

Capital Investment by Independent and System-Affiliated Hospitals

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Abstract

Capital expenditures are a critical part of hospitals' efforts to maintain quality of patient care and financial stability. Over the past 20 years, finding capital to fund these expenditures has become increasingly challenging for hospitals, particularly independent hospitals. Independent hospitals struggling to find ways to fund necessary capital investment are often advised that their best strategy is to join a multi-hospital system. There is scant empirical evidence to support the idea that system membership improves independent hospitals' ability to make capital expenditures. Using data from the American Hospital Association and Medicare Cost Reports, we use difference-in-difference methods to examine changes in capital expenditures for independent hospitals that joined multi-hospital systems between 1997 and 2008. We find that in the first 5 years after acquisition, capital expenditures increase by an average of almost \$16 000 per bed annually, as compared with non-acquired hospitals. In later years, the difference in capital expenditure is smaller and not statistically significant. Our results do not suggest that increases in capital expenditures vary by asset age or the size of the acquiring system.

Keywords

capital investment, capital access, health finance, hospital system

Introduction

Over the past 20 years, obtaining access to financial capital has become increasingly difficult for hospitals. After the phase-out of Medicare's retrospective reimbursement system for capital expenses, completed in 2001, the burden of meeting financing obligations fell squarely on the shoulders of hospital managers. The increases in managed care prevalence and declines in reimbursement mandated by the Balanced Budget Act of 1997 reduced the funding hospitals were able to generate internally and in doing so limited an important source of hospitals' investment capital. More recently, the credit crisis of 2008 and the simultaneous collapse of the auction rate security market, through which many hospitals borrowed, drastically increased borrowing costs for many hospitals.¹

Hospital managers struggling to maintain their facilities in a period of limited capital access have few options. Many hospitals that are unable to generate sufficient cash internally may manage to remain solvent by allowing their facilities to age, by foregoing prompt replacement and enhancement of equipment, facilities, and information technology.^{2,3} Managers and communities unwilling to accept this course of action have been advised to join multi-hospital systems in the hopes that doing so will help their hospitals gain access to much-needed capital. This advice is provided by hospital professional groups, hospital consultants, investment bankers, and even

managers of acquired facilities.⁴⁻⁹ Unfortunately, multi-hospital system membership comes with costs, including substantial transactions costs, higher market prices for hospital services, and a loss of community control.¹⁰⁻¹² Moreover, while proponents of multi-hospital systems have suggested that system membership can improve efficiency and reduce costs, research has failed to support these assertions.¹³⁻¹⁵ Currently there is scant empirical evidence available to guide policy makers and independent hospital boards as they weigh the benefits of multi-hospital system membership against its costs. To complicate matters, some acquiring systems have failed to provide capital funds to acquired hospitals despite contractual obligations to do so.¹⁶⁻¹⁸

Only three studies have examined the relationship between capital access and system membership. The results of these studies are mixed. Only one finds that system membership is associated with improved access to capital whereas

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two do not find a relationship between system membership and access to capital. Results from these studies may not generalize to the present health care environment as these studies use data from before the implementation of the prospective payment system for capital expenses^{19,20} or use system membership as a control variable rather than as the focus of the study.²¹

Our study focuses on the effects of system membership, in which formerly independent hospitals come under common ownership with other facilities. Acquisition by a system differs from a hospital merger because merging hospitals combine to operate under a single license, issue a single set of financial reports, submit to joint review by regulatory bodies, and may even combine physical facilities.^{14,22,23} Hospital systems can exist as either localized clusters of hospitals or larger, geographically dispersed groups of hospitals.²⁴ As a result, system membership is an option for hospitals in highly competitive markets as well as hospitals that are the sole providers of care to their communities. Mergers, however, are typically only an option for hospitals with a local competitor willing to merge. We focus on system membership because this is a strategy available to most hospitals, even those that lack a local competitor. It is likely that mergers and system acquisitions have different effects of capital investment, but we leave these differences as opportunities for future research.

