What is Behind the Size Effect? The Role of Large Hospitals in the Medicaid DSH Program

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Abstract

We investigate determinants of government subsidy in the U.S. health care industry, focusing on the Medicaid Disproportionate Share Hospital (DSH) program. We find that the amount of Medicaid DSH payment per bed increases significantly with increase in hospital size for government hospitals. This is partially explained by the distinctive role that large government hospitals play in the provision of care to the indigent population. However, costs, financial conditions, or types of services by themselves are not enough to explain DSH payments. Large government hospitals tend to have a higher ratio of DSH payments to Medicaid and uninsured costs. The difference in the DSH payment-to-cost ratio across ownership types increases significantly with increase in hospital size. We argue that these key patterns are unlikely to be driven by unobserved heterogeneity, using Altonji-Elder-Taber-Oster Method. Our results on payment-to-cost ratios are consistent with targeting by the state government to counterbalance disparities in hospitals' capability to cross-subsidize across patient types.

Keywords: Medicaid DSH, Hospital Ownership, Uninsured, Uncompensated Care, Cross-Subsidization

JEL Classification: I13, I18, I3, H75

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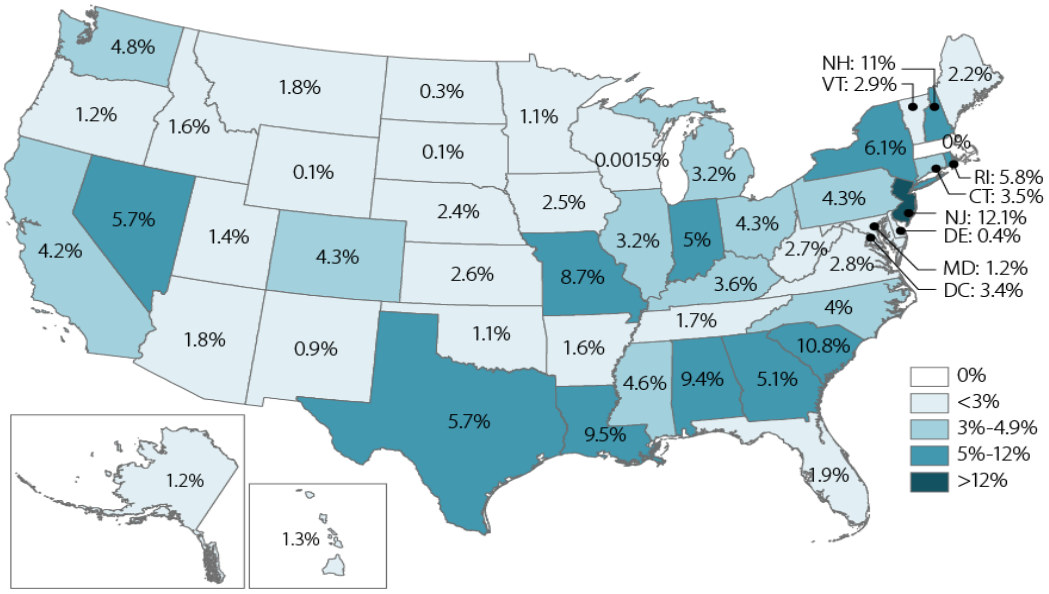
1 Introduction

Government subsidy is a prevalent phenomenon in many large industries. In this paper, we investigate determinants of government subsidy in the U.S. health care industry, focusing on the Medicaid Disproportionate Share Hospital (DSH) program. The Medicaid DSH payment is a form of subsidy and reimbursement from Medicaid, paid to hospitals that treat a large share of Medicaid and uninsured patients, to compensate for the costs of providing care.

There are several features of this program that make it an important subject of research. First, the Medicaid DSH program was intended to play an important role in sustaining hospitals with a large share of Medicaid and uninsured patients. However, the Affordable Care Act (ACA) is scheduled to significantly reduce the amount of federal contribution to the Medicaid DSH program, starting in 2018. This reduction is motivated by the fact that the ACA reduces the uninsured population through Medicaid expansion. Hospitals in states that have not expanded Medicaid eligibility will experience significant reductions in Medicaid DSH payments, which raises a concern about their future financial stability. Second, Medicaid DSH payments vary significantly across states. The federal government sets a general guideline for DSH payments. Within that general framework, each state sets its own formula for calculating payment as a function of key statistics, such as Medicaid inpatient utilization rates and costs of uninsured patient care. According to a Congressional Research Service (CRS) report by Mitchell (2013), in FY 2007, only nine out of 58 hospitals in Oregon received Medicaid DSH payments, while all hospitals in New Jersey received such payments. Moreover, some observers argue that Medicaid DSH payments do not effectively target hospitals that incur large costs due to uncompensated care of indigent patients (e.g., Government Accountability Office (2012)).

Our key research question is to what extent hospital size influences Medicaid DSH payments. States with a large state Medicaid DSH expenditure, as a share of total Medicaid medical assistance expenditures, tend to be either populous urban states or Southern states (Figure 1). The high level of DSH expenditures in Southern states is particularly noteworthy. The two groups of states also tend to have a relatively larger share of hospitals that receive Medicaid DSH payments (Figure 2). On the one hand, these patterns may appear to be driven by population characteristics. Southern states have a larger share of uninsured population than other states. Moreover, urban states historically had relatively generous Medicaid eligibility criteria.[1] Therefore, utilization rates of Medicaid and uninsured patients in the two groups of states may lead to a higher level of DSH payments than in other states. On the other hand, urban states and Southern states also differ significantly from other states in alternative dimensions. Hospitals in urban states tend to be larger than those in other states. In addition, Southern states have the strongest degree of hospital concentration, according

[1] Most of key demographic statistics related to the Medicaid program are available at the Kaiser Family Foundation webpage: `http://kff.org/statedata/`.



Source: Figure 6 in Mitchell (2013). CRS calculation using CMS Form CMS-64 data for FY2011

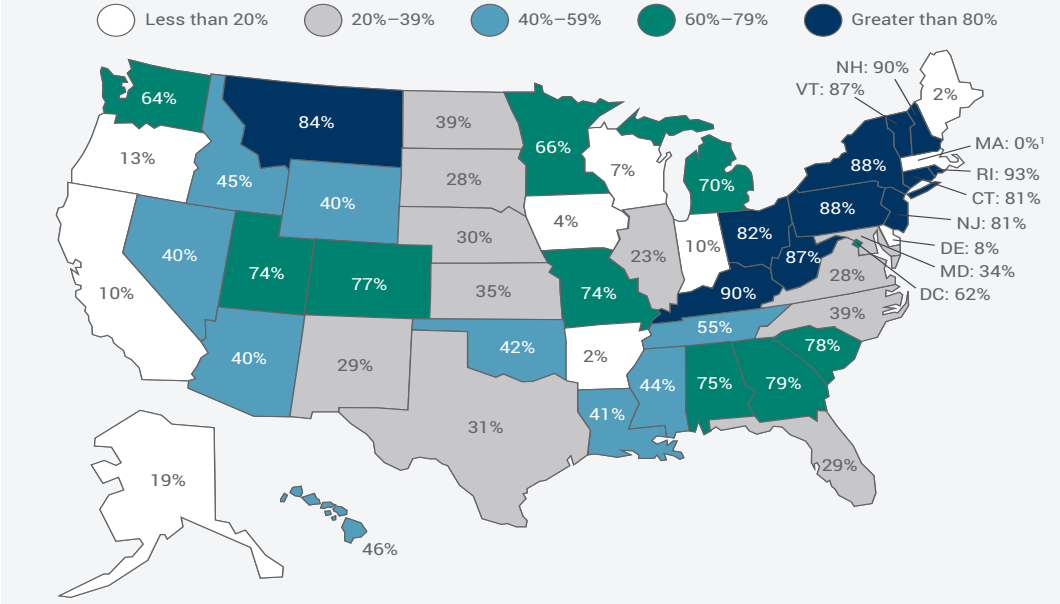
Figure 1: Total State DSH Expenditures as a Percentage of Total Medicaid Medical Assistance Expenditures, FY 2011

to Vogt and Town (2006). Furthermore, the period of rapid increases in DSH payments, the 1990s, also concurred with a wave of hospital mergers and acquisitions. These lead us to the question of to what extent Medicaid DSH payments are influenced by large hospitals' interactions with state governments, as opposed to other factors such as states' number of Medicaid enrollees and the uninsured population or costs that hospitals incur in providing care to the indigent population.

In order to study this question, we use annual Medicaid DSH audit reports from 2005 to 2011, which are hospital-year level panel data submitted by every state to the Center for Medicare and Medicaid Services (CMS). This data set contains critical information on hospitals receiving DSH payments, such as DSH payments received, Medicaid utilization, and Medicaid payments in various categories as well as uncompensated care costs due to Medicaid and uninsured patients. We complement this with the American Hospital Association (AHA) Annual Survey data on hospital characteristics and operations, and with Healthcare Cost Report Information System (HCRIS) data on financial conditions.

Our baseline findings can be summarized as follows. First, large hospitals, where size is measured by the number of beds, receive a significantly larger amount of Medicaid DSH payment per bed, compared with small hospitals. However, this relationship holds only for government hospitals. Moreover, the relationship between Medicaid DSH payment per bed and hospital size for government hospitals appears primarily in urban and Southern states.

Second, the relationship between DSH payment per bed and hospital size is partially explained by costs hospitals incur in providing care to Medicaid and uninsured patients (henceforth, "Med-



Source: MACPAC (2016)

Figure 2: Share of Hospitals Receiving Medicaid DSH Payment by State, FY 2011

icaid and uninsured costs"). Medicaid and uninsured costs increase *disproportionately* with increase in hospital size, only for government hospitals. This suggests the distinctive role that large government hospitals play in the treatment of the indigent population.

Third, despite apparent relationships between Medicaid and uninsured costs and Medicaid DSH payment per bed, costs alone do not explain the relationship between DSH payments and hospital size. The rate at which DSH payment per bed increases with hospital size is higher than the rate at which Medicaid and uninsured costs increase with hospital size, for government hospitals in urban and Southern states. Thus, the *ratio* of DSH payments to Medicaid and uninsured costs increases with hospital size for government hospitals. The same ratio also mildly decreases with hospital size for for-profit and non-profit hospitals, though such estimates are imprecise. Thus, the difference in that ratio across hospital ownership types increases significantly with hospital size.

Fourth, the rate of Medicaid reimbursement through channels other than DSH, that is, the total rate combining fee-for-service, Medicaid managed care organization (MCO) payments, and supplemental payments, is *not* higher for large hospitals, regardless of ownership types. Rather, hospital size is strongly related to the *variability* of the Medicaid reimbursement rates paid through these other channels. While small hospitals show notable variability, large hospitals tend to be fairly homogeneous.

We provide further analyses to strengthen our baseline results and discuss potential motives of the government behind the key patterns. We use Altonji-Elder-Taber-Oster method (Altonji et

al. (2005), Oster (2016)) to demonstrate that our baseline results on the ratio of DSH payment to Medicaid and uninsured costs are unlikely to be driven entirely by unobserved heterogeneity of hospitals. In addition, we compare hospitals with and without essential and costly services – emergency departments, trauma care, burn care, and graduate medical education – for the ratio of the DSH payment to Medicaid and uninsured costs. The comparison does not yield systematic relationships between their services and the ratio.

Finally, we explore potential motives of the government behind these key patterns by analyzing hospitals' financial conditions in terms of hospital size and ownership types. They suggest that state governments target hospitals based on size and ownership types in distributing DSH payments, to counterbalance disparities in hospitals' capability to cross-subsidize across patient types. Specifically, operating margin increases with hospital size for for-profit and non-profit hospitals, while it does not for government hospitals. Thus, the difference in the operating margin across ownership types increases with hospital size. Therefore, if state governments aim to adjust for hospitals' capability to cross-subsidize indigent patients with profits from non-indigent population, then state governments would set the DSH payments in a manner consistent with our finding.

Related Literature There are three literatures that this paper contributes to. The first literature is on determinants and effectiveness of Medicaid DSH payments. Duggan (2000) analyzes the effectiveness of the California Medicaid DSH program in the 1990s as a financial incentive for hospitals to treat Medicaid patients. He finds that for-profit and non-profit private hospitals actively reacted to the financial incentive of the program by cream-skimming profitable types of Medicaid patients, while government hospitals did not. He also finds that increased revenues for for-profit and non-profit private hospitals due to the Medicaid DSH program did not improve health outcomes for the indigent, because such revenues were used primarily to increase holdings of financial assets. Baicker and Staiger (2005) document that state governments in the 1990s abused their Medicaid DSH programs to increase rates of federal matching contributions, by paying a large amount to government hospitals and transferring it back through intergovernmental transfers. They find that states with a smaller degree of such "fiscal shenanigans" experienced a decrease in patient mortality.

Our study builds on Duggan (2000) and Baicker and Staiger (2005) in that we focus on the distinctive role of government hospitals in the Medicaid DSH program. It differs from the two previous studies, however, in several ways. First, we analyze the relationships between hospital size and key variables of the Medicaid DSH program. Hospital size is an important dimension to investigate because large hospitals may have a disproportionate influence on state governments' decisions and may also have a dominant role in providing care to the indigent population. Hospital size is also directly related to key conditions of the health care industry such as hospital concen-

tration and MCO penetration, which in turn influence hospitals' financial conditions. Analyses of the role of large hospitals in the Medicaid program can improve understanding of the interaction between pricing and operation of public insurance programs and such industry conditions. Second, the operation of the Medicaid DSH program analyzed in the present study is systematically different from the period analyzed in the two previous studies. The aforementioned misuse of the Medicaid DSH program by state governments had been prohibited from the early 2000s. This implies systematic changes in the role of government hospitals over time.

The second literature is on hospital size and market power. It has been argued that diffusion of MCOs is one of the main causes of the wave of hospital mergers and the consequential consolidation of the hospital industry from the 1990s (e.g., Vogt and Town (2006) and Park and Town (2014)). That is, increasing bargaining power against MCOs is thought to be the primary incentive for hospitals to be involved in consolidation.[2] Along this line, Gowrisankaran et al. (2015) develop a model of bargaining between MCOs and hospitals and show that hospital mergers may cause a significant price increase. The present study is partially motivated by this stream of research in that large hospitals' impact on patient welfare may also influence their interaction with Medicaid programs. It also differs from these studies because the operation of the Medicaid programs would naturally be influenced a great deal by non-market forces.

The third literature is on hospitals' cross-subsidization and cost-shifting. Cross-subsidization is a relatively broad concept that refers to a firm compensating for losses from one customer class using profits from another customer class. The literature on hospitals' cross-subsidization has been focused on cost-shifting, which is a narrow type of cross-subsidization behavior. Hospital cost-shifting typically refers to a situation where a reduction in government insurance reimbursement rates causes hospitals to raise private insurance reimbursement rates. Dranove (1988), one of the earliest studies in this literature, specifies a model of such behavior. Dranove et al. (forthcoming) study hospitals' response to negative financial shocks and show that the degree of cost-shifting critically depends on hospitals' market power. A recent survey by Frakt (2011) reviews both theory and empirical evidence. He argues that hospital cost-shifting can be rationalized only under a relatively narrow set of assumptions (e.g., hospitals have objectives other than pure profit-maximization). Moreover, he argues that time-series inverse relationships between public and private insurance reimbursement rates can be explained by structural changes unrelated to hospitals' cost-shifting behavior. The most conceptually close paper to ours is Glazer and McGuire (2002). They argue that public insurance may free-ride on the private payer and set its prices too low, using a theoretical model. Our findings are consistent with such an argument.

[2]The empirical evidence has been quite subtle. Town et al. (2007) find that the growth of MCOs does not explain the wave of hospital mergers. More recently, Park and Town (2014) argue that the *expectation* of the growth of MCOs, not the growth of MCOs *per se*, plays an important role in explaining the increased hospital consolidation.

2 Institutional and Conceptual Backgrounds

2.1 Institutional Background

Overview of the Medicaid Program Medicaid is a means-tested public health insurance program for the indigent population. It is the largest welfare program in the United States in terms of expenditures. According to the Kaiser Family Foundation, total Medicaid expenditure in the fiscal year 2013 was $ 446.7 billion[3], which was 2.7% of Gross Domestic Product (GDP). Medicaid is administered by state governments, jointly funded by federal and state governments.[4] The federal government determines the basic framework for eligibility and reimbursement rules. Within this framework, state governments have large discretion in setting details of the final rules. This leads to a large cross-state variation in both eligibility rules and reimbursement rates.

