The Price Ain't Right? Hospital Prices and Health Spending on the Privately Insured*

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Abstract

We use insurance claims data for 27.6 percent of individuals with private employer-sponsored insurance in the US between 2007 and 2011 to examine the variation in health spending and in hospitals' transaction prices. We document the variation in hospital prices within and across geographic areas, examine how hospital prices influence the variation in health spending on the privately insured, and analyze the factors associated with hospital price variation. Four key findings emerge. First, health care spending per privately insured beneficiary varies by a factor of three across the 306 Hospital Referral Regions (HRRs) in the US. Moreover, the correlation between total spending per privately insured beneficiary and total spending per Medicare beneficiary across HRRs is only 0.14. Second, variation in providers' transaction prices across HRRs is the primary driver of spending variation for the privately insured, whereas variation in the quantity of care provided across HRRs is the primary driver of Medicare spending variation. Consequently, extrapolating lessons on health spending from Medicare to the privately insured must be done with caution. Third, we document large dispersion in overall inpatient hospital prices and in prices for seven relatively homogenous procedures. For example, hospital prices for lower-limb MRIs vary by a factor of twelve across the nation and, on average, two-fold within HRRs. Finally, hospital prices are positively associated with indicators of hospital market power. Even after conditioning on many demand and cost factors, hospital prices in monopoly markets are 15.3 percent higher than those in markets with four or more hospitals.

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I. Introduction

Health care is one of the largest sectors of the US economy, accounting for 17.4 percent of US GDP in 2013. Sixty percent of the population has private health insurance, which pays for a third of health care spending (Hartman et al. 2015). However, because of poor data availability, most of the analysis of US health care spending has relied on Medicare data (Medicare covers Americans age sixty-five and over as well as individuals with a subset of disabilities). While research on Medicare spending has yielded remarkable insights, Medicare covers only 16 percent of the population and 20 percent of total health care spending. Moreover, whereas Medicare hospital prices are set by a regulator (as is true for prices for health care services in most countries), hospital prices for the privately insured are market-determined. Each private insurer engages in bilateral negotiations with providers over the price of services for their beneficiaries. Unfortunately, the results of these hospital/insurer negotiations – health care providers' transaction prices – have been treated as commercially sensitive and have been largely unavailable to researchers. As a result, there is a great deal that is unknown about how and why health care providers' prices vary across the nation and the extent to which providers' negotiated prices influence overall health spending for the privately insured.

In this paper, we use a recently released, large health insurance claims database that covers 27.6 percent of individuals in the US with employer-sponsored insurance coverage to study the variation in health spending for the privately insured. We examine the role that providers' negotiated transaction prices play in driving the variation in health spending on the privately insured. We then exploit the granularity of our data to examine how hospitals' transaction prices vary within and across geographic regions in the US and identify the key factors associated with this price variation.

The main data we use in this analysis are insurance claims between 2007 and 2011 from three of the five largest US insurers: Aetna, Humana, and UnitedHealthcare (the Health Care Cost Institute dataset). The data include more than eighty-eight million unique individuals and account for approximately 5 percent of total health spending and 1 percent of GDP annually. Further, the data contain claims-level detail including clinical diagnoses and procedure codes, patient characteristics, provider-specific negotiated transaction prices, and patient cost-sharing contributions. In this paper we focus primarily on hospital spending and hospital prices.

Hospitals represent 31 percent of health care spending and 5.6 percent of GDP. Furthermore, hospital care is expensive (the average price of an inpatient admission in 2011 is $12,976 in our data), so variation in hospital spending and prices can have a significant impact on welfare.

Research on US health spending using Medicare data has had a profound impact on our understanding of the factors that drive health care spending variation and on state and federal policy. As a result, it is vital to understand the applicability of analysis of Medicare spending (and the policy conclusions drawn from that analysis) to the privately insured. Therefore, a secondary focus of this paper is examining the extent to which the factors that drive spending variation for the privately insured are the same as those that influence health care spending for the Medicare population.

We point to four main conclusions from our work. First, health spending on the privately insured varies by more than a factor of three across the 306 hospital referral regions (HRRs) in the US.[1] Further, healthcare spending on the privately insured and Medicare beneficiaries are not highly correlated across HRRs. For example, in 2011 the correlation between private and Medicare total health spending per beneficiary across HRRs was only 0.140.[2] To illustrate the point, policy-makers have identified Grand Junction, Colorado as an exemplar of health-sector efficiency based on analyses of Medicare data (Bodenheimer and West 2010; Obama 2009a). In 2011, we find that Grand Junction does indeed have the third lowest spending per Medicare beneficiary among HRRs. However, in the same year, Grand Junction had the ninth *highest* average inpatient prices and the forty-third *highest* spending per privately insured beneficiary of the nation's 306 HRRs. Likewise, we find that other regions, such as Rochester, Minnesota, and La Crosse, Wisconsin, which have also received attention from policy-makers for their low spending on Medicare, are among the highest spending regions for the privately insured.