Hypotheses

A hospital's access to capital is constrained when suppliers of capital either refuse to provide a hospital with capital or when capital suppliers demand a rate of return that exceeds the risk-adjusted return that would be demanded by a more efficient capital market. Actually measuring changes in access to capital is challenging and there has been substantial debate in the finance literature regarding how to best measure access to capital.^{25,26} For this article, we use changes in capital expenditures as proxies for changes in access to capital. Improved access to capital will either make new sources of funds available to hospitals or reduce the required returns hospitals demand from their own capital investments. If a hospital's demand for capital investment is downward sloping with respect to the cost of capital, reductions in the cost of capital should lead to increases in the quantity of capital investment. We acknowledge that capital investment is an imperfect measure of access to capital. Hospitals may, for instance, experience increases in access to capital but wait until several years after the improvement in capital access to invest. Similarly, hospitals may use improved access to capital to take on achieve optimal leverage without actually making additional capital expenditures. We feel that neither of these scenarios is likely given the relatively high demand for capital investments among hospitals during the study period.

The primary question this article seeks to answer is whether or not an independent hospital's decision to join a

system results in an increase in that hospital's capital expenditures. If changes in capital expenditures occur due to the acquisition, they may be larger in the period immediately after an independent hospital joins a system. For this reason, we allow the effect of system membership to differ between the first 5 years after acquisition and all subsequent years.

We also address two additional hypotheses concerning the characteristics of hospitals and systems most likely to experience increases in capital expenditures. We expect that the hospitals with the oldest facilities in the pre-acquisition period should experience the largest increases in capital expenditures. Similarly, we expect that large systems are more likely to have ready access to capital and that independent hospitals acquired by large systems are more likely to see improved access to capital than independent hospitals acquired by smaller hospital systems.

Data and Methods

To test these hypotheses, we use difference-in-difference models. These models compare the changes in capital expenditure for independent hospitals that join systems in a given year (the first difference) to the changes in capital expenditure among hospitals without a system-status change in that year (the second difference). We include hospitals without a system-status change (both independent and system-affiliated hospitals) to control for trends in capital expenditures that would have affected changing hospitals, even if they had remained independent. For instance, if capital expenditures among all hospitals increased because reimbursement became more generous over the time period studied, simply looking at changes in capital expenditure among acquired hospitals would not allow us to distinguish the effect of joining a system from the broader industry trend. This analysis relies on the assumption that if acquired hospitals had not joined systems, their capital expenditure trends would have been similar to capital expenditure trends among hospitals without a system-status change.

To determine whether capital expenditures change for independent hospitals joining multi-hospital systems, we test the following model:

$$Capex_{i,t} = \alpha + \beta_1 PostSys5 + \beta_2 PostSys6 + \beta_3 Market_{i,t} + \beta_4 Organization_{i,t} + Hospital_i + Year_t,$$

where *Capex* is capital expenditure for hospital *i* in year *t*. The binary variable, *PostSys5*, captures the effect of system membership in the first 5 years after a hospital is acquired. *PostSys6Plus* captures the effects of system membership in subsequent years. (We also tested a model with a single post-variable that captured all years after a hospital was acquired. The magnitude and significance of this single post-acquisition variable were similar to the magnitude and significance of the variable that captured the effect in the first 5 years after acquisition.)

We include time-varying controls for organizational and market characteristics of each hospital as systems may selectively acquire hospitals with organizational characteristics that make capital expenditure growth likely. We also include hospital-specific fixed effects to control for time-invariant factors affecting capital expenditures, for instance, variation in state certificate of need laws. Year fixed effects control for changes in capital markets and other time-varying factors that affect all hospitals. Year fixed effects account for inflation as well and so the values of financial data were not transformed to account for inflation. A sensitivity analysis using financial data adjusted for inflation using the Producer Price Index for general medical and surgical hospitals yielded similar results.