Before the ACA, to be eligible for Medicaid, an individual needed to belong to one of five categories – children, parents, pregnant women, disabled, or elderly – and needed to meet the income requirement for the corresponding category. These core categories were identical across states. However, income thresholds for eligible categories varied across states. For example, in 2013, for parents, 215% of the federal poverty level (FPL) was the upper limit for income to be eligible for Medicaid in Minnesota, whereas 23% of the FPL was the corresponding limit in Alabama.

Reimbursement also varies considerably across states. For example, according to Roy (2013), for every dollar that a private insurer pays primary-care physicians to care for a patient, Medicaid pays 29 cents in New York and Rhode Island, 32 cents in New Jersey, while it pays 52 cents in the average state.

For hospitals, there are four ways to be reimbursed for their services to Medicaid patients: payments for traditional fee-for-service (FFS) plans, payments for managed care plans, supplemental payments, and DSH payments. Traditionally, Medicaid reimbursed providers on a fee-for-service basis. Since the 1990s, the proportion of enrollees for managed care plans has increased significantly. According to the CMS, the national Medicaid managed care penetration rate increased from 56% in 2000 to 74% in 2014. Supplemental payment, also known as UPL supplemental payment, is defined as payments states can make based on the difference between Medicaid payments for services and maximum payment level allowed under the upper payment limit (UPL) for Medicaid FFS payments for those services.[5] States made $26 billion of supplemental payments in FY 2011

[3] See the following website: http://kff.org/medicaid/state-indicator/total-medicaid-spending

[4] Before the ACA, the Federal Medical Assistance Percentage (FMAP), the percentage of total Medicaid expenditure that the federal government pays, has been on average 57 percent. There is a considerable cross-state variation in FMAP, as a function of states' per capita income. It ranges from 50% for the wealthiest states to 75% for poorer states. See the following website for details: https://www.medicaid.gov/medicaid-chip-program-information/by-topics/financing-and-reimbursement/financing-and-reimbursement.html

[5] See the following website for details: https://www.macpac.gov/wp-content/uploads/2015/01/

(MACPAC (2012)).

Medicaid Disproportionate Share Hospital (DSH) Program Medicaid DSH payments are made to hospitals serving a disproportionate share of Medicaid and uninsured patients in order to offset uncompensated care costs.[6] In FY 2014, the total amount of Medicaid DSH payments was $18 billion. This program was introduced in 1981 (Section 1902(a)(13)(A)(iv) of the Social Security Act) to fund payments for hospitals treating a disproportionate share of low-income patients. However, states did not use this program actively until 1987, when Congress required states to make Medicaid DSH payments to hospitals that treat a large share of low-income patients and extended the program to take into account uncompensated care for uninsured and Medicaid patients (Section 1923 of the Social Security Act).

As for the eligibility requirements that determine which hospitals will receive Medicaid DSH payments, the federal government specifies basic criteria, and state governments make final rules. According to federal statutes, hospitals are deemed as DSH hospitals if they satisfy the following criteria:

- Medicaid inpatient utilization rate (MIUR) is at least one standard deviation above the state average of hospitals treating Medicaid patients, or
- Low-income utilization rate (LIUR) is greater than 25%.

However, states are allowed to make DSH payments to hospitals with special conditions, such as having at least two obstetricians designated for Medicaid patients, if they have MIUR of at least 1%. There are also other criteria states can use to make exceptions, therefore states have flexibility in determining DSH eligibility rules.

Methodologies for calculating DSH payment amounts for hospitals are also set by state governments.[7] However, there are requirements by federal statutes for determining minimum amounts, which specify that one of the following methodologies has to be used:

- Medicare DSH adjustment methodology,

MACFacts-UPL-Payments_2012-11.pdf

[6] A detailed overview of the Medicaid DSH program can be found on the following MACPAC website: https://www.macpac.gov/wp-content/uploads/2016/03/Overview-of-Medicaid-Policy-on-Disproportionate-Share-Hospital-Payments.pdf

[7] Mitchell (2013) provides a good overview of the general framework. While federal requirements are readily available, the complete rules for each state tend to be complex and cannot be concisely summarized. Documents describing each state's Medicaid rules are available on the Medicaid State Plan Amendment website: https://www.medicaid.gov/state-resource-center/medicaid-state-plan-amendments/medicaid-state-plan-amendments.html. Documents describing Medicaid DSH rules can be sorted by inserting "DSH" in the search query.

- a methodology that increases DSH payments in proportion to the percentage by which a hospital's MIUR exceeds one standard deviation above the mean, or
- a methodology in which DSH payments depend on hospital type and is a function of Medicaid and low-income utilization rates.

Federal statutes also set DSH amount limits for institutions for mental diseases (IMDs). State governments also have flexibility in determining the amount of DSH payments to IMDs.

Medicaid DSH Allotment and the ACA In the early period of the Medicaid DSH program, there was no limit on the total amount of payments states could make to hospitals. This, in conjunction with the federal government's matching contributions, caused a significant growth of payments in the early 1990s and the aforementioned misuse of the program documented in Baicker and Staiger (2005). In order to address this problem, Congress enacted national and state-specific caps on DSH payments, called *DSH allotments*, and hospital-specific caps.

The ACA in 2010 brought various changes to Medicaid. One of the main goals of the ACA is to reduce the number of the uninsured by expanding Medicaid eligibility. Reduction in the uninsured population would decrease uncompensated care by health care providers. Thus, Congress enacted a plan to reduce DSH allotments nationally from FY 2014. However, after a series of enactments since 2011, the reduction plan has been postponed several times. As of 2016, the reduction is set to start in FY 2018.

2.2 Conceptual Background

In this subsection, we lay out conceptual frameworks for the behavior of hospitals and state governments.

Hospitals' Objectives In general, a hospital maximizes a weighted sum of its profit and the welfare of patients in its service area. The weight that a hospital assigns to its profit, as opposed to patient welfare, depends on the ownership type. As elaborated in Duggan (2000), ownership types can affect hospital behavior through three key channels: (1) sensitivity of managers' payoffs to the profit of the organization, (2) the type of managers that sort into the organization, and (3) softness of budget constraint. First, since the payoffs for managers of non-profit or governmental organizations cannot be tied closely to the organization's profit, they are more likely to pursue objectives other than profits. Second, the type of managers that sort into each type of organization may also matter. Those who sort into non-profit or governmental organizations may be less sensitive to pecuniary benefits in the first place. Third, ownership types may matter simply because governmental organizations have a looser budget constraint. In the case that governmental hospitals incur

a substantial amount of uncompensated care, state governments may easily expend resources to make up for their losses. This in turn may make managers of governmental hospitals less sensitive to profits.

Large Hospitals, Ownership Types and Welfare Provision There are various channels through which large hospitals can play an important role in providing care to the indigent population. Precisely, large hospitals' role in welfare provision stems primarily from their ownership types rather than their size *per se*. The proportion of large hospitals, with more than 400 beds, is significantly higher among government and non-profit hospitals than for-profit hospitals. Specifically, 9.0% of government hospitals and 11.1% of non-profit private hospitals have more than 400 beds while 2.1% of for-profit hospitals have more than 400 beds.

Government hospitals play a dominant role in the provision of welfare and high-cost services to their communities. For example, in 2011, the National Association of Public Hospitals and Health Systems (NAPH) reported that government hospitals in the ten largest U.S. cities in their study constituted 23 percent of emergency department visits, 29 percent of Medicaid discharges, 40 percent of Level I trauma care providers, and 63 percent of burn care beds, while they constituted only 12 percent of local acute care hospitals (See National Association of Public Hospitals and Health Systems (2011)).[8] Likewise, according to 2013 AHA Annual Survey, government hospitals constitute 40.8% of critical access hospitals that serve rural areas, while they account for about 24% of all hospitals in the U.S.

The dominant role of large government hospitals in the provision of care to indigent population may cause a burden on their financial conditions. Unlike for-profit and non-profit hospitals that have a relatively large, lucrative pool of patients with private insurance to cross-subsidize indigent patients, government hospitals may suffer from chronic deficits. This may in turn serve as a basis for the government to target large government hospitals in the allocation of government subsidies such as DSH payments.

Large Hospitals' Potential Influence on Medicaid Reimbursements Hospitals expend resources to make campaign contributions to state elections and lobby government officials to influence health care policies. Large hospitals can influence Medicaid reimbursements through two different channels. First, if the hospital industry in an area is composed of a small number of large hospitals rather than a large number of small hospitals, then it may make it easier for the hospital

[8]The NAPH, newly entitled 'America's Essential Hospitals' in 2013, is an industry trade group composed of approximately 250 hospitals, mostly public hospitals in urban areas that fill a safety net role in their communities. The statistics cited here are based on the annual survey of their member hospitals' characteristics. Therefore, these statistics are based on a *subset* of large government hospitals. Nevertheless, it is informative to see that a select group of public hospitals provide a disproportionate share of services that are costly and unprofitable, yet critical to the welfare of the indigent population.

industry to take a collective action in expending resources to influence state government officials. If the hospital industry is competitive and composed of a large number of small hospitals, then the benefit from their collective actions to influence Medicaid reimbursement rules would be diffuse, which would in turn reduce hospitals' contributions to such actions. Thus, the presence of large hospitals makes it easier for the industry to promote its interests. Second, large hospitals' decision to accept or decline Medicaid patients has a large influence on the value of being enrolled in Medicaid. Therefore, it may potentially be easier for large hospitals to secure high rates of Medicaid reimbursements.

Decision-Making in the State Government The typical decision-maker in charge of the operation of Medicaid at the state level is the head of the Medicaid agency (Medicaid director) that belongs to the state health department.[9] In case a decision on the Medicaid program has significant budgetary implications, state legislatures and the governor also participate in the decision making process. The Medicaid director decides reimbursement rates, reflecting objectives of state legislatures and the governor, who are held accountable by the voters of the state.

There are three key factors that influence the Medicaid director's decision: welfare of the non-indigent population, indigent patient welfare, and hospital profits. Generous Medicaid reimbursement rules are beneficial to both indigent patients and hospitals. However, such rules undermine the welfare of the non-indigent population through their impact on state government budgets. The Medicaid director can set up the Medicaid DSH payment as a function of various hospital characteristics to target specific subgroups of hospitals. If the Medicaid director assigns a relatively small weight to the hospital profit *per se*, he would want to set a high reimbursement rate only to hospitals that can significantly influence patient welfare – large hospitals that provide care to a significant number of Medicaid and uninsured patients in areas with a large share of the indigent population.

A Medicaid director may also target hospitals based on their ownership types for several reasons. First, the most straightforward reason is the linkage between government hospitals' finance and state governments' budget. Since the financial performance of government hospitals directly influences the government budget, a Medicaid director would want to design a payment scheme that is favorable to government hospitals. Second, from a Medicaid director's point of view, it may be better to induce allocation of Medicaid patients to government hospitals or non-profit hospitals away from for-profit hospitals, for the welfare of Medicaid patients themselves. Medicaid reimbursement rates tend to be significantly lower than reimbursement rates from private insurance.

[9]Just as the federal government has the Department of Health and Human Services, state governments also have corresponding state health departments, typically entitled 'State Department of Health'. Within the state health department, there is an agency in charge of Medicaid. An overview of the structure of state health departments and their operation is available on the following Association of State and Territorial Health Officials website: `http://www.astho.org/profile/volume-one/`.

Therefore, for-profit hospitals are more likely to compromise on the quality of care to reduce the cost of providing care to Medicaid or uninsured patients than would government or non-profit hospitals. Medicaid patients that for-profit hospitals choose to admit are also likely to be relatively less costly or healthier patients than average Medicaid patients.

3 Data

Medicaid and hospital data is composed of two different sets. The first data set is Medicaid DSH annual audit reports submitted by states to the CMS. It is a hospital-year level panel data set on Medicaid DSH payments for the period of 2005-2011. It includes key hospital-year level statistics on (1) medical service utilization such as MIUR and LIUR, (2) Medicaid payments in other categories, i.e., fee-for-service (FFS) payments, MCO payments, and supplemental payments, (3) uninsured patient revenues, and (4) uncompensated care cost. Data from the entire set of hospitals that receive Medicaid DSH payments is included (more than 3000 hospitals every year).

The second data set is the American Hospital Association (AHA) Annual Survey, which is hospital-year level panel data on hospital characteristics (e.g., size, type of services) and operations (e.g., Medicare and Medicaid patient admissions). Annual data from approximately 6,000 hospitals is included. We complement this data with The Hospital M&A Reports by Irving Levin Associates to keep track of hospital mergers and acquisitions.

The last data set is Healthcare Cost Report Information System (HCRIS) data, which is hospital-year level panel data on financial conditions (e.g., balance sheet components, inpatient revenues and expenses).

Table 1 presents summary statistics of the data we use in our baseline analyses. The raw data have observations with anomalous values and extreme skewness for key variables. To minimize the influence of extreme outliers, we use a data set that excludes observations with obvious anomalies or a value above the 99th percentile for any of the key outcome variables in our baseline analyses. In the supplementary material, we document details of the raw data and robustness checks of our key results using the sample including extreme outliers.

4 Analysis

In this section, we present our analyses. In Section 4.1, we present our baseline OLS regression results. In Section 4.2, we use Altonji-Elder-Taber-Oster method to strengthen our baseline results, analyze the role of essential high-cost services, and discuss key results in detail.

Table 1: Summary Statistics (Date Period: 2005-2011)

Variable	Mean	Std. Dev.	Min.	Max.	N
Panel A: DSH					
Medicaid DSH Payments ($ Million)	3.94	11.44	0	195.05	16101
IMD	0.04	0.19	0	1	16101
MIUR	0.26	0.16	0	1	15374
LIUR	0.21	0.19	0	1.95[a]	10907
Total Other Medicaid Payments ($ Million)	21.98	38.14	0	452.06	16048
Medicaid FFS Payments ($ Million)	14.3	25.1	0	267.22	16054
Medicaid MCO Payments ($ Million)	5.27	13.87	0	234.19	16049
Medicaid Supplemental Payments ($ Million)	2.33	8.16	-6.76[b]	255.97	16054
Total Medicaid Costs ($ Million)	24.82	41.68	0	558.49	15841
Total Medicaid Uncompensated Care Costs[c]($ Million)	2.53	9.58	-98.08	176.65	16013
Total Uninsured Revenue ($ Million)	0.72	2.25	0	62.42	16101
Total Uninsured Costs ($ Million)	6.39	13.04	0	232.59	15194
Total Uninsured Uncompensated Care Costs ($ Million)	5.46	11.75	-20.1	213.49	15971
Total Uncompensated Care Costs ($ Million)	7.77	15.57	-56.59	264.77	15737
Total Medicaid and Uninsured Cost ($ Million)	31.47	51.55	0.01	580.72	15190
Share of Uninsured Cost in M & U Cost	0.2	0.15	0	1	15190
Medicaid and Uninsured Operating Margin	-0.55	1.28	-22.72	0.63	15148
Panel B: AHA					
Hospital Size (Number of Beds)	174.74	169.84	4	908	16089
Government Hospital	0.27	0.44	0	1	16101
Federal	0	0.02	0	1	16101
State	0.04	0.19	0	1	16101
County/City	0.1	0.3	0	1	16101
Hospital District	0.13	0.33	0	1	16101
Private For-profit Hospital	0.14	0.35	0	1	16101
Private Non-profit Hospital	0.59	0.49	0	1	16101
Hospital Located in Urban Area	0.78	0.41	0	1	16101
Panel C: AHA and DSH					
Medicaid DSH Payments per Bed ($ 1,000)	18.3	30.35	0	290.2	16065
Ratio of DSH Payment to M & U Cost[d]	0.13	0.15	0	1.15	15190
Ratio of DSH Payment to Medicaid Cost	0.21	0.65	0	12.31	15833
Ratio of DSH Payment to Uninsured Cost	0.73	0.97	0	10.74	13797
Total M & U Cost per Bed ($ 1,000)	151.3	112.56	0.36	873.65	15154
Total Medicaid Cost per Bed ($ 1,000)	119.38	95.2	0	685.67	15805
Total Uninsured Cost per Bed ($ 1,000)	30.18	32.92	0	306.28	15158
Share of Uninsured Cost per Bed in M & U Cost per Bed	0.2	0.15	0	1	15154
Total Other Medicaid Reimburs. per Bed ($ Million)	104.84	88.56	0	609.01	16012
Ratio of Other Medicaid Reimburs. to M & U Cost	0.72	0.21	0	1.51	15189
Ratio of Other Medicaid Reimburs. to Medicaid Cost	0.89	0.23	0	1.91	15831
Ratio of Other Medicaid Reimburs. to Uninsured Cost	5.73	8.18	0	101.33	13793
Panel D: AHA, DSH and HCRIS					
Net Income from Service to Patients ($ Million)	-2.41	34.18	-685.61	893.9	12518
Net Patient Revenues ($ Million)	127.15	183.37	0.82	2476.77	12328
Total Operating Margin	-0.04	0.2	-3.06	0.8	12328

[a] Hospitals may have LIUR up to 2, because LIUR is defined as the sum of the two proportions: (1) hospital's revenue from Medicaid patients and cash subsidies from state and local governments, as a proportion of total revenues including cash subsidies, and (2) hospital's charges for inpatient services to uninsured patients as a proportion of total charges for inpatient care. For example, suppose a hospital only provides inpatient services. It has no patients with private insurance, but 80% of patients are Medicaid patients and 20% of them are uninsured. Further suppose that for all Medicaid patients, Medicaid reimburses 100% and that uninsured patients pay 0%. Then in this case, the first component of LIUR is 1 and the second component is 0.2. Thus, the final value of LIUR of this hospital becomes 1.2.

