewhat different from most other applications of it.

6. This is not to deny the desirability of more disaggregated studies. Rather, it is simply an assertion that a study based on more aggregative state data does indeed represent a meaningful contribution. In this respect, our analysis is similar to that of Joskow (1981).

7. It would of course be desirable to correct more effectively for case mix than we have been able to do here. However, since our goal is to analyze excess capacity, and there is no reason to believe our estimates of that are biased, we believe our procedure is satisfactory. Further research on hospital scale economies would nevertheless be a good thing.

8. See, for example, Keeler (1974), Ying and Keeler (1991), or Winston, Corsi, Grimm, and Evans (1990).

Table 1. Beds and Occupancy Rate in U.S. Short-term Hospitals

Year	Beds	Occupancy Rate
1979	983,694	73.9%
1980	988,387	75.7%
1981	1,003,435	76.0%
1982	1,012,191	75.3%
1983	1,018,482	73.5%
1984	1,017,057	69.1%
1985	1,000,678	64.8%
1986	978,275	65.7%
1987	958,312	64.9%
1988	946,697	65.7%
1989	933,318	66.2%

Table 2. Estimation Results for the Hospital Cost Function

Equation	SSE	MSE	R-Square	Adj R-Sq
TC	1.8672	0.003860	0.9906	0.9892
Lshare	0.1441	0.0002598	0.7652	0.7630
Kshare	0.1731	0.0003121	0.6457	0.6423

Parameter	Estimate	Std Err	Parameter	Estimate	Std Err
Intercept	-0.262284	0.02212	IP· OP	-0.096621	0.06222
PL	0.592247	0.00323	IP· TR	0.015293	0.01601
PK	0.350059	0.00351	IP· ST	0.009252	0.17278
IP	1.082921	0.05340	IP· BR	0.092889	0.12389
OP	0.154965	0.03614	IP· UT	0.016747	0.27933
TR	0.033420	0.00971	IP· SR	-0.198178	0.11515
ST	-0.436183	0.09230	IP· T	0.006104	0.01205
BR	0.246255	0.07396	IP· PPS	-0.049543	0.08967
UT	-0.706797	0.19802	IP· AP	-0.360636	0.05597
SR	0.227633	0.06457	OP· TR	0.002964	0.00988
T	0.058795	0.01175	OP· ST	-0.183699	0.10240
PPS	-0.221248	0.10386	OP· BR	-0.001130	0.07797
AP	-0.021591	0.02908	OP· UT	0.004697	0.16698
½ PL^2	0.141544	0.00669	OP· SR	0.180496	0.06425
½ PK^2	0.114913	0.00709	OP· T	-0.002157	0.00691

Table 2. Estimation Results for the Hospital Cost Function (cont.)

Parameter	Estimate	Std Err	Parameter	Estimate	Std Err
½ IP^2	0.144996	0.10830	OP· PPS	0.003098	0.05337
½ OP^2	0.074908	0.04741	OP· AP	0.174016	0.04418
½ TR^2	-0.000362	0.00118	TR· ST	0.026958	0.01889
½ ST^2	-0.400823	0.40928	TR· BR	0.012654	0.02098
½ BR^2	-0.464414	0.20844	TR· UT	-0.039882	0.03170
½ UT^2	-0.544651	1.14731	TR· SR	0.005534	0.00807
½ SR^2	0.182384	0.15426	TR· T	-0.003936	0.00171
½ T^2	-0.007091	0.00360	TR· PPS	0.012842	0.01203
½ PPS^2	-0.165761	0.19002	TR· AP	0.073854	0.02866
PL· PK	-0.105885	0.00672	ST· BR	0.302595	0.20016
PL· IP	-0.056410	0.00438	ST· UT	0.623584	0.50298
PL· OP	0.027523	0.00262	ST· SR	0.652675	0.21753
PL· TR	0.000015	0.00041	ST· T	-0.007660	0.01857
PL· ST	0.045462	0.00687	ST· PPS	-0.009291	0.15152
PL· BR	-0.004326	0.00564	ST· AP	0.082650	0.08693
PL· UT	0.153754	0.01411	BR· UT	0.535400	0.36276
PL· SR	0.018510	0.00450	BR· SR	-0.098523	0.19309
PL· T	-0.005056	0.00071	BR· T	0.000750	0.01481
PL· PPS	-0.026733	0.00481	BR· PPS	0.177472	0.11727
PL· AP	0.002415	0.00227	BR· AP	-0.326055	0.11027

Table 2. Estimation Results for the Hospital Cost Function (cont.)

Parameter	Estimate	Std Err	Parameter	Estimate	Std Err
PK· IP	0.058366	0.00476	UT· SR	0.737201	0.30420
PK· OP	-0.022279	0.00288	UT· T	0.002320	0.04244
PK· TR	0.000519	0.00045	UT· PPS	0.013464	0.31622
PK· ST	-0.063353	0.00746	UT· AP	0.321524	0.15437
PK· BR	0.010485	0.00616	SR· T	-0.020981	0.01197
PK· UT	-0.134721	0.01536	SR· PPS	0.217887	0.10698
PK· SR	-0.019567	0.00493	SR· AP	-0.392695	0.09553
PK· T	0.006723	0.00077	T· PPS	0.043838	0.02630
PK· PPS	0.026377	0.00526	T· AP	-0.001466	0.00644
PK· AP	-0.003632	0.00247	PPS· AP	0.034746	0.04549

Definitions: PL = price of labor; PK = price of capital

IP = inpatient days; OP = outpatient visits

TR = percentage trainees; ST = average length of stay

BR = percentage births; UT = utilization of beds

SR = percentage 65 or older; T = time trend

PPS = prospective payment system; AP = all-payer regulation

Table 3. Estimation Results for the Hospital Utilization Equations

Parameter	Estimate	Std. Error
Dependent Variable: Inpatient days (per capita)		
Intercept	0.001307	0.01285
BR	-0.779183	0.04541
SR	0.241997	0.04024
PPS	-0.122103	0.01865
AP	-0.007150	0.01906
HMO	-0.003001	0.00162
Adj. R Squared		0.7137
Dependent Variable: Outpatient visits (per capita)		
Intercept	-0.071964	0.02341
BR	-0.003181	0.08274
SR	0.109755	0.07332
PPS	0.109671	0.03398
AP	0.152286	0.03472
HMO	0.017527	0.00296
Adj. R Squared		0.2085
Dependent Variable: Average length of stay		
Intercept	-0.019382	0.01122
BR	-0.156865	0.03966
SR	0.167745	0.03534
PPS	-0.007146	0.01629
AP	0.063509	0.01664
HMO	-0.001578	0.00142
Adj. R Squared		0.2381