Hospital Systems and Bargaining Power: Evidence from Out-Of-Market Acquisitions*

MATTHEW S. LEWIS AND KEVIN E. PFLUM†

March 6, 2013

Competition analyses generally restrict their attention to how mergers alter concentration in the relevant consumer market. Studying hospital competition by focusing on the local patient market may be misleading, however, as multi-market hospital systems often play an important role in the price negotiations of their members with managed care organizations. We focus on out-of-market hospital mergers to investigate the cross-market effects of system membership on member hospital reimbursement rates. Based on acquisitions occurring across the United States during 2000-2009, we find that hospitals exhibit significant increases of around 30% in their net reimbursement rates after becoming affiliated with an out-of-market system compared to independent stand-alone hospitals. We find no evidence that the price effect results from changes in patient case-mix, the cost of providing care generally, or hospital quality. The findings reveal that systems can impact the market power of hospitals in ways that have not been considered in recent antitrust analysis.

I. Introduction

Over the last two decades the hospital industry in the United States has experienced an unprecedented wave of consolidation as numerous hospital mergers and acquisitions have resulted in significant growth in the role of hospital systems. Not surprisingly, there has been significant public concern that this consolidation has reduced competition, a notion that is particularly salient given the ever-escalating prices for health care services. In response, economists have undertaken a variety of different strategies to investigate how changes in market structure impact prices of hospital services. Traditional studies approached the formation of a system as a classic horizontal merger (e.g., Lynk, 1995;

* The authors thank Yaxuan He for excellent research assistance.

† Lewis: The Ohio State University, Department of Economics, 1945 N. High St, Columbus, OH 43210, lewis.1015@osu.edu. Pflum: University of Alabama, Department of Economics, Finance and Legal Studies, Box 870224, Tuscaloosa, AL, 35406, kpflum@cba.ua.edu.

Dranove and Ludwick, 1999; Keeler et al., 1999), analyzing the relationship between prices (i.e., reimbursement rates) and various measures of market concentration (usually the Herfindahl-Hirschman Index [HHI]). These studies simulated the impact of a merger between two hospitals in a market by estimating the price effect associated with the implied increase in the HHI. More recently, researchers (Town and Vistnes, 2001; Capps, Dranove and Satterthwaite, 2003) and antitrust authorities (Farrell, Balan, Brand and Wendling, 2011) have begun using more structural models that incorporate the fact that reimbursement rates are largely determined through bilateral negotiations between hospitals (or hospital systems) and managed care organizations (MCOs). These analyses estimate an empirical model of patients' hospital choice and then identify the market power of each hospital as a function of the amount MCO enrollees would be willing to pay for the option of being able to go to that hospital instead of their next best alternative if they are in need of hospital care.

Though the more traditional concentration-based approach and the structural bargaining-based approach are quite different, almost all of these studies share two important limitations. First, nearly all rely completely or very heavily on cross-sectional variation to estimate a relationship between market structure and prices, making it difficult to identify a true causal effect. In other words, very few take advantage of actual mergers when examining their competitive impact. Second, they all restrict their examination of the effects of system acquisitions and mergers to the local market, despite the fact that large regional and national hospital systems are becoming more common. Although it is often appropriate for competition analyses to restrict attention to the relevant consumer market, that may not be the case for hospital care as reimbursement rates are negotiated between hospitals and MCOs and multi-market hospital systems often play an important role in the negotiations of their member hospitals. Studies focusing only on local market structure ignore the potential price effects that may result if the bargaining power of member hospitals in these negotiations is influenced by their system affiliation.

In this study we directly investigate the cross-market effects that system membership

may have on the negotiated reimbursement rates of their member hospitals. Rather than attempting to specify and test a particular model of this cross-market system effect we utilize a difference-in-differences approach to examine the impact of actual system acquisitions and isolate the cross-market effect by focusing on out-of-market mergers that had no impact on the local market structure. Based on 113 such hospital acquisitions occurring across the United States during the years 2000-2009, we find that hospitals exhibit significant increases of about 30% in their net reimbursement rates after becoming affiliated with an out-of-market hospital system when compared with others that remained as independent stand-alone hospitals. We confirm that our results are not driven by systematic differences between hospitals that were chosen to be acquired and those that were not, and we show that the identified increases in reimbursement rates do not appear to be a result of changes in patient case-mix, the cost of providing care generally, or hospital quality. The findings reveal that systems can have a significant impact on the market power of hospitals in ways that have not been studied or taken into consideration in recent antitrust analysis. Moreover, the magnitude of the effects suggests that continued system growth could be a significant contributing factor to the rising costs of medical care.

The remainder of the paper is organized as follows. Section II presents a simple bargaining model and relates the approaches taken in the literature to the model. Section III describes the data we use in the analysis. Section IV describes the estimation strategy. The main results are presented in Section V. In Section VI we explore other explanations for the observed price effects. Lastly, Section VII concludes with some final remarks.

II. Hospital-MCO Bargaining

There exists an extensive literature studying the determinants of hospital reimbursement prices including the impact of hospital mergers (e.g., Dranove, Shanley and White, 1993; Lynk, 1995; Melnick, Zwanziger, Bamezai and Pattison, 1992; Connor, Feldman and Dowd, 1998; Simpson and Shin, 1998; Dranove and Ludwick, 1999; Keeler, Melnick

and Zwanziger, 1999; Cuellar and Gertler, 2005; Melnick and Keeler, 2007).[1,2] Following work by Brooks, Dor and Wong (1997), Town and Vistnes (2001) and Capps et al. (2003), however, empirical studies of hospital competition have increasingly adopted a structural approach by more directly incorporating a model of bargaining. This approach reflects the fact that reimbursement prices are unique to a hospital-MCO pair and established via negotiations between the two (e.g., Ho, 2009; Halbersma et al., 2010; Lewis and Pflum, 2012; Lee and Fong, 2012).[3] In this section we develop a simple bargaining model to illustrate how system membership can impact negotiated reimbursement rates and use it to motivate our empirical strategy.

A. A Simple Bargaining Model

Although there exist other models of bargaining that could be applied to hospital-MCO negotiations (Stole and Zweibel, 1996; Lee and Fong, 2012), the classic Nash bargaining model is sufficient to illustrate the ways in which system membership may impact a hospital's reimbursement price.[4] In the Nash bargaining game the players cooperate to choose the payment that maximizes their joint surplus. In this application, the surplus an MCO gains by accepting a contract with a hospital is the difference in the profit the MCO will make if that hospital is in its network of providers net the profit it would make if that hospital is not in its network of providers. Similarly a hospital's surplus generated by accepting a contract with an MCO is the additional profit it earns from being included in that MCO's network of providers. Let $\mathcal{M}$ represent the set of hospitals in MCO m's network of providers when MCO m and hospital h agree to a contract and let $\mathcal{H}$ represent the set

[1] Other work such as Robinson and Luft (1985), Luft et al. (1986) and French (1986) have examined how competition results in higher costs as hospitals compete for physicians via investments in technology.

[2] In addition to examining what hospital characteristics lead to higher reimbursement rates, a couple studies have examined what MCO characteristics lead to lower reimbursement rates. Sorensen (2003) examines how an HMO's ability to channel patients affects its ability to secure lower reimbursements and Wu (2009) considers the degree to which the hospitals' cost differential, the ability of MCOs to channel patients, and the excess capacity of hospitals contribute to the per diem price differential of hospitals.

[3] Although not focused on hospital-MCO negotiations Grennan (2013) similarly examines the prices established by negotiations between medical device manufacturers and hospitals by incorporating a structural bargaining model.

[4] Brooks et al. (1997), Capps et al. (2003), Halbersma et al. (2010), Lewis and Pflum (2012) and Grennan (2013) all utilize the asymmetric Nash bargaining model as the basis of their estimating equations. Outside of hospital markets Svejnar (1986) applied the asymmetric Nash bargaining model to labor markets and Draganska, Klapper and Villas-Boas (2011) applied the model to the German market for coffee.

of MCO provider networks to which hospital h belongs. The respective surpluses generated by MCO m and hospital h when they successfully negotiate a contract can then be expressed as:[5]

$$\text{(1a)} \quad \Pi_m(\mathcal{M}) - \Pi_m(\mathcal{M} \setminus h) = P(\mathcal{M}) - r_{h,m} D_h(\mathcal{M}) - \big[P(\mathcal{M} \setminus h) - r_{-h,m} D_h(\mathcal{M})\big],$$

$$\text{(1b)} \quad \Pi_h(\mathcal{H}) - \Pi_h(\mathcal{H} \setminus m) = r_{h,m} D_h(\mathcal{M}) - C_h\big(D_h(\mathcal{M})\big),$$

where $P(\mathcal{M})$ are the total premiums that can be collected by MCO m when it has network $\mathcal{M}$;[6] $P(\mathcal{M}\setminus h)$ are the total premiums that can be collected by m when it has network $\mathcal{M}\setminus h$; $r_{h,m}$ is the reimbursement price from m to hospital h; $r_{-h,m}$ is the average reimbursement payment to the other hospitals in MCO m's network; $D_h(\mathcal{M})$ are the number of patients insured by m who will choose h when h is in-network; and $C_h\big(D_h(\mathcal{M})\big)$ are h's additional costs from treating the patients that it attracts from MCO m.

The objective function for the asymmetric Nash bargaining game is simply the product of the two parties' surpluses weighted by their relative bargaining power and can be expressed as

$$\text{(2)} \quad \max_{r_{h,m}} \big[\Pi_m(\mathcal{M}) - \Pi_m(\mathcal{M} \setminus h)\big]^{1-\beta_h} \big[\Pi_h(\mathcal{H}) - \Pi_h(\mathcal{H} \setminus m)\big]^{\beta_h},$$

where β_h is hospital h's bargaining power vis-á-vis MCO m. The optimal reimbursement price is found by plugging (1a) and (1b) into (2) and taking the first-order condition with respect to the reimbursement price to get:

$$\text{(3)} \quad r_{h,m} = \frac{C_h\big(D_h(\mathcal{M})\big)}{D_h(\mathcal{M})} + \beta_h \left[r_{-h,m} + \frac{P(\mathcal{M}) - P(\mathcal{M} \setminus h) - C_h\big(D_h(\mathcal{M})\big)}{D_h(\mathcal{M})} \right].$$

The first term on the right-hand side of (3) represents the average cost of treating the

[5] As contract negotiations are time consuming and contracts are renegotiated infrequently, generally once every few years, we take the contract state of the market as given. That is, in describing the bargaining outcome we assume other hospitals or MCOs do not renegotiate their contract if hospital h and MCO m fail to establish a contract.

[6] Premiums are likely a function of the reimbursement price that insurers have to pay as well; however, to keep the model simple we follow the previous literature (e.g., Capps et al., 2003) in assuming that the premiums are only a function of the provider network.

