Rate of Return on Capital Investments at Small Rural Hospitals

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EXECUTIVE SUMMARY

Small rural hospitals tend to have older buildings and equipment than larger hospitals. This paper investigates whether the aging of rural facilities is due to a lower rate of return on capital investment at small rural hospitals. This paper also investigates whether membership in a hospital system improves access to capital and results in the updating of buildings and equipment.

To evaluate the rate of return on capital investments, net patient revenues are modeled as a function of capital, labor, and other inputs. The model generates an estimate of the average amount of patient revenue generated per dollar of capital expenditures at different types of hospitals. Data for the analysis comes from the 1988 through 1998 Medicare cost reports.

System membership may affect capital expenditures if hospital systems have better access to capital than independent small rural hospitals. The hospital systems may then borrow money and allocate funds to their member hospitals for capital improvements. The capital expenditures would result in lowering the average age of the hospitals' facility and equipment. To estimate the impact of system membership on the age of facilities, the average age of a hospital building and equipment is modeled as a function of historical system membership and a series of control variables such as hospital size and hospital profitability.

We estimate that hospitals have generated approximately 50 cents for every new dollar of capital expenditures. This implies that approximately 50 percent of capital expenditures would have to be funded by donors for the average capital expenditure to be fully funded. Since funded projects have yielded a low rate of return, we expect that the hospitals' unfunded potential projects have an equally low or even lower expected rate of return. While there may be a significant need for capital improvements at rural hospitals, it is unlikely that these capital projects will be profitable.

Our ordinary least squares regression model suggests that hospitals do not use system membership to overcome access to capital problems. These results cannot tell us whether this is because hospitals outside of systems have adequate access to capital or whether hospital systems aren't anymore willing to invest in member hospitals than other potential lenders are. However, if profitable lending opportunities existed, we would expect systems to be borrowing funds and allocating those dollars to their rural members.

Capital improvements tend to be concentrated in areas with physician growth, more hospital admissions and a history of operating profits. In contrast, the smallest rural hospitals generate lower levels of revenue per dollar of salary expense, have lower profit margins and invest less in renovating their buildings and equipment. Policy makers could choose to help small rural hospitals improve their buildings and equipment. However, given the historical returns on capital investments suggested by these results, we should not expect additional investments to generate enough additional revenue to repay the full cost of capital improvements at small rural hospitals. Federal assistance with capital projects could be justified as a means of assisting rural hospitals with their missions, but not as a means to correct a failure of private capital markets.

INTRODUCTION

Policy makers are concerned that rural hospitals are aging and in need of repair or replacement. From 1946 to 1974, the Hill-Burton program funded the construction and renovation of hospitals across the country through a system of matching grants (Lave and Lave, 1974). Now, almost 30 years after the termination of the program, many of these Hill-Burton hospitals are aging and many of the smallest hospitals may lack funds for renovation. The aging of small rural hospitals is of interest to policy makers who have proposed that a special loan program be set up to help small rural hospitals finance capital improvements. The objective of new rural loan programs is to improve access to modern technology for aging populations in rural areas. Capital improvements in rural areas could move us toward the goal of having more equitable access to high-quality medical care. The issue addressed in this paper is whether the equipment and other capital improvements purchased with new loans at small rural hospitals will generate enough new revenue to repay the loans.

Table 1 indicates that a hospital's age of plant is inversely related to its volume of admissions. On average, hospitals with low volumes have lower profit margins, less debt, older buildings and are more likely to be located in rural areas. There are several potential reasons why small rural facilities may be older, including demographics, profitability, lenders reluctance to finance rural projects and the transaction costs associated with small projects. First, small rural hospitals tend to be in areas with lower levels of population growth and may have less need to build new additions. Second, low patient volumes can contribute to low levels of profitability (MedPAC, 2001), making it difficult for hospitals to afford renovations. Third, small rural hospitals may lack access to capital markets if lenders are reluctant to lend to hospitals that are

