Effects of Contract Management on Hospital Performance

John E. Kralewski, Bryan Dowd, Laura Pitt, and Errol L. Biggs

The performance of contract-managed (CM) hospitals is compared to that of a set of internally managed hospitals matched on a variety of hospital and market area characteristics. The performance of the study hospitals was similar to that of the matches in the years before the onset of contract management. Among 12 performance indicators, only occupancy rates differed significantly in the two samples in the years before contract management. Occupancy rates were lower on average in the hospitals which later became contract managed. During the 3 years following the onset of contract management, the CM hospitals showed no improvement in productive efficiency but did show changes in the way services were priced. The ratio of gross patient revenue to total expense increased significantly in the CM hospitals relative to their matches. This increase also appears to be associated with an increase in net profits in the CM hospitals relative to their matches.

INTRODUCTION

Community nonprofit hospitals are turning increasingly to management by other hospitals or management firms as a means of achieving the benefits of multi-institutional arrangements without giving up their local autonomy and control. Consequently, during recent years the administration of these hospitals, through contract management by offsite organizations, has gained considerable momentum [1]. This

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John E. Kralewski, Ph.D. is Professor and Director of the Center for Health Services Research at The University of Minnesota; Bryan Dowd, Ph.D. is an Assistant Professor and Laura Pitt, M.P.H. is a Research Fellow at the Center. Errol L. Biggs, Ph.D. is Administrator of Presbyterian-Denver Hospital, Denver, Colorado. Address correspondence and requests for reprints to Professor Kralewski at Center for Health Services Research, University of Minnesota, 420 Delaware Street SE, Box 729, Minneapolis, MN 55455.

method of administration often provides a breadth and depth of management talent not readily available to single, independent institutions; thus, allegedly it greatly improves organizational performance [2]. Unfortunately, while the growth of contract management has been well documented [3,4,5] (and somewhat over described), few studies have been devoted to its impact on the performance of the managed hospitals.

Lewin and his colleagues [6] in a study of hospitals owned and managed by for-profit hospital systems found that they used fewer staff per occupied bed and had less costly fixed assets than matched independent nonprofit hospitals. However, the nonprofit hospitals had slightly lower costs per day, and Lewin concluded that "the investor-owned home office costs did not appear to produce offsetting economies." In a previous study of matched contract- and inhouse-managed nonprofit hospitals, Biggs, Kralewski, and Brown found few differences in performance [7]. Contract-managed hospitals had somewhat higher patient-day costs but the average length of stay was shorter; total cost per patient-stay, therefore, was slightly less than in the traditionally managed hospitals. Occupancy rates, number of employees per bed, and the ratio of payroll expenses to total expenses were comparable under the different management systems. Contrary to expectations, however, the contract-managed hospitals tended to offer a somewhat broader range of services, especially in the outpatient area.

While the Biggs et al. study provided important insights into the effects of different management systems on hospital performance, the lack of time series data limited the usefulness of the findings. Lacking precontract data, the authors were unable to assess the effects, if any, of contract management on existing performance trends in those institutions. Conceivably the contract-managed hospitals could have been operating at significantly lower performance levels than the matched institutions before entering into their contracts, and this, in fact, could have been a factor in their decision to choose that form of management. If so, contract management improved the performance of those institutions so that by the time of the study no differences were found.

This appears to be supported by a recent study conducted by Zuckerman et al. [8]. In a study of financial performance indicators in hospitals before and after contract management by nonprofit hospital systems, improved revenues and profitability were found after the contracts were initiated. Few changes, however, were found in other aspects of the hospitals' performances. It is, therefore, not clear whether the increase in profitability resulted from improvements in organizational performance or from creative accounting or pricing pro-

cedures. Furthermore, the lack of comparison with a control group of traditionally managed hospitals raises questions about the role contract management played in achieving the financial improvements.

The study reported in this article was designed to build on this previous work by assessing changes in performance measures of matched contract-managed and traditionally managed nonprofit hospitals before and after the contracts were executed. Hospitals were matched on the basis of size, geographic location, population base, average per capita income in the population base, ownership or control, and presence of a medical education program. A detailed description of the matching process had been reported earlier [7]. Data were collected on 20 matched pairs of nonprofit community hospitals distributed across the United States. Each pair consisted of a hospital managed by an externally controlled firm under a contract and a hospital managed traditionally. Data were collected on each hospital for a 6-year period, including the 3 years before initiation of contract management and the first 3 years that the contract was in effect.