We test the subsequent hypotheses (that older hospitals and hospitals joining larger systems should experience greater increases in capital expenditures) using the same model presented above. However, in these models we allow the effect of system membership to vary by the age of an acquired hospital's assets and the size of the acquiring system. Model parameters are estimated using ordinary least squares. Estimated standard errors are robust to heteroskedasticity and account for clustering at the hospital level. (Difference-in-difference methods can result in standard errors that are smaller than they should be if outcomes are serially correlated. To address this concern, we also estimate standard errors and point estimates for our base model by ignoring time series information and collapsing the data into pre- and post-periods using the method described in Bertrand, Duflo, and Mullainathan.²⁷

Sample

Study data come from 2 sources, the American Hospital Association (AHA) hospital database (1996-2009) and Medicare Cost Report (MCR) records from 1996 to 2009. Non-acute-care hospitals are excluded from the study, as are hospitals that are federally owned and hospitals located in US territories outside the 50 US states. Hospitals owned by state or local governments are included as they may also join multi-hospital systems in search of capital. Hospitals with multiple system-status changes are excluded, because it is unclear whether these changes in system status represent real organizational changes or whether they are errors in the data.

Measures

Capital Investment and System Membership

Capital investment is measured as capital purchases per hospital bed and comes from the Medicare Cost Report Worksheet A7. For acquired hospitals, capital expenditures are scaled by the number of beds before acquisition so that our estimates are not inflated by hospitals that reduce their bed size after acquisition or diminished by hospitals that used capital expenditures to add bed capacity.

Table 1. System Acquisitions by Year.

Year	No. of acquisitions	No. of unique acquiring systems
1997	15	11
1998	36	27
1999	19	16
2000	15	13
2001	22	15
2002	7	6
2003	6	5
2004	9	8
2005	9	7
2006	9	6
2007	11	10
2008	10	9
2009	12	11
Total	180	91

Note. Acquisitions occurring in 2009 are included in the sample because capital expenditures made in the year of acquisition are considered to occur in the post-acquisition period.

Data on system status are taken from the AHA hospital database. Hospitals that joined systems were identified by changes in the hospital's AHA-assigned system status. These changes were cross-checked against annual lists of hospital mergers and acquisitions published by *Modern Healthcare* and the Hospital Acquisition reports published by Irving Levin and Associates. If neither the *Modern Healthcare* lists nor the Hospital Acquisition reports contained a record of the transaction, we looked for information about the transaction on the hospital's Web page and for online news coverage of the transaction. If none of these attempts yielded confirmation that the transaction occurred, the hospital was eliminated from the sample as it was impossible to determine whether and when a change in system status truly occurred.

Our sample includes 180 system acquisitions. Table 1 shows the number of acquisitions that took place in each year of the study period. We are able to include data from acquisitions for years up to 2009 (the end of our study period) because our outcome is a hospital's annual per bed capital expenditures. Acquisitions that occurred in 2004 have a full 5 years of data to use in calculating their average annual post-acquisition capital expenditures. Acquisitions that occurred in 2008 have only 2 years of post-acquisition data available to use in calculating their post-acquisition capital expenditures. Unfortunately, exact dates of acquisition are not available for most hospitals, and we assume that acquisitions take place on January 1 of the acquisition year, so the year of acquisition is the first year in the post-acquisition period.

Facility Age

Our measure of facility age is based on the average age of plant ratio, defined as accumulated depreciation divided by depreciation expense. Instead of using the continuous age of

plant measure, we create a binary facility age variable used in the model. The variable is determined by whether the changing hospital's age of plant is above or below the median age of plant (10.3 years) for independent hospitals with a BBB rating from Standard and Poor's in 2011. This measure is preferred to the continuous age of plant measure, as the effect of changes in plant age on capital expenditure is not likely to be constant and because it is not clear how large a change in the age of plant measure is required to signify a substantive change in a hospital's past ability to access capital. Using information from a bond rating agency allows us to identify a value of plant age which is likely to be associated with lower bond ratings and barriers to accessing capital. For changing hospitals, the hospital's average age of plant is calculated over the pre-change period so that changes in capital expenditure associated with joining a system do not affect the measure of hospital age.