Second, for the privately insured, hospital transaction prices play a large role in driving inpatient spending variation across HRRs. In contrast, consistent with the existing literature, we find that variation in hospitals' Medicare prices (i.e., reimbursements) across HRRs account for

[1] Hospital Referral Regions (HRRs) are geographic regions created by researchers at the Dartmouth Institute for Health Care Policy to approximate markets for tertiary medical care in the United States. Each HRR generally includes at least one major referral center. They were designed to capture areas where patients would be referred for major cardiovascular surgery or neurosurgery. The United States is broken into 306 HRRs. See www.dartmouthatlas.org/downloads/methods/geogappdx.pdf for more information.

[2] The correlation of inpatient spending across HRRs for Medicare beneficiaries and the privately insured is 0.267.

little of the variation in Medicare inpatient spending across HRRs. Instead, differences in the quantity of health care delivered across HRRs are the primary drivers of inpatient spending variation for the Medicare population.

Third, we find that hospitals' negotiated transaction prices vary substantially across the nation. For example, looking at the most homogeneous of the seven procedures that examine, hospital-based MRIs of lower-limb joints, the most expensive hospital in the nation has prices twelve times as high as the least expensive hospital. What is more, this price variation occurs across and within geographic areas. The most expensive HRR has average MRI prices for the privately insured that are five times as high as average prices in the HRR with the lowest average prices. Likewise, within HRRs, on average, the most expensive hospital has MRI negotiated transaction prices twice as large as the least expensive hospital. In contrast, within the regulated Medicare reimbursement system, the hospital with the highest reimbursement for lower limb MRIs in the nation is paid 1.87 times the least reimbursed. Likewise, within HRRs, the highest reimbursed hospital is, on average, paid only 6 percent more by Medicare than the rate of the lowest reimbursed hospital.

Finally, we describe some of the observable factors correlated with hospital prices. Measures of hospital market structure are strongly correlated with higher hospital prices. Being for-profit, having more medical technologies, being located in an area with high labor costs, being a bigger hospital, being located in an area with lower income, and having a low share of Medicare patients are all associated with higher prices. However, even after controlling for these factors and including HRR fixed effects, we estimate that monopoly hospitals have 15.3 percent higher prices than markets with four or more hospitals. Similarly, hospitals in duopoly markets have prices that are 6.4 percent higher and hospitals in triopoly markets have prices that are 4.8 percent higher than hospitals located in markets with four or more hospitals. While we cannot make strong causal statements, these estimates do suggest that hospital market structure is strongly related to hospital prices.

This paper is structured as follows. In Section II, we provide background on health care spending and the existing literature. Section III discusses data, and Section IV examines the relationship between Medicare and private spending. Section V characterizes hospital price dispersion. Section VI analyzes the factors associated with the variation in inpatient prices and prices. Section VII concludes. More details about the data and additional analysis are in Online Appendices A and B.

II. Health Care Spending, Hospital Prices, and Price Dispersion

IIA. Background

The prices private insurers pay for health care services are determined by bilateral negotiations between insurers and providers. Hospitals have a "chargemaster," which presents the list or "sticker" prices for each procedure hospitals perform and for all the medical items associated with care. However, private insurers seldom pay these chargemaster prices (referred to as "charges"). Typically, insurers pay hospitals either a percentage of their chargemaster prices, a markup over the hospital's Medicare reimbursements, or they negotiate with hospitals over the prices of individual procedures or service lines (Reinhardt 2006). While Medicare payments to hospitals are public, the prices that hospitals negotiate with private insurers have historically been treated as commercially sensitive and are generally unavailable to researchers and the public. In the absence of data on actual, hospital-level transaction prices, researchers have generally constructed estimates of transaction prices or in rare cases had access to transaction price data for a very limited sample (e.g., for a particular market as the result of an antitrust case, data from a particular company, or data from a particular state). However, in the absence of nationwide data on actual transaction prices, there is a great deal that remains unknown about health care spending and hospital prices for the privately insured, including the factors that influence their variation.

IIB. Some Existing Literature

Our work links to the existing literature on health spending and the determinants of hospital prices (in particular, hospital market structure). The bulk of our understanding about health care spending is based on the analysis of Medicare data. Previous analysis of Medicare data has revealed that risk-adjusted Medicare spending per beneficiary varies by more than a factor of two across HRRs in the US (Fisher et al. 2003). This variation cannot be explained by differences in patient characteristics across regions (Fisher, Bynum, and Skinner 2009). Instead, research has found that most of the variation in Medicare spending is driven by differences in the quantity of health care delivered in different regions (Skinner and Fisher 2010). These findings are not surprising, since Medicare pays providers using administered prices that aim to capture the local costs associated with providing care in particular regions.[3] Ultimately, this payment system constrains the amount hospital reimbursement rates can vary to a level specified by the Centers for Medicare and Medicaid Services (CMS). Moreover, it results in providers within a geographic area being paid roughly the same amount for the same services.