Statistical analyses were carried out to determine the effects of contract management on various aspects of the hospitals' performance. The differences in performance before and during contract management were studied, as well as differences in contract- and non-contract-managed hospitals over time. Various financial indicators such as profit margins, markup, return-on-assets, and several revenue and expenditure ratios were used to evaluate performance. Production indicators such as staffing patterns, length of stay, occupancy rates, admissions, and bed capacity were also examined. Data for these analyses were obtained from American Hospital Association tapes.

THEORY AND ANALYTIC METHODS

Two separate behavioral models underlie the analysis. In the first, a hospital's decision to become contract managed is triggered by an absolute decline in performance. In the second model, the decision is triggered by a decline in performance relative to nearby hospitals with similar characteristics.

The hypothesis which follows from the first model is that performance measures in a number of hospitals will decline, on average, in the 3 years leading up to contract management, and will improve in the 3 years thereafter. The hypothesis which follows from the second model is that performance in the contract-managed hospitals declines relative

to the matched hospital for the 3 years preceding contract management, then improves relative to the match during contract management. Thus, testing the second hypothesis requires use of the matched sample data. A matched sample analysis also controls for national trends in hospital performance which could have affected the variables being studied. Only by comparing contract- to matched non-contract-managed hospitals can one verify the existence of improvement above and beyond that generated by a national trend.

The analytic methods used in an evaluation of this type are somewhat complex, and we, therefore, feel it important to provide the reader with a detailed description of the methods. The performance variables in the analysis are denoted Y_{ijt} and the explanatory variables are denoted X_{ijt} where:

i = the ith matched pair of hospitals, i = 1,2, . . . 20.
j = the contract-managed (j = 1) or non-contract-managed (j = 2) hospital.
t = the year of observation, t = 1,2 . . . 6.
t = 1,2,3 represents 3 years preceding the inception of contract management.
t = 4,5,6 represents 3 years subsequent to the inception of contract management.

Thus: Y_{ijt} = the observation of the dependent variable Y in the tth year in the contract (j = 1)- or non-contract (j = 2)-managed hospital of the ith pair of hospitals. t = 1,2, or 3 represents 3 years before contract management, and t = 4,5, or 6 represents 3 years during contract management. Contract management actually occurred sometime during year 3. We do not expect to observe any effects of contract management until the fourth year.

X_{ijt} = the observation of the explanatory variable (or vector of variables) in the contract (j = 1)- or non-contract (j = 2)-managed hospital of the ith pair of hospitals in the tth year.

It is important to note that while t = 1,2, . . . 6 represents the same years for both hospitals within a matched pair, t represents different years *across* pairs in cases where the contract-managed hospitals in the two pairs became contract-managed in different years. This type of indexing makes comparison of financial data difficult across hospitals since dollars in one year cannot be compared to dollars in another year without adjusting for inflation. To circumvent this problem, we constructed ratios of financial variables. The ratios allow for meaningful comparison of financial data between hospitals that became contract managed in different years without adjusting for inflation.

Using ratios cancels the effects of inflation only for "flow" varia-

bles, such as revenues and expenses, however. Ratios which include "stock" variables, such as assets which may be valued in ensuing financial statements at historical cost rather than at their current value, *are* affected by inflation, as discussed by Finkler [9]. Return on assets is one such ratio included in our analysis. Since the responding hospitals almost certainly valued assets at historical costs, we advise caution in interpreting return on assets as an indicator of performance.

In order to evaluate the full effects of contract management on hospital performance, we examined both the averages and the slopes of the performance variables for each of the matched hospitals before and during the contract-managed period.

We began our examination of slopes and averages using an analysis of covariance regression model. Not even relatively unrestricted specifications of the model fit the data well, however. As an alternative, we turned to the least restrictive form of the covariance model, separate equations for each hospital, allowing the maximum variance in slopes and intercepts.