[b] Some hospitals have a negative Medicaid supplmental payment, because states use it as a means to adjust Medicaid FFS payments, when the total Medicaid FFS payments exceed UPL.

[c] Medicaid (uninsured) uncompensated care cost is defined as the shortfall between Medicaid payments (uninsured revenues and payments) and the cost incurred to Medicaid (uninsured) patients. Therefore, if payments or revenues exceed costs to Medicaid or uninsured patients, hospitals may have negative values for Medicaid or uninsured uncompensated care costs.

[d] M & U costs refer to Medicaid and uninsured costs.

4.1 Baseline Analysis

We analyze the following key variables: (1) DSH payment per bed, (2) costs of providing care to Medicaid and uninsured patients per bed, (3) ratio of DSH payments to these costs, and (4) other forms of Medicaid reimbursements per bed. For each of these variables, we analyze its relationship to hospital size, measured by the number of beds, for all hospitals and by ownership type. Specifically, we estimate a model of the following form:

$$\begin{aligned} y_{it} &= \beta_0 + \beta_1 Hospital\ Size + \beta_2 Govmt + \beta_3 NonProf + \beta_4 IMD \\ &\quad + \beta_5 Govmt \times Hospital\ Size + \beta_6 NonProf \times Hospital\ Size + \beta_7 IMD \times Hospital\ Size \\ &\quad + \beta_8 \mathbf{x}_{it} + \alpha_i + \gamma_t + \varepsilon_{it} \end{aligned}$$

where *Hospital Size* is hospital size measured by the number of beds, *Govmt* is a dummy variable for government hospitals, *NonProf* is a dummy variable for nonprofit hospitals, *IMD* is a dummy variable for IMDs, $\mathbf{x}_{it}$ is a vector of MIUR, county-level uninsured population, and county-level median rent price to reflect geographic variation in price level[10], α_i are state fixed effects, and γ_t are year fixed effects. For all the analyses presented in this paper, we have also estimated specifications with flexible higher-order polynomials. Since they did not improve the goodness of fit and did not affect key results, we only present simple linear specifications.[11] We also present each of the key analyses by state type – whether a state is an urban/Southern state or other.

4.1.1 Hospital Size and DSH Payments

First, we compare the amount of DSH payment per bed across hospital size and ownership types. Figure 3 plots DSH payment per bed against hospital size, excluding Institutions for Mental Diseases (IMDs)[12] . The upper-left panel shows roughly two groups of hospitals: a dense group of hospitals below $100,000 of DSH payment and a sparse group of hospitals above $100,000.

What creates such patterns can be understood by comparison across hospital ownership types. While private hospitals (both for-profit and non-profit) mostly belong to the first group, a large proportion of government hospitals belong to the second group. For private hospitals, DSH payment per bed does not increase as hospital size increases. In contrast, for government hospitals, a dense cluster of hospitals with low DSH payment disappears around hospital size with 400 beds. Above

[10] We use median rent price in county level from American Community Survey.

[11] All results with higher-order polynomials are available upon request.

[12] We exclude IMDs in all our figures for three reasons. First, the nature of their service differs significantly from other hospitals'. Second, there are separate DSH payment rules for IMDs. Third, they constitute only a small proportion (4.9%) of observations in our sample. In tables, however, we include IMDs because we can easily separate out patterns for non-IMDs by controlling for a dummy variable for IMDs and its interactions with other variables. In the supplementary material, we provide figures for IMDs.

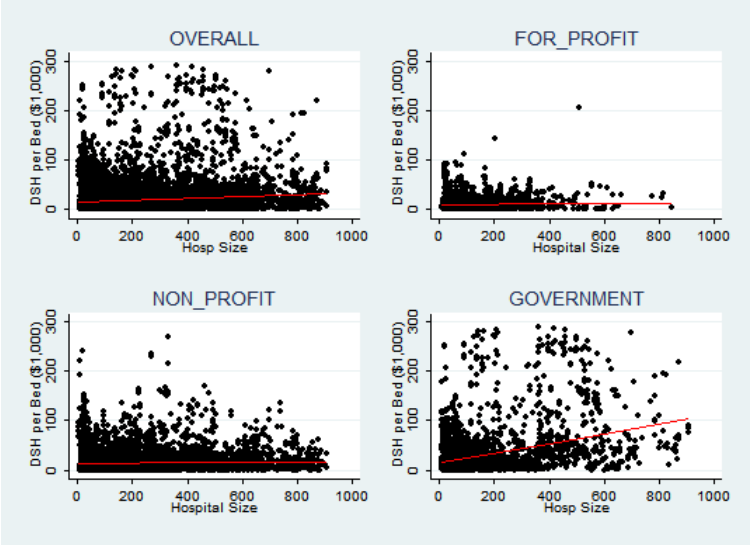
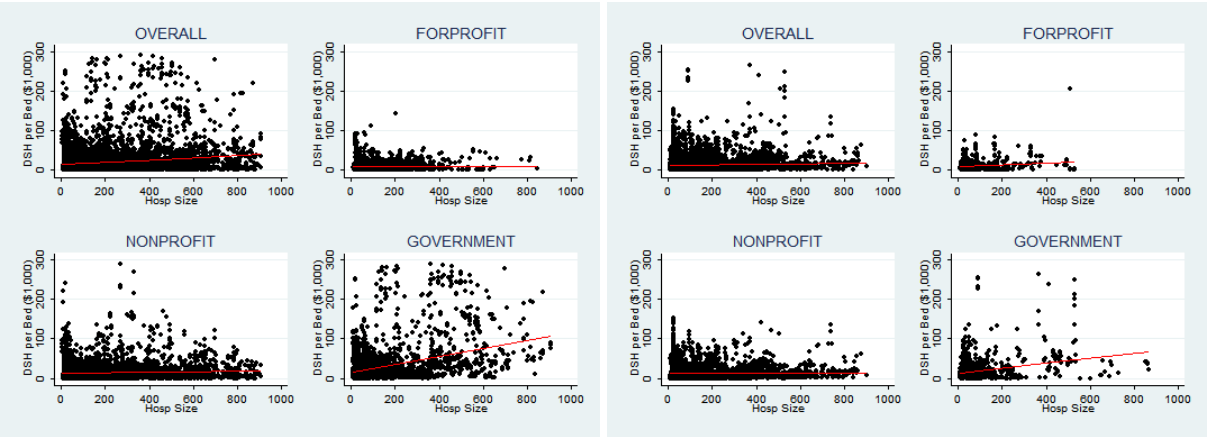


Figure 3: DSH Payment per Bed (Non-IMDs)

hospital size with 400 beds, hospitals with more than $100,000 of DSH payment per bed constitute a substantial proportion. Overall, the amount of DSH payment per bed increases significantly as hospital size increases, for government hospitals.



(a) Urban or Southern States

(b) All Other States

Figure 4: DSH Payment per Bed by State Type (Non-IMDs)

Figure 4 compares the distribution for different types of states. Panel (a) shows the distribution for urban[13] and Southern[14] states, and (b) shows the distribution for other states. We compare

[13]We define as 'urban states' the following fifteen states which have largest percentages of urban population according to *Percent Urban and Rural by State* (US Census, 2010): DC, CA, NJ, NV, HI, FL, RI, UT, AZ, IL, CT, NY, MD, CO and TX (in descending order of the percentage).

[14]We define seventeen states as 'Southern states' following the Census Regions and Divisions of the United States used in the US Census: AL, AR, DC, DE, FL, GA, KY, LA, MD, MS, NC, OK, SC, TN, TX, VA and WV (in alphabetical order).

Table 2: OLS Regression of DSH Payment per Bed ($ 1,000)

	All States				Urban or Southern		Other	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Hospital Size	0.0107**	0.0139***	-0.00940	-0.00515	-0.0151	-0.0119	0.0106	0.0207
	(0.00515)	(0.00495)	(0.00944)	(0.00884)	(0.0108)	(0.0101)	(0.0198)	(0.0194)
Govmt=1 ×*Hospital Size*			0.0867***	0.0885***	0.0958***	0.101***	0.0405	0.0304
			(0.0216)	(0.0208)	(0.0256)	(0.0238)	(0.0245)	(0.0245)
NonProf=1 ×*Hospital Size*			0.00579	0.00197	0.00920	0.00544	-0.0101	-0.0187
			(0.00921)	(0.00845)	(0.00993)	(0.00938)	(0.0207)	(0.0204)
IMD=1 ×*Hospital Size*	0.109***	0.113***	0.0238	0.0260	0.00568	0.00467	0.0729	0.0899
	(0.0275)	(0.0291)	(0.0387)	(0.0408)	(0.0475)	(0.0494)	(0.0490)	(0.0594)
Govmt=1			10.75***	9.258**	10.42**	8.193*	12.99***	13.43***
			(3.250)	(3.524)	(4.605)	(4.620)	(4.461)	(4.338)
NonProf=1			4.883***	5.681**	3.780*	5.263**	6.827**	8.258**
			(1.740)	(2.134)	(2.021)	(2.481)	(3.133)	(3.551)
IMD=1	6.600	4.682	12.30	11.07	17.00	16.63	5.568	2.780
	(9.835)	(9.980)	(8.677)	(9.043)	(11.86)	(12.38)	(8.258)	(9.595)
MIUR	40.89***	40.34***	37.90***	37.20***	42.49***	41.72***	29.94***	27.41***
	(9.666)	(10.58)	(8.174)	(8.655)	(10.96)	(11.05)	(7.191)	(9.159)
Uninsured Pop	0.223	0.211	0.00129	0.210	0.0142	0.267	-0.00235	0.0145
	(0.195)	(0.213)	(0.202)	(0.204)	(0.247)	(0.309)	(0.322)	(0.166)
Median Rent Price	0.0215***	0.0160**	0.0225***	0.0182***	0.0248***	0.0202**	0.0180	0.0125*
	(0.00652)	(0.00663)	(0.00564)	(0.00642)	(0.00659)	(0.00845)	(0.0120)	(0.00661)
Constant	-14.97**	1.205	-17.23**	-7.719	-19.42**	-9.777	-14.91	12.70
	(7.192)	(5.682)	(6.576)	(5.621)	(8.772)	(6.916)	(10.55)	(9.480)
State FE	No	Yes	No	Yes	No	Yes	No	Yes
Observations	15,339	15,339	15,339	15,339	9,197	9,197	6,142	6,142
R^2	0.145	0.244	0.254	0.340	0.271	0.333	0.170	0.351

Note 1: Standard errors, clustered by state, in parentheses. *** p<0.01; ** p<0.05; * p<0.1
Note 2: Year fixed effects are included in all specifications.

these two groups for two reasons. First, as shown in Figure 1, urban and Southern states show notably different patterns from other states in the total state DSH expenditures as a percentage of total Medicaid medical assistance expenditures. Second, urban and Southern states both tend to have a large share of the indigent and uninsured population. The figure shows that the key patterns in Figure 3 are mostly from urban and Southern states. A large proportion of hospitals with a high level of DSH payment per bed are located in urban and Southern states. Moreover, large variation in DSH payments among hospitals with comparable size also comes primarily from urban or Southern states. Other states have a weaker relationship between hospital size and DSH payments even among government hospitals. They also have an overall smaller variation among hospitals with comparable size.

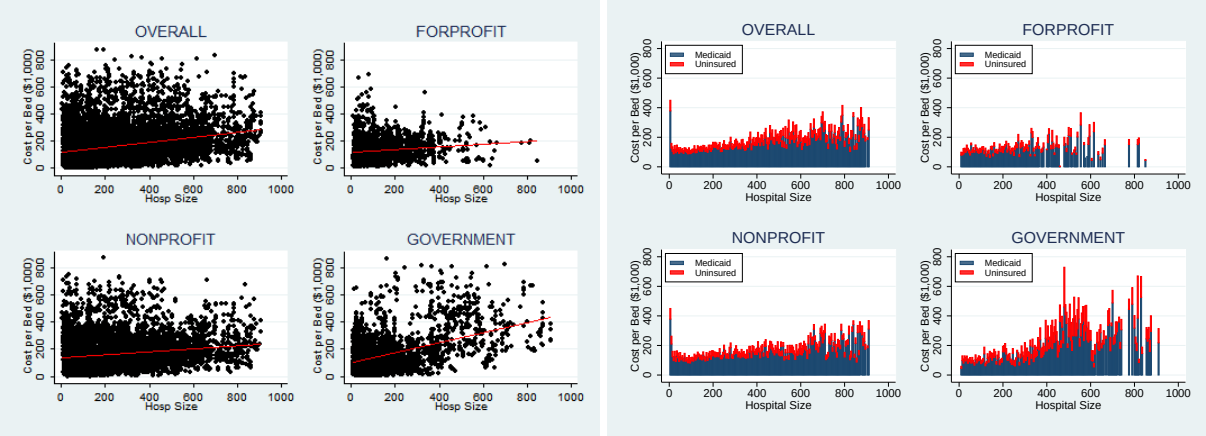
Table 2 presents results from the OLS regression of DSH payment per bed on hospital size, ownership types, and their interactions. Columns (1)-(4) show the results for all states. The coefficient estimate for hospital size is statistically significant in the specification without interactions with ownership types. In specifications where hospital size is interacted with ownership types, coefficient for hospital size is statistically significant only for government hospitals. The magnitude of the coefficient is also quantitatively significant for government hospitals: One standard deviation increase in hospital size, which is 166.4 beds[15], is associated with a 0.30 standard deviation increase in DSH payment per bed, which is $13,868 and 42.7% of the mean level. It is also worthwhile to note that dummy variables for nonprofit and government hospitals both have statistically significant positive estimates, with the coefficient for government hospitals being significantly large. Therefore, for any given level of hospital size, government hospitals receive substantially larger DSH payments than for-profit hospitals, and non-profit hospitals tend to receive amounts between government hospitals' and non-profit hospitals'.

Columns (5)-(8) of Table 2 present results from the OLS regression by state type (urban or Southern vs. other states). They show that regression results for urban or Southern states are very similar to those for all states. In urban or Southern states, coefficients for hospital size are significant only for government hospitals. The coefficients imply that one standard deviation increase in hospital size, which is 179.5 beds, is associated with a 0.32 standard deviation increase in DSH payment per bed, which is $15,991 and 43.5% of the mean level. In addition, government hospitals on average tend to receive more DSH payment per bed than private hospitals for any given level of hospital size. In contrast, in other states, which constitute approximately 40% of our sample, the coefficient for hospital size is not statistically significant regardless of specifications. In addition, one standard deviation increase in hospital size for government hospitals, which is 120.6 beds, is associated with only a 0.18 standard deviation increase in DSH payment per bed, which is $6,201 and 26.9% of the mean level. This clear contrast demonstrates that the overall pattern in columns

[15]Throughout this section, the standard deviation used in the interpretation of coefficient estimates is one for the relevant subsample. For example, 166.4 beds is the standard deviation of hospital size for government hospitals.

(1)-(4) is driven by urban and Southern states.

4.1.2 Hospital Size and Medicaid/Uninsured Patient Care Costs



(a) Scatter Plots

(b) Averages Costs

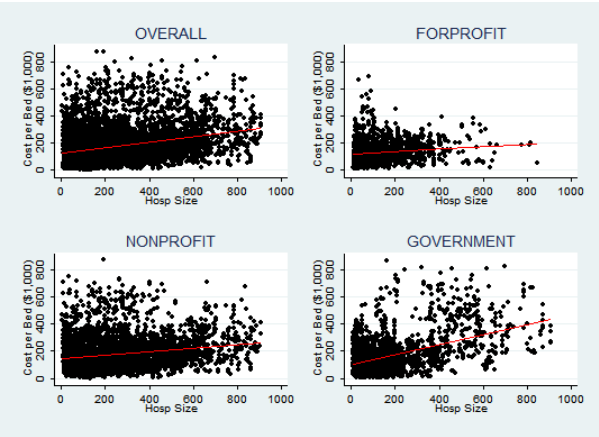
Figure 5: Medicaid and Uninsured Costs per Bed (Non-IMDs)

In the previous section, we have shown that large government hospitals tend to receive significantly larger DSH payment per bed. A straightforward potential reason could be that larger government hospitals incur higher costs per bed for Medicaid and uninsured patients than other hospitals do. Thus, in this section, we examine the relationship between hospital size and costs hospitals incur to provide care for Medicaid and uninsured patients (henceforth, "Medicaid and uninsured costs"). We use Medicaid and uninsured costs reported in annual DSH audit reports, defined as total costs of inpatient and outpatient care for Medicaid or uninsured patients. We focus on those costs incurred *per bed*.