Recent analysis has suggested that Medicare spending per beneficiary may not be highly correlated with spending per privately insured beneficiary. Philipson et al. (2010) argued that while private insurers have a greater ability to limit the utilization of care than public insurers, public insurers have greater opportunities to exploit their monopsony power to constrain providers' reimbursement rates. Using data at the three-digit zip code level from employees and retirees enrolled in health plans from thirty-five Fortune 500 firms and Medicare data from the Medicare Current Beneficiary Survey, they found that regional variation in utilization is greater for Medicare beneficiaries, while variation in spending appears to be greater for beneficiaries with private insurance. Chernew et al. (2010) analyzed MarketScan data from 1996 to 2006 and found a small negative correlation between private and Medicare spending per beneficiary across HRRs. Newhouse et al. (2013) also look at the correlations between private spending from two commercial data sources (MarketScan and Optum) and Medicare spending from 2007 through 2009 and find correlations of between 0.081 and 0.112, respectively.[4] The MarketScan data used in these studies are comprised of insurance claims for enrollees in large employers and group health plans. As a consequence, unlike HCCI, MarketScan does not cover insurance claims for individuals employed by medium and smaller firms, which account for a large share of the

[3] For a detailed discussion of how Medicare pays providers, see Edmunds and Sloan (2012). Briefly, for inpatient hospital care, the Medicare PPS system pays providers a fixed, predetermined amount per medical-severity adjusted diagnosis related group (MS-DRG). The MS-DRGs are grouped by the primary diagnosis and then differentiated by the presence of comorbidities or complications. Hospitals' reimbursement is divided into a labor and non-labor component. The labor component, which accounts for approximately 60 percent of a hospital's reimbursement, is adjusted by a wage index that captures the input prices associated with providing care in the local area. Medicare hospital payments are also adjusted for hospital characteristics, so that teaching hospitals and hospitals that treat a large share of uninsured or Medicaid patients receive higher payments.

[4] Similarly, Franzini, Mikhail, and Skinner (2010) looked at spending by individuals insured by Blue Cross and Blue Shield of Texas and found that spending per private beneficiary in McAllen, Texas was 7 percent lower than in El Paso. In contrast, a widely read *New Yorker* article highlighted that Medicare spending per beneficiary in McAllen Texas was four times higher than it was in El Paso during the same period (Gawande 2009).

privately insured (National Institute for Health Care Management 2013).[5] In addition, although it covers approximately 90 percent of HRRs, the MarketScan data have very low numbers of patients in some less populated areas (e.g. many HRRs have fewer than 200 patients per year, whereas the least populated HRR in the HCCI data includes 4,402 patients).[6] The Optum data include claims from 2006 through 2010 for 14 million individuals per year from self-insured firms and claims for 9 million individuals per year with private commercial insurance (The Lewin Group 2012). This is approximately half the number of covered lives per year that we have in the HCCI data.

Some recent studies have also obtained limited data on providers' negotiated prices. The United States Government Accountability Office (2005) analyzed health care claims data from the Federal Employees Health Benefits Program and found that hospital prices varied by 259 percent across metropolitan areas. The Massachusetts Attorney General's Office (Coakley 2011) found that hospitals' prices varied by over 300 percent in the state and argued that these prices were uncorrelated with hospital quality or teaching status. Using insurance claims data for beneficiaries in eight cities, Ginsburg (2010) found that San Francisco hospitals' private prices were 210 percent of Medicare reimbursements compared with 147 percent in Miami. Similarly, White, Reschovsky, and Bond (2014) use claims data from autoworkers to examine hospital prices in thirteen Midwestern markets. They found that the highest priced hospitals in a market were typically paid 60 percent more for inpatient care than the lowest priced hospitals.[7]

There is a large literature on hospital competition (see Gaynor, Ho, and Town 2015), which has generally found that hospital prices are substantially higher in more concentrated

[5] Twenty-five percent of workers with employer sponsored health insurance were employed in firms of size 49 or less, thirty-four percent in firms smaller than one hundred, and forty-nine percent in firms of size four hundred ninety-nine or less (NIHCM Foundation 2013).

[6] We provide further detail on the contrast between MarketScan and HCCI in Appendix A1. MarketScan data are not useable for this research because it does not include unique hospital IDs, it cannot be linked to external data on hospitals, and it does not include geographic detail lower than the three-digit zip code level.

[7] While notable, this sort of variation is not unique to health care. Many other industries exhibit price variation. Pratt, Wise, and Zeckhauser (1979) find large price variation for a range of services in the Boston area. They find, for example, that prices in the markets for bicycles, mufflers, dry cleaning, pet cleaning, and vocal lessons have coefficients of variation of 0.044, 0.174, 0.168, 0.128, and 0.383, respectively. Hortaçu and Syverson (2004) document extensive variation in mutual fund fees. Eizenberg, Lach, and Yiftach (2015) observe extensive price variation in retail prices at supermarkets in Jerusalem. Similarly, Kaplan and Menzio (2014) use data from the Kilts-Nielson Consumer panel data and find that the coefficient of variation for 36 oz. plastic bottles of Heinz ketchup is 0.23 in Minneapolis in 2007. Therefore, while we focus on health care in this study, price dispersion is a common phenomenon and understanding the determinants of price dispersion a general problem.

markets. The majority of this literature, however, uses estimates of transaction prices (usually based on charges) rather than actual data on transaction prices and mostly employs data from just one state - California.