System Size

The final hypothesis suggests that independent hospitals joining large systems should experience larger increases in capital expenditure than hospitals that join smaller systems. System size is measured as the number of hospitals affiliated with the acquiring system. This measure is transformed into a categorical variable as the effects of system size are unlikely to be constant with respect to system size. Categories include acquiring systems with 2 to 4 hospitals, 5 to 9 hospitals, 9 to 36 hospitals, and more than 36 hospitals. Without a compelling theoretical basis for defining size categories, we set cut-points such that each category would contain a roughly equal percentage of the sample of acquired hospitals.

Control Variables

Each model included other variables with the potential to affect capital investment, including market controls at the county level (median income, the percentage of county residents below age 65 without health insurance, urban or rural status, and the county's hospital Herfindahl-Hirschman Index). Most organizational characteristics are controlled for through the hospital-specific fixed effects included in the model. We include controls for bed size, critical access status, and ownership, as some hospitals experienced changes in these factors during the course of the study period.

Descriptive Statistics

Table 2 lists descriptive statistics for changing hospitals (before and after acquisition) as well as for independent and system-affiliated hospitals without a change in system status during the study period. The simple means suggest hospitals generally experience an increase in capital expenditures after being acquired by multi-hospital systems. Mean per

bed capital expenditures rise from \$40 549 per year in the pre-acquisition period to \$61 942 per year in the post-acquisition period.

Community characteristics for all categories of hospital are roughly similar, though system-affiliated hospitals are more likely to be located in metropolitan areas. It is surprising to see an increase in the proportion of acquired hospitals located in metropolitan areas from 67% in the pre-acquisition to 74% in the post-acquisition period. This may reflect the growth of certain metropolitan areas throughout the 14-year study period or that hospitals in metro areas were more likely to be acquired early in the study period and hence to have more post-acquisition observations. The proportion of investor-owned acquired hospital observations increased from 4% in the pre-acquisition period to 15% in the post-acquisition period, whereas the proportion of government-owned hospital observations declined from 15% to only 7%. Some of the acquired hospitals also appear to have gained critical access hospital designation after joining systems. Acquired hospitals appear to have older facilities during the pre-acquisition period than both independent and system-affiliated hospitals. This is consistent with the hypothesis that some independent hospitals have particular trouble accessing capital needed to update their facilities whereas other independent hospitals and system-affiliated hospitals do not share these challenges. Relatively small hospital systems were active in acquiring independent hospitals throughout the study period. In total, 57% of acquired hospitals joined systems with 9 or fewer affiliated hospitals even though systems of this size accounted for only 26% of all the system-affiliated hospitals that did not experience a change in system status during the study period.

We include several measures of financial health in the descriptive statistics to assess the possibility that acquired hospitals had greater financial reserves in the pre-acquisition period than other hospitals and that they may have been better positioned than other hospitals to increase their capital spending, even if they had not joined systems. The data do not support this possibility. In the pre-acquisition period, acquired hospitals have lower profitability than non-acquired independent hospitals (return on assets of 0.02 vs. 0.03). Moreover, acquired hospitals carry slightly more debt than independent hospitals (0.32 vs. 0.26) and have equivalent cash reserves (110 vs. 108 days cash on hand). Overall, acquired hospitals do not appear better positioned to fund increased capital spending than hospitals retaining independent status.

The financial health measures also suggest that acquired hospitals experienced a substantial increase in operating expense per bed (\$473 017 pre-acquisition compared with \$688 123 post-acquisition). It is not clear what caused this increase. This may reflect inefficiencies caused by the process of integrating an acquired hospital into a system. Some of the increase likely reflects inflation throughout the study

Table 2. Descriptive Statistics.