Table 1

Financial Performance and Age of Hospital Plant, Property and Equipment

Type of Hospital	Age of Plant and Equipment for Median Hospital[1]	Hospitals with Average PPE Age Over 20 Years	Median Debt to Revenue Ratio in 1998	Median Operating Margin in 1998	Median Net Margin in 1998	Median Population Growth In the County 1988-1998
Rural, <500 admissions (n=255)	11.6 years	13%	26%	-11%	-1%	-1%
Rural, 500-1,000 admissions (n=310)	10.6 years	4%	27%	-6%	1%	1%
Rural, >1,000 admissions (n=851)	9.4 years	4%	38%	0%	4%	4%
Urban, <500 admissions[2] (n=28	12.4 years	9%	43%	-15%	-5%	11%
Urban, 500-1,000 admissions (n=43)	10.9 years	3%	50%	-8%	2%	4%
Urban, >1,000 admissions (n=1,368)	9.6 years	6%	51%	-1%	4%	7%

[1]Age was calculated as accumulated depreciation expense/depreciation expense in 1998.
[2]Urban refers to hospitals in counties that are part of a metropolitan statistical area (MSA).

dependent on a small population base, a small physician staff or government support for survival. Fourth, lenders may also be reluctant to spend the time evaluating the risk of small hospital loans since smaller loans will generate less interest income.

From a public policy perspective it is important to know why small rural hospitals are not funding capital improvements to their facilities. If projects are not being funded because they would be unprofitable and small rural hospitals cannot afford to subsidize them, policy makers should focus on the profitability of small rural hospitals. In contrast, if projects are profitable but are not being funded due to a failure of the capital markets, then policy makers should examine ways to improve the way capital markets operate for rural hospitals.

The objectives of this paper are to estimate rural hospitals' return on capital. First, we estimate rural hospitals' average return on capital investments during 1989-1998. If small rural hospitals are generating high returns on their investments, it may indicate that lenders are under-serving small rural hospitals. In contrast, if capital investments at small rural hospitals are unprofitable and generate less revenue per dollar of investment than at larger facilities, the age of hospital buildings may be due to budget constraints rather than access to capital constraints. Second, we test whether hospitals that have been members of hospital systems in recent years have more modern buildings and equipment than independent hospitals. If small rural hospitals are good risks but lack access to capital markets, then we should find that system hospitals would have more modern buildings and equipment than independent non-system affiliated hospitals. We expect that hospital systems would be in a position to accurately evaluate the returns to investment in their member hospitals and would allocate funds to member hospitals if they thought the financial and patient care benefits warrant the investments. If small hospitals lack

access to capital markets, joining a system may be a method of obtaining access to capital markets.

After evaluating hospitals' return on capital investments and evaluating whether system membership impacts capital expenditures, we discuss current public policy options regarding the funding of capital improvements at rural hospitals. If we find that rural hospitals have been able to generate positive rates of return on capital and that independent hospitals have more difficulty obtaining capital than members of systems, there may be profitable opportunities to lend to rural hospitals that are not being taken by public and/or private lenders. Under this first scenario, public and/or private lenders could profitably lend and rural hospitals could profitably borrow to modernize hospital buildings and equipment.

In contrast, if we find that rural hospitals capital investments are not profitable and that system membership does not improve access to capital, it would suggest that the aging of small rural hospitals is not caused by inefficient capital markets. In this scenario, any efforts to help small rural hospitals would have to be justified by quality of care or access to care concerns. Since additional capital projects would not be expected to generate enough revenue to repay loans, further efforts to modernize rural hospitals would have to be partially subsidized by government sources or charitable donors.

THEORTICAL FRAMEWORK AND METHODOLOGY

This section starts by providing a typology of capital improvement projects that lets us think more systematically about the expected rate of return from hospital investments in buildings and equipment. Second, a description of the methodology for estimating the rate of return on capital improvement projects is described. Third, a methodology for testing whether

system membership has helped hospitals overcome difficulties that they may have accessing capital is presented.