$D_h(\mathcal{M})$ patients from MCO m that choose h over the other hospitals in m's network of providers. In addition to covering the cost of care, the hospital and MCO split the total surplus generated by the contract, with the hospital getting a share equal to β_h. The total surplus from the contact is the difference in the premium revenues the MCO receives net the cost of treating those patients and the amount the MCO would have to pay in reimbursements if the patients that choose hospital h had to choose among the other hospitals in m's provider network. The bracketed term on the right-hand side of (3) represents the per patient average of this surplus. For each patient from MCO m that h treats it will receive a markup over cost equal to the average surplus generated by the contract weighted by its bargaining power. For example, if the hospital has no bargaining power (i.e., $\beta_h = 0$), then the reimbursement price would equal the average cost of treating m's patients and the hospital would not earn an additional surplus by joining m's provider network. On the other hand, if the hospital has all of the bargaining power (i.e., $\beta_h = 1$), then it would extract all of the surplus generated by joining m's provider network and the MCO would not extract any additional surplus from the contract.

Expression (3) helps illustrate the variety of factors that impact a hospital's reimbursement price. For example, price is directly related to the cost of treatment. Hospitals that tend to treat sicker patients requiring more intensive treatments will receive higher average reimbursements per discharge. The expression also indicates that the reimbursements received by other hospitals will impact the negotiated reimbursement price since it affects the contract surplus. Essentially, the reimbursement prices for the other hospitals represent the opportunity cost associated with failing to reach an agreement. Higher reimbursement rates at competing hospitals allow a hospital to secure a higher rate for itself as well. The revenues earned by the MCO from premiums also impact the surplus, but only to the extent that the addition of hospital h allows m to set a higher premium (or attract more enrollees). By including a hospital in its provider network, an insurer is giving enrollees the option to seek treatment at that hospital.[7] Having the option to seek care at a particular hospi-

[7]Enrollees can still visit hospitals that are out of network, however, they will have to pay substantially higher coinsurance rates. In some cases they may have to pay the full amount billed by the hospital creating an enormous disincentive

tal may be very valuable to enrollees depending on how close of a substitute the other in-network hospitals are, and the MCO can extract some of that value through higher premiums. Hospitals that are perceived as particularly valuable or desirable to enrollees will generate the largest difference in premiums. In consequence, the surplus generated by a contract with these hospitals will be larger and they will have higher reimbursement prices, *ceteris paribus*.

While it is important to control for these different factors in our analysis, our primary interest is in assessing how system membership affects reimbursement prices. There are two main channels through which systems can impact the competitive environment. First, when two or more local hospitals merge to form a system, they typically offer MCOs an all-or-nothing choice with respect to their inclusion in the MCO's provider network. That is, the MCO must either agree to a contract that includes all of the system members or it does not agree and none of the hospitals are added to its provider network. The option value to enrollees of having access to all of those system members will be higher than the sum of the option values of having access to any one of the members given the others are in the MCO's network since enrollees cannot substitute between the hospitals when none are in-network. In negotiating as one, the system members improve their *bargaining position* by increasing the surplus generated by their inclusion. This change in bargaining position will occur whenever a system acquisition increases the concentration of hospitals in a patient market.

The second channel through which system membership can impact competition is by altering the *bargaining power* of a member hospital. A hospital's bargaining power identifies the proportion of the contract surplus that it will extract for itself. A hospital may get a bump in bargaining power by joining a system if the system pools its information giving the member hospital more information to use in the bargaining process; or a joining hospital may be able to exercise more bargaining power because the system shares the costs of creating a larger and more skilled team of contract negotiations.[8] Regardless of

to seeking care at out of network hospitals.

[8]The theoretical literature on bargaining have established other mechanisms by which parties will have different

the underlying mechanism, if system membership increases a joining hospital's bargaining power, then, without altering the concentration of hospitals in the local market, it will be able extract more of the surplus generated by joining an MCO's provider network resulting in a higher reimbursement price.

B. Discussion and Empirical Strategy

The traditional body of literature consists of classical price-concentration or structure-conduct-performance, analyses that have focused almost exclusively on local market concentration (i.e., bargaining position) effects. These reduced-form studies rely largely on HHI or local market share measures to capture the impact of market structure on prices (e.g., Melnick et al., 1992; Dranove et al., 1993; Lynk, 1995; Connor et al., 1998; Keeler et al., 1999; Cuellar and Gertler, 2005; Melnick and Keeler, 2007). In contrast, many of the structural studies such as Town and Vistnes (2001), Capps et al. (2003) and Ho (2009) utilize an option demand approach to estimate how mergers or changes in market structure impact the value MCO enrollees place on the option to visit each particular hospital.[9,10] In this approach, the negotiated reimbursement prices are assumed to vary proportionately with changes in this willingness-to-pay, implying that bargaining power is constant and unaffected by changes in market structure. As a result, if system membership also impacts prices by altering the hospital's bargaining power these reduced-form and structural studies will fail to capture the resulting price changes or mistakenly characterize them as being associated with a change in local concentration.

The main motivation of our empirical analysis is to identify whether hospitals that join out-of-market systems experience a significant increase in bargaining power. Melnick and Keeler (2007) discuss this possibility and present suggestive reduced-form evidence that the

amounts of bargaining power. For example, Fudenberg and Tirole (1983) and Sobel and Takahashi (1983) show that uncertainties in the value of a contract to the other party can weaken the uncertain party's bargaining power and Binmore et al. (1986) and Rubinstein et al. (1992) show that in a two-player bargaining game of strategic counteroffers the more risk averse player will have lower bargaining power.

[9]The approach taken by Ho (2009) differs in that she incorporates the value of hospitals to MCOs with data on MCO plan prices and network information to estimate hospital markups.

[10]Other structural approaches to estimating hospital price effects include Brooks et al. (1997) who estimate a structural model of hospital-MCO bargaining using the list-price and Medicare reimbursement rate for appendectomy pricing and Gaynor and Vogt (2003) who model markets as differentiated product oligopolies.

higher prices that system hospitals receive are a result of more than changes in local market concentration. Lewis and Pflum (2012) use a structural bargaining model to separately identify bargaining position from bargaining power and show that system hospitals have significantly higher bargaining power than non-system hospitals and that this bargaining power is increasing in system size. As both of these studies rely largely on cross-sectional variation, however, they are only able to establish evidence of a correlation between system membership and bargaining power.

So that we can more directly estimate a causal effect of system affiliation on bargaining power we examine the observed changes in reimbursement rates associated with actual system acquisitions using a difference-in-differences approach.[11] Rather than relying on a specific structural model to isolate a bargaining power effect from changes in bargaining position, we identify a bargaining power effect by focusing our investigation on out-of-market system acquisitions, which, because they do not alter the concentration of hospitals in the acquired hospital's local patient market, have no impact on bargaining position. The data also allow us to control for hospital characteristics like patient case-mix and the hospital's average cost of care to assure that any changes in hospital operation that might occur during a system acquisition and that might impact reimbursement rates are not being mistakenly interpreted as a change in bargaining power.[12] As a result, this approach allows us to provide the first direct empirical evidence that system affiliation can strengthen a hospital's bargaining power and allow it to command higher reimbursement rates, even when the system has no local market presence.

III. Data

We construct a panel spanning the years 1998 to 2010 using data from the American Hospital Association's (AHA) Annual Survey of Hospitals and the Centers for Medicare and Medicaid Services' (CMS). Data from the two sources are matched using the CMS

[11] There are a couple hospital merger case studies that also use a difference-in-differences approach to better identify a causal effect (Vita and Sacher, 2001; Tenn, 2011), but both these studies examine the price impact of a particular merger between local competitors, so do not consider broader bargaining power effects.

[12] In fact, we find very little evidence of significant changes in hospitals' patient care operations following mergers with out-of-market systems. These findings are discussed near the end of Section VI.A.

Medicare provider numbers and observations are at the hospital-year level.

Hospital system status come from the AHA annual survey of hospitals, 1998-2010. The AHA annually surveys all of the approximately 6,000 hospitals within the U.S. and its territories soliciting information such as system membership, ownership type, and service offerings. We only consider hospitals from the non-territorial United States that provide general short term care. A hospital is only included in our analysis if it was never part of a system during our sample period, or is observed to have joined a system during the period from 2000–2009 and remained in a system for the rest of the sample period. This selection assures that sample includes at least two years of observations before a hospital joins a system and at least two years of observations in a system.

When hospitals are acquired by systems we want to distinguish between those that operate in patient markets in which that system has no presence—out-of-market acquisitions—and those that operate in patient markets in which the acquiring system already has other member hospitals—in-market acquisitions. Identifying patient markets is often done by examining patient flow data (e.g., Melnick et al., 1992; Melnick and Keeler, 2007; Capps et al., 2003); however, as we do not have discharge data for all of the hospitals in the sample we simply categorize hospitals as belonging to the same patient market if they are within 45 miles from one another.[13] Distance is calculated as the straight-line distance between hospitals' latitude and longitude. Figure 1 reports the number of out-of-market and in-market system acquisitions from 2000 to 2009.

All Medicare-certified hospitals are required to submit an annual cost report to CMS. The data from the reports are maintained in the Healthcare Cost Report Information System (HCRIS) and are available for download by the public on the HCRIS website at cms.gov. HCRIS contains information on hospital utilization and financial information such as Medicare payments, charges, and operating expenses. HCRIS reports the total gross charges by

[13]Based on the discharge abstracts for 2000-2010 provided by the California Office of Statewide Health Planning and Development, much less than 1% of each hospital's demand would also select the other hospital in California when those hospitals are about 45 miles apart suggesting that the two hospitals combined would have an extremely small impact on their bargaining position. A more precise market definition is not needed in this context since we are not utilizing any measures of market share or concentration.

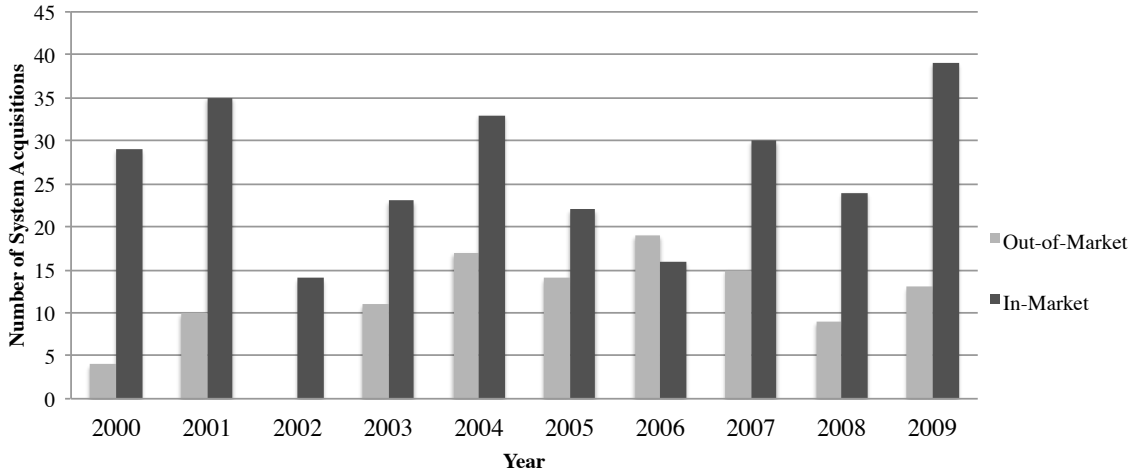

FIGURE 1. TIMING OF SYSTEM ACQUISITION BY TREATMENT GROUP, 2000-2009

a hospital for a variety of inpatient and outpatient care services such as general routine care, intensive care, and ancillary services.