	Acquired hospitals		No change in affiliation	
	Pre-acquisition	Post-acquisition	Independent	System affiliated
No. of hospitals	180	180	1639	1580
Capital expenditure per bed (\$)	40 549	61 942	42 071	45 893
Market and organizational controls				
Hospital beds	168	211	137	199
Median income (\$)	43 540	46 460	40 900	43 070
Uninsured (%)	13.42	14.88	15.45	15.84
Metro area	67	74	42	65
Small urban area	28	20	30	22
Rural area	5	5	28	13
Herfindahl-Hirschman Index	0.59	0.52	0.70	0.53
Investor owned (%)	4	15	4	26
Government owned (%)	15	7	41	11
Not for profit (%)	80	78	55	63
Critical access status (%)	2	10	19	9
Facility age				
>10.3 years (%)	43	21	27	25
System size				
3-4 hospitals (%)	—	34	—	7
5-9 hospitals (%)	—	23	—	18
10-36 hospitals (%)	—	19	—	33
>36 hospitals (%)	—	23	—	42
Financial measures				
Return on assets	0.02	0.03	0.03	0.05
Operating expense (\$ per bed)	473 017	688 123	454 464	523 211
Long-term debt/total assets	0.32	0.36	0.26	0.34
Days cash on hand	110	82	108	71

Note. Financial variables are not adjusted for inflation. Year fixed effects are included in the regression account for the effects of inflation.

period. It is also possible, though by no means certain, that system affiliation results in an increase in operating expenses. Hospitals that were system affiliated throughout the study period also have higher operating expenses than independent hospitals. Future research should more thoroughly address the relationship between changes in operating expenses and system affiliation.

Results

Baseline results are listed in Table 3. Model 1 suggests that in the first 5 years after an independent hospital joins a system, it experiences on average a \$15 927 increase in capital expenditures per bed, relative to hospitals that did not change their system status. This is a 39% increase relative to mean pre-acquisition capital expenditures (\$40 549 per bed annually), and the difference is statistically significant ($P = .025$). As predicted, the vast majority of the increase in capital expenditures is concentrated in the first 5 years after acquisition. After this period, acquired hospitals still experience a \$5726 per bed change in capital expenditure relative to non-changing hospitals. This change in later years is statistically

insignificant ($P = .42$). The results associated with the control variables in all models are generally as expected. Critical access status and median income are associated with higher capital expenditures. Larger hospitals (measured by bed size) have fewer capital expenditures per bed than smaller hospitals. This suggests that capital expenditures may be subject to economies of scale.

Model 2 permits the effect of joining a system to differ for hospitals with relatively old assets and those with newer assets. The results do not support the hypothesis that hospitals with the oldest assets and, presumably, the most opportunity to benefit from increased access to capital, experience the largest increases in capital expenditures. Hospitals with relatively old assets do experience an increase in capital expenditures in the first 5 years after joining a system, but there is not a statistically significant difference in the changes experienced by the 2 groups of hospitals. We replicated this analysis using a more extreme cut-point to define the group of relatively old hospitals, and the results were similar to those presented in Table 2; hence, the results do not appear to be sensitive to our specific definition of “old” facilities. As in the previous model, changes in capital expenditures occurring in

Table 3. Effect of system membership on capital expenditures.

	Model 1	Model 2	Model 3
Change in capital expenditures			
Post-acquisition			16 968** (7930)
5 years post	15 927** (7107)	18 459*** (7099)	
6+ years post	5726 (7166)	16 299 (11 106)	
Changes by age of assets			
Old assets × 5-year post		-4747 (9198)	
Old assets × 6-year post		-19 813 (12 124)	
Changes by system size			
Post, 5-9 hospitals			-10 167 (11 651)
Post, 10-36 hospitals			-1482 (15 292)
Post, >36 hospitals			-5490 (18 194)
Control variables			
Critical access	5963* (2554)	5835* (2550)	6085** (2553)
Median income	0.065** (0.031)	0.065** (0.031)	0.064** (0.031)
Percent uninsured	-55 (287)	-60 (287)	-52 (287)
Urban	-135 655 (164 441)	-135 752 (169 367)	-135 785 (169 362)
Rural	-144 981 (170 744)	-154 107 (170 739)	-145 174 (170 737)
Herfindahl-Hirschman Index	21 784 (17 058)	22 221 (17 076)	21 874 (17 058)
Bed size	-89*** (14)	-90*** (14)	-88*** (14)
Investor owned	-3436 (6017)	-3273 (6021)	-3151 (5714)
Government owned	5237 (4440)	5120 (4440)	5443 (4449)
Constant	69 392 (76 076)	69 246 (77 623)	69 363 (77 637)
Hospital fixed effects	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes

Note. Heteroskedasticity robust standard errors are given in parentheses.