Motivations for Capital Investments

Hospital boards have dual objectives of (1) improving current patient care and (2) generating profits so the hospital will have the resources to provide future patient care. A concern over current patients' well being may induce hospitals to fund unprofitable services as part of their mission. Because most hospitals are not simply maximizing their profitability, a hospital's return on capital investments will be based on a blend of projects that have different motivations. To highlight the potential differences in motivations, we categorize capital investments into three categories: profitable projects, unprofitable projects motivated by concern for patients, and regulatory compliance projects. We believe this framework is useful when thinking about how different types of projects influence a hospital's return on capital.

Profitable Projects. Profitable projects are defined as projects that produce enough revenue to cover the project's net costs. Net costs refer to the cost of operating a project and financing the capital equipment net of project specific donations. An example of a profitable project is an MRI machine that is expected to generate enough revenue to cover its operating costs as well as depreciation and interest costs on the purchase price net of project specific donations. Profitable projects should be the easiest to finance since the hospital's profitability is expected to increase following completion of the project.

Unprofitable Projects. The second category of projects consists of unprofitable projects that hospital boards choose to undertake because the health care benefits are expected to justify the financial losses. The hospital must cover the losses on these projects with profits on other services and financial reserves. For example, a rural hospital may choose to add a wing to its

assisted living facility to care for the specific needs of Alzheimer's patients. While the hospital board may expect to lose money caring for these patients, they may feel the losses are justified by the benefits to local Alzheimer's patients and their families. These projects will be more difficult to finance with funds from private lenders since the hospital's profitability is expected to decline following completion of the project.

Regulatory Compliance. The third category includes projects in which hospital management feels the costs outweigh the benefits, but regulators insist on the capital improvement. While these projects may have some patient benefits, the projects would not be undertaken without pressure from regulators. For example, a small rural hospital planned to spend $10,000 expanding a ramp that is used for central supply deliveries. Although patients did not use the ramp, the slope of the ramp was not in compliance with building codes for hospitals. The hospital administrator did not believe the modifications to the ramp and the connecting building planned to generate any positive benefits for patients or the hospital, but would modify the ramp to be in compliance with building codes and hospital regulations. Regulatory compliance projects may be difficult to finance since they will usually reduce profitability.

Average Return on Capital. When a hospital's average rate of return on capital is estimated, it will be calculated using a weighted average return on projects that are motivated by financial, patient care concerns, and regulatory compliance concerns. In this paper we test whether the average rate of return on capital investments differs depending on rural location or hospital size. It is possible that small rural hospitals have a lower return on investment due to having fewer patients and hence less revenue to fund the large fixed cost component of specific projects.

Calculating Rates of Return on Capital Projects

To test whether the productivity of capital is dependent on rural location or hospital size, we need to formulate a model to estimate a hospital's return on capital. For a specific project, a hospital's rate of return on investment is specified by the following equations:

Rate of return = (Project Revenue-Project Costs) / Capital Costs

Project costs = operating costs + [(interest rate +depreciation rate)*(capital costs - project specific donations)]

Project specific donations are defined as donations that a hospital would not have received if the specific project was not completed. One difficulty we would encounter trying to empirically implement this rate of return model is that it is not known whether donations to a specific project will cause a reduction in unrestricted donations. For example, if a hospital had a special fund drive for a new Alzheimer's wing, the hospital will not know the extent to which the Alzheimer's fund drive reduced unrestricted donations to the hospital. Because the level of project-specific donations is unknown, we cannot calculate the rate of return shown above. A second, more fundamental difficulty to empirically implementing the rate of return model is that publicly available data only include aggregate changes in capital from one year to the next. Due to the difficulty obtaining information on project specific donations and project specific capital, the project specific return on capital cannot be calculated and we must develop a model for estimating the aggregate return on capital.

To estimate returns on capital, a production function approach is used where patient revenue is modeled as a function of capital expenditures, other inputs and a series of productivity influencing variables. The primary objective is to estimate how much revenue is generated per dollar of additional capital expenditures. Tests are conducted to evaluate whether the average return on capital investments differs by rural/urban location, hospital size or for-profit status.