AVERAGES

The difference in averages for the ith hospital in the contract-managed sample was defined as:

$$\Delta\bar{Y}_{i1.} = \frac{1}{3}\left(\sum_{t=4}^{6} Y_{i1t} - \sum_{t=1}^{3} Y_{i1t}\right)$$

To test whether the difference in averages before and during contract management was significant, we treated $\Delta\bar{Y}_{i1.}$ as a random variable from a normal distribution and used a t-test with $n-1$ degrees of freedom. Note that it would be incorrect to compare

$$\frac{1}{3n}\sum_{i=1}^{n}\sum_{t=4}^{6} Y_{i1t} \text{ to } \frac{1}{3n}\sum_{i=1}^{n}\sum_{t=1}^{3} Y_{i1t}$$

since the two samples would not be independent and the assumptions underlying the use of the t-test would be violated. (For a discussion, see Freund [10].)

When significant differences in averages were found in the contract-managed sample, we tested to see if the differences varied significantly from differences in the matched non-contract-managed hospitals. For the non-contract-managed hospitals, the change in averages from the first 3 to the last 3 years was defined as:

$$\Delta\bar{Y}_{i2.} = \frac{1}{3}\left(\sum_{t=4}^{6} Y_{i2t} - \sum_{t=1}^{3} Y_{i2t}\right)$$

We used the *t*-test to test for a significant difference in:

$$\Delta\bar{Y}_{...} = \Delta\bar{Y}_{.1.} - \Delta\bar{Y}_{.2.}$$

treating $\Delta\bar{Y}_{...}$ as a random variable from a normal distribution.

Examining averages alone could be misleading, since the average in the years before and after contract management could be the same, even though performance was declining, then increasing, or vice versa (see Figure 1a). On the other hand, there could be no improvement in the rate of change in performance after contract management, but averages could show a significant improvement (Figure 1b). If averages were lower during the contract management period than before contract management, one could conclude erroneously that contract management had a negative effect. As Figure 1c illustrates, however, contract management in fact might have ended the decline in performance. Thus, testing the hypothesis of "improved performance after contract management" using only averages increases the risk of both Type I and Type II errors.

Figure 1d shows that examining only slopes can be equally misleading. In Figure 1d, the slope of the performance variable is the same before and after contract management, but averages are significantly different. To resolve these problems, we compared estimated slopes of performance variables before and after contract management as well as averages.

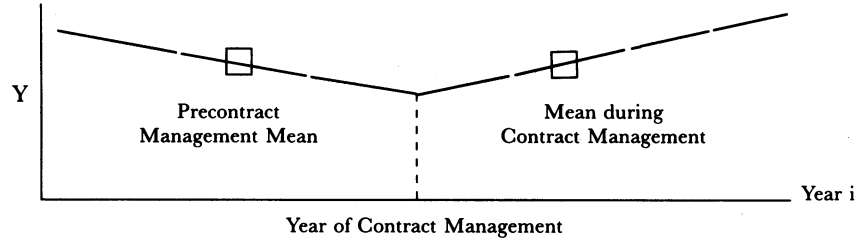
SLOPES

We calculated the ordinary least-squares (OLS) estimate of the slope for each hospital in the years before contract management and the slope for those hospitals in the contract-management years. Then we took the arithmetic difference of these two slopes for each hospital (Appendix). A *t*-statistic was used to test if this difference was significantly different from zero.

In the next step of the analysis we checked whether the slope differences in the contract-managed hospitals before and after execution of the contracts were significantly different from the slope differences in their non-contract-managed matches over the same period.

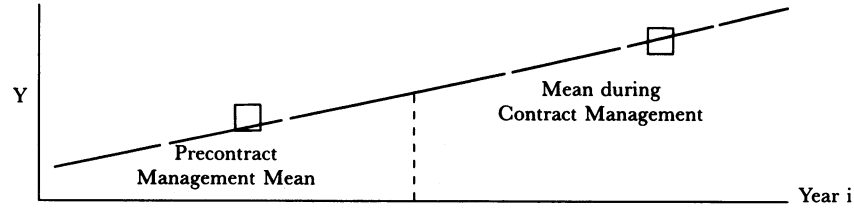
The empirical results of the analysis of the paired comparisons are to be interpreted with the same precautions as the results of the contract-managed-only analysis. Greater improvement in averages

Figure 1: Financial Performance Averages (1a, 1b) and Variables (1c, 1d): 3 Years Pre- and 3 Years Post-Contract-Management Initiation