We extend the literature by using a new, comprehensive database that covers a larger population in more detail than anything previously examined. Previous work has relied on data covering particular states, small groups of cities, or groups of companies. We capture claims for individuals with employer-sponsored insurance from three of the five largest insurers in the US. Moreover, rather than using charges or estimated prices, we have the actual transaction prices that capture the true payments made for care. This allows us to examine variation in spending and price and contribute to the broader literature on price dispersion. Finally, we add to the hospital competition literature by using comprehensive data on actual transaction prices for 2,252 hospitals across all fifty states to observe the relationship between market structure and hospital prices.

III. Data and Variables

III.A HCCI data

The main data we use in this analysis come from the Health Care Cost Institute (HCCI).[8] We discuss the data in more detail in Appendix A but sketch some of the main features here. The HCCI database includes insurance claims for individuals with employer-sponsored insurance obtained from three large insurance companies.[9] Our data cover the period 2007 to 2011.[10] Table 1 shows that the raw data contain 2.92 billion claims for 88.7 million unique individuals. Figure A1 shows the proportion of the privately insured that the HCCI data cover by state.[11] The data

[8] HCCI is a nonprofit organization dedicated to advancing knowledge about US health care costs and utilization. See http://www.healthcostinstitute.org for more information.
[9] The data include claims from fully insured and self-insured firms.
[10] The HCCI data does not include all employer-sponsored insurance plans offered by the data contributors. Some of the three insurers' customers have opted not to have their data made available for research. Likewise, insurance plans that cover individuals working on national security-related matters are not included in the HCCI data.
[11] At the high end, the data capture more than 30 percent of the relevant population in Texas, Arizona, Colorado, Florida, Georgia, Kentucky, Ohio, Wisconsin, New Jersey, and Rhode Island. At the low end, there are between 1.9 percent and 10 percent of the privately insured in Vermont, Michigan, Alabama, Wyoming, Montana, South Dakota, and Hawaii.

include individuals in all 306 HRRs.[12] Although we describe the most comprehensive picture to date of the privately insured, we do not have claims from every insurer and, in particular, from the Blue Cross Blue Shield insurers. However, to address concerns about the generalizability of our results, we show below that our results are stable across areas where the HCCI data have high and low coverage of the insured population and where Blue Cross Blue Shield plans have high and low coverage of the insured population.

The de-identified claims data from HCCI include a unique provider identifier, a unique patient identifier, the date services were provided, the amount providers' charged (chargemaster price), providers' negotiated transaction prices (broken down by facilities and physician fees), and payments to providers made by patients. As a result, we know the amounts paid to hospitals for all health care encounters recorded in our data whether a hospital was paid on a fee-for-service or per-diem basis.[13]

III.B Hospital Level data

We use an encrypted version of health care providers' National Plan and Provider Identification System (NPI) code in the HCCI to link to data on hospital characteristics from the American Hospital Association (AHA) annual survey, quality scores from Medicare's Hospital Compare webpage, Medicare activity from the American Hospital Directory (AHD), Medicare reimbursement information from CMS, and reputational quality scores from U.S. News & World Report. We use hospitals' five-digit zip codes to link to local area characteristics from the census. A complete list of data sources is contained in Appendix A1. Our process for identifying hospitals using their NPI code is outlined in Appendix A2.

III.C Sample Definitions

All our analysis is carried out on data for individuals age eighteen through sixty-four years with private employer-sponsored health insurance. We create three broad sub-samples from the raw HCCI data: the "spending sample", the "inpatient sample" and the "procedure samples".

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[12] In 2011, the least populated HRR in the data (Great Falls, Montana) contained 4,402 members. The most populated HRR (Houston, Texas) contained 1,753,724 individuals.

[13] We present a sample hip replacement episode constructed from claims data online at www.healthcarepricingproject.org

The *spending sample* measures overall spending per private beneficiary, including all inpatient, outpatient, and physician spending (but not drug spending).[14] We calculate spending per beneficiary by summing spending for each individual insured in each HRR per year. To get the total number of private beneficiaries per HRR, we sum up the member months of coverage per HRR per year and divide by twelve. We limit our analysis to individuals enrolled in coverage for at least six months. In most instances, we present spending analysis of our most recent year of data, 2011.[15] We use data from the Dartmouth Atlas for 2008 through 2011 to analyze variation in spending per Medicare beneficiary.[16] Following the approach taken by Dartmouth, we risk-adjust our HCCI spending sample for age and sex.[17]

The *inpatient sample* uses hospital claims for all inpatient care provided to our covered population. We limit our analysis to services provided within AHA-registered facilities that self-identified as short-term general medical and surgical hospitals, orthopedic hospitals, cardiac hospitals, and obstetric and gynecology hospitals.[18] We aggregate our claims-level data to the level of an individual inpatient stay, which we call an "episode". This includes all of a patient's claims from admission through discharge. We limit our providers to those that deliver at least fifty episodes of inpatient care per year.[19] This restriction excludes approximately 10 percent of inpatient observations in our data. We also exclude observations with missing provider IDs or missing patient information and those observations with prices in the top or bottom 1 percent of the distributions per Diagnosis Related Group (DRG).[20] We drop patients in the top 1 percent of

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[14] We exclude prescription drug spending because it is not readily available for Medicare beneficiaries.