The gross charges represent the revenue the hospital would receive if it was paid its list price; however, as Medicare and Medicaid pay a fixed rate and most insurers negotiate special rates that are less than the list price, a hospital receives its list price for very few, if any, discharges. A rough estimate of a hospital's true prices can still be made, though, as HCRIS also reports hospitals' total contractual deductions from list price. An estimate of the average price per discharge for a hospital in a given year can be generated by first multiplying a hospital's gross revenues from inpatient care by the ratio of the hospital's total net revenues to gross revenues and subtracting from this all of the revenue the hospital can attribute to inpatient care for Medicare patients. This represents an estimate of the total net-revenues from non-Medicare inpatient care. Next, an average price per discharge can be generated by dividing the net inpatient revenue from non-Medicare patients by the total number of non-Medicare discharges. A detailed description of the price derivation we use is provided in Appendix A. To eliminate outliers generated by data entry errors we trim the upper and lower tails at the 2.5th and 97.5th percentiles of the distribution for the dependent

variable. We test the robustness of the results to the trimming levels by also performing the analysis with data that has not been trimmed and with data that has the upper and lower tails at the 5th and 95th percentiles. The trim levels did not have a substantive impact on the results and the estimates from these analyses are reported in Appendix B.

When the average price per discharge is calculated in this way, it will be biased by several factors. First, the ratio of a hospital's total net revenues to gross revenues is distorted by the Medicare and Medicaid patients treated by the hospital. As the Medicare and Medicaid payments are independent of whatever list price a hospital may establish, any changes in list price that are related to system status will bias the discount. Second, HCRIS does not report Medicaid revenues. Hospitals that treat more Medicaid patients will appear to have a lower price and any change in the price negotiated with private payers associated with system membership will be dampened by the Medicaid payments, which will not change. To mitigate some of this bias we include only those hospitals in which at least 10% of their patient population is privately insured (about 2% of the sample are outside of this threshold). The next section describes the other approaches we take to deal with the bias generated by the Medicare and Medicaid patients. Table 1 reports the summary statistics for the panel.

Lastly, we utilize the Medicare case mix index (CMI) assigned by the CMS to help control for differences over time in the illness severities of the patient population treated by a hospital. The CMI measures the relative weight for all of the Medicare discharges at a hospital for a given year and represents the differences in clinical complexity and resource use required to treat discharges belonging to different diagnosis-related groups (DRGs). The CMIs are collected from Medicare's inpatient prospective payment system final rules which are also available online at cms.gov.

IV. Estimation

Our empirical analysis uses a difference-in-differences approach to identify how a hospital's reimbursement rate changes as a result of becoming affiliated with a hospital system. The main treatment group, T1, consists of the 113 stand-alone hospitals that become affili-

TABLE 1—HOSPITAL SUMMARY STATISTICS

	Full Sample ($N = 16,256$)			
	Mean	Standard Dev.	Min.	Max.
Log(Price/Discharge)	8.707	0.845	0.101	16.79
Log(Price/Day)	7.326	0.819	-0.964	16.35
Log(CMI)	0.268	0.195	-1.242	1.122
Log(Length of Stay)	1.369	0.514	-6.167	8.956
Log(Cost/Day)	7.507	0.531	4.904	16.83
% Private	0.383	0.154	0.100	1.000
% Medicare	0.498	0.159	0	0.896
% Medicaid	0.119	0.101	0	0.840
% OP Revenue	0.480	0.168	0	0.999
	Hospitals Acquired by Out-Of-Market Systems ($N = 1,329$)			
	Mean	Standard Dev.	Min.	Max.
Log(Price/Discharge)	8.791	0.815	3.250	12.52
Log(Price/Day)	7.481	0.751	2.503	11.98
Log(CMI)	0.283	0.217	-1.242	1.054
Log(Length of Stay)	1.292	0.359	-0.754	3.302
Log(Cost/Day)	7.582	0.460	6.253	11.80
% Private	0.369	0.446	0.100	0.995
% Medicare	0.503	0.156	0.006	0.890
% Medicaid	0.128	0.101	0	0.820
% OP Revenue	0.477	0.168	0	0.990

Note: Summary statistics are based on the full sample used in the analysis before trimming the 2.5th percentile tails.

ated with a system that is completely out-of-market during our sample period. By definition these are hospitals that have no affiliated partner hospitals within their local market at any time before or after merger during the sample period.[14] For comparison purposes we also consider a second treatment group that includes the 266 stand-alone hospitals that join a system in which there are other same system members within the same patient market at the time they joined. In addition to a potential change in bargaining power these hospitals may also enjoy a strengthening of their bargaining position as they now negotiate reimbursement rates jointly with other local partners.

[14] An additional 15 hospitals join systems that are out-of-market, however, other hospitals within the same local market are observed to join the same system during the sample period. These hospitals are excluded from the treatment group as it may have been known that a hospital was going to join a particular system well in advance potentially violating the identification assumption.

Our model for estimation can be expressed as:

$$r_{ht} = \alpha + \beta_1 T1_{ht} + \beta_2 T2_{ht} + d_{ht}\delta + g_{ht}\gamma + \kappa_{ht} + \mu_t + \xi_h + \epsilon_{ht}, \tag{4}$$

where r_{ht} is hospital h's reimbursement price at time t; $T1_{ht}$ is an indicator taking the value of 1 when hospital h is in treatment group T1 and is in a system at time t; $T2_{ht}$ is an indicator taking the value of 1 when hospital h is in treatment group T2 and is in a system at time t; the $j \times 1$ vector d_{ht} represents characteristics of hospital h's discharges at time t that impact the cost of care; the $k \times 1$ vector g_{ht} represents characteristics of hospital h's patient population at time t that may bias the estimated reimbursement price; κ_{ht} is an indicator variable that takes the value of one if hospital h joined a system in year t and zero otherwise;[15] μ_t are time controls (time trends or time fixed effects); ξ_h are hospital fixed effects; and ϵ_{ht} is a mean zero, heteroskedastic disturbance term capturing unobserved heterogeneity in hospitals' prices. We assume this disturbance, ϵ_{ht}, is independent across hospitals but may be correlated across years for a given hospital. The sample used for estimation includes all 1,127 general acute care hospitals that are not in a system at the beginning of our sample period, so the control group for our analysis becomes all hospitals that do not join a system at any time between 1998 and 2010.

The specification reported in (4) includes two groups of control variables. The d_{iht} includes the hospitals' CMI, average cost per inpatient day and average length of stay. Average cost per inpatient day is calculated by multiplying the hospital's total operating expenses by the ratio of gross inpatient revenues to total gross revenues and dividing by the number of inpatient days. All three controls capture different aspects of cost. The average length of stay captures differences in the cost of treatment that come from bed utilization. Some hospitals will tend to keep patients of the same illness severity longer than others, potentially impacting their average discharge price if they are paid a per diem for some of their discharges.[16] The CMI captures differences in the cost of treatment that come

[15]The change-year dummy is included because the timing of system acquisitions are not precisely known so the difference-in-differences compares reimbursement prices before merger to prices in the years following the merger.

[16]Per diems and sliding scale per diems are common payment arrangements between MCOs and hospitals. Other

from resource intensity differences related to other resources such as surgical time, more rigorous monitoring, and heavier staff utilization. With the inclusion of the other controls, the average cost per day captures differences in hospital efficiency that are unrelated to patient population illness severities and bed utilization.

The second set of control variables, the g_{jht}, are used to control for factors that will bias the measure of reimbursement price due to the limitations of the data used in its estimation. The HCRIS reports only an overall measure of contractual deductions from list prices that is aggregated across in- and outpatient revenues from all payer types. Gross charges are reported separately for inpatient and outpatient visits but not by payer type. As a result, our calculated measure of net inpatient revenue for privately insured patients will be distorted by the fact that the contractual discount measure is based partially on revenues from Medicare and Medicaid patients as well as revenues from outpatient care. The Medicare and Medicaid revenues will tend to distort the estimated net reimbursement rate downward since the government imposed reimbursement rates for these patients are typically lower than those for the privately insured. Similarly, if contractual discount rates for outpatient care systematically differ from those for inpatient care then our measure of inpatient net revenue will be biased the direction of the difference. We include the proportion of patients that are insured by Medicare and Medicaid as well as the proportion of gross revenues that outpatient revenues represent to help control for these distortions.[17]

In addition to biasing the calculated reimbursement prices, the treatment effects associated with a system acquisition are also likely attenuated by the presence of Medicare and Medicaid patients. As reimbursement rates paid by Medicare and Medicaid are set by the government, any increase in bargaining power resulting from system affiliation will impact only the share of patients that are privately insured. However, the data only allow us to calculate an average contractual discount based on all the hospital's patients. As a result, the extent to which the true treatment effect for privately insured patients will be reflected

arrangements include DRG payments, case rates and package pricing, capitation and straight discounts from list price (Kongstvedt, 2001).

[17]The HCRIS does not report the number of outpatient visits so the only measure of outpatient care available are the gross charges.

in the hospital's overall average net price measure will be proportional to the percent of revenue that comes from the privately insured. To illustrate the problem, consider the case in which gross charges remain unchanged after a hospital joins a system so that a price effect appears entirely through a change in the contractual discount. At one extreme, where privately insured patients represent an arbitrarily small proportion of the hospital's overall revenue, the increase in reimbursement price from those MCOs will have a negligible impact on the average discount factor. In consequence, it will appear as though there is no treatment effect. At the other extreme, where the hospital treats only privately insured patients, then any change in the negotiated reimbursement price will be fully captured in the average discount factor and the estimate of the average treatment effect will reflect the true effect for MCO patients.

To handle this potential source of bias we also estimate the model

$$r_{ht} = \alpha + [\beta_1 T1_{ht} + \beta_2 T2_{ht}] \times FracPrvt_{ht} + d_{ht}\delta + g_{ht}\gamma + \kappa_{ht} + \mu_t + \xi_h + \epsilon_{ht}, \tag{5}$$

where $FracPrvt_{ht}$ represents the fraction of a hospital h's inpatient discharges that are from privately insured patients at time t and the other variables are the same as in eq. (4). Since the treatment dummies are now interacted with the proportion of patients that are privately insured, the estimated values of β_1 and β_2 represent the true impact on a hospital's reimbursement prices from private insurance companies when it is acquired by a system.

The identification of treatment effects in our difference-in-differences model also relies on the assumption that stand-alone hospitals that do not become part of a system represent a valid counterfactual for how prices would have changed for hospitals in the treatment group had they not been acquired by a system. In particular we want to be sure that we control for both market-wide trends in prices and any differences in trends between the treatment and control groups that are not explained by observable hospital characteristics. Fortunately, as there is considerable variation in the years that our treatment hospitals are acquired by systems, we have considerable flexibility in how we control for differences in

time trends for the treatment and control groups.[18] We consider four different approaches of controlling for time trends: a common time trend, treatment-specific time trends, time fixed effects, and treatment-specific time fixed effects.