For example, in 1998 rural hospitals may have generated x cents in revenue for every dollar of capital expenditures. These capital expenditures include depreciation expenses, cost of equipment leases, interest expenses on borrowed funds, and insurance on the acquired property plant and equipment. If more than a dollar of revenue is generated for every dollar of capital expenditures and labor expense, then the project is deemed profitable.

We use a fixed effects multivariate regression model to estimate hospitals' average return on capital expenditures as shown below.[1] A fixed effects model statistically assesses the extent to which deviations from each individual hospital's mean level of revenue over the ten-year period are explained by changes in a set of explanatory variables over that ten year period. In assessing the 'explanatory power' of this set of independent variables, a fixed effects model purposively ignores differences *between* hospitals, and concentrates solely on the variation *within* each hospital's experience. In this way a fixed effects model is able to effectively eliminate the influence of the many factors that might operate *between* hospitals, which are difficult to obtain the data to control for directly.

$$R_{it} = \alpha_t + \beta_c C_{it} + \beta_s S_{it} + \beta_o O_{it} + \sum_x \beta_x X_x + \sum_g \beta_g E_g + \varepsilon, \text{ where:}$$

R_{it} = Deviation from hospital i's mean level of normalized **revenue** during 1989-1998.
α_t = A fixed effects time variable that affects all hospitals in **year t**.
C_{it} = Deviation from hospital i's mean level of normalized **capital** expenditures, 1989-1998.
S_{it} = Deviation from hospital i's mean level of normalized **salary** expense, 1989-1998.
O_{it} = Deviation from the hospital i's mean level of normalized **expenses other than capital and salary** expenses during 1989-1998
X_{it} = A vector of interaction variables where capital and labor expenses are interacted with certain size variables, a rural location dummy, and a for-profit dummy to account for the impact of rural location, size and for-profit status on labor and capital productivity.
E_g = Deviations from the mean level of growth in environmental variables (real income, physicians in the county, and county population) since 1988
β = The estimated coefficients on the explanatory variables
ε = The error term which is assumed to be normally distributed

[1] A random effects model also was tested, however, a Hausman test revealed that the individual effects in the revenue equation are correlated with the independent variables. This suggests that omitting the fixed effect could result in biased coefficients. Therefore, a fixed effects model was chosen over a random effects model.

The variables in the revenue equation are "normalized" to account for variations in size and the impact of inflation. To account for variance in size and to limit heteroscedasticity, the input and revenue variables were both divided by the hospital's level of revenue in 1988. To account for inflation, all monetary values were deflated to 1982-84 prices using the Bureau of Labor Statistics (BLS) price index for hospital services.

The study excludes hospitals that receive cost-based reimbursement from Medicare. A total of 38 hospitals were excluded due to being Rural Primary Care Hospitals in 1996 and 1997 or Critical Access Hospitals in 1998. These hospitals were excluded because their Medicare revenue is determined by expenditures as opposed to the volume of services provided to Medicare beneficiaries.

Estimating the Impact of System Membership on Capital Expenditures

To test for the effect of system membership on capital expenditures, the average age of a hospital's plant and equipment at the end of fiscal year 1998 is modeled as a function of historical profitability, historical patient volume, environmental variables and system membership. Historical profitability is measured as the hospital's median net margin during 1994-1996. Historical margins are used instead of current margins**,** because historical margins will have affected the hospital's ability to afford capital expenditures, while current margins may have been influenced by the current age of the hospital's plant and equipment. Two dummy variables are used to account for shifts in capital and labor productivity based on size. The first dummy variable examines shifts in productivity for hospitals with more than 500 admissions during 1994-1996 and a second dummy variable approximates an additional shift in productivity of capital for hospitals with more than 1,000 admissions. We chose economies of scale shifters

located at 500 and 1,000 admissions after examining the data and prior work by MedPAC (2001) that indicates that costs of providing care increase significantly for hospitals with less than 1,000 admissions.[2] The smallest hospitals have fewer patients to use a new piece of equipment. Some types of equipment are characterized by "lumpiness," where you can't tailor the size of the equipment purchase to fit your circumstance. A facility with more patients would have a larger base of patients to spread the fixed costs of this equipment than would a smaller hospital. The model also includes variables representing the percentage growth in income, physician supply and population in the hospital's county from 1988 to 1998. The growth in physicians and population are proxies for increasing regional demand for hospital services. The growth in income (adjusted for inflation) reflects changes in the county's ability to afford a new facility.