[15] Analysis of other years is very similar and full results are available online at www.healthcarepricingproject.org.

[16] Data from the Dartmouth Atlas can be downloaded at: http://www.dartmouthatlas.org/tools/downloads.aspx. Information on how Medicare spending per beneficiary is calculated is available in their Research Methods document, accessible at: http://www.dartmouthatlas.org/downloads/methods/research_methods.pdf.

[17] Because we do not have data on race, we risk-adjust using age and sex as opposed to Dartmouth who risk-adjust using age, sex, and race. Like Dartmouth, we also risk-adjust spending using indirect standardization. For a detailed discussion of the risk-adjustment methods, see:
http://www.dartmouthatlas.org/downloads/methods/indirect_adjustment.pdf.

[18] We exclude longer-term facilities like rehabilitation hospitals, and specialized facilities, like psychiatric or pediatric hospitals. We include specialty hospitals that perform the inpatient or outpatient care analyzed in our procedure samples.

[19] We introduced this restriction because some hospitals treated very few HCCI-covered patients. These hospitals would have had price indexes created using small numbers of DRGs, which could have produced irregular price observations. Results are robust to using other minimum thresholds such as thirty or seventy cases per year.

[20] Our results are robust to winsorizing the top and bottom 1 percent instead of excluding them. We exclude episodes with spending in the top or bottom 1 percent per DRG to limit the influence of extremely expensive and extremely inexpensive observations (e.g., the $9 million knee replacement).

length of stay by DRG to exclude cases with complications where the patients remained in the hospital for extremely long lengths of time (i.e., twenty-one days or more). Finally, we exclude providers registered with CMS as critical access hospitals.[21] In total, all these exclusions lead to a subsample of 2,252 out of the 3,830 AHA hospitals that meet our restriction criteria (see Table A1).

We also create seven *procedure samples*, which capture claims for hospital-based surgical or diagnostic inpatient and outpatient procedures. We create procedure samples for hip replacements, knee replacements, cesarean sections, vaginal deliveries, percutaneous transluminal coronary angioplasties (PTCAs), diagnostic colonoscopies, and magnetic resonance imaging (MRI) of lower-limb joints without contrast. These procedures occur with sufficient frequency to support empirical analysis and are relatively homogeneous, thereby facilitating comparison across facilities and areas (Centers for Disease Control and Prevention 2010).

Each observation in the seven procedure samples includes all hospital (facilities) claims from when the patient entered the hospital until he or she exited the facility. We limit the observations included in our analysis to those without major medical complications and define the conditions narrowly using diagnosis and procedure codes (see Appendix A3). We limit our observations to providers who deliver at least ten of a given procedure per year. As in the inpatient sample we drop individual observations with prices in the top or bottom 1 percent or with length of stay in the top 1 percent and limit providers to those registered with the AHA that self-identified as short-term general medical and surgical, orthopedic, cardiac, obstetric and gynecology hospitals.[22]

Table 2 reports summary statistics for the inpatient sample.[23] Our sample of hospitals is generally similar to the universe of AHA hospitals, but there are some differences (Table A1). Hospitals in the inpatient sample are located in less concentrated markets and also have a higher share of teaching and not-for-profit facilities, as well as a greater share of hospitals ranked by the U.S. News & World Reports as top performers. The hospitals in our samples also receive slightly

[21] Critical access hospitals are facilities with less than twenty-five beds in rural areas that Medicare reimburses differently from other hospitals in order to make them financially viable.
[22] For MRI we also require a separate physician claim for the reading of the MRI, which we do not include in our main analyses of price. We also limit MRI observations to outpatient cases where the only purpose of visiting the hospital is to have the MRI (and nothing else is done to the patient on the day of the MRI).
[23] The descriptive statistics for the sub-samples for each of the seven procedures look qualitatively similar and are available online at www.healthcarepricingproject.org.

higher payments from Medicare and treat a larger share of Medicare patients than the universe of AHA-registered hospitals.

III.D Measuring Hospital-level Prices

We measure hospital prices in two ways. First, we create a private-payer overall inpatient price index that is adjusted for the mix of care that hospitals deliver and the mix of patients that hospitals treat. This measure is similar to what has been used previously in the literature; for example, in Gaynor and Vogt (2003) and Gowrisankaran, Nevo, and Town (2015). Second, we construct procedure-level price indexes for six surgical and one imaging procedure. For the procedure prices, we chose procedures that are generally considered to be fairly homogeneous so that we isolate variation in price rather than variation in the type of care delivered within each episode. For inpatient procedures, the procedure price captures the combined price on all claims associated with services provided to the patient by hospitals, from admission through discharge. For outpatient procedures (colonoscopies and MRIs), the price the price is the sum of all claims on the day the patient was in the hospital for the MRI or the colonoscopy. For colonoscopies and MRIs, we further limit our analysis to observations where no other medical care was provided to patient on the day of the MRI or colonoscopy and exclude MRIs and colonoscopies that were performed within a wider hospital stay. As a robustness check, we also examine the sum of hospital and physician prices for inpatient and procedure prices.