V. Results

The first set of results are reported in Table 2. The top panel reports the results of several specifications based on eq. (4), which have simple treatment dummies, and the bottom panel reports the results of several specifications based on eq. (5), in which treatment dummies are interacted with the proportion of a hospital's inpatients that are privately insured. The log of the average price per non-Medicare discharge is used as the measure of reimbursement price. All specifications include hospital fixed effects and a time trend. Specification A includes log CMI as a control for the case severities of the patient population treated by the hospital, specification B instead includes the log of the average length of stay to control for severity differences as well as the log of the average cost per inpatient day to control for the relative cost of treatment. Specification C includes these two controls as well as log CMI. Specifications D, E, and F add additional controls for the proportion of patients that are insured by Medicare and Medicaid as well as the proportion of a hospital's gross revenues that can be attributed to outpatient care.

The estimated treatment effect is somewhat dependent on which controls are included. For example, the price effect is least significant when only the CMI is included as a cost control, but is statistically significant at the 5 percent level or better when the length of stay and cost per day are also present. From the top panel, specifications B, C, E and F indicate that hospitals that join an out-of-market system experience a 5.5 to 7.5 percent increase in its reimbursement price. When we control for the attenuation created by the publicly insured patients by interacting the treatment dummies with the fraction of patients that are privately insured the estimates (in the bottom panel) indicate that hospitals experience a 17 to 22 percent increase in reimbursement price. The relative magnitude of these two sets of

[18] In these specifications, the counterfactual change in price for a hospital that has been acquired by a system becomes the average change in price that is observed at other hospitals that will soon be acquired or have recently been acquired by a system but were not acquired in this particular year.

TABLE 2—THE IMPACT OF SYSTEM MEMBERSHIP ON THE PRICE/DISCHARGE

Log(Price/Discharge)	A	B	C	D	E	F
T1	0.033	0.063^a	0.075^b	0.029	0.055^a	0.066^b
	(0.042)	(0.032)	(0.035)	(0.039)	(0.030)	(0.032)
T2	0.051^b	0.073^c	0.071^c	0.031	0.058^c	0.055^c
	(0.025)	(0.019)	(0.019)	(0.023)	(0.018)	(0.018)
Log(CMI)	0.583^c		0.226^c	0.516^c		0.232^c
	(0.094)		(0.074)	(0.083)		(0.063)
Log(Length of Stay)		0.834^c	0.960^c		0.832^c	0.910^c
		(0.029)	(0.021)		(0.027)	(0.020)
Log(Cost/Day)		1.146^c	1.251^c		0.949^c	1.039^c
		(0.043)	(0.038)		(0.041)	(0.034)
% Medicare				−0.322^c	0.456^c	−0.031
				(0.101)	(0.101)	(0.085)
% Medicaid				−0.382^c	−0.420^c	−0.342^c
				(0.108)	(0.098)	(0.077)
% OP Revenue				−2.635^c	−1.692^c	−1.686^c
				(0.103)	(0.090)	(0.096)
Adj. R^2	0.011	0.349	0.398	0.179	0.419	0.461
N	12976	14813	12976	12976	14813	12976

Log(Price/Discharge)	A	B	C	D	E	F
T1×% Private	0.118	0.188^b	0.218^b	0.100	0.170^b	0.188^b
	(0.092)	(0.078)	(0.085)	(0.081)	(0.074)	(0.080)
T2×% Private	0.179^c	0.214^c	0.212^c	0.108^b	0.169^c	0.159^c
	(0.049)	(0.037)	(0.037)	(0.045)	(0.036)	(0.036)
Log(CMI)	0.575^c		0.215^c	0.511^c		0.225^c
	(0.094)		(0.073)	(0.082)		(0.063)
Log(Length of Stay)		0.833^c	0.958^c		0.832^c	0.909^c
		(0.029)	(0.021)		(0.027)	(0.020)
Log(Cost/Day)		1.146^c	1.254^c		0.950^c	1.042^c
		(0.043)	(0.038)		(0.041)	(0.034)
% Medicare				−0.315^c	0.469^c	−0.019
				(0.102)	(0.101)	(0.086)
% Medicaid				−0.369^c	−0.400^c	−0.321^c
				(0.107)	(0.098)	(0.077)
% OP Revenue				−2.631^c	−1.686^c	−1.680^c
				(0.103)	(0.090)	(0.096)
Adj. R^2	0.013	0.351	0.400	0.179	0.419	0.462
N	12976	14813	12976	12976	14813	12976

Note: All specifications include a time trend and hospital fixed effects. Standard errors in parentheses are clustered by hospital. Significance Levels: a =p $< .10$, b =p$< .05$, c =p $< .01$

treatment effects is sensible given that, on average in our sample, only 38% of patients are privately insured.

Interestingly, the price effect for in-market system acquisitions is very similar to the out-of-market price effect, despite the fact that within market mergers can potentially

strengthen the hospitals' bargaining position as well as impact their bargaining power. This can likely be explained by the fact that within market mergers between neighboring hospitals or hospitals that are direct competitors are likely to be relatively rare as they face a very high probability of being challenged by antitrust authorities.[19] In fact, most of the within market mergers that we observe in our sample occur in larger cities or involve hospitals that are reasonably far from one other.[20] In these cases the market will not experience a substantial change in concentration and the merging hospitals will have only marginally improved their bargaining position. As an illustration of this fact we generated a rough measure of HHI based on hospital discharge shares within a 45 mile radius of the acquired hospitals. On average the acquisition resulted in an increase in HHI of around 0.0055, and for over 95 percent of the acquisitions the increase in HHI is less than 0.0100, well below the threshold for further scrutiny under the FTC merger guidelines.

Increases in the CMI, average length of stay, and average cost per day all result in higher prices. Including both CMI and length of stay reduces the point estimate for CMI by over 50 percent indicating that a higher bed utilization per discharge accounts for a sizable portion of the case mix cost. In fact CMI appears to account for very little of the variation in prices and the treatment standard error is at its largest when CMI is the only cost control. The fit of the model improves substantially when length of stay and average cost per day are included. Including the patient population characteristics (percents insured by Medicare and Medicaid, and the percent of gross charges attributed to outpatient services) further increases the fit, but not to the extent of the length of stay and average cost per day.

The impact that treating Medicare patients has on the reimbursement price is dependent on the other controls. When only CMI is included as a cost control, an increase in the proportion of Medicare patients treated at a particular hospital lowers that hospital's reimbursement price. In contrast the results indicate that an increase in the proportion of Medicare patients treated at a particular hospital will increase that hospital's reimburse-

[19]The Federal Trade Commission (2012) reports several proposed mergers of hospitals that were dropped after the FTC challenged them. Recent examples include the proposed acquisition of Prince William Hospital by Inova Health System (D. 9326) and OSF Healthcare System's proposed acquisition of Rockford Health System (D. 9349).

[20]The average distance between all in-market acquisitions is 22 miles.

ment price when the length of stay and average cost per day are used for the illness severity and cost controls. This can likely be explained by the fact that the proportion of a hospital's patients that come from Medicare is negatively correlated with the hospital's CMI and average cost. When all of the controls are included, there is no relationship between the proportion of patients that come from Medicare and the hospital's reimbursement price.

As expected, an increase in the proportion of patients insured by Medicaid results in a lower estimated reimbursement price. Since we are not able to net out Medicaid payments from the price calculation, their relatively low reimbursement rates will bring down the average price measure for the hospital. Controlling for the proportion of gross revenue that comes from outpatient care also appears to be important. The negative coefficient estimates on outpatient revenue share suggest that outpatient prices are discounted more heavily than inpatient prices.

Table 3 reports the results of estimating the model including all of the controls from specification F in Table 2 but using different time trend controls. Specifications A through D are based on eq. (4) and include simple treatment dummies while specifications E through H are based on eq. (5) and interact the treatment dummy with the proportion of inpatients that are privately insured. Specifications A and E include a simple annual time trend, specifications B and F allow for treatment specific-time trends, specifications C and G include year fixed effects, and specifications D and H include treatment-specific year fixed effects.

The estimates for these specifications are fairly consistent with one another; however, allowing for treatment-specific time trends or fixed effects generally doubles the magnitude of the treatment effects while increasing the standard errors by about 50 percent resulting in higher statistical significance. When treatment-specific time trends or fixed effects are included, the estimates indicate that hospitals joining out-of-market systems enjoy a 10 to 13.5 percent increase in reimbursement price when a simple treatment dummy is used (specifications B and D) and a 29 to 37 percent increase when we account for the attenuation in the treatment effect caused by the publicly insured discharges (specifications F and

TABLE 3—THE IMPACT OF SYSTEM MEMBERSHIP ON THE PRICE/DISCHARGE

Log(Price/Discharge)	A	B	C	D	E	F	G	H
T1	0.066^b	0.135^c	0.047	0.098^b				
	(0.032)	(0.046)	(0.032)	(0.047)				
T2	0.055^c	0.087^c	0.053^c	0.092^c				
	(0.018)	(0.024)	(0.018)	(0.022)				
T1×% Private					0.188^b	0.368^c	0.144^a	0.293^b
					(0.080)	(0.117)	(0.079)	(0.114)
T2×% Private					0.159^c	0.267^c	0.150^c	0.269^c
					(0.036)	(0.047)	(0.035)	(0.044)
Log(CMI)	0.232^c	0.232^c	0.096	0.096	0.225^c	0.221^c	0.091	0.088
	(0.063)	(0.063)	(0.062)	(0.062)	(0.063)	(0.062)	(0.061)	(0.061)
Log(Length of Stay)	0.910^c	0.910^c	0.909^c	0.910^c	0.909^c	0.909^c	0.909^c	0.909^c
	(0.020)	(0.020)	(0.020)	(0.019)	(0.020)	(0.020)	(0.019)	(0.019)
Log(Cost/Day)	1.039^c	1.039^c	1.017^c	1.018^c	1.042^c	1.043^c	1.020^c	1.022^c
	(0.034)	(0.034)	(0.034)	(0.034)	(0.034)	(0.034)	(0.034)	(0.034)
% Medicare	−0.031	−0.023	0.216^b	0.222^b	−0.019	0.004	0.225^b	0.244^c
	(0.085)	(0.085)	(0.090)	(0.089)	(0.086)	(0.085)	(0.090)	(0.089)
% Medicaid	-0.342^c	-0.342^c	-0.238^c	-0.237^c	-0.321^c	-0.304^c	-0.220^c	-0.203^c
	(0.077)	(0.077)	(0.079)	(0.078)	(0.077)	(0.076)	(0.079)	(0.078)
%OP Revenue	-1.686^c	-1.688^c	-1.727^c	-1.730^c	-1.680^c	-1.681^c	-1.721^c	-1.722^c
	(0.096)	(0.096)	(0.094)	(0.094)	(0.096)	(0.095)	(0.093)	(0.093)
Time Controls	Time Trend	Treatment Time Trends	Time FEs	Treatment Time FEs	Time Trend	Treatment Time Trends	Time FEs	Treatment Time FEs
Adj. R^2	0.461	0.462	0.502	0.502	0.462	0.463	0.503	0.504
N	12976	12976	12976	12976	12976	12976	12976	12976

Note: % OP Revenue represents the percentage of hospital gross revenues (charges) that are attributed to outpatient care. All specifications include hospital fixed effects. Standard errors in parentheses are clustered by hospital.
Significance Levels: a =p $< .10$, b =p$< .05$, c =p $< .01$

H). The differences in the treatment effects, T1 and T2, are not statistically significant at conventional levels.