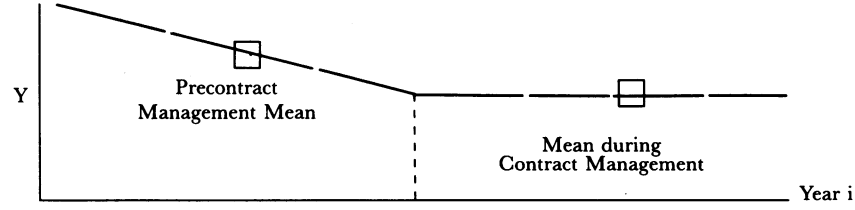
Year of Contract Management

Figure 1a



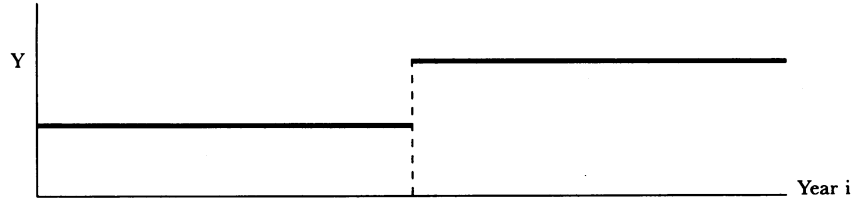
Year of Contract Management

Figure 1b



Year of Contract Management

Figure 1c



Year of Contract Management

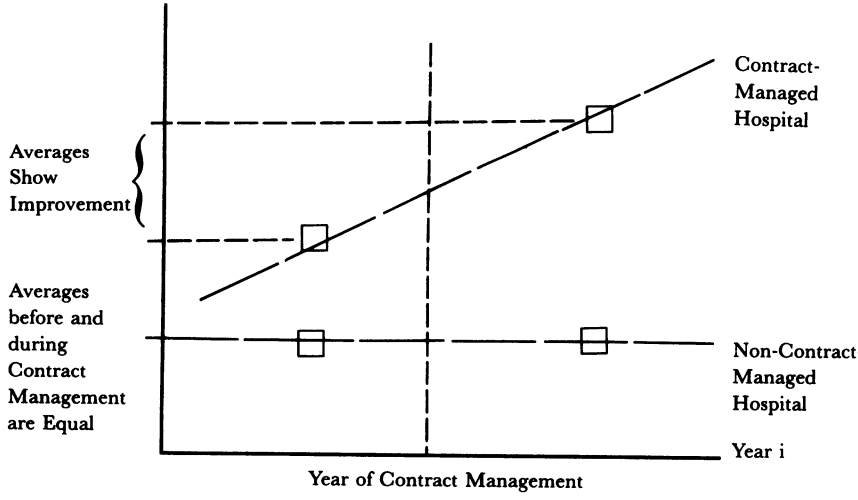
Figure 1d

alone would not necessarily be evidence of improvement. As the hypothetical case in Figure 2 illustrates, the situation could arise where the contract-managed hospital's average performance increased with no change in the slope of either the contract-management hospital or its match's performance during the period of contract management. Thus, statistical evidence would not be sufficient to attribute the difference in averages to the effects of contract management. If both slopes and averages or slopes alone showed significantly greater improvement in the contract-managed hospital, however, it could be concluded that the contract-managed hospitals had improved relative to the non-contract-managed hospitals.

EMPIRICAL RESULTS

The empirical analysis proceeds in three steps. First, we establish baseline reference data for the contract-managed hospitals. These data represent the hospitals' performance in the years before contract management. Next, we compare performance in the years preceding contract management to performance during contract management for the contract-managed hospitals. Finally, we compare the performance of

Figure 2: Improved Mean Values for Contract Managed Hospitals (Not Necessarily Attributable to the New Management if Slopes of Contract-Managed and Non-Contract-Managed Hospitals Do Not Change over Time)



the contract-managed hospitals to that of the matched hospitals during the pre- and postcontract periods.

The results are striking for some variables. Contract management is associated with significant changes in several performance variables, and these changes are significantly different from those observed in non-contract-managed hospitals.

In Table 1, the difference in contract-managed and matching hospital means of all the performance variables are compared for the pre-contract-management years. Only occupancy rate is significantly different in the two samples. Occupancy rates were higher on average in the matched hospitals. Table 1 shows that the matched hospitals are good controls in that, with the exception of occupancy rates, their *initial* levels of performance are not significantly different from those of the contract-managed sample.