A general concern when analyzing differences in prices across firms is that variation in prices could reflect unobserved differences in quality. For example, a hospital could look like it has high-priced hip replacements either because its price is actually higher or because the type of surgery it performs for a hip replacement is different from what is performed at other hospitals.

We work to address this concern in several ways. First, we define our procedures narrowly and seek to avoid DRGs with very differentiated treatments and episodes where there were complications. Second, as we discuss later, we risk-adjust each price measure by age, sex, and patients' underlying comorbidities, which we measure using the Charlson Index of Comorbidities.[24] Third, we choose high volume, routine surgeries and imaging tests where the

[24] The Charlson Index is a measure of the probability that a patient will die within a year. It is calculated as a weighted sum of the patient's comorbid conditions, such as cancer or diabetes. We measure the Charlson Index on a

treatments are largely standardized. To further narrow our sample, we exclude colonoscopies where a biopsy was taken. Fourth, we also measure prices and price variation for lower-limb MRIs. For MRIs, we restrict our observations to those for which the MRI itself was the only intervention occurring during the visit to the hospital and for which there is a separate professional claim for the reading of the MRI, so that the facility portion only captures the technical component of the MRI. There is virtually no difference in how MRIs are performed across facilities and these represent a plausibly homogenous product. Fifth, for knee and hip replacements, we limit our analysis to individuals between forty-five and sixty-four years of age to obtain a more homogeneous group of patients. For cesarean and vaginal delivery, we limit our analysis to mothers who are between twenty-five and thirty-four years of age.

Inpatient Price Index: Our private-payer inpatient price index captures the combined amount paid by patients and insurers for patient episode i in DRG d delivered in hospital h, and provided in year t. Following Gaynor and Vogt (2003) and Gowrisankaran, Nevo, and Town (2015), we regress the hospital payments ($p_{i,h,d,t}$) on year-specific hospital fixed effects ($\alpha_{h,t}$), a vector of patient characteristics ($X_{i,h,d,t}$) comprised of indicators for patient age (measured in ten-year age bands), a dummy for the patient's sex, and dummies for patients' Charlson Index score, and DRG fixed effects (γ_d). The regression to produce our inpatient prices has the form:

(1) $$p_{i,h,d,t} = \alpha_{h,t} + X_{i,h,d,t}\beta + \gamma_d + \varepsilon_{i,h,d,t}$$

with $\varepsilon_{i,h,d,t}$ the stochastic error term. We recover the vector of hospital fixed effects $\hat{\alpha}_{h,t}$ and calculate a hospital price index for each year at the sample means of the patient characteristics ($\bar{X}$) and the DRG indicators, $\bar{d}$ (i.e., the sample mean basket of DRGs).[25]

(2) $$\hat{p}_{h,t} = \hat{\alpha}_{h,t} + \bar{X}\hat{\beta} + \bar{d}\hat{\gamma}_d$$

This yields the hospital's price, adjusted for its mix of treatments and mix of patients.

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zero-to-six scale based on six months of insurance claims data. For more information, see Charlson et al. (1987) or Quan et al. (2011).

[25] For robustness, we also created alternate price indexes using different functional forms. For example, we calculated regressions where DRG complexity was parameterized using CMS's MS-DRG weights as right hand side control variables, rather than as fixed-effects for each DRG. We also calculated a price index where we regressed the DRG price divided by the DRG weight against patient characteristics and hospital fixed effects. These price measures are all highly correlated with each other (correlation coefficients greater than 0.95), and using alternative price measures does not materially affect our results.

Procedure price indexes: In addition to creating an inpatient price index, we also create risk-adjusted prices for the specific procedures we study. We adjust prices for differences in patient characteristics, just as we did in the inpatient price index. These regressions take the form:

(3) $$p_{i,h,d,t} = \alpha_{h,d,t} + X_{i,h,d,t}\beta_d + e_{i,h,d,t}$$

Superscript d indicates one of our seven procedures (a slight abuse of notation since these are actually narrower than a DRG). We then recover our estimates of the hospital-year-procedure fixed effects analogously to equation (2).

Table A3 reports the main results from estimating equations (1) and (3).

III.E Calculating Medicare Reimbursement

We also construct hospital Medicare reimbursement rates for the services we observe from the HCCI data. Medicare reimburses providers for inpatient care on the basis of DRGs; these are set in an attempt to compensate hospitals slightly above their costs of treating Medicare patients. To calculate the payment for specific episodes of care, federal regulations stipulate that a hospital's base payment is multiplied by a DRG weight that is set by CMS to capture the complexity of treating a particular type of episode. Using data obtained from the CMS webpage, we follow the regulations and calculate the base payment rate for every hospital for every year from 2008 through 2011, including adjustments for wage index reclassifications, indirect medical education payments, and disproportionate share payments. The base payment rate is the hospital's Medicare price before any adjustment for its specific mix of DRGs. This is analogous to the risk-adjusted private price. In addition, we also obtain DRG weights from CMS that allow us to know the rates CMS paid hospitals for every DRG per year from 2008 through 2011. We also create Medicare reimbursement rates for our outpatient services using the relevant ambulatory payment classification weights.