Instead of regressing the average price of a discharge and including the length of stay to control for utilization differences, we can use the average reimbursement price per inpatient day as the measure of price. This is the same as using the average price per discharge and constraining the coefficient on length of stay to be one, which may not be an unreasonable assumption given that the point estimates for length of stay are all near one in Tables 2 and 3. Table 4 reproduces the specifications reported in Table 3 using the log price per inpatient day as the dependent variable. The point estimates on the treatment effects are slightly higher in all of the specifications resulting in slightly higher significance levels, but the results are qualitatively nearly identical to when log price per inpatient discharge is

TABLE 4—THE IMPACT OF SYSTEM MEMBERSHIP ON THE PRICE/INPATIENT DAY

Log(Price/Day)	A	B	C	D	E	F	G	H
T1	0.074^b	0.148^c	0.058^a	0.117^b				
	(0.031)	(0.047)	(0.031)	(0.048)				
T2	0.058^c	0.093^c	0.057^c	0.098^c				
	(0.019)	(0.025)	(0.018)	(0.023)				
T1×% Private					0.195^b	0.373^c	0.156^b	0.310^c
					(0.079)	(0.121)	(0.078)	(0.119)
T2×% Private					0.164^c	0.274^c	0.156^c	0.276^c
					(0.038)	(0.051)	(0.038)	(0.049)
Log(CMI)	0.215^c	0.216^c	0.073	0.074	0.208^c	0.205^c	0.067	0.065
	(0.065)	(0.065)	(0.065)	(0.065)	(0.065)	(0.065)	(0.064)	(0.064)
Log(Cost/Day)	1.043^c	1.043^c	1.023^c	1.024^c	1.045^c	1.046^c	1.025^c	1.027^c
	(0.034)	(0.034)	(0.034)	(0.034)	(0.034)	(0.034)	(0.034)	(0.034)
% Medicare	0.003	0.011	0.260^c	0.267^c	0.016	0.038	0.271^c	0.290^c
	(0.087)	(0.086)	(0.091)	(0.090)	(0.087)	(0.087)	(0.091)	(0.091)
% Medicaid	-0.365^c	-0.364^c	-0.256^c	-0.255^c	-0.342^c	-0.323^c	-0.236^c	-0.218^c
	(0.082)	(0.081)	(0.083)	(0.082)	(0.081)	(0.081)	(0.083)	(0.082)
% OP Revenue	-1.695^c	-1.696^c	-1.739^c	-1.741^c	-1.690^c	-1.690^c	-1.733^c	-1.733^c
	(0.095)	(0.095)	(0.093)	(0.093)	(0.095)	(0.095)	(0.093)	(0.093)
Time Controls	Time Trend	Treatment Time Trends	Time FEs	Treatment Time FEs	Time Trend	Treatment Time Trends	Time FEs	Treatment Time FEs
Adj. R^2	0.363	0.364	0.411	0.411	0.364	0.366	0.411	0.412
N	12976	12976	12976	12976	12976	12976	12976	12976

Note: % OP Revenue represents the percentage of hospital gross revenues (charges) that are attributed to outpatient care. All specifications include hospital fixed effects. Standard errors in parentheses are clustered by hospital.
Significance Levels: a =p $< .10$, b =p$< .05$, c =p $< .01$

used as the dependent variable.

After controlling for cost changes and allowing for systematic differences in price trends between treatment and control hospitals, our estimates consistently suggest that reimbursement rates for privately insured patients tend to increase by approximately 30% when a hospital becomes affiliated with a system—even if the system has no other members in that local market. While this effect is quite substantial, several previous studies have also found evidence that system hospitals enjoy a price premium of similar magnitude over non-system hospitals, even after controlling for differences in local market concentration. For example, Melnick and Keeler (2007) find that hospitals belonging to a large system enjoy prices that are about 34 percent higher than non-system hospitals and Lewis and Pflum (2012) find that system hospitals in California have stronger bargaining power than

non-system hospitals resulting in prices that are about 20 percent higher on average. Ho (2009) similarly finds that system hospitals have markups that are about $3,200 higher than non-system hospitals.[21] While these studies rely on cross-sectional data and are not able to explicitly identify a causal effect of system membership, our findings suggest that much of the observed price differences in these studies are likely to have been a direct result of system membership, rather than simply arising due to some type of positive selection effect.

VI. Robustness and Alternative Explanations

The findings of the previous section identify an important cross-market price effect of system formation that has not been heavily studied. This result suggests that, in addition to potentially increasing concentration in the local market, system affiliation significantly strengthens a hospital's bargaining power. In this section we consider several empirical tests that attempt to clarify the importance of bargaining power in explaining the observed price increases.

A. Cost of Care and Profit Margins

The price regressions in the previous section include measures of patient care costs (e.g., length of stay, cost per patient day) as control variables to assure that increases in observed reimbursement rates following a merger are not simply a result of an increase in the illness complexity of the patients they treat. However, patient care costs are a function of both the inherent illness complexity of the patient and the cost efficiency with which the hospital can provide treatment. As a result, one could interpret the treatment effects from our price regressions as indicators of how the profit margins of these hospitals change when they are acquired by a system.

If the cost efficiency of the hospital is relatively unaffected by the system acquisition,

[21] As Ho (2009) does not utilize hospital-level data it is not clear what the average price of a discharge was for the hospitals in her study, but in our national sample the average price of a discharge in 2002 (the year used in her study) was $14,200, suggesting that system hospitals had prices that were about 23% higher than non-system members having similar costs.

then an observed increase in profit margin largely translates to an increase in reimbursement rates. It is possible, however, that the increase in profit margin could be partially (or predominantly) driven by a reduction in costs, which would obviously have very different policy implications.[22] We can investigate this possibility further by separately estimating how treatment costs themselves appear to respond following a system acquisition. We use the same difference-in-differences approach as before with the average cost of care (by inpatient day or discharge) as the dependent variable:

$$c_{ht} = \alpha + \beta_1 T1_{ht} + \beta_2 T2_{ht} + d_{ht}\delta + g_{ht}\gamma + \kappa_{ht} + \mu_t + \xi_h + \epsilon_{ht}, \tag{6}$$

where c_{ht} is the measure of hospital average cost; the d_{ht} again represents characteristics of hospital h's discharges at time t that impact the cost of care; the g_{ht} represents characteristics of hospital h's patient population at time t; κ_{ht} is an indicator variable that takes the value of one if hospital h joined a system in year t and zero otherwise; ξ_h are hospital fixed effects; μ_t are time controls (time trends or time fixed effects); and ϵ_{ht} is a mean zero, heteroskedastic disturbance term capturing unobserved heterogeneity in hospitals' cost of care.

In the price specifications the patient population controls (% Medicare and % Medicaid) are used to control for biases in the estimated reimbursement price. With the hospitals' cost of care as the dependent variable, these controls capture the impact the patient populations have on the cost of care, which is important as hospitals may utilize fewer resources on some patient populations such as Medicaid patients. In consequence, treating a larger proportion of patients that are insured by Medicaid will lower the average cost of care. In contrast to the price specifications, we do not interact the treatment dummies with the share of privately insured patients. These interactions are unnecessary in the cost specifications as changes to the cost of treatment resulting from a system acquisition are likely to effect all patients while changes in bargaining power only impact the reimbursements

[22] Ho (2009) finds that, more generally, lower cost hospitals have a higher markup compared to high cost hospitals suggesting that the low cost hospitals have more bargaining power.

TABLE 5—THE IMPACT OF SYSTEM MEMBERSHIP ON AVERAGE HOSPITAL COST OF CARE

	Log(Cost/Day)				Log(Cost/Discharge)			
	A	B	C	D	A	B	C	D
T1	−0.015	−0.011	−0.015	−0.013	−0.018	0.002	−0.020	−0.002
	(0.020)	(0.023)	(0.020)	(0.024)	(0.019)	(0.022)	(0.019)	(0.022)
T2 >	−0.001	0.004	−0.001	0.001	−0.001	0.003	−0.002	0.000
	(0.012)	(0.014)	(0.012)	(0.014)	(0.011)	(0.013)	(0.011)	(0.013)
Log(CMI)	0.255^c	0.255^c	0.261^c	0.261^c	0.283^c	0.283^c	0.277^c	0.277^c
	(0.042)	(0.042)	(0.043)	(0.043)	(0.044)	(0.044)	(0.045)	(0.045)
Log(LOS)					0.327^c	0.327^c	0.327^c	0.327^c
					(0.029)	(0.029)	(0.029)	(0.029)
% Medicare	0.301^c	0.301^c	0.302^c	0.301^c	0.561^c	0.562^c	0.581^c	0.582^c
	(0.048)	(0.048)	(0.052)	(0.052)	(0.046)	(0.046)	(0.048)	(0.048)
% Medicaid	−0.060	−0.059	−0.070	−0.073	−0.033	−0.033	−0.036	−0.037
	(0.058)	(0.058)	(0.059)	(0.059)	(0.051)	(0.051)	(0.051)	(0.051)
Time Controls	Time Trend	Treatment Time Trends	Time FEs	Treatment Time FEs	Time Trend	Treatment Time Trends	Time FEs	Treatment Time FEs
Adj. R^2	0.284	0.284	0.290	0.291	0.329	0.329	0.336	0.337
N	13512	13512	13512	13512	13512	13512	13512	13512

Note: All specifications include hospital fixed effects. LOS: Length of stay. Standard errors in parentheses are clustered by hospital. Significance Levels: a =p $< .10$, b =p$< .05$, c =p $< .01$

from the privately insured. Estimation results from these cost regressions are reported in Table 5.

The estimated treatment effects for both in- and out-of-market system acquisitions are often negative but are very small in magnitude compared with the estimated increases in prices (or profit margins). In all specifications the treatment effects are close to zero and statistically insignificant. As expected, the case-mix and length of stay both increase costs of care while the cost of care for the Medicaid population tends to lower average costs and the cost of care for the Medicare population tends to increase average costs.