Note that the results in Table 1 do not rule out the first behavioral model. That is, *average* performance could be identical in two hospitals even through performance was declining in one hospital and stable or improving in the other. Table 1 does tell us, however, that subsequent results in the analysis are *not* due to the starting of two hospitals in a matched pair at significantly different points on the performance scale.

Table 2 reports the slopes of the performance variables in the contract-managed hospitals in the 3 years before contract management. Only the slope of the "payroll-to-total expense" ratio was significantly different from zero (negative) in the years preceding contract management.

These baseline reference data allow us to evaluate the changes in slopes and averages in the contract-managed hospitals after contracts were executed (Table 3). These data also enable us to assess the degree to which these changes (if any) resulted from industry changes as reflected by the changes in the matched non-contract-managed hospitals (Table 4). Table 3 shows that the averages of 7 out of 12 variables were significantly different before and during the contract-management period. At the .05 confidence level, hospitals exhibited increased average markup, net profit ratios, and return on assets after becoming contract managed, although any change in return on assets must be interpreted cautiously since, as previously noted, assets are usually valued at historical cost. The ratios of payroll-to-total expenses and net patient-to-gross patient revenues declined significantly in these hospitals; the latter ratio indicating an increase in discounts, bad debts, and contractual arrangements. At the .10 confidence level, these hospitals exhibited a decrease in length of stay and an increase in the ratio of employees-to-inpatients.

Table 1: Difference in Performance Variable Averages in the Years before Contract Management (Contract-Managed Value minus Non-Contract-Managed Value)

Variable Name	*No. of Cases*	*Mean Difference*	t-*value*
1. Markup: Gross patient revenue / Total expense	16	-0.03	-0.68
2. Net profit: Total net revenue-total expense* / Total net revenue	17	-0.03	-1.07
3. Net patient revenue† / Total net revenue	17	-0.02	-0.81
4. Net patient revenue / Gross patient revenue	16	-0.01	-0.54
5. Number of employees / Number of beds	18	-0.07	-0.66
6. Payroll expense / Total expense	15	-0.01	-0.53
7. Length of stay	18	-0.60	-0.96
8. Employees‡ / Patients	18	0.03	0.17
9. Return on assets: Total net revenue-total expense / Total assets	15	-0.02	-0.93
10. Occupancy	18	-6.88	-2.11§
11. Beds	19	3.53	1.41
12. Admissions	18	-216.94	-0.56

*Total net revenue = net patient revenue plus other revenue from appropriations, contributions, grants and miscellaneous revenue.
†Net patient revenue = gross revenue from service to inpatients and outpatients minus deductions for contractual adjustments, bad debts, charity, etc.
‡Number of patients refers to average daily number of inpatients receiving care.
§Significant at the .05 level.

In the second stage of the analysis, we asked whether these significant differences in averages were accompanied by a significant change in slopes. Similarly, we asked whether insignificant differences in averages actually represented improvement with the effects masked by a change in slopes as shown in Figure 1a.

In Table 3, only one variable, the ratio of net patient-to-gross patient revenues, showed significant average *and* slope differences

Table 2: Slopes of the Performance Variables for Contract-Managed Hospitals in the 3 Years before Contract Management

	Variable Name	*No. of Cases*	*Slope*	t-*value*
1.	Markup: Gross patient revenue / Total expense	14	0.000	0.03
2.	Net profit: Total net revenue-total expense / Total net revenue	15	0.011	0.82
3.	Net patient revenue / Total net revenue	15	-0.010	-1.67
4.	Net patient revenue / Gross patient revenue	14	-0.001	-0.43
5.	Number of employees / Number of beds	16	-0.043	-0.72
6.	Payroll expense / Total expense	14	-0.025	-3.54*
7.	Length of stay	17	-0.148	-0.80
8.	Employees / Patients	16	-0.063	-0.85
9.	Return on assets: Total net revenue-total expense / Total assets	11	0.014	1.12
10.	Occupancy	17	1.747	1.13
11.	Beds	19	-0.500	-0.16
12.	Admissions	17	48.500	0.50

*Significant at the .05 level.

before and during contract management at the .05 level, indicating a *decline* in performance during contract management. At the .10 level, markup showed a significant increase in slope along with higher average values. The slope of the employees-to-beds ratio increased although the difference in average values did not. The performance of this variable is illustrated in Figure 1a, where slopes, but not averages, are significantly improved.