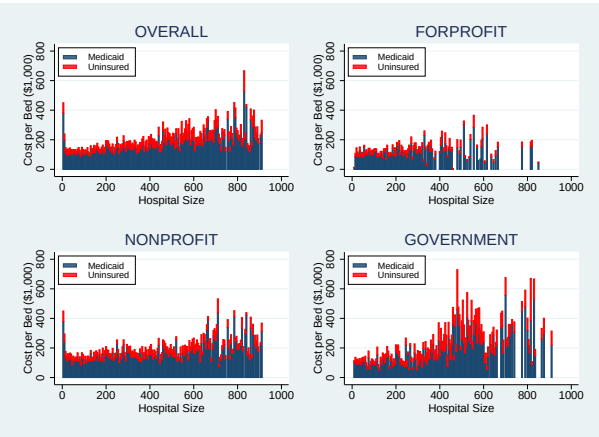
Figure 5 shows that Medicaid and uninsured costs per bed increase as hospital size increases. As in the case of DSH payment per bed, this pattern is driven largely by government hospitals. This confirms an intuitively straightforward possibility that variation in Medicaid and uninsured costs contributes to variation in DSH payments. There is an important difference, however, between patterns of DSH payments and those of Medicaid and uninsured costs. While DSH payments have shown no relationship with hospital size for non-profit and for-profit hospitals, Medicaid and uninsured costs have a positive relationship with hospital size even for non-profit and for-profit hospitals. This suggests that large hospitals play a more active role in providing care to the indigent population for every ownership type, although the variation across hospital size is stronger for government hospitals.[16]

[16]There are certainly alternative explanations for this pattern. For example, it may reflect price level variation across locations. Large hospitals may be located in areas where price level is higher, which would lead to larger costs

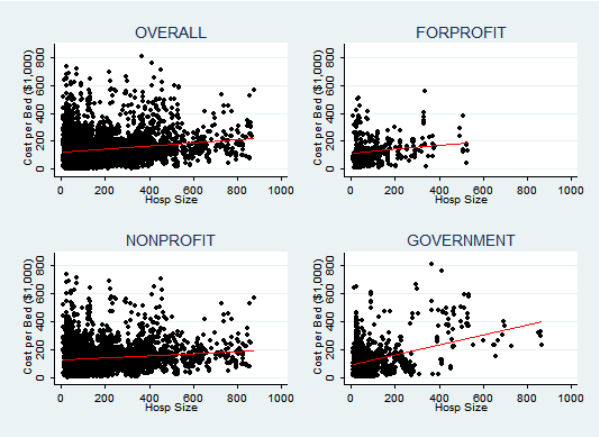
The figure also shows a greater degree of heterogeneity in the behavior among non-profit and government hospitals, compared with for-profit hospitals. Specifically, large government hospitals with 400 to 600 beds incur a high level of uninsured cost per bed. Overall, the figure suggests that there is a sub-group of nonprofit and government hospitals, especially large government hospitals, that serve as "safety-net" hospitals for the indigent population, while the rest of non-profit and government hospitals behave similarly to for-profit hospitals.



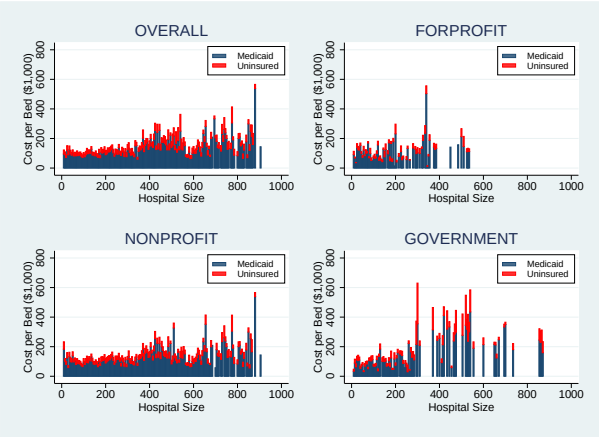
(a) Scatter Plots – Urban or Southern States



(b) Average Costs – Urban or Southern States



(c) Scatter Plots – Other States



(d) Average Costs – Other States

Figure 6: Medicaid and Uninsured Costs per Bed by State Type (Non-IMDs)

Figure 6 compares the joint distribution of Medicaid and uninsured costs per bed and hospital size for different types of states. It shows that government hospitals that incur large Medicaid and

of the same service. Therefore, a precise understanding requires a more in-depth analysis of patient mix. However, there are reasons to believe that price level may not be driving these patterns. First, we control for the proportion of the uninsured population, which is correlated with a host of economic characteristics of hospital locations, as well as county-level median rent price. Second, key coefficient estimates are robust to inclusion of state fixed effects. Different states may have markedly different price levels. If price level variation drove the patterns in the costs across hospital size, then coefficient estimates would have been affected by inclusion of state fixed effects.

Table 3: OLS Regression of Medicaid and Uninsured Costs per Bed ($1,000)

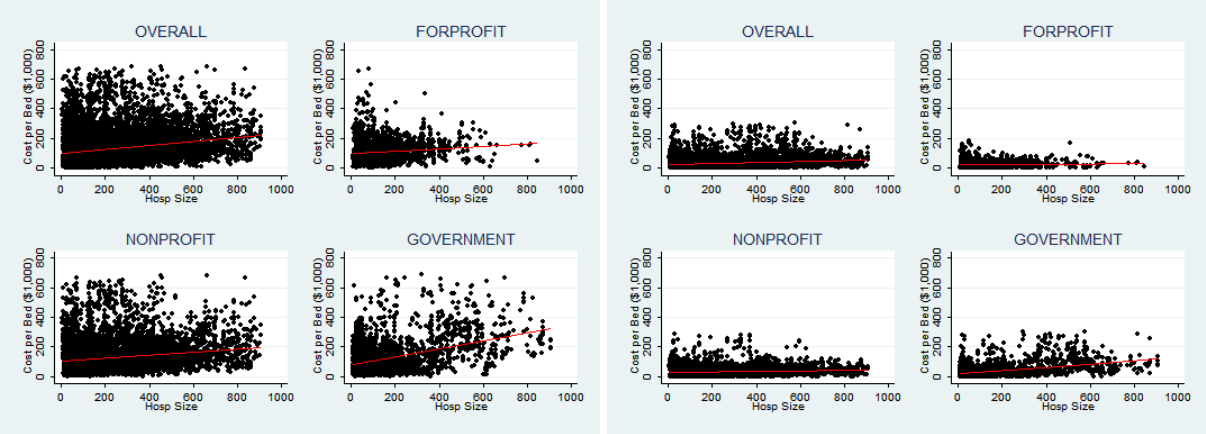
	All States				Urban or Southern		Other	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Hospital Size	0.0999***	0.0946***	-0.00872	-0.00933	-0.0224	-0.0298	0.0232	0.0792
	(0.0156)	(0.0164)	(0.0286)	(0.0297)	(0.0303)	(0.0291)	(0.0826)	(0.0730)
Govmt=1 ×*Hospital Size*			0.253***	0.241***	0.281***	0.274***	0.199*	0.116
			(0.0464)	(0.0478)	(0.0528)	(0.0537)	(0.108)	(0.0888)
NonProf=1 ×*Hospital Size*			0.0647**	0.0623*	0.0921***	0.0954***	0.0148	-0.0490
			(0.0313)	(0.0318)	(0.0312)	(0.0303)	(0.0916)	(0.0775)
IMD=1 ×*Hospital Size*	-0.135	-0.130	-0.280**	-0.265*	-0.338**	-0.326*	-0.0262	-0.0228
	(0.110)	(0.118)	(0.134)	(0.144)	(0.154)	(0.161)	(0.124)	(0.163)
Govmt=1			1.635	1.204	-5.825	-5.937	14.40	23.47*
			(8.634)	(7.970)	(9.916)	(9.519)	(15.03)	(11.38)
NonProf=1			25.85***	24.08***	19.26**	18.49**	36.80**	43.50***
			(7.370)	(7.119)	(8.276)	(8.159)	(14.22)	(12.28)
IMD=1	-50.78**	-50.45*	-32.55	-33.37	-12.11	-12.80	-76.93***	-76.23**
	(25.10)	(26.27)	(25.94)	(27.61)	(36.15)	(36.01)	(20.87)	(27.29)
MIUR	324.4***	338.2***	322.2***	334.0***	325.4***	328.4***	339.4***	353.9***
	(23.27)	(23.95)	(21.53)	(22.32)	(27.29)	(27.51)	(32.39)	(40.66)
Uninsured Pop	-0.0871	0.559	0.265	0.878	0.952*	1.035	0.0994	0.217
	(0.566)	(0.517)	(0.579)	(0.540)	(0.517)	(0.636)	(1.516)	(0.971)
Median Rent Price	0.124***	0.122***	0.121***	0.123***	0.123***	0.121***	0.132**	0.123***
	(0.0208)	(0.0155)	(0.0199)	(0.0154)	(0.0190)	(0.0166)	(0.0575)	(0.0394)
Constant	-57.76***	-65.88***	-74.51***	-79.64***	-89.56***	-72.97***	-86.17*	-70.83*
	(18.61)	(10.36)	(16.36)	(10.09)	(15.12)	(12.11)	(45.56)	(39.81)
State FE	No	Yes	No	Yes	No	Yes	No	Yes
Observations	14,501	14,501	14,501	14,501	9,131	9,131	5,370	5,370
R^2	0.327	0.376	0.353	0.399	0.370	0.392	0.301	0.394

Note 1: Standard errors, clustered by state, in parentheses. *** p<0.01; ** p<0.05; * p<0.1
Note 2: Year fixed effects are included in all specifications.

uninsured costs per bed are mostly located in urban or Southern states. Therefore, as in the case of DSH payment, urban and Southern states drive the overall pattern for all hospitals. Average costs show a more subtle pattern, however. Medicaid and uninsured costs per bed are higher for large government hospitals than for other hospitals, not only in urban and Southern states but also in other states. Moreover, all hospital ownership types show a mild increase in average Medicaid and uninsured costs per bed as hospital size increases, also in other states, although the degree is smaller than in urban or Southern states.

Table 3 presents the results from the OLS regressions of Medicaid and uninsured costs per bed on hospital size, ownership types, and their interactions. Columns (1)-(4) present the results for all states. Coefficient estimates associated with hospital size confirm the observations from Figures 5. Government hospitals show a significant positive relationship between hospital size and costs. Specifically, one standard deviation increase in hospital size for government hospitals is associated with a 0.30 standard deviation increase in Medicaid and uninsured costs per bed, which is $38,547 and 25.3% of the mean level. Non-profit hospitals also have a positive relationship between the costs per bed and hospital size. However, the relationship is weaker than government hospitals, as the size of coefficient estimates on hospital size is smaller than that of goverment hospitals.

Columns (5)-(8) of Table 3 present results from the OLS regression of Medicaid and uninsured costs per bed for different state types. Coefficient estimates also confirm our observations from Figure 6. Variation across ownership types in the relationship between hospital size and the Medicaid and uninsured costs per bed is stronger in urban or Southern states. One standard deviation increase in hospital size for government hospitals is associated with a 0.33 standard deviation increase in Medicaid and uninsured costs per bed, which is equivalent to $43,827 and 26.8% of the mean level in urban or Southern states. On the other hand, it is associated with a 0.21 standard deviation increase, which is $23,686 and 18.7% of the mean level in other states. Statistical



(a) Medicaid Costs Only

(b) Uninsured Costs Only

Figure 7: Medicaid vs. Uninsured Costs per Bed (Non-IMDs)

Table 4: OLS Regression of Medicaid/Uninsured Costs per Bed ($1,000)

	Dependent Variable					
	Medicaid Cost Only		Uninsured Cost Only		Share of Uninsured Cost	
	(1)	(2)	(3)	(4)	(5)	(6)
Hospital Size	-0.0110	-0.00858	0.00389	0.00478	3.58e-05	3.06e-05
	(0.0216)	(0.0221)	(0.0109)	(0.0109)	(5.35e-05)	(4.52e-05)
Govmt=1 ×*Hospital Size*	0.169***	0.161***	0.0848***	0.0778***	0.000103	7.89e-05
	(0.0354)	(0.0344)	(0.0202)	(0.0195)	(7.35e-05)	(5.43e-05)
NonProf=1 ×*Hospital Size*	0.0625**	0.0597**	0.00230	0.000201	-4.76e-05	-5.01e-05
	(0.0246)	(0.0236)	(0.0124)	(0.0112)	(5.70e-05)	(4.48e-05)
IMD=1 ×*Hospital Size*	-0.258***	-0.265**	-0.0214	-0.00316	0.000368	0.000441*
	(0.0938)	(0.101)	(0.0427)	(0.0439)	(0.000227)	(0.000223)
Govmt=1	-3.394	-6.141	5.534*	7.470**	0.0521***	0.0610***
	(6.530)	(5.492)	(3.215)	(3.203)	(0.0169)	(0.0136)
NonProf=1	16.30***	13.29**	9.712***	11.38***	0.0418***	0.0446***
	(5.729)	(5.658)	(2.142)	(2.141)	(0.0129)	(0.0103)
IMD=1	-50.35***	-48.70***	17.44*	16.23	0.133***	0.129***
	(16.89)	(16.84)	(9.515)	(10.60)	(0.0451)	(0.0456)
MIUR	318.0***	322.7***	3.123	8.825	-0.342***	-0.316***
	(21.19)	(21.96)	(7.182)	(6.953)	(0.0352)	(0.0303)
Uninsured Pop	-0.565	0.589	0.988***	0.329	0.00560***	0.000818
	(0.520)	(0.415)	(0.217)	(0.208)	(0.00112)	(0.000969)
Median Rent Price ($1,000)	87.46***	82.88***	31.04***	34.00***	0.0700*	0.0917***
	(18.77)	(14.06)	(8.179)	(8.012)	(0.0402)	(0.0246)
Constant	-48.76***	-56.32***	-28.70***	-22.27***	0.0767**	0.122***
	(15.43)	(12.59)	(6.413)	(4.481)	(0.0344)	(0.0221)
State FE	No	Yes	No	Yes	No	Yes
Observations	15,143	15,143	14,505	14,505	14,501	14,501
R^2	0.384	0.435	0.188	0.257	0.229	0.343

Note 1: Standard errors, clustered by state, in parentheses. *** p<0.01; ** p<0.05; * p<0.1
Note 2: Year fixed effects are included in all specifications.

significance is also weaker in other states.

Figure 7 presents separate figures for Medicaid costs per bed and uninsured costs per bed. Both Medicaid costs and uninsured costs show patterns that are consistent with those in Figure 5. Variation in Medicaid costs is larger, however, suggesting that the patterns in Figure 5 were primarily driven by Medicaid costs.

Columns (1)-(4) in Table 4 show the results from the OLS regression of Medicaid/uninsured cost per bed. They are consistent with observations from Figure 7. They also indicate that whether we look at the combined Medicaid and uninsured costs per bed or the two categories separately, only government hospitals show a significant positive relationship between hospital size and costs. Specifically, one standard deviation increase in hospital size for government hospitals is associated with a 0.25 (0.31) standard deviation increase in Medicaid (uninsured) costs per bed, which is $25,361 ($13,740) and 22.1% (36.5%) of the mean level.

The last two columns of Table 4 show regression results where the dependent variable is the share of uninsured costs in total Medicaid and uninsured costs per bed. For the share of uninsured costs, hospital size does not show any relationship regardless of ownership type. However, both dummy variables for government and non-profit hospitals have statistically significant positive coefficient estimates, showing that non-profit and government hospitals play a more active role in treating uninsured patients relative to Medicaid patients, compared to for-profit hospitals.