III.F Descriptives Statistics on Prices

Table 3 presents the means, standard deviations, range and cross-correlations of our inpatient hospital price index, procedure prices and the Medicare inpatient base payment rate averaged across 2008–2011. There is high correlation within service lines (e.g., the correlation of hip with knee replacements is 0.932) and weaker but still substantial correlation across service lines (e.g., the correlation of knee replacement with vaginal delivery prices is 0.506). By contrast, there is a low correlation between the Medicare base payment rate with both the inpatient price (0.165) and the procedure prices (ranging between -0.001 and 0.298). Medicare attempts to set administered prices to cover hospitals' costs so the base payment rate should be a reasonable proxy for exogenous cost pressures like local wages. Therefore, the low correlation between Medicare and private prices suggests that private price variation is driven by more than simply variation in costs. We address this further in Section VI.

The difference between Medicare and private-payer payment rates is substantial. Figure 1 shows that Medicare payments are 53 percent of private rates for inpatient care, 55 percent for hip replacement, 56 percent for knee replacement, 67 percent for cesarean delivery, 65 percent for vaginal delivery, 52 percent for PTCA, 39 percent for colonoscopy, and 27 percent for MRI. As an illustration of the magnitude of this difference, we estimate that if (rather than using the true private-payer prices) private prices were set 20 percent higher than Medicare rates, inpatient spending on the privately insured would decrease by 17.4 percent.[26]

There has also been significant interest in hospitals' charges - the list prices for hospital services.[27] Indeed, in 2013, the Department of Health and Human Services began releasing hospital charge information for all inpatient claims billed to Medicare (Department of Health and Human Services 2013). However, hospital charges capture neither the levels nor the variation in transaction prices. Figure 1 also illustrates the relative magnitudes of charges compared to negotiated prices. Charges are between 157 percent and 193 percent of the negotiated prices. Figure 2 presents a scatter plot showing the relationship between hospital charges and negotiated private-payer prices for knee replacements in 2011. There is a positive correlation but it is only 0.31. The other procedures, presented in Figure A2, have similarly low correlations between charges and transaction prices ranging between 0.25 and 0.48. These low correlations illustrate the importance of using transaction rather than list prices to analyze hospital pricing.

[26] This thought experiment holds quantity constant (i.e., assumes no behavioral response). If inpatient care was paid at 100 percent of Medicare rates, it would lower spending by 31.2 percent. Similarly, paying at 110 percent of Medicare, 130 percent of Medicare, and 140 percent of Medicare would lower spending by 24.2 percent 10.5 percent and 3.7 percent, respectively.

[27] For example, see Bai and Anderson (2015) and Hsia and Akosa Antwi (2014). There has also been significant interest in hospital charges from the popular press, e.g. Brill (2013).

IV. Medicare vs. Private Spending Per Beneficiary and the Contributions of Price and Quantity to Spending Variation

IV.A Spending Variation across HRRs

We present maps of overall spending per beneficiary across HRRs in 2011 in Figure 3. Panel A displays spending per privately insured beneficiary, and Panel B shows spending per Medicare beneficiary. As Figure 3 illustrates, there is substantial variation in private spending across the nation. In 2011, overall spending per privately insured beneficiary in the highest spending HRR (Napa, California) was $5,515.95, more than three times as high as spending in the lowest spending HRR (Honolulu, Hawaii), which spent $1,707.38 per person.[28] Likewise, for the privately insured, the coefficient of variation for total spending across HRRs in 2011 is 0.152 and the 90^{th}-10^{th} percentile ratio is 1.53. The corresponding statistics for Medicare spending are 0.141 and 1.45, respectively. It is apparent that patterns of spending variation for the privately insured differ from those for the Medicare population. This is particularly evident in the northern Midwest states of Wisconsin, Illinois, Iowa, and Minnesota. These states have fairly low spending per Medicare beneficiary and fairly high spending per privately insured beneficiary. The correlation in spending per Medicare beneficiary and spending per privately insured beneficiary is 0.140 overall, although it is higher for inpatient spending (0.267).[29] Maps of inpatient spending per beneficiary for Medicare and privately insured individuals are presented in Figure A3. The maps illustrate that areas with low Medicare spending are not generally those with low private spending and vice versa.

[28] HCCI masking rules prohibit us identifying HRRs below a defined number of providers.

[29] To illustrate that our results are robust in areas where the HCCI data contributors have high and low market shares, we examine the correlations between spending per beneficiary for Medicare recipients and the privately insured in states where HCCI insurers have more than the median share of the privately insured beneficiaries and less than the median share. The median HCCI coverage per state is 20 percent of the privately insured. The correlation between overall spending per Medicare beneficiary and privately insured beneficiary is -0.01 when we limit our analysis to states where the HCCI data cover more than 20 percent of the privately insured. The correlation between overall spending per Medicare beneficiary and privately insured beneficiary is 0.212 when we limit our analysis to states with less than 20 percent of the privately insured. While the numbers vary, they do not alter the basic conclusion that private and Medicare spending are weakly correlated. We also carry out similar tests of robustness for states with above median Blue Cross/Blue Shield (BCBS) coverage rates (above 19 percent of total coverage) and states with below median coverage (based on 2011 data from CCIIO). In states with BCBS coverage above the median, the correlation between spending per HCCI beneficiary and spending per Medicare beneficiary is 0.05. In states with low BCBS coverage, the correlation is 0.215. Again, the numbers differ, but the basic conclusion of low private/Medicare correlation does not.