Since the variables in Table 3, which display significantly higher average values in the period during contract management, do not also exhibit increased slopes, one might suspect that the higher averages are due to the continuation of a trend that existed before the contracts were

Table 3: Difference in Performance Variables Contract-Managed Hospitals before and during Contract Management ("During Contract Management" minus "Before Contract Management")

	Variable Name	*No. of Cases*	*Mean Difference (after minus before)*	*t-value*
1.	Markup			
	$\frac{\text{Gross patient revenue}}{\text{Total expense}}$			
	Average	13	0.114	6.60*
	Slope	14	0.027	1.80†
2.	Net profit			
	$\frac{\text{Total net revenue–total expense}}{\text{Total net revenue}}$			
	Average	14	0.065	4.39*
	Slope	15	-0.006	-.36
3.	$\frac{\text{Net patient revenue}}{\text{Total net revenue}}$			
	Average	14	0.007	1.28
	Slope	15	0.012	1.70
4.	$\frac{\text{Net patient revenue}}{\text{Gross patient revenue}}$			
	Average	13	-0.027	-3.34*
	Slope	14	-0.011	-2.20*
5.	$\frac{\text{Number of employees}}{\text{Number of beds}}$			
	Average	16	0.087	.93
	Slope	16	0.097	1.99†
6.	$\frac{\text{Payroll expense}}{\text{Total expense}}$			
	Average	13	-0.050	-5.89*
	Slope	14	0.006	.63
7.	Length of stay			
	Average	17	-0.408	-1.86†
	Slope	17	-0.013	-.06
8.	$\frac{\text{Employees}}{\text{Patients}}$			
	Average	16	-0.179	1.93†
	Slope	16	0.143	1.40

Continued

Table 3: Continued

Variable Name	*No. of Cases*	*Mean Difference (after minus before)*	*t-value*
9. Return on assets			
$\frac{\text{Total net revenue-total expense}}{\text{Total assets}}$			
Average	10	0.062	7.47*
Slope	11	-0.006	-.43
10. Occupancy			
Average	17	2.840	.14
Slope	17	-2.055	-1.14
11. Beds			
Average	19	-0.67	-0.21
Slope	19	0.16	0.06
12. Admissions			
Average	17	106.80	0.58
Slope	17	31.60	0.36

†Significant at the .10 level.
*Significant at the .05 level.

initiated (such as that illustrated in Figure 1b). The hypothesis of an underlying time trend in markup, net profit, and return on assets may be ruled out, however, since we know from Table 2 that the slope of these variables was not significantly different from zero in the years preceding contract management. Thus, the significant difference in averages must be due to a change of the type illustrated in Figure 1d: a shift from one horizontal line to another of higher intercept. The decrease in the ratio of payroll-to-total expense could be due to a preexisting trend, however, since the slope of this variable was significantly negative in the years before contract management (Table 2).

To test whether the changes in the contract-managed hospitals were also occurring in the noncontract hospitals, we next compared the contract-managed hospitals to their matches for both the averages and slopes of the performance variables (Table 4).

The changes in average markup ratio, net profit, and return on assets were greater in the contract-managed hospitals than in the matched hospitals, while the difference in their slope changes was not significant. This finding indicates that a shift took place in these variables similar to that illustrated in Figure 1d in the contract-managed

Table 4: Changes in Performance of Contract-Managed Hospitals Relative to Matched Non-Contract-Managed Hospitals (Contract-Managed Value minus Non-Contract-Managed Value)

Variable Name	*No. of Cases*	*Mean Difference (after minus before)*	t-*value*
1. Markup			
$\frac{\text{Gross patient revenue}}{\text{Total expense}}$			
Average	10	0.065	2.03*
Slope	12	0.019	0.70
2. Net profit			
$\frac{\text{Total net revenue-total expense}}{\text{Total net revenue}}$			
Average	12	0.061	2.22*
Slope	13	-0.007	-0.34
3. $\frac{\text{Net patient revenue}}{\text{Total net revenue}}$			
Average	11	-0.014	-1.12
Slope	13	0.034	2.12*
4. $\frac{\text{Net patient revenue}}{\text{Gross patient revenue}}$			
Average	10	-0.028	-4.48†
Slope	12	0.007	-0.69
5. $\frac{\text{Number of employees}}{\text{Number of beds}}$			
Average	14	-0.229	-1.34
Slope	14	0.034	0.47
6. $\frac{\text{Payroll expense}}{\text{Total expense}}$			
Average	11	-0.007	-0.35
Slope	13	0.008	0.59
7. Length of stay			
Average	15	-0.643	-0.93
Slope	15	-0.184	-0.63
8. $\frac{\text{Employees}}{\text{Patients}}$			
Average	14	-0.162	-0.72
Slope	14	0.027	-0.23