4.1.3 Ratio of DSH Payments to Medicaid and Uninsured Patient Care Costs

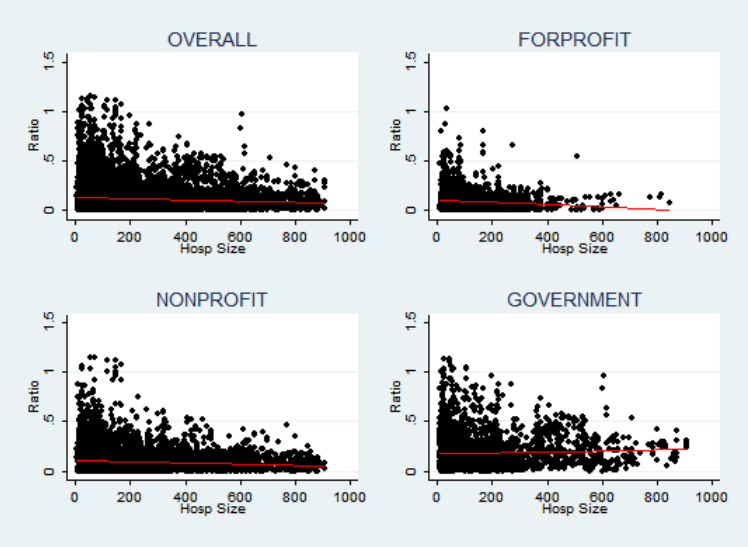
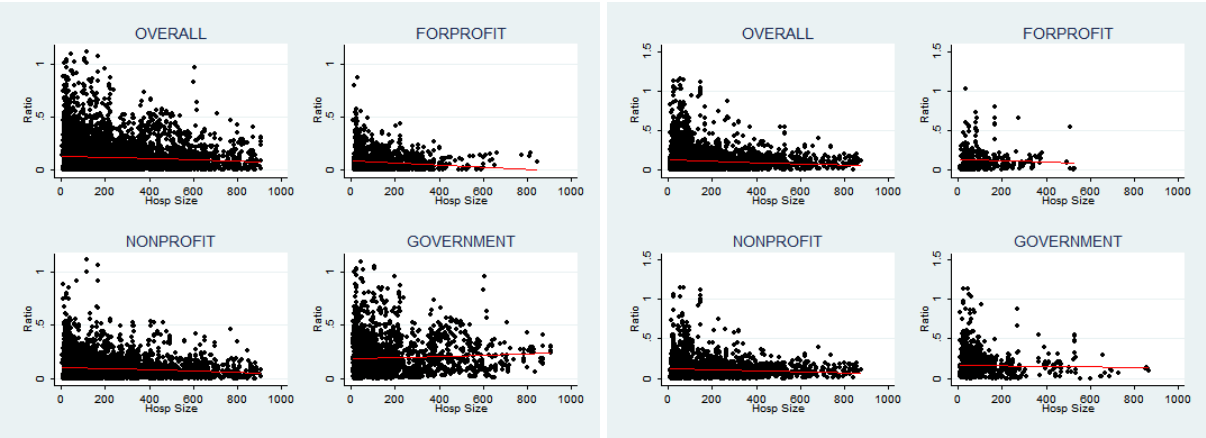


Figure 8: Ratio of DSH Payments to Medicaid and Uninsured Costs (Non-IMDs)

Now we analyze how much of Medicaid and uninsured costs is covered by DSH payment. The purpose of this analysis is to understand to what extent variation in costs drives variation in DSH

payments, documented in Section 4.1.1, and how much of variation in DSH payments can be explained by other factors such as hospital characteristics.

Figure 8 shows a mild inverse relationship between hospital size and the ratio of DSH payments to Medicaid and uninsured costs for for-profit and non-profit hospitals. Government hospitals do not exhibit an inverse relationship and have a higher ratio overall than for-profit and non-profit hospitals.



(a) Urban or Southern States

(b) All Other States

Figure 9: Ratio of DSH Payments to Medicaid and Uninsured Costs by State Type (Non-IMDs)

Figure 9 plots the ratio against hospital size by state type. As in the case of other variables analyzed in earlier sections, urban and Southern states drive the main pattern. Variation in the ratio for a given level of hospital size is generally greater in urban or Southern states. The breakdown by ownership type shows that this difference in overall variation mostly comes from government hospitals.

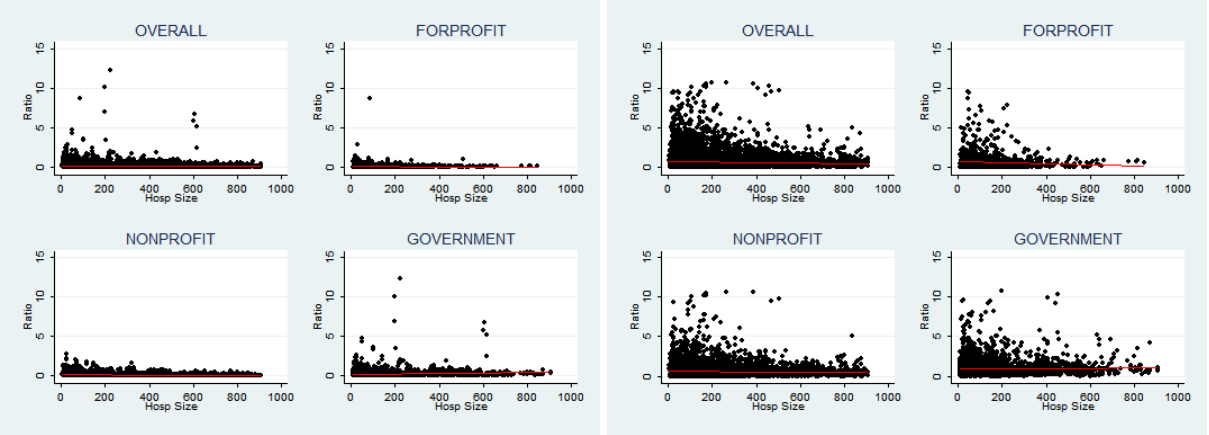
Table 5 presents the results of the OLS regression of the ratio on hospital size, ownership types, and their interactions. Columns (1)-(4), which include all states, show that larger hospitals tend to have a greater ratio of DSH payments to Medicaid and uninsured costs, only for government hospitals. Specifically, one standard deviation increase in hospital size for government hospitals is associated with a 0.09 standard deviation increase in the ratio of DSH payments to Medicaid and uninsured costs, which is 0.02 and 8.7% of the mean level. Moreover, the dummy variable for government hospitals has a larger coefficient estimate than for-profit and non-profit hospitals. Therefore, for any given level of hospital size, the ratio is higher for government hospitals on average. Columns (5)-(8) indicate that this overall pattern is mainly driven by urban or Southern states.

Figure 10 presents separate plots for the ratio of DSH payments to Medicaid costs and that to uninsured costs. Both variables show patterns consistent with those in Figure 8. However, the ratio to uninsured costs demonstrates larger variation and a stronger pattern, because the denominator is

Table 5: OLS Regression of Ratio of DSH Payment to Medicaid and Uninsured Costs

	All States				Urban or Southern		Other	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Hospital Size ($1,000)	-0.0432	-0.0266	-0.0758	-0.0660	-0.0839	-0.0694	-0.0417	-0.0644
	(0.0259)	(0.0210)	(0.0575)	(0.0471)	(0.0639)	(0.0525)	(0.0994)	(0.0961)
Govmt=1 ×*Hospital Size*			0.137**	0.176***	0.156**	0.192***	0.0170	0.101
			(0.0553)	(0.0475)	(0.0588)	(0.0528)	(0.0806)	(0.0688)
NonProf=1 ×*Hospital Size*			0.0284	0.0147	0.0287	0.00519	0.00385	0.0291
			(0.0554)	(0.0447)	(0.0591)	(0.0490)	(0.101)	(0.0928)
IMD=1 ×*Hospital Size*	0.906***	0.941***	0.675***	0.681***	0.638***	0.622***	1.122***	1.199***
	(0.125)	(0.139)	(0.127)	(0.141)	(0.135)	(0.138)	(0.294)	(0.291)
Govmt=1			0.0860***	0.0783***	0.0913***	0.0805***	0.0765**	0.0720***
			(0.0185)	(0.0182)	(0.0242)	(0.0236)	(0.0280)	(0.0239)
NonProf=1			0.0100	0.0178	0.0145	0.0225*	-0.000476	0.00661
			(0.0113)	(0.0106)	(0.0110)	(0.0126)	(0.0247)	(0.0153)
IMD=1	0.0839**	0.0710*	0.0877***	0.0826***	0.0767**	0.0761**	0.0684	0.0550
	(0.0340)	(0.0362)	(0.0287)	(0.0296)	(0.0367)	(0.0360)	(0.0414)	(0.0483)
MIUR	-0.0445	-0.0692*	-0.0531	-0.0751**	-0.0438	-0.0582	-0.0727*	-0.113
	(0.0367)	(0.0372)	(0.0330)	(0.0337)	(0.0409)	(0.0379)	(0.0365)	(0.0668)
Uninsured Pop	0.00122	0.000850	-0.000066	0.000467	0.000094	0.000906	-0.000612	0.000214
	(0.00107)	(0.000827)	(0.00108)	(0.000742)	(0.00117)	(0.00108)	(0.00213)	(0.000805)
Median Rent Price ($1,000)	-0.00705	-0.0292	0.00579	-0.00868	0.00363	-0.0130	0.0189	0.00982
	(0.0291)	(0.0298)	(0.0271)	(0.0260)	(0.0339)	(0.0331)	(0.0643)	(0.0329)
Constant	0.140***	0.250***	0.121***	0.203***	0.116**	0.190***	0.132*	0.202***
	(0.0368)	(0.0298)	(0.0409)	(0.0306)	(0.0524)	(0.0400)	(0.0715)	(0.0378)
State FE	No	Yes	No	Yes	No	Yes	No	Yes
Observations	14,524	14,524	14,524	14,524	9,154	9,154	5,370	5,370
R^2	0.158	0.314	0.241	0.383	0.269	0.395	0.198	0.376

Note 1: Standard errors, clustered by state, in parentheses. *** p<0.01; ** p<0.05; * p<0.1
Note 2: Year fixed effects are included in all specifications.
Note 3: Unlike in earlier tables, we use 1,000 beds as the unit of hospital size in this table because the dependent variable, which is a ratio, makes the magnitude of coefficients small.



(a) Medicaid Costs

(b) Uninsured Costs

Figure 10: Ratio of DSH Payments to Medicaid/Uninsured Costs (Non-IMDs)

smaller.

Table 6 shows the results from the OLS regression of the ratio of DSH payments to Medicaid or to uninsured costs only. Coefficient estimates are consistent with observations from Figure 10. The ratio tends to increase as hospital size increases for government hospitals for both Medicaid costs and uninsured costs. Specifically, one standard deviation increase in hospital size for government hospitals leads to a 0.07 (0.02) standard deviation increase in the ratio of DSH payments to Medicaid (uninsured) costs, which is 0.08 (0.03), and 17.2% (2.8%) of the mean level. The OLS regression of the ratio of DSH payments to Medicaid and uninsured costs for different state types, which we include in the supplementary material, gives results consistent with Figure 9.

The analyses presented so far demonstrate the advantages that large government hospitals have in reimbursement of their costs through Medicaid DSH payments. However, the DSH payment scheme behind this pattern is not entirely clear, because large government hospitals have different behaviors than others, as demonstrated in Section 4.1.2. Specifically, large government hospitals in urban areas tend to have larger Medicaid/uninsured costs per bed (and higher Medicaid utilization rates). Given that one purpose of the Medicaid DSH program is to subsidize hospitals that play a disproportionate role in treating Medicaid and uninsured patients, such patterns may well indicate that large government hospitals in urban areas receive a higher proportion of their costs reimbursed through DSH, purely because of the large costs they incur, rather than size, ownership types, or locations *per se*.

This issue is partially addressed by controlling for MIUR and the share of the uninsured population in all regressions. There are remaining concerns, however, that potential nonlinearity in the influence of those factors could potentially be falsely attributed to hospital size, ownership, or locations. To address this issue further, we now present comparisons across hospital size, ownership types, and locations in greater detail.

Table 6: OLS Result of Ratio of DSH Payment to Medicaid/Uninsured Costs Only

	Dependent Variable			
	Ratio to Medicaid Costs		Ratio to Uninsured Costs	
	(1)	(2)	(3)	(4)
Hospital Size ($1,000)	0.0673	0.121	-0.949**	-0.936***
	(0.149)	(0.132)	(0.423)	(0.269)
Govmt=1 ×*Hospital Size*	0.301	0.347*	0.752*	1.106***
	(0.205)	(0.192)	(0.434)	(0.314)
NonProf=1 ×*Hospital Size*	-0.0252	-0.0751	0.533	0.594**
	(0.134)	(0.119)	(0.407)	(0.273)
IMD=1 ×*Hospital Size*	4.444*	4.547*	1.284	0.958
	(2.639)	(2.662)	(0.817)	(0.643)
Govmt=1	0.208***	0.194***	0.240**	0.141
	(0.0558)	(0.0574)	(0.0939)	(0.0852)
NonProf=1	0.0497*	0.0743**	-0.0539	-0.0927
	(0.0294)	(0.0335)	(0.0866)	(0.0622)
IMD=1	0.643**	0.652**	0.277**	0.270**
	(0.294)	(0.301)	(0.134)	(0.123)
MIUR	-0.727***	-0.922***	1.591***	1.603***
	(0.184)	(0.209)	(0.299)	(0.263)
Uninsured Pop	0.00594**	-0.00169	-0.0214***	-0.000149
	(0.00264)	(0.00247)	(0.00724)	(0.00390)
Median Rent Price ($1,000)	-0.0871	-0.126*	0.195	0.00139
	(0.0601)	(0.0737)	(0.163)	(0.110)
Constant	0.200***	0.377***	0.725***	0.906***
	(0.0738)	(0.0612)	(0.240)	(0.108)
State FE	No	Yes	No	Yes
Observations	15,158	15,158	13,202	13,202
R^2	0.292	0.330	0.138	0.252

Note 1: Standard errors, clustered by state, in parentheses. *** p<0.01; ** p<0.05; * p<0.1
Note 2: Year fixed effects are included in all specifications.
Note 3: Unlike in earlier tables, we use 1,000 beds as the unit of hospital size in this table because the dependent variable, which is a ratio, makes the magnitude of coefficients small.

Figure 11 shows the relationship between DSH payment per bed and Medicaid and uninsured costs per bed by hospital size, ownership type, and location. Hospitals are classified into three groups based on their size, measured by the number of beds: small (less than 100 bed), medium (100-399 beds), and large (400 beds or more). In order to determine if a hospital is located in an

urban or a rural area, we use a variable, CBSATYPE, in the AHA Annual Survey.[17]

Panel (a) shows several interesting patterns, largely consistent with patterns in previous sections but with additional information on DSH payment schemes. First, linear fit performs fairly well in capturing the relationship in all sub-samples. Theoretically, the curvature of the relationship conveys information on the extent to which Medicaid DSH gives disproportionate returns to hospitals that play an active role in providing care to the indigent population. That is, the gradient of DSH payment per bed with respect to Medicaid and uninsured costs per bed approximates the rate of reimbursement through DSH payment. The figure shows a fairly constant gradient across the level of costs *within* each sub-sample.

Second, there is a significant variation in the distribution of Medicaid and uninsured costs per bed across the nine sub-samples shown. As in Section 4.1.2, this implies substantial heterogeneity in hospital behavior across groups. However, this variation in costs *per se* is not the main driver of the variation in the ratio of DSH payments to Medicaid and uninsured costs documented in Section 4.1.3. When we compare hospitals of the same size across ownership types, the rate of reimbursement through DSH payment varies notably. Most importantly, a significant share of non-profit hospitals incur a large amount of Medicaid and uninsured costs ($400,000-$600,000) per bed. However, they receive a relatively small amount of DSH payment compared with government hospitals that incur comparable costs. Likewise, when we compare small-sized government hospitals with medium and large-sized hospitals, the rate of reimbursement is higher for the latter for the same level of costs, although the difference within ownership types across hospital size is smaller than the difference within hospital size across ownership types.

Panel (b) presents the same variables as in Panel (a), but for rural areas.[18] A comparison of small rural hospitals across ownership types shows a similar variation as in Panel (a).