These findings suggest that the cost of care at hospitals that join systems is largely unchanged given the same patient population; however, there remains the possibility that the overall cost of care is still altered because of changes to the patient population. For example hospitals that join systems may experience a change in the case-mix of their patients or may attract a different proportion of patients who are publicly insured. To explore this final possibility we estimate similar models to (6) in which the dependent variable are patient population measures (CMI, length of stay, % Medicare, % Medicaid). Table 6 reports the

TABLE 6—THE IMPACT OF SYSTEM MEMBERSHIP ON INPATIENT CHARACTERISTICS

	Log(CMI)				Log(Length of Stay)			
	A	B	C	D	A	B	C	D
T1	0.007	0.013	0.004	0.007	−0.021	−0.012	−0.021	−0.017
	(0.010)	(0.010)	(0.010)	(0.010)	(0.020)	(0.023)	(0.020)	(0.022)
T2	0.011^b	0.006	0.011^b	0.007	−0.007	−0.019	−0.007	−0.017
	(0.005)	(0.005)	(0.005)	(0.005)	(0.014)	(0.017)	(0.014)	(0.017)
% Medicare	−0.011	−0.011	0.036	0.035	−0.627^c	−0.627^c	−0.627^c	−0.629^c
	(0.023)	(0.023)	(0.024)	(0.023)	(0.067)	(0.067)	(0.069)	(0.069)
% Medicaid	−0.051^b	−0.051^b	−0.022	−0.022	0.078	0.078	0.076	0.078
	(0.022)	(0.022)	(0.022)	(0.022)	(0.073)	(0.073)	(0.074)	(0.074)
Time Controls	Time Trend	Treatment Time Trends	Time FEs	Treatment Time FEs	Time Trend	Treatment Time Trends	Time FEs	Treatment Time FEs
Adj. R^2	0.010	0.011	0.046	0.045	0.028	0.028	0.027	0.027
N	14072	14072	14072	14072	14072	14072	14072	14072

	% Medicare				% Medicaid			
	A	B	C	D	A	B	C	D
T1	0.013	−0.004	0.016^a	< 0.001	0.004	0.006	0.004	0.009
	(0.008)	(0.009)	(0.008)	(0.009)	(0.008)	(0.008)	(0.008)	(0.008)
T2	0.010^b	0.001	0.010^b	−0.001	< 0.001	0.001	> -0.001	−0.001
	(0.005)	(0.005)	(0.005)	(0.005)	(0.004)	(0.004)	(0.004)	(0.004)
Time Controls	Time Trend	Treatment Time Trends	Time FEs	Treatment Time FEs	Time Trend	Treatment Time Trends	Time FEs	Treatment Time FEs
Adj. R^2	0.167	0.168	0.213	0.214	0.006	0.006	0.014	0.013
N	14072	14072	14072	14072	14072	14072	14072	14072

Note: All specifications include hospital fixed effects. Standard errors in parentheses are clustered by hospital.
Significance Levels: a =p $< .10$, b =p$< .05$, c =p $< .01$

results of these regressions.

The estimated treatment effects for both in- and out-of-market system acquisitions are generally very small in magnitude and fairly precisely estimated suggesting that there truly are no treatment effects. The only characteristic for which there is some evidence of a treatment effect is the proportion of patients that are insured by Medicare and it is effected by only the in-market acquisitions. However, the effect vanishes when treatment group specific time trends or year fixed effects (specifications B and D) are included. Together these findings suggest that the increases in profit margins enjoyed by a hospitals joining systems are not the result of reductions in treatment costs or changes in patient characteristics.

B. Hospital Quality

Another possible explanation for observing higher prices following a system acquisition might be that the acquired hospitals tend to improve their quality of care or the quality of their facilities allowing them to command higher reimbursement rates. Unfortunately we have no information on hospital quality, so we cannot directly control for these potential changes like we can for changes in cost of treatment or severity of the patient case-mix. However, any price increase that is facilitated by an improvement in quality of care must occur because the hospital is now able to attract more patients at any given price level. As a result, if quality improvements are largely responsible for observed price increases we should observe an increase in the number of patients visiting the hospital despite the fact that their prices have gone up. This is particularly true since insured patients' hospital choices are likely more responsive to quality of care (or attractive facilities) than they are to changes in price. On the other hand, if increases in bargaining power are the main driver of the price increases that follow system acquisition we should see little change in number of patients choosing the hospital, or, if anything, a reduction in patient discharges as insurers steer these enrollees to lower cost providers.

We once again adopt our standard difference-in-differences specification; this time to examine the effects of system acquisitions on the quantity of care provided. We consider two different measures of hospital output—the total number of discharges and the number of privately insured patient discharges—as well as several measures of the hospital's market share. Market shares are calculated as the hospital's share of all discharges observed at hospitals within a 45-mile radius and also within a 15-mile radius. Since we are using output measures instead of price as the dependent variable in these specifications we no longer need to include additional controls for patient care costs or patient mix, but we still consider a variety of different time trend and time fixed effects specifications to control for other factors affecting hospital usage.

Table 7 reports the estimated treatment effects for each of the different measures of hospital output and market share. For both in-market and out-of-market acquisitions the

TABLE 7—THE IMPACT OF SYSTEM MEMBERSHIP ON DEMAND

	Log(# Discharges)				Log(# Privately Insured Discharges)			
	A	B	C	D	A	B	C	D
T1	−0.033	−0.043	−0.028	−0.022	−0.041	−0.009	−0.047	−0.003
	(0.036)	(0.037)	(0.035)	(0.038)	(0.047)	(0.051)	(0.047)	(0.051)
T2	0.010	< 0.001	0.012	0.006	−0.003	0.035	−0.003	0.038
	(0.019)	(0.018)	(0.019)	(0.018)	(0.026)	(0.027)	(0.026)	(0.027)
Time Controls	Time Trend	Treatment Time Trends	Time FEs	Treatment Time FEs	Time Trend	Treatment Time Trends	Time FEs	Treatment Time FEs
Adj. R^2	0.020	0.020	0.037	0.037	0.020	0.021	0.028	0.028
N	14814	14814	14814	14814	14814	14814	14814	14814
	Log(45 Mile Market Share)				Log(15 Mile Market Share)			
	A	B	C	D	A	B	C	D
T1	−0.017	−0.015	−0.009	0.004	−0.039	−0.031	−0.035	−0.015
	(0.040)	(0.044)	(0.039)	(0.044)	(0.043)	(0.048)	(0.043)	(0.047)
T2	0.020	0.018	0.021	0.022	0.001	0.008	0.002	0.012
	(0.018)	(0.019)	(0.018)	(0.019)	(0.021)	(0.021)	(0.021)	(0.021)
Time Controls	Time Trend	Treatment Time Trends	Time FEs	Treatment Time FEs	Time Trend	Treatment Time Trends	Time FEs	Treatment Time FEs
Adj. R^2	0.021	0.021	0.034	0.034	0.008	0.008	0.013	0.013
N	13100	13100	13100	13100	13100	13100	13100	13100

Note: All specifications include hospital fixed effects. Data in all specifications is trimmed at the 2.5th percent tails of the log(price/discharge) distribution. Standard errors in parentheses are clustered by hospital.
Significance Levels: a =p $< .10$, b =p$< .05$, c =p $< .01$

impact on the quantity of care appears to be very small. Nearly all coefficient estimates are negative and none are statistically different form zero in any specification. In general the results provide no evidence that improvements in quality (if they exist) are having the kind of meaningful impact on the attractiveness of the hospital that would be necessary to command higher reimbursement rates from insurers.

C. Medicare Reimbursement Rates and System Acquisition

All of our empirical findings support the idea that out-of-market acquisitions impact reimbursement rates by strengthening the hospital's bargaining power in its negotiations with MCOs. In light of this we implement one final test of our research design by examining the effect of these acquisitions on a hospital's average reimbursement rate from Medicare patients. The Medicare reimbursement formula is not negotiated; instead it is based on the

TABLE 8—THE IMPACT OF SYSTEM MEMBERSHIP ON THE MEDICARE PRICE

	Log(Medicare Price/Day)				Log(Medicare Price/Discharge)			
	A	B	C	D	A	B	C	D
T1	-0.034^{b}	-0.056^{c}	-0.023	-0.037^{b}	-0.025	-0.032^{a}	-0.017	-0.018
	(0.017)	(0.019)	(0.017)	(0.017)	(0.015)	(0.017)	(0.015)	(0.016)
T2	-0.018^{a}	-0.016	-0.021^{b}	-0.027^{b}	-0.028^{c}	-0.008	-0.031^{c}	-0.019^{b}
	(0.010)	(0.013)	(0.009)	(0.011)	(0.009)	(0.010)	(0.009)	(0.009)
Log(CMI)	0.095^{b}	0.095^{b}	0.208^{c}	0.208^{c}	0.199^{c}	0.200^{c}	0.289^{c}	0.290^{c}
	(0.045)	(0.045)	(0.044)	(0.044)	(0.037)	(0.037)	(0.037)	(0.037)
Log(LOS)					0.030^{c}	0.031^{c}	0.029^{c}	0.029^{c}
					(0.010)	(0.010)	(0.010)	(0.010)
Log(Cost/Day)	0.383^{c}	0.383^{c}	0.388^{c}	0.387^{c}	0.188^{c}	0.188^{c}	0.190^{c}	0.190^{c}
	(0.023)	(0.023)	(0.022)	(0.022)	(0.017)	(0.017)	(0.017)	(0.017)
% Medicare	-0.316^{c}	-0.317^{c}	-0.515^{c}	-0.515^{c}	0.070^{a}	0.071^{a}	-0.080^{b}	-0.077^{b}
	(0.054)	(0.054)	(0.058)	(0.058)	(0.038)	(0.038)	(0.039)	(0.039)
% Medicaid	0.297^{c}	0.297^{c}	0.198^{c}	0.198^{c}	0.252^{c}	0.252^{c}	0.174^{c}	0.174^{c}
	(0.054)	(0.055)	(0.054)	(0.054)	(0.044)	(0.044)	(0.042)	(0.042)
% OP Revenue	0.959^{c}	0.958^{c}	0.984^{c}	0.984^{c}	0.581^{c}	0.580^{c}	0.598^{c}	0.598^{c}
	(0.058)	(0.058)	(0.055)	(0.055)	(0.048)	(0.048)	(0.046)	(0.046)
Time Controls	Time Trend	Treatment Time Trends	Time FEs	Treatment Time FEs	Time Trend	Treatment Time Trends	Time FEs	Treatment Time FEs
Adj. R^2	0.704	0.704	0.755	0.755	0.625	0.625	0.684	0.685
N	13634	13634	13634	13634	13634	13634	13634	13634

Note: % OP Revenue represents the percentage of hospital gross revenues (charges) that are attributed to outpatient care. All specifications include hospital fixed effects. Standard errors in parentheses are clustered by hospital.
Significance Levels: a =p $< .10$, b =p$< .05$, c =p $< .01$

average costs of providing care nationally and adjusted for case severity and geographic factors. As a result, a change in a hospital's bargaining power should not impact revenues from Medicare patients the way it does for privately insured patients.

We observe both the total patient-care-related revenues received by the hospital for Medicare patients and the total number of Medicare patient discharges and inpatient days, so we can construct accurate measures of average reimbursement rates for these patients. However, it is still necessary to control for any changes in case mix, as Medicare reimbursement formulas are calculated based on the relative cost and complexity of treating each diagnosis. To control for these differences we include the CMI and cost per day just as we have in the privately insured price specifications in Tables 3 and 4. Estimates from these Medicare price regressions are reported in Table 8.

Though some of the estimated treatment effects for Medicare prices are statistically

different from zero, they are all of opposite sign and much smaller in magnitude than those estimated in the price regressions for privately insured patients. The fact that we do not observe increases in average reimbursement rates for Medicare patients suggests that the treatment effects we observe for privately insured patients are not simply the result of unobserved increases in the cost of treatment or the severity of the case mix of a hospital's overall patient population. In addition, any decrease in the average Medicare reimbursement rate following a merger will tend to bias downward our estimated treatment effect for private patients, since our measure of net private patient revenue relies on an average contractual discount calculated using both Medicare and privately insured patients. These findings help demonstrate the robustness of the treatment effects identified for privately insured patients as well as confirm that system acquisitions appear to only increase the reimbursement price for patients whose reimbursement rates are subject to negotiation.