The key explanatory variable is a dummy variable representing whether the hospital was in a system from 1996-1998. If a hospital reported to the AHA that it belonged to a hospital system during each of the three years prior to the end of fiscal year 1998, the dummy variable is coded 1. We chose three years since it may take several years after joining a system for a hospital to have the system approve its request for capital improvements. If the hospital was not in a system for each of those three years, the dummy variable is coded 0. If data is missing or if the hospital reported joining or dropping out of a system during those three years, the observation was deleted from the regression. The objective is to see if belonging to a system for three years leads hospitals to have more modern plants and equipment. The effects of system membership for the duration of one and five years also are tested. The multivariate regression that is used to estimate hospitals' average age of plant and equipment is shown below.

[2] A standard quadratic estimation of the production function also was examined and similar coefficients were obtained with almost identical levels of statistical significance. We chose to present the dummy variable approach due to its ease of interpretation and because it does not force a single functional form upon the whole cost curve.

$$A = \alpha + \beta_S S + \sum_j \beta_j O_j + \sum_g \beta_g E_g + \varepsilon, \text{ where:}$$

A = Average age of plant and equipment at the end of fiscal year ending between October 1, 1998 and September 30, 1999.
α = constant term
S = In a hospital system from 1996-1998
O_j = Other hospital characteristics such as historical income, historical admissions over 500, and historical admissions over 1000.
E_g = Growth in county-level environmental variables (real income, physicians in the county, and county population) since 1988
β = The estimated coefficients on the explanatory variables
ε = The error term which is assumed to be normally distributed

DATA AND DESCRIPTIVE STATISTICS

A panel data set was compiled that has ten years of financial, demographic, and system membership information. Financial data were obtained from Medicare cost reports from 1989 through 1998. Definitions of the financial variables are shown in Appendix A.

Environmental variables were obtained from the 2001 Area Resource File that provides information on the number of physicians, per capita income, and population in a county. Data from the American Hospital Association's annual survey of hospitals are used to determine system membership.

Table 2 indicates that small rural hospitals tend to be located in areas with low population growth rates and low physician growth rates. Smaller rural facilities also are less likely to be members of hospital systems than larger hospitals. Table 2 suggests that differences in hospital age are more closely related to hospital size than their urban or rural location. Due to the small number of hospitals in MSAs with under 1,000 admissions, the statistics for small urban hospitals should be viewed with caution.

Table 2

Descriptive Statistics – Mean Values[1]

	Type of Hospital					
	Rural, < 500 Admissions (n=255)	**Rural, 500-1,000 Admissions (n=310)**	**Rural, > 1,000 Admissions (n=851)**	**Urban, < 500 Admissions (n=28)**	**Urban, 500-1,000 Admissions (n=43)**	**Urban, > 1,000 Admissions (n=1,368)**
# hospital admissions	319	720	3,412	303	775	9,915
Operating margin	-17.0%	-7.5%	-0.8%	-27.0%	-11.0%	-3.0%
Net margin	-2.0%	0.6%	4.7%	-5.0%	-0.2%	3.7%
System member	27.0%	21.0%	34.0%	21.0%	22.0%	63.0%
For-profit	1.0%	4.0%	9.0%	7.0%	7.0%	14.0%
Capital assets FY 98	$1,981,455.	$3,152,836	$16,952,220	$2,472,836	$10,722,747	$57,588,382
Average age of PPE[2]	13.3	11.2	10.0	13.3	11.1	10.5
Capital costs	$204,922	$364,339	$1,778,972	$318,893	$599,254	$6,019,338
Salary costs	$2,163,504	$3,517,837	$12,809,898	$4,577,294	$4,621,632	$46,676,445
Other costs[3]	$2,251,265	$3,910,630	$15,834,735	$4,870,650	$5,536,919	$58,853,226
Net patient revenue	$4,063,544	$7,316,106	$30,626,147	$8,268,116	$9,524,488	$108,924,800
Population growth	0.0%	3.0%	5.0%	10.0%	13.0%	10.0%
Income growth[4]	-22.0%	-20.0%	-18.0%	-18.0%	-20.0%	-17.0%
Physician growth	17.0%	26.0%	30.0%	36.0%	37.0%	38.0%