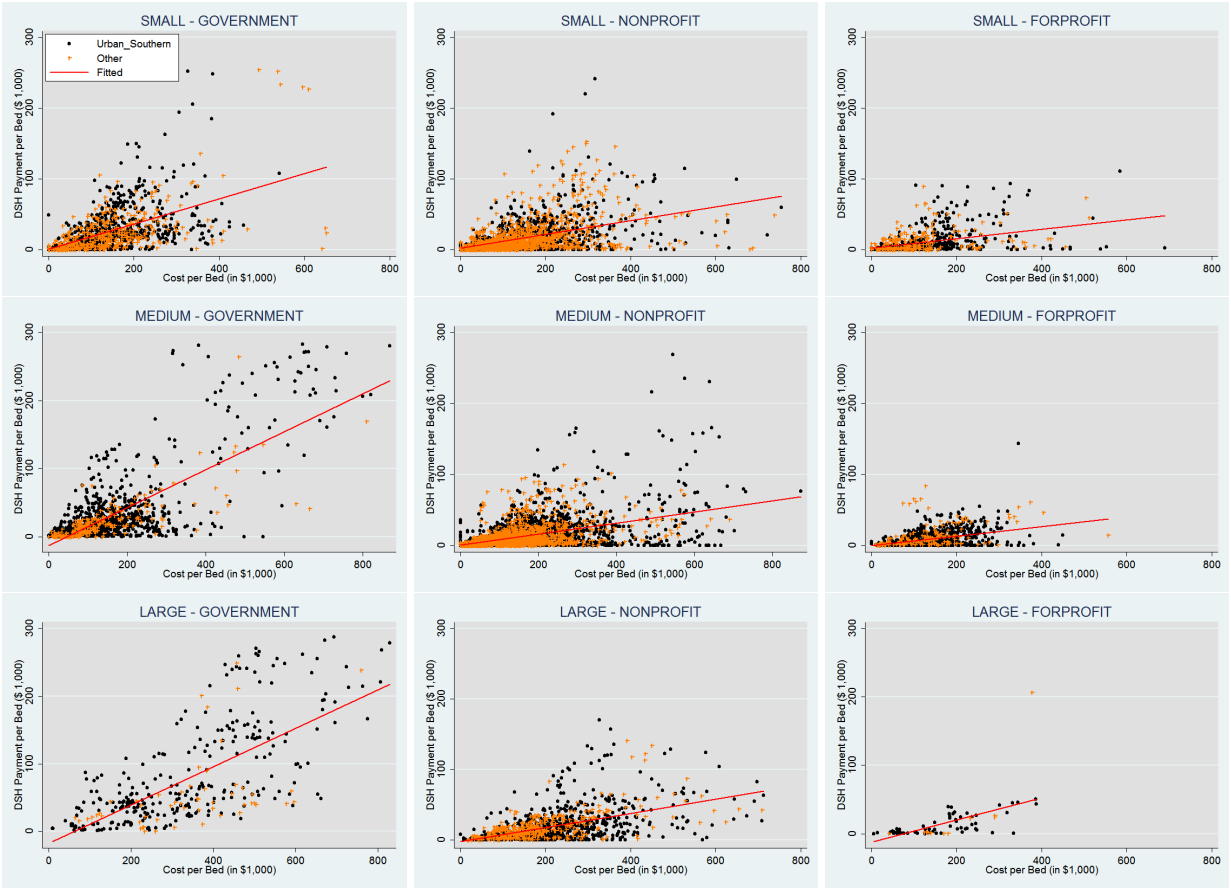
We also plotted relationships between DSH payment per bed and MIUR, in place of Medicaid/uninsured costs per bed, across hospital size, ownership types, and locations (not presented in this text).[19] It gives patterns similar to those in Figure 11. The only difference is that the variation in slope across hospital size is larger when we use MIUR in place of Medicaid/uninsured costs. This seems to reflect a variation in the overall health care cost of locations correlated with hospital size. That is, larger hospitals are located in more densely populated areas, which have higher price levels.

We also plotted relationships between DSH payment per bed and Medicaid costs per bed, in

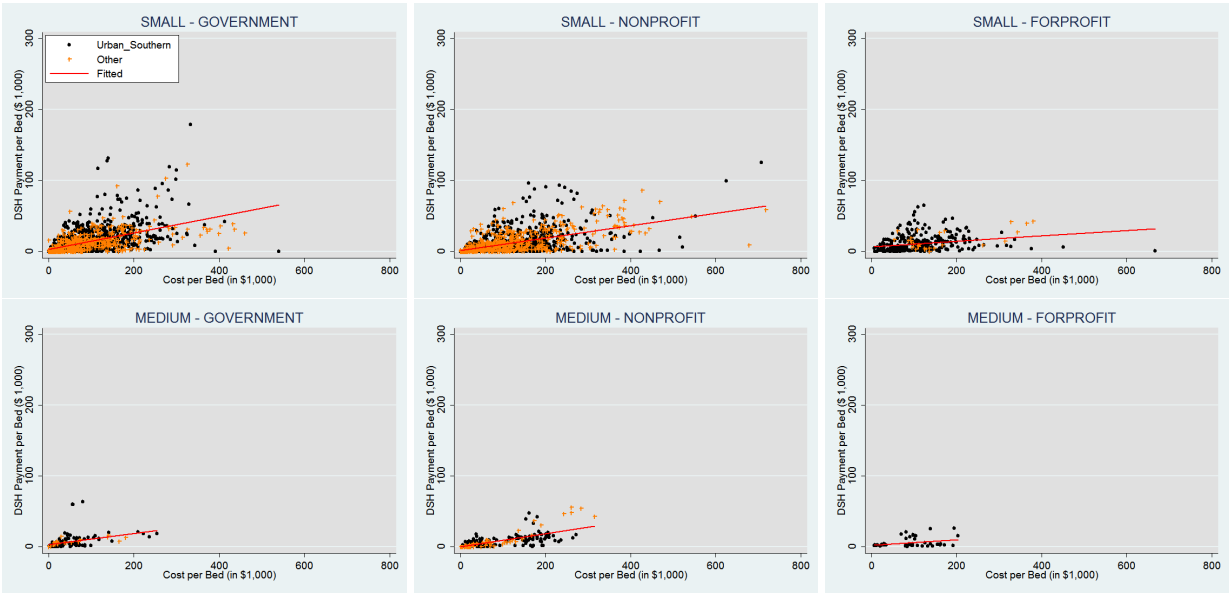
[17]CBSATYPE indicates the Core Based Statistical Area (CBSA) where a hospital is located. A CBSA is a geographic area that includes counties clustered around at least one core area with the population of 10,000 or more and adjacent counties which are socioeconomically associated with the urban core by commuting. If a hospital is located in a Metropolitan Division, Metropolitan Statistical Area, or Micropolitan Statistical Area according to CBSATYPE, which implies that the population in the area is more than 10,000, then it is classified to be in an urban area.

[18]We omitted a panel for large hospitals because there are too few large hospitals in rural areas.

[19]Results discussed but not presented in this paragraph are all available upon request.



(a) Urban Areas



(b) Rural Areas

Figure 11: DSH Payment and Medicaid and Uninsured Costs per Bed by Hospital Size and Ownership Types (Non-IMDs)

place of Medicaid/uninsured costs per bed, across hospital size, ownership types, and locations (not presented in this text). It essentially yields the same patterns as in Figure 11, which is intuitive given that uninsured costs are substantially smaller than Medicaid costs.

We also plotted relationships between Medicaid costs per bed and MIUR across hospital size, ownership types, and locations (not presented in this text). The gradient of Medicaid costs per bed with respect to MIUR is uniformly higher among larger hospitals. This also seems to reflect a variation in the overall health care cost of locations correlated with hospital size. When compared across ownership types, the gradient is smaller for for-profit hospitals than non-profit or government hospitals of the same size. Thus, for-profit hospitals tend to treat less costly Medicaid patients than do non-profit or government hospitals. However, this does not necessarily imply that for-profit hospitals are cream-skimming profitable patients because reimbursement rates through Medicaid DSH are lower for for-profit hospitals.

4.1.4 Hospital Size and Other Medicaid Reimbursements

Results in Sections 4.1.1 and 4.1.2 show that DSH payment per bed as well as Medicaid and uninsured costs per bed increase as hospital size increases, for government hospitals. Thus, patterns in DSH payments are partially driven by hospitals' services, more precisely, costs. However, in Section 4.1.3, the results on the *ratio* of DSH payments to Medicaid and uninsured costs demonstrated the advantages given to large government hospitals. That is, costs alone do not explain key patterns in DSH payments across hospital size and ownership types.

To put this result in a broader perspective, in this section we analyze the relationship between hospital size and Medicaid reimbursements through channels other than DSH payments (henceforth, "other (Medicaid) reimbursements"). We first analyze the relationship between hospital size and the amount of other reimbursements per bed. Then, we analyze the relationship between hospital size and the ratio of other Medicaid reimbursements to Medicaid and uninsured costs.

As described in Section 2.1, there are three kinds of Medicaid reimbursements, other than DSH payments, for hospitals' care provided to Medicaid patients: FFS, MCO, and supplemental payments. For hospitals' care provided to uninsured patients, there are two kinds of revenue sources: revenue from uninsured patients (out-of-pocket payments) and Section 1011 payments[20]. We focus on other Medicaid reimbursements, rather than revenues from treating uninsured patients because the latter is negligible compared to the former.

Other Medicaid Reimbursements per Bed Figure 12 presents relationships between other Medicaid reimbursements per bed and hospital size. Key patterns are similar to those of Medi-

[20]Section 1011 payments are provided by the federal government to eligible providers for the costs of providing emergency care to undocumented aliens.

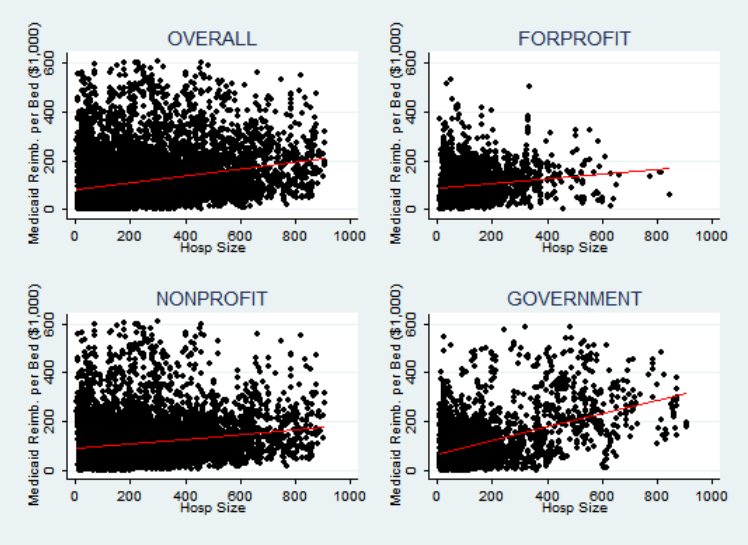
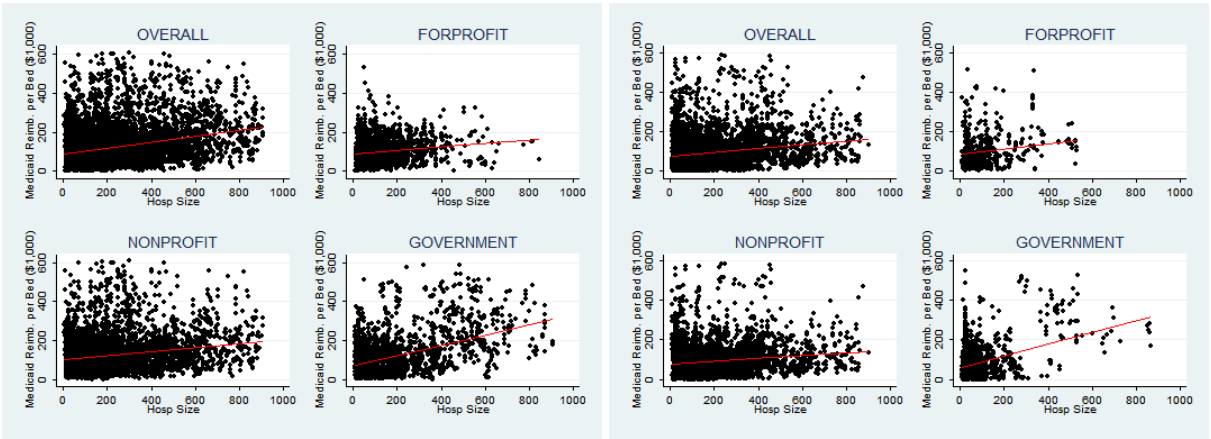


Figure 12: Other Medicaid Reimbursements per Bed (Non-IMDs)

caid and uninsured costs and Medicaid costs per bed in Figures 5 and 7. The amount increases mildly as hospital size increases, which is primarily driven by government hospitals. Non-profit and government hospitals, especially government hospitals, also show a larger degree of heterogeneity compared with private hospitals, even among hospitals of the same size. The similarity between patterns of Medicaid costs and other Medicaid reimbursements leads to the question of whether large hospitals receive a higher ratio of these other forms of Medicaid reimbursements relative to their costs, a question we address in the second part of this subsection.



(a) Urban or Southern States

(b) All Other States

Figure 13: Other Medicaid Reimbursements per Bed by State Type (Non-IMDs)

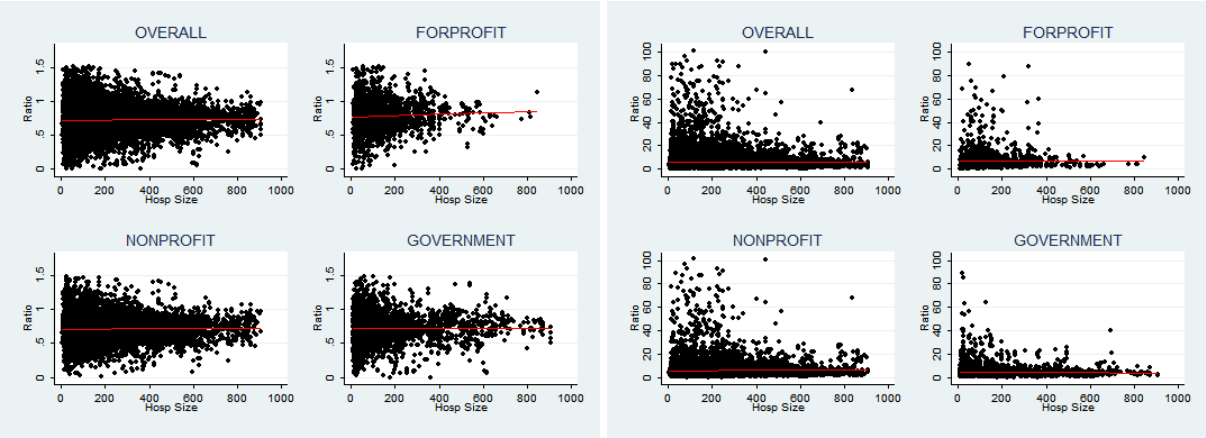
Figure 13 compares the distribution for different types of states. As in the case of other variables, the key patterns shown in Figure 12 are mostly from urban and Southern states. Although the gradient of other reimbursement amounts with respect to hospital size is similar for urban/Southern

and other states, there is a significantly smaller degree of heterogeneity among hospitals in other (non-urban, non-Southern) states. Large government hospitals that receive a large amount of other Medicaid reimbursements per bed are mostly in urban or Southern states.

Table 7 presents results from the OLS regressions of other Medicaid reimbursements per bed on hospital size, ownership types, and their interactions. Like in other variables, larger hospitals are associated with greater other Medicaid reimbursements per bed only for government hospitals. One standard deviation increase in hospital size for government hospitals is associated with a 0.30 standard deviation increase in other Medicaid reimbursement per bed, which is $28,602, and 28.1% of the mean level. For urban or Southern (other) states, one standard deviation increase in hospital size is associated with a 0.32 (0.25) standard deviation increase in other Medicaid reimbursements per bed, which is $30,946 ($21,902), and 28.3% (25.8%) of the mean level.

Ratio of Other Medicaid Reimbursements to Medicaid and Uninsured Costs Now, we analyze the ratio of other Medicaid reimbursements to Medicaid and uninsured costs. The purpose of this analysis is to examine similarity and differences between Medicaid DSH payments and other forms of Medicaid reimbursements. In previous sections, we documented that the ratio of DSH payments to Medicaid and uninsured costs increases as hospital size increases, for government hospitals. To gain deeper understanding of the role of large government hospitals in Medicaid, it is useful to analyze whether a similar pattern appears for other forms of Medicaid reimbursements.

Figure 14 presents the ratio of other Medicaid reimbursements to Medicaid and uninsured costs as well as to uninsured costs only. Panel (a) shows that unlike other variables analyzed above, this variable does not increase as hospital size increases, for any ownership types. Specifically, the ratio has an average of around 0.75 with remarkable consistency across hospital size and ownership types.