* $P < .10$. ** $P < .05$. *** $P < .01$.

periods more than 6 years after acquisition are large but statistically insignificantly different from zero.

The final model allows the effect of joining a system to differ based on the size of the system the acquired hospital joins. The results are counter to the standing hypothesis. Hospitals that join systems of fewer than 5 hospitals experience an annual \$16 968 increase in capital expenditures per bed ($P = .03$). We

found no evidence that hospitals joining larger systems experienced different changes in capital expenditures. Moreover, the point estimates suggest that hospitals joining larger systems have changes in capital expenditures that, while still positive, are between \$1000 and \$10 000 smaller than this, though these estimates are not statistically significantly different than the increases for hospitals joining smaller systems.

Discussion

This study finds that, on average, independent hospitals that join systems do experience increases in capital expenditures. This is consistent with the notion that system membership improves access to capital for acquired hospitals, either by opening up sources of debt or equity previously unavailable to the acquired hospital or by reducing the cost of borrowed funds. However, the results are consistent with at least 3 other explanations. First, system membership may bring new investment opportunities for acquired hospitals, for instance, new service lines. Although possible, we believe this is an unlikely driver of capital expenditure increases because the majority of the increase in capital expenditure occurs in the first 5 years after acquisition and because integrating an acquired hospital into a hospital system is typically a challenging endeavor. A second possible explanation for the increase in capital expenditures is that these expenditures represent the costs associated with integrating an independent hospital into a system. Integration costs could include expenses like new signage or the purchase of new information technology systems to upgrade or replace the independent hospital's existing systems. This is possible and consistent with the fact that the largest capital expenditure increases occur relatively soon after acquisition. A third explanation for the increase in capital expenditures is that system membership increases an acquired hospital's market power or negotiating expertise; as a result, an acquired hospital's existing investment opportunities become more profitable. Several studies have shown an association between price increases and system membership.^{10,14}

Initially, we hypothesized that certain groups of hospitals would have greater increases in capital expenditures than others. We hypothesized that hospitals with older assets would have the greatest demand for capital investment and that hospitals joining larger systems would enjoy greater increases in capital availability than those joining smaller systems. As a result, we expected both groups of hospitals to enjoy larger than average increases in capital expenditures. Our results do not support the idea that these differences exist. Instead, our results suggest the processes that relate system membership to capital expenditure are more nuanced than reports in the hospital trade press suggest.

The fact that hospitals with relatively old assets had similar changes in capital investment to hospitals with newer assets is consistent with the idea that much of the increase in capital investment funds costs of integration. If this is the case, the question becomes, "How much of this expenditure goes toward purchases that will improve access to care or the quality of care offered and how much of this expenditure will simply standardize work systems across the multi-hospital system without much affecting quality or access?" An alternative to the integration cost explanation is that hospitals with older and newer assets have similar levels of demand for capital investment but that they differ in the kinds of

investments required. Perhaps newer facilities spend capital to fund new growth opportunities while relatively older facilities use capital to fund renovation and maintenance.

The lack of evidence that hospitals acquired by larger systems have larger increases in capital expenditures suggests some commonly held ideas about system membership and capital access may be incorrect. Perhaps capital market benefits that system size has been assumed to generate, such as economies of scale in borrowing due to lower default risks, do not actually exist. Alternatively, hospital systems size may confer capital market benefits, but these benefits may be exhausted after modest increases in system size so that even relatively small hospital systems fully enjoy the benefits of improved access to capital. Another possibility is that larger systems do enjoy greater access to capital than smaller ones but that there are other factors which limit an acquired hospital's ability to accrue these benefits. For instance, larger systems may be more reluctant to allocate this capital to newly acquired facilities than smaller systems. This would be the case if larger systems have less information about the local market conditions and investment opportunities available to acquired hospitals.