[1]Unless otherwise noted in the table, the means reported here are based on the entire 10 years of data. The growth rates are for 1989 to 1998.
[2]PPE refers to property, plant and equipment.
[3]Other costs refer to expenditures other than on capital (i.e. depreciation, interest, etc.) and salaries, such as the purchase of supplies or investments in joint ventures.
[4]Per capita income is deflated by the BLS price index for hospital services. Because the prices for hospital services are growing faster than income, patient's purchasing power with respect to medical care is declining in inflation-adjusted dollars from 1988 to 1998.

MULTIVARIATE RESULTS

Return to Capital

Table 3 presents results from the hospital revenue equation which show how deviations from a hospital's mean level of capital expenditures over the period 1989 through 1998 resulted in deviation in its net patient revenue. For every marginal dollar of net capital expenditures (including depreciation) over the ten-year period, an estimated 46 cents of additional revenue was generated to cover capital costs. This suggests that unless over half of the capital expenditures are funded with donations, new projects that require capital will cause a drain on hospital resources.

Table 3 shows that the difference in profitability between larger hospitals and smaller hospitals appears to largely be due to lower returns to labor at small and rural hospitals. While small rural hospitals (under 500 admissions per year) generate an estimate of $1.03 of additional revenue for every marginal dollar of salary expense, labor productivity appears higher in larger hospitals. The regression equation estimates that hospitals with over 1,000 admissions generate three cents more of revenue per dollar of salary expense than hospitals with between 500 and 1,000 admissions. On average, rural hospitals also appear to generate an average of four cents less revenue per dollar of salary expense than urban facilities. However, this finding should be viewed with caution since we found the significance of the rural variable was lost when the production function was tested using other functional forms such as a quadratic production function. The other coefficients were robust to changes in the functional form of the production function. In contrast, for-profit hospitals on average generate ten cents more revenue per dollar of salary expense. This could be due to lower staffing levels per occupied bed at for-profit hospitals.

Table 3

Predicting Patient Revenue (Net of Discounts)

Variable	Coefficient	Standard Error	Significance
Inputs			
Capital expenditures (exp)	.46	.02	.00
Capital exp. if admissions over 500	.13	.08	.15
Capital exp. if admissions over 1,000	-.02	.08	.83
Capital exp. if in an urban county	.09	.06	.23
Capital exp. if a for-profit hospital	-.10	.06	.10
Salary expense	1.03	.02	.00
Salary expense if admissions over 500	.02	.01	.12
Salary expense if admissions over 1,000	.03	.01	.01
Salary expense if in a urban county	.04	.02	.04
Salary expense if a for-profit hospital	.10	.02	.00
Other expenses	.79	.01	.00
Time Trends			
Year = 1989 * revenue in 1988 $	.01	.01	.44
Year = 1990 * revenue in 1988 $	.00	.01	.79
Year = 1991 * revenue in 1988 $	.02	.01	.01
Year = 1992 * revenue in 1988 $	.03	.01	.00
Year = 1993 * revenue in 1988 $	.04	.01	.00
Year = 1994 * revenue in 1988 $	.04	.01	.00
Year = 1995 * revenue in 1988 $	.04	.01	.00
Year = 1996 * revenue in 1988 $	.05	.01	.00
Year = 1997 * revenue in 1988 $	.04	.01	.00
Environmental Variables			
Population growth, 1988 – 1998	.05	.03	.09
Growth in population, 1988 – 1998	.01	.01	.12
Deflated income growth, 1988 - 1998	.01	.04	.72