(a) Medicaid and Uninsured Costs (b) Uninsured Costs Only

Figure 14: Ratio of Other Medicaid Reimb. to Medicaid/Uninsured Costs (Non-IMDs)

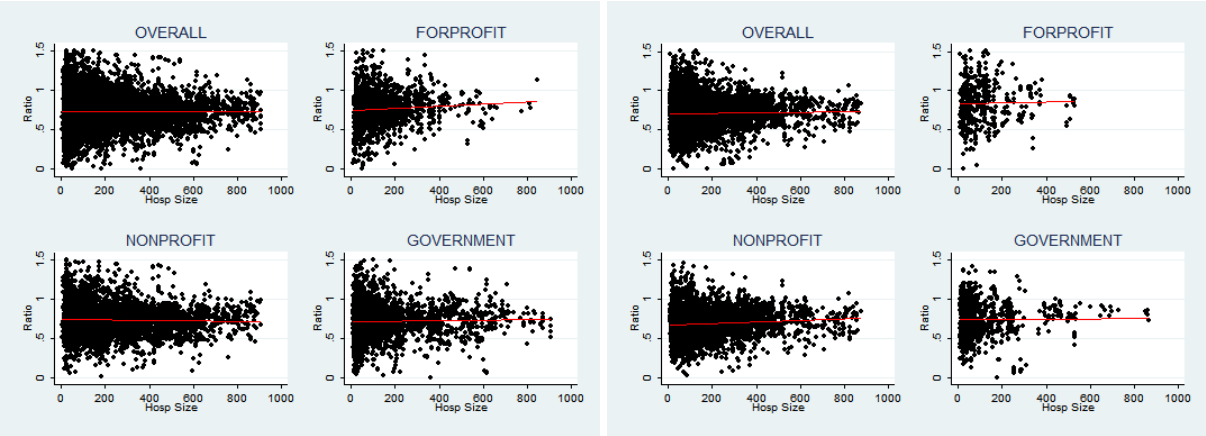
Table 7: OLS Regression of Other Medicaid Reimburesment per Bed ($1,000)

	All States				Urban or Southern		Other	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Hospital Size	0.0854***	0.0832***	0.0116	0.0199	0.00573	-0.00357	0.0456	0.104**
	(0.00998)	(0.0107)	(0.0219)	(0.0231)	(0.0241)	(0.0235)	(0.0523)	(0.0452)
Govmt=1 ×*Hospital Size*			0.170***	0.152***	0.182***	0.176***	0.154*	0.0765
			(0.0299)	(0.0297)	(0.0304)	(0.0322)	(0.0802)	(0.0629)
NonProf=1 ×*Hospital Size*			0.0462*	0.0370	0.0565**	0.0644**	0.00767	-0.0555
			(0.0240)	(0.0246)	(0.0265)	(0.0257)	(0.0575)	(0.0501)
IMD=1 ×*Hospital Size*	-0.228**	-0.232**	-0.313***	-0.309***	-0.345***	-0.335***	-0.146*	-0.158*
	(0.0875)	(0.0910)	(0.0953)	(0.100)	(0.107)	(0.111)	(0.0789)	(0.0909)
Govmt=1			-9.349	-7.032	-12.58*	-11.24*	-6.266	5.830
			(6.255)	(5.459)	(6.616)	(6.316)	(12.44)	(9.845)
NonProf=1			10.55**	12.28**	10.75	8.894	10.99	24.82***
			(4.882)	(5.080)	(6.703)	(6.432)	(7.268)	(6.659)
IMD=1	-47.77***	-44.71***	-36.80**	-34.39**	-27.43	-28.24	-64.57***	-54.10***
	(14.08)	(14.61)	(15.23)	(15.96)	(21.30)	(21.12)	(14.57)	(17.81)
MIUR	299.8***	298.2***	298.2***	295.2***	293.8***	290.6***	318.1***	309.7***
	(13.37)	(14.30)	(12.91)	(14.21)	(17.32)	(18.95)	(21.98)	(24.79)
Uninsured Pop	-0.167	0.302	0.0705	0.530	-0.0549	0.638	1.570	0.302
	(0.499)	(0.372)	(0.468)	(0.376)	(0.345)	(0.442)	(1.214)	(0.793)
Median Rent Price	0.0667***	0.0681***	0.0637***	0.0667***	0.0642***	0.0674***	0.0780**	0.0639**
	(0.0138)	(0.00997)	(0.0134)	(0.00948)	(0.0142)	(0.00853)	(0.0297)	(0.0257)
Constant	-43.13***	-44.69***	-47.09***	-49.29***	-46.89***	-47.93***	-77.63***	-53.98*
	(14.01)	(9.249)	(13.91)	(9.620)	(13.51)	(13.00)	(24.38)	(27.29)
State FE	No	Yes	No	Yes	No	Yes	No	Yes
Observations	15,306	15,306	15,306	15,306	9,172	9,172	6,134	6,134
R^2	0.390	0.441	0.404	0.453	0.405	0.434	0.378	0.459

Note 1: Standard errors, clustered by state, in parentheses. *** p<0.01; ** p<0.05; * p<0.1
Note 2: Year fixed effects are included in all specifications.

In addition, heterogeneity among hospitals of comparable size decreases as hospital size increases, quite consistently across ownership types. Both figures show no significant relationship between the ratio to costs and hospital size. In addition, the fact that variation among the ratio to uninsured costs is significantly greater than the ratio to Medicaid and uninsured costs combined indicates that Medicaid costs, rather than uninsured costs, drive the key patterns in Figure 14 (a). [21]

Figure 15 presents separate figures for urban/Southern states and other states. The two groups of states show similar patterns in terms of the relationship between ratio to costs and hospital size, although urban/Southern states have larger variation in hospital size.



(a) Urban and Southern States

(b) Other States

Figure 15: Ratio of Other Medicaid Reimbursements to Medicaid and Uninsured Costs by State Type (Non-IMDs)

Table 8 presents results from the OLS regression of the ratio of other Medicaid reimbursements to Medicaid and uninsured costs on hospital size. Whether we look at all states or different state types, the coefficient estimate for hospital size is not statistically significant for any ownership types.

Table 9 summarizes the results of the separate regression of ratio of other Medicaid reimbursement to Medicaid costs only and uninsured costs only. As in Table 8, the coefficient estimate for hospital size is not significant for any specifications.

In summary, other Medicaid reimbursements per bed increase as hospital size increases for government hospitals. However, this merely reflects increases in costs incurred for providing care to Medicaid patients.

[21] Unlike in other variables we analyzed earlier, this feature is an obvious one by construction. While DSH payments are intended to subsidize treatment of both Medicaid and uninsured patients, other forms of payments are supposed cover the costs of treating Medicaid patients only.

Table 8: OLS Regression of Ratio of Other Medicaid Reimbursement to Medicaid and Uninsured Costs

	All States				Urban or Southern		Other	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Hospital Size ($1,000)	0.0539*	0.0652**	0.0540	0.0997*	0.144**	0.129**	-0.0875	0.0275
	(0.0276)	(0.0268)	(0.0557)	(0.0511)	(0.0524)	(0.0499)	(0.140)	(0.128)
Govmt=1 ×*Hospital Size*			-0.00482	-0.0601	-0.0598	-0.0816	0.0643	-0.0347
			(0.0590)	(0.0607)	(0.0643)	(0.0564)	(0.132)	(0.179)
NonProf=1 ×*Hospital Size*			0.0131	-0.0158	-0.103	-0.0730	0.196	0.0980
			(0.0679)	(0.0612)	(0.0693)	(0.0649)	(0.147)	(0.128)
IMD=1 ×*Hospital Size*	-0.958***	-0.977***	-0.877***	-0.887***	-0.825***	-0.811***	-1.089***	-1.215***
	(0.121)	(0.126)	(0.132)	(0.140)	(0.158)	(0.167)	(0.282)	(0.354)
Govmt=1			-0.0926***	-0.0753***	-0.0724***	-0.0610***	-0.158***	-0.121**
			(0.0217)	(0.0190)	(0.0212)	(0.0175)	(0.0557)	(0.0442)
NonProf=1			-0.0769***	-0.0611***	-0.0344*	-0.0374**	-0.168**	-0.122***
			(0.0268)	(0.0190)	(0.0172)	(0.0140)	(0.0627)	(0.0409)
IMD=1	-0.0265	-0.0164	-0.0421	-0.0309	-0.0588	-0.0552	-0.0295	0.0227
	(0.0492)	(0.0529)	(0.0438)	(0.0488)	(0.0663)	(0.0695)	(0.0390)	(0.0482)
MIUR	0.408***	0.356***	0.403***	0.352***	0.354***	0.346***	0.500***	0.361***
	(0.0615)	(0.0381)	(0.0595)	(0.0350)	(0.0679)	(0.0404)	(0.0883)	(0.0630)
Uninsured Pop	-0.00260	-0.00189*	-0.00296	-0.00191*	-0.00596***	-0.00165	0.00652**	-0.00187
	(0.00218)	(0.00103)	(0.00224)	(0.00103)	(0.00164)	(0.00106)	(0.00267)	(0.00262)
Median Rent Price ($1,000)	-0.162***	-0.131***	-0.166***	-0.150***	-0.185***	-0.157***	-0.0692	-0.131*
	(0.0415)	(0.0333)	(0.0419)	(0.0357)	(0.0394)	(0.0438)	(0.0903)	(0.0722)
Constant	0.780***	0.787***	0.860***	0.845***	0.899***	0.821***	0.748***	0.854***
	(0.0608)	(0.0284)	(0.0697)	(0.0324)	(0.0527)	(0.0357)	(0.129)	(0.121)
State FE	No	Yes	No	Yes	No	Yes	No	Yes
Observations	14,523	14,523	14,523	14,523	9,154	9,154	5,369	5,369
R^2	0.153	0.299	0.173	0.313	0.203	0.307	0.205	0.335

Note 1: Standard errors, clustered by state, in parentheses. *** p<0.01; ** p<0.05; * p<0.1
Note 2: Year fixed effects are included in all specifications.
Note 3: Unlike in earlier tables, we use 1,000 beds as the unit of hospital size in this table because the dependent variable, which is a ratio, makes the magnitude of coefficients small.

Table 9: OLS Regression of Ratio of Other Medicaid Reimbursement to Medicaid/Uninsured Costs Only

	Dependent Variable			
	Ratio to Medicaid Cost		Ratio to Uninsured Cost	
	(1)	(2)	(3)	(4)
Hospital Size ($1,000)	0.0687	0.142*	-5.277*	-4.891*
	(0.0825)	(0.0755)	(2.956)	(2.778)
Govmt=1 ×*Hospital Size*	0.172	0.0448	1.129	2.089
	(0.147)	(0.115)	(3.097)	(3.016)
NonProf=1 ×*Hospital Size*	0.00269	-0.0488	3.902	4.458
	(0.0861)	(0.0768)	(3.357)	(3.011)
IMD=1 ×*Hospital Size*	-0.812***	-0.754***	-23.78***	-25.25***
	(0.149)	(0.108)	(5.641)	(5.469)
Govmt=1	-0.0620**	-0.0302	-2.838***	-3.394***
	(0.0285)	(0.0197)	(0.905)	(0.924)
NonProf=1	-0.0581*	-0.0338*	-1.572*	-2.146***
	(0.0299)	(0.0184)	(0.784)	(0.733)
IMD=1	0.119***	0.137***	5.481**	5.616**
	(0.0373)	(0.0402)	(2.422)	(2.417)
MIUR	0.116	0.0883*	16.72***	15.54***
	(0.0766)	(0.0476)	(1.855)	(2.038)
Uninsured Pop	0.00427	-0.00177	-0.213***	-0.0776*
	(0.00343)	(0.00114)	(0.0403)	(0.0402)
Median Rent Price ($1,000)	-0.109*	-0.0784*	1.600	0.0985
	(0.0563)	(0.0435)	(1.266)	(1.100)
Constant	0.902***	0.981***	6.671***	5.925***
	(0.0893)	(0.0366)	(1.336)	(0.990)
State FE	No	Yes	No	Yes
Observations	15,156	15,156	13,198	13,198
R^2	0.067	0.283	0.129	0.176

Note 1: Standard errors, clustered by state, in parentheses. *** p<0.01; ** p<0.05; * p<0.1
Note 2: Year fixed effects are included in all specifications.
Note 3: Unlike in earlier tables, we use 1,000 beds as the unit of hospital size in this table because the dependent variable, which is a ratio, makes the magnitude of coefficients small.

4.2 Further Analysis and Discussion

In Section 4.1, we documented key differences between large government hospitals and others. One of the key differences is in the rate of reimbursement through DSH payments, for which large government hospitals in urban or Southern states seem to have an advantage. However, there may

be other (unobserved) hospital characteristics or behavior that may explain the variation in Medicaid DSH payments, such as other types of services they provide to their communities. Thus, in this section, we provide further analyses to strengthen our baseline results and discuss potential mechanisms behind the advantage for large government hospitals in the ratio of DSH payments to Medicaid and uninsured costs. In Section 4.2.1, we address concerns about the influence of unobserved heterogeneity using the Altonji-Elder-Taber-Oster method. In Section 4.2.2, we analyze the relationship between the DSH payment-to-cost ratio and other services that hospitals provide to communities – emergency, burn care, trauma care, and graduate medical education. In Section 4.2.3, we analyze the linkage between the DSH payment-to-cost ratio and hospitals' financial conditions. Using the results on financial conditions, we discuss potential cross-subsidization motives behind the government's distribution of DSH payments.

4.2.1 Altonji-Elder-Taber-Oster Method

Altonji et al. (2005) (henceforth, AET) suggest a method for evaluating the robustness of regression results to unobserved controls, based on the assumption that the relationship between treatment and observed controls can provide information on the relationship between treatment and unobserved controls. Consider the following regression model:

$$Y = \beta T + W_1 + W_2 \tag{1}$$

where Y is a dependent variable, T is treatment, W_1 is the part of Y explained by observed controls, and W_2 is the part of Y explained only by unobserved controls. Assume $W_1 \perp W_2$.

Ideally, what researchers want to estimate would be the value of β in (1). AET suggests the following method to estimate the bound of β. First, they make an assumption that the degree of selection on unobserved controls is not greater than the degree of selection on observed controls. Let δ be defined as the ratio of the selection on unobserved controls to the selection on observed controls. In other words,

$$\delta \frac{Cov(W_1, T)}{Var(W_1)} = \frac{Cov(W_2, T)}{Var(W_2)}. \tag{2}$$

An equal selection assumption ($\delta = 1$) can be used to obtain a bound on β. Since observed controls are typically selected in the order of relevance in explaining the variation in the dependent variable, and these observed controls are chosen to capture some of the variation explained by unobserved controls, it is unlikely that more variation is left to be explained only by unobserved controls than by observed controls. With this assumption, AET estimates bounds on β. One bound is the value of β in the model with observed controls only, denoted by $\tilde{\beta}$. The other bound is the hypothetical value of β in the full model with observed and unobserved controls, denoted by β^*. β^* is estimated by assuming equal selection and observing coefficient stability when observed

controls are included. AET also suggests an alternative way to test robustness of the regression result. They suggest to estimate the value of δ under the null of zero treatment effect (i.e., $\beta = 0$). Using the same argument for the equal selection assumption, they suggest that if δ is estimated to be greater than 1, then the result can be regarded as robust.

Oster (2016) generalizes this method by suggesting that the predictive power of control variables, measured by the change in the value of R^2, needs to be considered as well. She also argues that because of factors such as measurement errors, R^2 in the model with unobserved controls, denoted by R_{max}, may not be equal to 1 as assumed in AET. As an alternative, she suggests using $R_{max} = \min\{1, 1.3\tilde{R^2}\}$ where $\tilde{R^2}$ is the value of R^2 in the model with observed controls only.[22]

We apply these methods to obtain bounds on the parameters from the regression of the ratio of DSH payments to costs on hospital size and ownership types. We first estimate bounds on the parameter of hospital size for each of the three ownership types. Then, we estimate bounds on the parameter of *Govmt* as a binary treatment variable for three subgroups of hospital size.

Hospital Size as a Treatment Table 10 shows the result of applying the AET-Oster method to hospital size as a treatment variable. The table compares the baseline estimate without and with control and presents the bound. The bound on β does not include zero and the value of δ under the null hypothesis of zero treatment effect is greater than 1 for every subgroup. Thus, there is a treatment effect of hospital size, not driven by unobserved heterogeneity, for every ownership type. The signs of β confirm the positive treatment effect of hospital size for government hospitals and the negative treatment effect of hospital size for for-profit and non-profit hospitals.

Government Hospital as a Treatment Table 11 shows the result of applying the AET-Oster method to government hospital as a treatment variable. For this application, we categorize hospitals into three groups: hospitals with less than 100 beds, 100-399 beds, and more than 400 beds. All

[22]This is based on her analyses of experimental studies. She found that 90% of the studies passed the test for robustness checks when $R_{max} = min\{1, 1.3\tilde{R^2}\}$ is used.