VII. Conclusions

While previous studies have shown that merging hospitals frequently increase their reimbursement prices by reducing competition over patients, our results suggest that mergers increase hospital market power even when they do not reduce hospital competition within a patient market. We find that hospitals that join out-of-market systems experience an increase of around 30% in their reimbursement price. Furthermore, we show that these results are not driven by systematic differences between hospitals that were chosen to be acquired by systems and those that were not; nor do the identified increases in reimbursement rates appear to be a result of changes in patient case-mix, the cost of providing care, or the quality of the care provided. Taken together, these findings indicate that hospitals increase their bargaining power vis-á-vis MCOs in the price negotiation game by joining a system.

The fact that hospitals secure higher reimbursement prices as a consequence of joining out-of-market systems raises some important policy questions. Antitrust authorities have largely adopted the option demand approach developed by Town and Vistnes (2001) and Capps et al. (2003) for defining hospital markets and studying competition.[23] This

[23] Dranove and Sfekas (2009) provide an overview of how these methods have been used in antitrust cases and Farrell

methodology focuses entirely on identifying the difference in value of an individual hospital compared to that of the merged system. Although the ability of hospitals to raise prices by reducing competition within a local patient market continues to have the potential to increase market power, our study suggests that systems can have a substantial impact on the market power of member hospitals in other ways as well. Acquisitions of hospitals by national chains such as Hospital Corporation of America, Ascension Health, or Tenet Healthcare may not result in higher concentrations in the affected local markets, but could nevertheless generate higher prices if the acquired hospitals now have greater bargaining power.

Merger simulations based on the option demand approach will severely underestimate the effect on prices in cases where there is little to no change in the local patient market but the merger increases the bargaining power of the acquired hospital. In fact, the majority of the 379 acquisitions that take place during our study period had either minimal impact (in the case of in-market acquisitions) or no impact on local market concentration yet the acquired hospitals typically secured large price increases after their acquisition. Although increasing hospital concentration in local patient markets may have been an important source of market power in the merger wave of the 1990s, these findings suggest that the changes to the relative bargaining power of acquired hospitals has been one of the more important sources of increased market power in recent acquisitions. In light of this, future theoretical and empirical work examining the underlying mechanisms that contribute to hospital bargaining power could be particularly valuable.

et al. (2011) describes how the method is used in hospital cases specifically.

REFERENCES

Binmore, K., A. Rubinstein, and A Wolinsky, "The Nash Bargaining Solution in Economic Modelling," *RAND Journal of Economics*, 1986, *17*, 176–188.

Brooks, John M., Avi Dor, and Herbert S. Wong, "Hospital-insurer bargaining: An empirical investigation of appendectomy pricing," *Journal of Health Economics*, 1997, *16*, 417–434.

Capps, Cory, David Dranove, and Mark Satterthwaite, "Competition and market power in option demand markets," *RAND Journal of Economics*, 2003, *34* (4), 737–763.

Connor, Robert A., Roger D. Feldman, and Bryan E. Dowd, "The effects of market concentration and horizontal mergers on hospital costs and proces," *International Journal of Economics and Business*, 1998, *5*, 159–180.

Cuellar, A.E. and P.J. Gertler, "How the expansion of hospital systems has affected consumers," *Health Affairs*, 2005, *24* (1), 213–219.

Draganska, Michaela, Daniel Klapper, and Sofia B. Villas-Boas, "A Larger Slice or a Larger Pie? An Empirical Investigation of Bargaining Power in the Distribution Channel," *Marketing Science*, 2011, *29*, 57–74.

Dranove, D. and R. Ludwick, "Competition and pricing by nonprofit hospitals: a reassessment of Lynk's analysis," *Journal of Health Economics*, 1999, *18*, 87–98.

Dranove, David and Andrew Sfekas, "The Revolution in Healthcare Antitrust: New Methods and Provocative Implications," *Milbank Quarterly*, 2009, *87* (3), 607–632.

_ , M. Shanley, and W. White, "Price and Concentration in Hospital Markets: The Switch from Patient-Driven to Payer-Driven Competition," *Journal of Law and Economics*, 1993, *36*, 179–204.

Farrell, Joseph, David J. Balan, Keith Brand, and Brett W. Wendling, "Economics at th FTC: Hospital Mergers, Authorized Generic Drugs, and Consumer Credit Markets," *Review of Industrial Organization*, 2011, *39* (4), 271–296.

Federal Trade Commission, "Overview of FTC Antitrust Actions in Health Care Services and Products," September 2012.

French, W.E., *Competition and Monopoly in Medical Care*, Aei Press, 1986.

Fudenberg, Drew and Jean Tirole, "Sequential Bargaining with Incomplete Information," *Review of Economic Studies*, 1983, *50* (2), 221–247.

Gaynor, Martin and William Vogt, "Competition Among Hospitals," *RAND Journal of Economics*, 2003, *34* (4), 764–785.

Grennan, Matthew, "Price Discrimination and Bargaining: Empirical Evidence from Medical Devices," *American Economic Review*, 2013, *103* (1), 145–177. Mimeo.

Halbersma, R., M. Mikkers, E. Motchenkova, and I. Seinen, "Market structure and hospital-insurer bargaining in the Netherlands," *The European Journal of Health Economics*, 2010, pp. 1–15.

Ho, Katherine, "Insurer-Provider Networks in the Medical Care Market," *American Economic Review*, 2009, *99* (1), 393–430.

Keeler, E., G. Melnick, and J. Zwanziger, "The Changing Effects of Competition on Non-profit or For-profit Hospital Pricing Behavior," *Journal of Health Economics*, 1999, *18*, 69–86.

Kongstvedt, Peter R., *The Managed Health Care Handbook*, Aspen Publishers, Inc., 2001.

Lee, Robin and Kyna Fong, "Markov-Perfect Network Formation: An Applied Framework for Bilateral Oligopoly and Bargaining in Buyer-Seller Networks," 2012. Working Paper.

Lewis, Matthew S. and Kevin E. Pflum, "Diagnosing Hospital System Bargaining Power," 2012. Working Paper.

Luft, Harold S., James C. Robinson, Deborah W. Garnick, Susan C. Maerki, and Stephen J. McPhee, "The Role of Specialized Clinical Services in Competition Among Hospitals," *Inquiry*, 1986, *23* (1), 83–94.

Lynk, W., "Nonprofit Hospital Mergers and the Excercise of Market Power," *Journal of Law and Economics*, 1995, *38*, 437–461.

Melnick, Glenn and Emmett Keeler, "The effects of multi-hospital systems on hospital prices," *Journal of Health Economics*, 2007, *26*, 400–413.

_ , Jack Zwanziger, A. Bamezai, and R. Pattison, "The Effects of Market Structure and Bargaining Position on Hospital Prices," *Journal of Health Economics*, 1992, *11*, 217–234.

Robinson, James C. and Harold S. Luft, "The impact of hospital market structure on patient volume, average length of stay, and the cost of care," *Journal of Health Economics*, 1985, *4* (4), 333–356.

Rubinstein, Ariel, Zvi Safra, and William Thomson, "On the Interpretation of the Nash Bargaining Solution and Its Extension to Non-Expected Utility Preferences," *Econometrica*, 1992, *60* (5), 1171–1186.

Simpson, John and Richard Shin, "Do nonprofit hospitals excercise market power?," *Journal of Economics and Business*, 1998, *5*, 141–158.

Sobel, Joel and Ichiro Takahashi, "A Multistage Model of Bargaining," *Review of Economic Studies*, 1983, *50* (3), 411–426.

Sorensen, Alan T., "Insurer-hospital bargaining: negotiated discounts in post-deregulation Connecticut," *Journal of Industrial Economics*, 2003, *51* (4), 469–490.

Stole, L. A. and J. Zweibel, "Intra-Firm Bargaining under Non-binding Contracts," *Review of Economic Studies*, 1996, *63*, 375–410.

Svejnar, J., "Bargaining power, fear of disagreement, and wage settlements: Theory and evidence from U.S. industry," *Econometrica*, 1986, *5*, 1055–1078.

Tenn, Steven, "The Price Effects of Hospital Mergers: A Case Study of the SutterSummit Transaction," *International Journal of the Economics of Business*, 2011, *18* (1), 65–82.

Town, Robert and Gregory Vistnes, "Hospital Competition in HMO Networks," *Journal of Health Economics*, 2001, *20*, 733–753.

Vita, Michael G. and Seth Sacher, "The Competitive Effects of Not-For-Profit Hospital Mergers: A Case Study," *Journal of Industrial Economics*, 2001, *XLIX*, 63–84.

Wu, Vivian Y., "Managed care's price bargaining with hospitals," *Journal of Health Economics*, 2009, *28*, 350–360.

APPENDIX A: HOSPITAL PRICE CALCULATION

The average price per discharge for a given year is calculated as follows. As HCRIS reports gross revenues for both inpatient and outpatient services, but reports only total contractual deductions, the net inpatient revenues are found by discounting the gross inpatient revenues by the amount implied by the contractual adjustments. That is, gross inpatient revenues are multiplied by $1 - (\text{total contractual adjustments})/(\text{gross inpatient revenues} + \text{gross outpatient revenues})$. This generates an estimate for total net inpatient revenue, from which we subtract the total payments received from Medicare. Lastly, this non-Medicare net-revenue is divided by the number of non-Medicare discharges to generate an average price per discharge. The following equation reports the calculation used to estimate a hospital average price per discharge.

$$\text{Discharge Price} = \frac{\left[\text{Gross Inpatient Revenue} \times (1 - \text{discount})\right] - \text{Medicare Payments}\big]}{\text{Non-Medicare Discharges}},$$

where

$$\text{discount} = \frac{\text{Total contractual adjustments}}{\text{Gross Inpatient Revenue} + \text{Gross Outpatient Revenue}}.$$

Gross inpatient and outpatient revenues come from the values reported on Line 25, columns 1 and 2, respectively, of Worksheet G-2, Form CMS-2552-96. In the case of inpatient revenues this value represents the revenues represented by the list prices for the general routine care, intensive care, and ancillary services provided during the reporting period.

The Medicare payments represent all payments received from inpatient care provided to Medicare patients including patients' out-of-pocket costs, adjustments given for graduate medical education, cost of teaching physicians, special add-on payments for new technologies, and other pass-through costs. The Medicare payments come from line 16 of Worksheet E, Part A, line 17 of Worksheet E, Part B, line 4 of Worksheet E-3 Part I, and line 19 of Worksheet E-3 Part II all from Form CMS-2552-96.

Total contractual adjustments come from line 2 Worksheet G-3 and the non-Medicare discharges is the difference between line 12, columns 6 and 4 of Worksheet S-3, Form CMS-2552-96.

APPENDIX B: ROBUSTNESS OF RESULTS TO DATA TRIMMING

The following results tables reproduce the specifications reported in Table 3 with different amounts of trimming performed on the data. Table B2 reports the results when estimated without any trimming of the tails of the price/discharge distribution while Table B4 reports the results when estimated on a sample of the data in which values for price/discharge have been trimmed below the 5th percentile and above the 95th percentile.