n=23,881; R^2 within = .71

The model in Table 3 explains 71 percent of the changes in net patient revenue over the ten-year period. The 29 percent of net patient revenue that is not explained by the fixed effects regression model could be due to differences in the types of capital expenditure from year to year and differences in staffing per occupied bed. Variance in revenue per dollar of expense also could arise due to yearly differences in the cost of caring for Medicare patients. In one year a hospital may have several unprofitable Medicare admissions with long lengths of stay and then have several Medicare patients that leave the hospital early the next year.

In sum, we find no evidence to suggest that hospitals increased their profits in years following the completion of capital investments. We also find no evidence to suggest that average returns on capital differ based on rural/urban location or hospital size.

The Impact of System Membership on Age of Plant and Equipment

The results shown in Table 4 examine whether system membership results in lower average age of buildings and equipment. The model shows no evidence that being a system member for three years affects the average age of a hospital's building and equipment. While not presented, the impact of system membership for the duration of one and five years was also tested and we again found no evidence that system membership affects capital expenditures. In addition, we tested whether system membership resulted in newer facilities among hospitals that have historically been profitable; we found no evidence that system membership affects capital expenditures for this subset of hospitals.

We did find that hospital admissions, past hospital profitability, and whether the hospital is a for-profit facility are all inversely associated with the age of a hospital's plant and equipment. Among factors influencing the age of plant and equipment, historical profitability has the clearest impact. The strongest environmental factor is countywide growth in the number

Table 4

Predicting Average Age of Plan and Equipment in 1998

Variable	Coefficient	Standard Error	Significance
Hospital Characteristics			
System membership, 1996 - 1998	.01	.26	.97
Median net margin, 1994 - 1996	-11.14	1.75	.00**
Over 500 admissions, 1995 – 1996	-.11	.56	.55
Over 1,000 admissions, 1995 - 1996	-1.03	.39	.01**
For-profit hospital	-3.13	.60	.00**
Constant	16.44	1.76	.00**
Environmental Variables			
Rural (non-MSA) county	-.33	.28	.24
Population growth 1988 – 1998	-1.01	1.06	.34
Growth in population 1988 – 1998	-1.01	.37	.00**
Deflated income growth 1988 – 1998	-1.58	1.65	.34

n=1,654; R^2 = .09

** $p<.01$

of physicians. It is possible that growth in the number of physicians leads the hospital to expand capacity. There is a potential endogeneity problem with this impact since it is possible that expanded facilities may improve physician recruitment. Our model estimate of the impact of physician growth may reflect both directions of causal impact.

These model results suggest that hospitals do not use system membership to overcome access to capital problems. The results cannot indicate whether this is because hospitals do not have problems accessing capital or whether hospital systems are not more willing to invest in small rural hospitals than potential lenders are. If profitable lending opportunities existed, we would expect systems to be borrowing funds and allocating those dollars to their rural members.

The model only explains nine percent of the variance in the age of hospital buildings and equipment. Part of the reason for the difficulty explaining age is that replacements of buildings result in "lumpy" investments. A hospital may have the oldest building one-year and then construct a new facility the next year while its historical profitability and environmental characteristics have not changed. Due to the lumpy nature of investment, a low R^2 is expected.

Limitations

Capital can be measured as a flow (capital expenditures) or a stock (capital assets). The advantage of measuring assets as a flow is that you can include equipment leases and other capital expenditures that are not directly related to the purchase of fixed assets. The limitation of this approach is that Medicare expenditure data includes interest expense. Therefore, some hospitals may have greater capital expenditures if they are funded more with debt than equity. In the case where assets are funded with donations, we do not account for the lost potential interest income that the hospital could have made with the donated funds if they were not invested in

capital purchases. The financial return that society receives on capital expenditures may be lower than the rate of return implied by this study.