A final possibility is that changes in capital expenditure do differ by subgroup but that our methods do not allow us to detect those differences. This would occur if our sample were too small to capture the differences in capital expenditures, which have high year-to-year variability. Repeating this analysis using a larger sample of acquired hospitals would be telling. Unfortunately, limited available data make identifying acquired hospitals a challenge, and it is likely that our data include most of the independent hospitals that joined systems between 1997 and 2009. Our inability to find evidence of differences by subgroup could also relate to our definitions of asset age and system size, but this is not likely. We have experimented with alternative definitions of both "old" hospitals and alternative categories of system size. In all sensitivity analyses our results were similar to those presented here.

Limitations and Conclusion

These results suggest that system membership is associated with substantial increases in capital expenditure among acquired hospitals. This is good news for independent hospitals that are considering joining systems to relieve capital constraints. However, we did not find evidence that hospitals with older assets enjoy greater increases in capital expenditures or that acquisition by a large system affords greater capital expenditure increases than acquisition by a smaller system. We have detailed a few likely explanations for these counterintuitive results, but more research is needed to fully understand them. Further research is also needed to distinguish between the different explanations for the observed increases in access to capital (namely, that hospital systems membership improves access to capital, that capital

expenditures increases reflect the costs required to integrate acquired hospitals into the acquiring system, or that new investment becomes more profitable as a result of increases in contracting leverage). If system membership does relax capital market frictions, perhaps there are public policy interventions that can help overcome these frictions and allow independent hospitals to maintain their independent status and avoid the disadvantages of system membership. Alternatively, if increases in revenue and prices are responsible for the increases in capital expenditures, independent hospital boards should be conscious of these factors when deciding whether or not to join a system.

In addition, further research is required to understand the social welfare implications of increases in hospital capital expenditures. This type of investment could reflect the purchase of new equipment required to improve both access to care and the quality of care provided by acquired hospitals. However, the hospital capital expenditure may result in the creation of duplicative services that enable rivalry, as opposed to price competition. Such duplication could contribute to the growing cost of medical care.²⁸ This possibility is a concern as some not-for-profit hospitals are particularly vulnerable to agency problems that reduce the board's ability to effectively represent community stakeholders.²⁹ Future research should examine associations between increases in capital expenditures in acquired hospitals and other outcomes such as the quality of care provided by acquired facilities, access to care in the communities these hospitals serve, and area variation in health care expenditures.

This research faces several limitations. First, system membership is not exogenous and may be correlated with other factors affecting capital expenditures. Our research design controls for many factors that would affect hospital capital expenditures, and our data do not suggest that acquired hospitals are financially better prepared to increase their capital expenditures than control hospitals. Although it is possible our results are driven by factors other than independent hospitals' acquisition by systems, we believe this is unlikely. A second limitation is that in many cases, a system's motivation for acquiring an independent hospital may be unrelated to capital expenditures; for example, many acquisitions occur because a system wants to expand its market power or its geographic reach or because the system can improve an acquired hospital's operations. System motivation is likely an important determinant of changes in capital expenditures for acquired hospitals, and future research should give closer examination to these motivations. Finally, we could not confirm that the control hospitals, which include system-affiliated hospitals without a change in system status during the study period, did not join a system in the years immediately before the start of the study period. This may have biased our estimates, but we expect the magnitude of that bias is small (as the number of recently acquired hospital is probably small relative to the total number of system-affiliated hospitals) and the direction of the bias is

toward zero (as our results suggest that recently acquired hospitals would have higher capital expenditures than other hospitals in the control group).

Despite these limitations, this article contributes to the existing literature on system membership by using a design with strong internal validity to establish a link between system membership and changes in hospitals' capital expenditures. These results shed light on the benefits of hospital system membership and will be useful to independent hospital boards considering joining multi-hospital systems as well as policy makers tasked with regulating the growth of multi-hospital systems.

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