Table 10: Application of the AET-Oster method with *Hospital Size* as a Treatment

Ownership	**Baseline Effect**		**Controlled Effect**		$\mathbf{R_{max} = 1.3\tilde{R}^2}$		
	β	**R-squared**	β	**R-squared**	$\mathbf{R_{max}}$	**Bound of** β	δ **for** $\beta = 0$
(1) Government	0.1944	0.0261	0.0897	0.4681	0.6085	[0.0564, 0.0897]	1.9048
	(0.0918)		(0.0621)				
(2) Non-Profit	-0.0628	0.0108	-0.0469	0.2910	0.3783	[-0.0469, -0.0406]	3.528
	(0.0293)		(0.0173)				
(3) For-Profit	-0.1165	0.0136	-0.0842	0.3087	0.4013	[-0.0843, -0.0741]	2.2914
	(0.0588)		(0.0413)				

Note 1: Standard errors in parentheses are clustered by state.
Note 2: Control variables included in the controlled effect: *MIUR*, *Uninsured Pop*, median rent price, *IMD*, *IMD* $\times$ *Hospital Size*, year FE and state FE.

three subgroups of hospital size have lower bounds of β strictly greater than zero. Likewise, the value of δ under the null hypothesis of zero treatment effect is all greater than 1. Furthermore, the bounds of β for medium and large hospitals contain larger values of β than the bound for small hospitals. This implies that government hospitals, especially among medium and large ones, have advantages in the ratio of DSH payments to the costs, not entirely driven by unobserved heterogeneity.

Table 11: Application of the AET-Oster Method with *Govmt* as a Treatment

Hospital Size	**Baseline Effect**		**Controlled Effect**		$\mathbf{R_{max} = 1.3\tilde{R}^2}$		
	β	**R-squared**	β	**R-squared**	$\mathbf{R_{max}}$	**Bound of** β	**δ for** $\beta = 0$
(1) Small	0.0724	0.0523	0.0636	0.3446	0.4480	[0.0604, 0.0636]	8.2284
	(0.0180)		(0.0137)				
(2) Medium	0.1417	0.1565	0.1154	0.4381	0.5695	[0.1031, 0.1154]	2.5795
	(0.0237)		(0.0167)				
(3) Large	0.2120	0.3184	0.1460	0.6831	0.8880	[0.1089, 0.1460]	1.7811
	(0.0418)		(0.0250)				

Note 1: Standard errors in parentheses are clustered by state.
Note 2: Hospital size: small (less than 100 beds), medium (between 100 and 399 beds) and large (400 beds or more)
Note 3: Control variables included in the controlled effect: *MIUR*, *Uninsured Pop*, median rent price, *IMD*, year FE and state FE.

4.2.2 High-Cost Services

In this subsection, we conduct further investigations into the details of services that large government hospitals provide. One of the key roles of government hospitals is to provide their community with essential medical services. Some essential services, such as emergency, trauma, or burn care centers, incur large expenses but are not necessarily profitable. Due to the high cost of these services, large government hospitals may take an active role in providing these types of services, relative to small hospitals or for-profit hospitals. This, in turn, may be a basis on which large government hospitals gain advantage in receiving subsidies.

We focus on three essential services mentioned above – emergency, trauma, and burn care services – plus graduate medical education.[23] We examine whether those services provided by large government hospitals can explain the advantages they have in receiving DSH payments. For this purpose, we use indicator variables, available from the AHA annual survey data, for whether a hospital provides each service or not.

Table 12 presents summary statistics for hospitals with and without them and by ownership type. (For simplicity, we only present differences between private (for-profit and non-profit combined) and government hospitals.) The table shows significant differences in the *amount* of DSH payment between hospitals that provide high-cost services and those that do not, for government hospitals.

[23] One reason why we analyze graduate medical education along with the three essential services is because "safety net" hospitals, which play a dominant role on those three services, also tend to play an active role in graduate medical education.

Table 12: Summary Statistics for Selected High-Cost Services

	Total	With the Service				Without the Service			Mean Diff.	
	N	Mean	Std. Dev.	N	Pct.	Mean	Std. Dev.	N	Diff.	P-value
A. Government Hospitals										
(a) Emergency Department										
DSH per Bed	3,368	**28,168**	42,801	3,258	96.7%	**15,965**	22,136	110	12,204	0.003***
Ratio to Costs	3,293	**0.176**	0.157	3,176	96.4%	**0.19**	0.224	117	**-0.013**	0.376
(b) Certified Trauma Center										
DSH per Bed	3,366	**38,705**	56,313	1,268	37.7%	**21,144**	29,080	2,098	17,561	0.000***
Ratio to Costs	3,291	**0.169**	0.143	1,236	37.6%	**0.181**	0.169	2,055	**-0.012**	0.040**
(c) Burn Care										
DSH per Bed	3,366	**77,222**	72,640	204	6.1%	**24,568**	37,446	3,162	52,654	0.000***
Ratio to Costs	3,291	**0.209**	0.158	201	6.1%	**0.175**	0.16	3,090	**0.034**	0.004***
(d) Graduate Medical Education										
DSH per Bed	3,968	**85,004**	80,953	486	12.2%	**19,750**	24,950	3,482	65,253	0.000***
Ratio to Costs	3,873	**0.226**	0.167	487	12.6%	**0.176**	0.166	3,386	**0.049**	0.000***
B. Private Hospitals										
(a) Emergency Department										
DSH per Bed	9,746	**13,628**	19,160	9,289	95.3%	**10,374**	17,231	457	3,254	0.000***
Ratio to Costs	9,119	**0.095**	0.106	8,667	95.0%	**0.092**	0.131	452	**0.003**	0.533
(b) Certified Trauma Center										
DSH per Bed	9,740	**15,393**	21,257	3,709	38.1%	**12,296**	17,516	6,031	3,097	0.000***
Ratio to Costs	9,113	**0.087**	0.097	3,547	38.9%	**0.1**	0.112	5,566	**-0.012**	0.000***
(c) Burn Care										
DSH per Bed	9,746	**22,561**	29,771	449	4.6%	**13,031**	18,298	9,297	9,531	0.000***
Ratio to Costs	9,118	**0.095**	0.095	423	4.6%	**0.095**	0.107	8,695	**0.000**	0.995
(d) Graduate Medical Education										
DSH per Bed	11,466	**18,085**	25,180	2,527	22.0%	**11,825**	16,823	8,939	6,259	0.000***
Ratio to Costs	10,728	**0.087**	0.087	2,344	21.8%	**0.097**	0.114	8,384	**-0.010**	0.000***

Note 1: *** p<0.01; ** p<0.05; * p<0.1

This leads to the question of whether such services lead providing hospitals to gain advantages in DSH payments. However, comparison across ownership types, as well as statistics on the *ratio* of DSH payments to Medicaid and uninsured costs, suggests otherwise. The difference in DSH payments between private hospitals that provide these services and those that do not is substantially smaller than in the case of government hospitals. Moreover, the difference between government hospitals that provide these services and those that do not is small when we focus on the *ratio* of DSH payments to costs, and the sign of the difference is inconsistent across services. Therefore, although provision of these services tends to be highly correlated with DSH payments, it does *not* give a clear advantage in Medicaid reimbursement through the DSH program. In the supplementary material, we provide additional analyses and regression results that support this conclusion.

4.2.3 Operating Margins

Finally, we explore the governments' potential motives behind the key patterns of the DSH payment-to-cost ratio. Since a key purpose of the Medicaid DSH program is to sustain financial stability of the hospitals that provide care to indigent population, exploring the role of financial conditions is central in understanding the large government hospitals' advantage in the distribution of DSH payments. We explore this issue in two different sets of regressions. First, we explore how much of predictive power hospital size and ownership have for financial conditions. Second, we check if large government hospitals' advantage in the ratio of DSH payments to Medicaid and uninsured costs is driven by their financial conditions. These two questions address essentially the same issue. However, the former conveys more clear information on the role of cross-subsidization behind the distribution of DSH payments.

We construct two operating margins: total operating margin and Medicaid and uninsured operating margin. Total operating margin is defined as:

$$\text{Total Operating Margin} = \frac{\text{Profit from Service to Patients}}{\text{Net Patient Revenues}}.$$

Medicaid and uninsured operating margin is defined as:

$$\text{M\&U Operating Margin} = \frac{\text{Profit from Service to Medicaid and Uninsured Patients}}{\text{Total Payments for Service to Medicaid and Unisured Patients}}.$$

where the profit from service to Medicaid and uninsured patients is defined as total revenues from Medicaid and uninsured patients, excluding DSH payments, minus Medicaid and uninsured costs.

Table 13 presents the results. Columns (1)-(4) show the results of regressing operating margin variables on the same set of explanatory variables as in the baseline analyses. When total operating margin is used as the dependent variable, the coefficient of hospital size is significant. Furthermore, while total operating margin significantly increases with hospital size for for-profit hospitals, the relationship is negligible and negative for government hospitals. When Medicaid and uninsured operating margin is used as the dependent variable, a similar pattern can be observed (positive relationship between hospital size and the ratio for non-profit hospitals in contrast to negative relationship for government hospitals), although the coeffici ent estimates are not statistically significant. Results from total operating margin in Columns (1)-(2) suggest that an adjustment for potential cross-subsidization could be a motive behind the key patterns of the DSH payment-to-cost ratios. Suppose that the government expects hospitals to cross-subsidize indigent patients with Medicaid or no insurance, using profits from relatively lucrative patients with a private insurance. Then, it would allocate DSH payments so that the DSH payment-to-cost ratio decreases with hospital size for for-profit and non-profit hospitals, while it mildly increases with hospital size for government hospitals.

Table 13: OLS Regression with Operating Margins

	Dependent Variable							
	Total Operating Margin		M&U Operating Margin		Ratio of DSH to Medicaid and Uninsured Costs			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Hospital Size ($1,000)	0.259***	0.280***	-0.00436	0.0895	-0.0459	-0.0478	-0.0777	-0.0644
	(0.0619)	(0.0682)	(0.189)	(0.184)	(0.0622)	(0.0544)	(0.0582)	(0.0473)
Govmt=1 ×*Hospital Size*	-0.256**	-0.286**	-0.266	-0.421	0.0860	0.136**	0.136**	0.170***
	(0.0983)	(0.108)	(0.298)	(0.323)	(0.0564)	(0.0524)	(0.0547)	(0.0475)
NonProf=1 ×*Hospital Size*	-0.182***	-0.194***	0.0478	-0.0318	-0.00113	6.31e-05	0.0304	0.0143
	(0.0603)	(0.0636)	(0.176)	(0.165)	(0.0606)	(0.0520)	(0.0562)	(0.0450)
IMD=1 ×*Hospital Size*	-0.636	-0.695	-8.742***	-8.795***	0.791***	0.848***	0.543***	0.546***
	(0.611)	(0.635)	(3.228)	(3.221)	(0.258)	(0.277)	(0.0996)	(0.112)
Govmt=1	-0.116***	-0.106***	-0.296***	-0.286***	0.0710***	0.0628***	0.0812***	0.0741***
	(0.0167)	(0.0153)	(0.0845)	(0.0857)	(0.0177)	(0.0174)	(0.0179)	(0.0178)
NonProf=1	-0.0573***	-0.0477***	-0.144**	-0.145**	0.00534	0.0116	0.00730	0.0155
	(0.0135)	(0.0130)	(0.0615)	(0.0579)	(0.0125)	(0.0118)	(0.0113)	(0.0105)
IMD=1	-0.153	-0.141	-0.894**	-0.932**	0.0418	0.0272	0.0727**	0.0682**
	(0.118)	(0.124)	(0.403)	(0.414)	(0.0415)	(0.0380)	(0.0279)	(0.0276)
MIUR	-0.139***	-0.140***	1.664***	1.752***	-0.0544*	-0.0691*	-0.0271	-0.0485
	(0.0426)	(0.0476)	(0.247)	(0.263)	(0.0317)	(0.0361)	(0.0326)	(0.0329)
Uninsured Pop	-0.00252*	-0.00197*	-0.00902	-0.000935	-0.000680	0.000462	-0.000261	0.000464
	(0.00135)	(0.00116)	(0.00764)	(0.00611)	(0.000982)	(0.000814)	(0.00107)	(0.000720)
Median Rent Price ($1,000)	-0.0785**	-0.0259	-0.194*	-0.123	0.000496	-0.00740	0.00300	-0.0106
	(0.0317)	(0.0398)	(0.108)	(0.0918)	(0.0268)	(0.0248)	(0.0271)	(0.0263)
Total Operating Margin					-0.0934***	-0.0841***		
					(0.0187)	(0.0190)		
M&U Operating Margin							-0.0153***	-0.0153***
							(0.00407)	(0.00359)
Constant	0.141***	0.0471	-0.372**	-0.547***	0.139***	0.198***	0.117***	0.194***
	(0.0324)	(0.0295)	(0.162)	(0.115)	(0.0399)	(0.0322)	(0.0417)	(0.0315)
State FE	No	Yes	No	Yes	No	Yes	No	Yes
Observations	11,758	11,758	14,489	14,489	11,064	11,064	14,489	14,489
R^2	0.115	0.152	0.243	0.273	0.179	0.346	0.255	0.396

Note 1: Standard errors, clustered by state, in parentheses. *** p<0.01; ** p<0.05; * p<0.1
Note 2: Year fixed effects are included in all specifications.
Note 3: Unlike in earlier tables, we use 1,000 beds as the unit of hospital size in this table because the dependent variables, which are ratios, make the magnitude of coefficients small.

Columns (5)-(8) show the regression results when the ratio of DSH payments to Medicaid and uninsured costs is regressed on either of the operating margin variables in addition to the set of explanatory variables from baseline analyses. First of all, the signs of operating margin variables are as expected: hospitals doing worse financially tend to receive greater DSH payments even when the costs for Medicaid and uninsured patients are the same. However, the coefficients of hospital size are still positive and statistically significant for government hospitals for most specifications. In Column (6), the coefficient of hospital size for government hospitals indicates that one standard deviation increase in hospital size, leads to a 0.08 standard deviation increase in the ratio of DSH to Medicaid and uninsured costs, which is 0.014 and 7.3% of the mean level. In Column (8), the coefficient of hospital size for government hospitals indicates that one standard deviation increase in hospital size is associated with 0.09 standard deviation increase in the ratio, which is 0.018 and 8.4% of the mean level. These show that the results in the baseline analyses on the large government hospitals' advantage in DSH payments are robust and are not driven by financial conditions. That is, although hospital size and ownership type are systematically related to hospitals' financial conditions, they do not seem to be used as mere proxies for financial conditions in the distribution of DSH payments.

5 Conclusion

In this study, we investigated the allocation of government subsidies from the Medicaid DSH program, focusing on the role of hospital size and ownership structure. Our key results show that large government hospitals tend to have a higher share of their Medicaid and uninsured patient care costs subsidized by Medicaid DSH payments. This advantage of large government hospitals is neither driven by the magnitude of their Medicaid and uninsured costs itself nor the high-cost services that they provide to their communities. Rather, DSH payment schedules themselves have a tendency to favor large government hospitals, in urban and Southern states.

Relative to large private hospitals, which tend to have a relatively large pool of lucrative patients with private insurance, large government hospitals tend to have financial disadvantages. Therefore, a DSH payment scheme that favors large government hospitals counterbalances disparities across hospitals in their capability to cross-subsidize Medicaid and uninsured patients with those with private insurance.

The welfare implication of large government hospitals' advantage in the DSH payment contrasts with private hospitals' advantage in contracting with private insurance. Large private hospitals have bargaining power such that patient welfare is compromised due to higher prices; large government hospitals, on the other hand, have an advantage in Medicaid DSH payments such that patient welfare, for those enrolled in Medicaid, is potentially enhanced. Moreover, it is in urban and

Southern states that large government hospitals play an active role in the treatment of the indigent population and have an advantage in the distribution of Medicaid DSH payments. Those states experienced a large wave of hospital merger and acquisitions, which resulted in an increase in hospital concentration. An increase in the profitability of patients with private insurance, resulting from an increase in hospitals' market power, discourages hospitals from treating Medicaid and uninsured patients. The presence of large government hospitals that are active in the treatment of the indigent population and receive rewards for it countervails the negative influence of hospital concentration on indigent patient welfare.

Finally, there are important remaining issues on the Medicaid DSH program that needs research. The ACA stipulates reductions in Medicaid DSH allotments due to the decrease in the uninsured population. Southern states that chose not to expand their Medicaid eligibility may experience a large negative impact from this change. Understanding how such potential impact varies across different types of hospitals would be useful to assess the consequence of targeting large government hospitals under the DSH program.

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