DISCUSSION

If the results had indicated that hospitals are generating healthy returns on their capital investments and system membership resulted in increased capital investments, then there would be an opportunity for private or public lenders to help rural hospitals make profitable investments. This is not what we found. We have no evidence that profitable projects are going unfunded.

The estimated revenue generated per dollar of capital investment is low. Since projects that hospitals chose to undertake have yielded low financial returns, it is unlikely that there exist a great number of profitable unfunded opportunities for rural hospitals. The low rate of return should not be viewed as a negative finding. This indicates that rural hospitals have been willing to make capital investments to improve the health of their communities even when those investments have not yielded positive economic returns. Our findings are indicative of rural hospitals following charitable missions.

The construction and updating of facilities appears to be concentrated in areas with physician growth, more hospital admissions and a history of operating profits. In contrast, the smallest rural hospitals generate lower levels of revenue per dollar of salary expense, have lower profit margins and invest less in renovating their buildings and equipment. Policy makers could choose to help small rural hospitals improve their buildings and equipment. However, given historical returns on capital investments, we should not expect additional investments to generate

enough additional revenue to cover the full cost of capital improvements at small rural hospitals. Federal assistance with capital projects could be justified as a means of assisting rural hospitals with their missions, but not as a means to correct a failure of private capital markets.

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Appendix A

Definitions of Variables in the Multivariate Models

Variable	Description of Variable*
Inputs	
Capital expenditures	Capital expenditures on plant and equipment that are reported on Worksheet A, column 2 of lines 1, 2, 3, and 4 on hospital cost reports. These expenditures include the cost of depreciation, leases, rentals, taxes, insurance and interest costs associated with the acquisition of land and/or depreciable assets used in patient care.
Capital expenditures if admissions are greater than 500	Capital expenditures multiplied by a dichotomous variable indicating the hospital had fewer than 500 admissions.
Capital expenditures if admissions are greater than 1,000	Capital expenditures multiplied by a dichotomous variable indicating the hospital had fewer than 1,000 admissions.
Capital expenditures if in a rural county	Capital expenditures multiplied by a dichotomous variable indicating whether the hospital is located outside of a metropolitan statistical area.
Capital expenditures if a for-profit hospital	Capital expenditures multiplied by a dichotomous variable indicating whether the hospital is a for-profit entity.
Salary expense	Total salaries for the facility.
Salary expense if admissions under 500	Total salaries multiplied by a dichotomous variable indicating the hospital had more that 500 admissions.
Salary expense if admissions under 1,000	Total salaries multiplied by a dichotomous variable indicating the hospital had more than 1,000 admissions.
Salary expense if in a rural county	Total salaries multiplied by a dichotomous variable indicating the hospital had fewer than 1,000 admissions.

Definitions of Variables in the Multivariate Models

Variable	Description of Variable*
Inputs (continued)	
Salary expense if a for-profit hospital	Total salaries multiplied by a dichotomous variable indicating that the hospital is a for-profit entity.
Other expenses	Total facility expenses – capital related expenses such as interest payments and depreciation that are shown as variables f441, f442, f443 and f444 on hospital cost reports.
System Membership	
AHA system membership 1996 – 1998	A dichotomous variable that is equal to one if the hospital reports being in a hospital system for the year in question and the prior two years. If the hospital reports being in a system in some of the three years and not in others, the variable is dropped.
Environmental Variables	
Population growth, 1988 – 1998	County-level population growth as reported in the Area Resource File.
Growth in physicians, 1988 – 1998	Growth in the number of physicians as reported in the Area Resource File which obtains the information from the American Medical Association's practitioner database.
Deflated income growth, 1988 – 1998	Per capita income as reported in the Area Resource File. As with other financial variables, income is deflated by the BLS price index for hospital services.

* All financial variables are deflated using the Bureau of Labor Statistics (BLS) price index for hospital services.