Continued

Table 4: Continued

Variable Name	*No. of Cases*	*Mean Difference (after minus before)*	t-*value*
9. Return on assets			
$\frac{\text{Total net revenue-total expense}}{\text{Total assets}}$			
Average	8	0.070	2.39†
Slope	9	0.004	0.19
10. Occupancy			
Average	15	-12.40	-0.42
Slope	15	-2.32	-1.03
11. Beds			
Average	19	-4.90	-1.19
Slope	19	3.97	0.74
12. Admissions			
Average	15	-467.40	-2.43†
Slope	15	170.40	1.21

*Significant at the .10 level.
†Significant at the .05 level.

hospitals. The upward shift in contract-managed hospitals was greater than that exhibited by their matches.

The average of net-to-gross patient revenue showed greater decline in the contract-managed hospitals than in the matched sample. Neither the change in the average nor the slope of the ratio of payroll-to-total expenses differed significantly in the contract-managed and matched samples. This finding adds credibility to the hypothesis that changes in this variable observed in Table 3 are not due to contract management.

Two variables which were not significantly different before and during contract management in the contract-managed sample alone showed significant differences when the contract-managed and matched hospitals were compared. The ratio of net patient revenue-to-total revenue increased in slope more in the contract-managed hospitals than in the matched hospitals. The fact that the change in the contract-managed hospitals before and during contract management was not significantly different from zero indicates that this finding resulted from a large decline in the slope of the matched hospitals' performance during that period. Conversely, the matched hospitals

Table 5: Summary of Empirical Results

Variable	*Direction of Change*
Variables Affected by Contract Management and Direction of Change	
Markup = $\frac{\text{Gross patient revenue}}{\text{Total expense}}$	Increase
Net profit = $\frac{\text{Total net revenue-total expense}}{\text{Total expense}}$	Increase
Return on assets = $\frac{\text{Total net revenue-total expense}}{\text{Total assets}}$	Increase
$\frac{\text{Net patient revenue}}{\text{Gross patient revenue}}$	Decrease
Variables Unaffected by Contract Management	
Net patient revenue-to-total revenue	
$\frac{\text{Number of employees}}{\text{Number of beds}}$	
$\frac{\text{Payroll expense}}{\text{Total expense}}$	
Average length of stay	
$\frac{\text{Employees}}{\text{Patients}}$	
Occupancy rate	
Beds	
Admissions	

showed a significantly greater increase in average admissions during the study period than did the contract-managed hospitals, thus further improving the favorable position enjoyed before the contract periods. A summary of the empirical findings is displayed in Table 5.

DISCUSSION

The analysis of both the averages and slopes of performance indicators provides important new insights into the dynamics of contract management of community nonprofit hospitals by offsite firms. First of all, it appears that occupancy rates may have been a factor in the hospitals' decision to pursue contract management. As illustrated in Table 1, average occupancy rate was the only performance variable explored in this study which had significantly different (lower) values in the

contract-managed hospitals than in their noncontract counterparts during the 3-year period before the contracts were established.

None of the other performance variables explored in this study, including financial indicators such as net profit and return on assets, differed significantly in the matched pairs of hospitals before the management contracts were initiated. Therefore, although occupancy rates may have had some influence on the decision to seek contract management, it seems unlikely, given the homogeneity of the hospitals' financial positions, that occupancy rates played a pivotal role. Rather, we suspect that factors other than hospital performance may have played the major role in this decision. In either event, it does not appear that contract management significantly changed the average occupancy rates of the contract hospitals. However, performance of some financial indicators clearly improved in the contract-managed hospitals during the contract period relative to their noncontract counterparts. Both net profit and return on assets improved in the contract-managed hospitals (as indicated by mean differences in Table 4).