TABLE B1—THE IMPACT OF SYSTEM MEMBERSHIP ON THE PRICE/DISCHARGE, FULL SAMPLE

Log(Price/Discharge)	A	B	C	D	E	F	G	H
T1	0.049	0.113^a	0.031	0.087				
	(0.047)	(0.066)	(0.046)	(0.068)				
T2	0.058^b	0.103^c	0.056^b	0.108^c				
	(0.026)	(0.036)	(0.026)	(0.034)				
T1×% Private					0.208^b	0.431^c	0.166	0.383^b
					(0.104)	(0.152)	(0.104)	(0.152)
T2×% Private					0.195^c	0.358^c	0.183^c	0.367^c
					(0.045)	(0.071)	(0.045)	(0.070)
Log(CMI)	0.360^c	0.360^c	0.204^b	0.205^b	0.350^c	0.345^c	0.196^b	0.192^a
	(0.101)	(0.101)	(0.099)	(0.099)	(0.100)	(0.100)	(0.099)	(0.099)
Log(Length of Stay)	0.972^c	0.972^c	0.973^c	0.973^c	0.972^c	0.972^c	0.973^c	0.973^c
	(0.020)	(0.020)	(0.019)	(0.019)	(0.020)	(0.020)	(0.019)	(0.019)
Log(Cost/Day)	1.114^c	1.114^c	1.094^c	1.094^c	1.115^c	1.117^c	1.096^c	1.098^c
	(0.038)	(0.038)	(0.036)	(0.036)	(0.038)	(0.038)	(0.036)	(0.036)
% Medicare	−0.156	−0.147	0.135	0.141	−0.144	−0.113	0.144	0.171
	(0.124)	(0.124)	(0.130)	(0.130)	(0.124)	(0.124)	(0.131)	(0.131)
% Medicaid	-0.270^b	-0.270^b	−0.145	−0.147	-0.247^b	-0.224^b	−0.127	−0.105
	(0.113)	(0.113)	(0.114)	(0.114)	(0.113)	(0.113)	(0.114)	(0.113)
% OP Revenue	-2.097^c	-2.099^c	-2.145^c	-2.150^c	-2.088^c	-2.087^c	-2.136^c	-2.136^c
	(0.132)	(0.131)	(0.129)	(0.129)	(0.131)	(0.130)	(0.128)	(0.127)
Time Controls	Time Trend	Treatment Time Trends	Time FEs	Treatment Time FEs	Time Trend	Treatment Time Trends	Time FEs	Treatment Time FEs
Adj. R^2	0.424	0.424	0.451	0.452	0.425	0.426	0.452	0.453
N	13459	13459	13459	13459	13459	13459	13459	13459

Note: % OP Revenue represents the percentage of hospital gross revenues (charges) that are attributed to outpatient care. All specifications include hospital fixed effects. Standard errors in parentheses are clustered by hospital.
Significance Levels: a =p $< .10$, b =p$< .05$, c =p $< .01$

TABLE B2—THE IMPACT OF SYSTEM MEMBERSHIP ON THE PRICE/DAY, FULL SAMPLE

Log(Price/Discharge)	A	B	C	D	E	F	G	H
T1	0.049	0.113^a	0.032	0.087				
	(0.047)	(0.066)	(0.047)	(0.068)				
T2	0.059^b	0.103^c	0.056^b	0.108^c				
	(0.026)	(0.036)	(0.026)	(0.034)				
T1×% Private					0.210^b	0.433^c	0.168	0.385^b
					(0.105)	(0.152)	(0.104)	(0.152)
T2×% Private					0.196^c	0.359^c	0.184^c	0.367^c
					(0.045)	(0.071)	(0.045)	(0.070)
Log(CMI)	0.343^c	0.344^c	0.188^a	0.189^a	0.333^c	0.328^c	0.180^a	0.177^a
	(0.101)	(0.101)	(0.100)	(0.100)	(0.101)	(0.100)	(0.100)	(0.100)
Log(Cost/Day)	1.129^c	1.129^c	1.109^c	1.109^c	1.131^c	1.132^c	1.111^c	1.112^c
	(0.036)	(0.036)	(0.035)	(0.035)	(0.036)	(0.036)	(0.035)	(0.035)
% Medicare	−0.106	−0.097	0.183	0.189	−0.094	−0.064	0.192	0.219
	(0.130)	(0.129)	(0.135)	(0.135)	(0.130)	(0.130)	(0.135)	(0.135)
% Medicaid	-0.271^b	-0.271^b	−0.145	−0.146	-0.248^b	-0.225^b	−0.126	−0.104
	(0.113)	(0.113)	(0.114)	(0.114)	(0.113)	(0.113)	(0.114)	(0.114)
% OP Revenue	-2.077^c	-2.079^c	-2.128^c	-2.132^c	-2.068^c	-2.067^c	-2.119^c	-2.119^c
	(0.131)	(0.131)	(0.128)	(0.128)	(0.130)	(0.130)	(0.128)	(0.127)
Time Controls	Time Trend	Treatment Time Trends	Time FEs	Treatment Time FEs	Time Trend	Treatment Time Trends	Time FEs	Treatment Time FEs
Adj. R^2	0.322	0.322	0.355	0.355	0.323	0.325	0.356	0.357
N	13462	13462	13462	13462	13462	13462	13462	13462

Note: % OP Revenue represents the percentage of hospital gross revenues (charges) that are attributed to outpatient care. All specifications include hospital fixed effects. Standard errors in parentheses are clustered by hospital.
Significance Levels: a =p $< .10$, b =p$< .05$, c =p $< .01$

TABLE B3—THE IMPACT OF SYSTEM MEMBERSHIP ON THE PRICE/DISCHARGE, 5% TAILS TRIMMED

Log(Price/Discharge)	A	B	C	D	E	F	G	H
T1	0.066^b	0.107^c	0.048	0.071^a				
	(0.032)	(0.040)	(0.032)	(0.039)				
T2	0.060^c	0.085^c	0.058^c	0.091^c				
	(0.017)	(0.024)	(0.016)	(0.022)				
T1×% Private					0.164^a	0.257^b	0.121	0.187^a
					(0.085)	(0.115)	(0.085)	(0.111)
T2×% Private					0.165^c	0.252^c	0.157^c	0.257^c
					(0.034)	(0.046)	(0.034)	(0.043)
Log(CMI)	0.202^c	0.202^c	0.069	0.068	0.196^c	0.194^c	0.064	0.062
	(0.059)	(0.059)	(0.058)	(0.058)	(0.058)	(0.058)	(0.057)	(0.057)
Log(Length of Stay)	0.882^c	0.883^c	0.882^c	0.882^c	0.882^c	0.882^c	0.881^c	0.881^c
	(0.022)	(0.022)	(0.021)	(0.021)	(0.022)	(0.022)	(0.021)	(0.021)
Log(Cost/Day)	0.974^c	0.974^c	0.955^c	0.955^c	0.976^c	0.977^c	0.957^c	0.958^c
	(0.033)	(0.033)	(0.033)	(0.033)	(0.033)	(0.033)	(0.033)	(0.033)
% Medicare	0.062	0.068	0.297^c	0.302^c	0.075	0.091	0.307^c	0.321^c
	(0.080)	(0.079)	(0.083)	(0.083)	(0.080)	(0.079)	(0.084)	(0.083)
% Medicaid	-0.325^c	-0.324^c	-0.227^c	-0.227^c	-0.303^c	-0.290^c	-0.208^c	-0.197^c
	(0.073)	(0.073)	(0.075)	(0.075)	(0.073)	(0.073)	(0.075)	(0.075)
% OP Revenue	-1.638^c	-1.639^c	-1.663^c	-1.665^c	-1.632^c	-1.632^c	-1.656^c	-1.657^c
	(0.092)	(0.092)	(0.092)	(0.092)	(0.092)	(0.092)	(0.092)	(0.092)
Time Controls	Time Trend	Treatment Time Trends	Time FEs	Treatment Time FEs	Time Trend	Treatment Time Trends	Time FEs	Treatment Time FEs
Adj. R^2	0.449	0.450	0.499	0.499	0.450	0.451	0.500	0.500
N	12331	12331	12331	12331	12331	12331	12331	12331

Note: % OP Revenue represents the percentage of hospital gross revenues (charges) that are attributed to outpatient care. All specifications include hospital fixed effects. Standard errors in parentheses are clustered by hospital.
Significance Levels: a =p $< .10$, b =p$< .05$, c =p $< .01$

TABLE B4—THE IMPACT OF SYSTEM MEMBERSHIP ON THE PRICE/DAY 5% TAILS TRIMMED

Log(Price/Discharge)	A	B	C	D	E	F	G	H
T1	0.083^c	0.119^c	0.065^b	0.085^b				
	(0.027)	(0.039)	(0.027)	(0.039)				
T2	0.068^c	0.093^c	0.066^c	0.099^c				
	(0.017)	(0.023)	(0.017)	(0.021)				
T1×% Private					0.228^c	0.334^c	0.186^c	0.263^c
					(0.060)	(0.090)	(0.061)	(0.091)
T2×% Private					0.181^c	0.270^c	0.174^c	0.273^c
					(0.034)	(0.046)	(0.034)	(0.044)
Log(CMI)	0.217^c	0.218^c	0.071	0.073	0.208^c	0.207^c	0.065	0.064
	(0.060)	(0.059)	(0.060)	(0.060)	(0.059)	(0.059)	(0.060)	(0.060)
Log(Cost/Day)	0.994^c	0.994^c	0.979^c	0.979^c	0.997^c	0.998^c	0.981^c	0.983^c
	(0.034)	(0.034)	(0.035)	(0.034)	(0.034)	(0.034)	(0.035)	(0.034)
% Medicare	0.050	0.056	0.299^c	0.305^c	0.066	0.083	0.311^c	0.328^c
	(0.079)	(0.079)	(0.083)	(0.083)	(0.079)	(0.079)	(0.084)	(0.083)
% Medicaid	-0.294^c	-0.294^c	-0.196^b	-0.195^b	-0.269^c	-0.255^c	-0.174^b	-0.161^b
	(0.076)	(0.076)	(0.078)	(0.078)	(0.076)	(0.075)	(0.078)	(0.078)
% OP Revenue	-1.699^c	-1.701^c	-1.727^c	-1.730^c	-1.692^c	-1.694^c	-1.720^c	-1.721^c
	(0.099)	(0.099)	(0.099)	(0.099)	(0.098)	(0.098)	(0.098)	$(0.098)[.1cm]$
Time Controls	Time Trend	Treatment Time Trends	Time FEs	Treatment Time FEs	Time Trend	Treatment Time Trends	Time FEs	Treatment Time FEs
Adj. R^2	0.365	0.365	0.421	0.421	0.367	0.367	0.422	0.423
N	12345	12345	12345	12345	12345	12345	12345	12345

Note: % OP Revenue represents the percentage of hospital gross revenues (charges) that are attributed to outpatient care. All specifications include hospital fixed effects. Standard errors in parentheses are clustered by hospital.
Significance Levels: a =p $< .10$, b =p$< .05$, c =p $< .01$