The pattern of results for the financial performance variables is particularly important. The slope of net profit and return on assets is not significantly different from zero in the years preceding contract management in the contract-managed hospitals, and it does not change significantly during contract management. However, the average of the variables differed significantly before and during contract management and between contract- and non–contract-managed hospitals. We conclude that the change in these averages must have resulted from an upward shift in the intercept of the slope (Figure 1d). In other words, it appears that a one-time change in these indicators occurred in the contract-managed hospitals at some time during the contract period. Since markup on services was the only other variable that increased in the contract-managed hospitals relative to the noncontract hospitals during this time period, it appears that any improvement in the financial health of hospitals associated with contract management resulted from marking up services at a greater rate than did the noncontract hospitals (Table 4). No evidence in these data suggests that contract management improved the efficiency of those hospitals by reducing expenses or expanding the quantity of services provided. Changes in staffing ratios, payroll expenses, length of stay, and admissions were not significantly different between the contract and noncontract hospitals before and after the contracts were initiated.

One variable, the ratio of net-to-gross patient revenue, decreased significantly more in the contract-managed hospitals than in the noncontract hospitals. On average, contract-managed hospitals were expe-

riencing a decline in the ratio of net patient-to-gross patient revenue before entering into contract management, and this trend accelerated during the contract-management period. Non-contract-managed matched hospitals had the same average ratio of net patient-to-gross patient revenue in the precontract period (Table 1) but differed during the postcontract period as the ratio declined in the contract-managed hospitals and remained relatively stable in the non-contract-managed hospitals. This indicates that the contract-managed hospitals either experienced an increase in bad debts, including charity care, during the contract period or initiated (or expanded) a discount program, possibly to improve admissions.

In summary, our results indicate that the primary effect of contract management in our sample hospitals has been to increase the markup ratio—the ratio of gross patient revenue-to-total expense. This increased revenue seems to be associated with increased net profit in the contract-managed hospitals relative to their matches and had a favorable effect on return-on-assets ratios. Apparently, not all of the increased billings have been collected, however, since the ratio of net patient-to-total patient revenue has declined in the contract-managed hospitals relative to their matches. The most disappointing finding, in our view, is that contract management does not appear to improve the hospital's productive efficiency. This implies that the management firms are unlikely to generate societal benefits. They may improve an individual hospital's financial health but only at the expense of those paying higher charges and higher insurance premiums. Ours is not an exhaustive list of variables, however, and perhaps management firms are able to achieve efficiency gains in areas other than those which we were able to measure.

APPENDIX

COMPUTATIONAL FORMULA FOR "SIMPLE SLOPES"

The formula for simple slope differences in this study is derived from the ordinary least-squares (OLS) estimates of the slopes in *each* hospital, before and during the years of contract management. Let Y_t be the value of a performance variable in the t^{th} year ($t = 1,2, \ldots 6$) and let t be the value of the year, used as an explanatory variable. For an individual hospital, the slope in the 3 years before contract management equals:

$$\frac{\text{cov}(Y,t)}{\text{var}(t)} = \sum_{t=1}^{3} \frac{(Y_t - \bar{Y})(t - \bar{t})}{(t - \bar{t})^2} = \frac{Y_3 - Y_1}{2} \quad (1)$$

Similarly, the slope in the years during contract management is $(Y_6 - Y_4)/2$ and the difference in slopes in the two periods ("during" minus "before") is:

$$1/2(Y_6 - Y_4 - Y_3 + Y_1) \quad (2)$$

This variable is computed for each of the i ($i = 1,2, \ldots 20$) contract-managed hospitals and a t-statistic is used to determine if the mean difference in slopes is significantly different from zero.

To compare the contract-managed hospitals to the matched sample, an identical variable is constructed for each of the non-contract-managed hospitals. The slope difference in each contract-managed hospital is then subtracted from the difference in its matched hospital. Thus, the relative difference in slope changes is:

$$1/2\{(Y_6^N - Y_4^N - Y_3^N + Y_1^N) - (Y_6^C - Y_4^C - Y_3^C + Y_1^C)\} \quad (3)$$

Where the superscript N denotes non-contract-managed (matched sample) hospital and C denotes contract management. Again, this variable is treated as a random variable from a normal distribution, and a t-statistic is used to test whether its mean is significantly different from zero.

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