Figure 4 illustrates this low correlation by presenting a scatter plot of the ranks of the 306 HRRs (higher numbers represent more spending) in terms of total spending per Medicare and per privately insured beneficiary. We have made the points for Grand Junction, Colorado, La Crosse, Wisconsin, and Rochester, Minnesota, more prominent than the others. These three HRRs have been highlighted by policy-makers as regions with low Medicare spending that could serve as best practice models for the nation.[30] While Grand Junction is the third-lowest HRR for Medicare spend per beneficiary in 2011, it is the forty-third *highest*-spending HRR for privately insured beneficiaries (and the ninth highest average inpatient prices) in 2011. Similarly, Rochester, Minnesota has the fourteenth lowest spending per Medicare beneficiary, the eleventh highest spending per privately insured beneficiary, and the thirty-third highest average inpatient prices in the nation.[31] Finally, for 2011, La Crosse, Wisconsin has the lowest total spending per Medicare beneficiary and the twenty-second highest spending per privately insured beneficiary. A scatter plot for inpatient spending only is presented in Figure A4. It looks much the same as the scatter plot for total spending. To further illustrate, in Table A4 we list ten areas that have low spending for both Medicare and the privately insured and ten areas with high spending for both. This highlights the fact that case studies from Medicare do not easily generalize to the privately insured.[32]

IV.B The Contributions of Price vs. Quantity to Spending Variation

We are interested in determining the extent to which variation in the price of care across HRRs or the quantity of care provided across HRRs contributes to the national variation in

[30] For examples of the discussion of Grand Junction, Colorado, La Crosse, Wisconsin, and Rochester, Minnesota by policy-makers, see Obama (2009a), Obama (2009b), Gawande (2009), Gawande et al. (2009), and Nichols, Weinberg, and Barnes (2009). For example, in a 2009 speech, President Obama said, "Now here -- if you don't -- I know there's some skepticism: Well, how are you going to save money in the health care system? You're doing it here in Grand Junction. You know -- you know that lowering costs is possible if you put in place smarter incentives; if you think about how to treat people, not just illnesses; if you look at problems facing not just one hospital or physician, but the many system-wide problems that are shared. That's what the medical community in this city did, and now you're getting better results while wasting less money. And I know that your senator, Michael Bennet, has been working hard on legislation that's based on putting the innovations that are here in Grand Junction into practice across the system, and there's no reason why we can't do that" (Obama 2009a).

[31] A scatter plot of 2011 spending per privately insured beneficiary and spending per Medicare beneficiary with axis in dollars is presented in Figure A4.

[32] In Figures A5 and A6, we present scatter plots of risk-adjusted spending per Medicare beneficiary and spending per privately insured beneficiary in dollars. Figure A6 presents total spending per beneficiary; Figure A6 presents inpatient spending per beneficiary.

inpatient spending for the privately insured and the Medicare population. To do so, we first calculate inpatient spending per beneficiary for the privately insured and for Medicare recipients. Inpatient spending per beneficiary in HRR r (y_r) is a function of the quantity (q_r) of care provided and the price of care (p_r):

(4) $$y_r = \frac{\sum_{h,d}(p_{h,d}q_{h,d})}{B_r},$$

where B_r is the number of beneficiaries in HRR r and $\sum_{h,d}$ indicates summing across all DRGs in a hospital and the all hospitals in an HRR. The price of DRG d at hospital h in HRR r is represented by $p_{h,d}$ and quantity is $q_{h,d}$ (we suppress the subscript r for economy of notation).

We now compute counterfactuals to calculate the relative contributions of price and quantity to variation in inpatient spending. The first counterfactual we create is to fix all prices per DRG to be the same as the national average ($\bar{p}_d$) and then analyze spending variation. This allows us to identify the relative contribution that differences in the quantity of care provided across regions make to variation in spending per beneficiary. Spending per beneficiary calculated with national average prices is (where ~ indicates a counterfactual calculation):

(5) $$\tilde{y}_r^{\bar{p}_d} = \frac{\sum_{h,d}(\bar{p}_d q_{h,d})}{B_r}.$$

The second counterfactual is to fix the quantity and mix of inpatient care delivered in each HRR to be the same as the national average mix and quantity of care ($\bar{q}_d$) and then analyze spending variation.[33] To do so, we calculate:

(6) $$\tilde{y}_r^{\bar{q}_d} = \frac{\sum_{h,d}(\bar{q}_d p_{h,d})}{B_r}.$$

This allows us to identify the relative contribution that differences in price make to variation in spending per beneficiary across HRRs. These are, of course, purely accounting decompositions to gauge rough magnitudes, as quantity and price are both endogenously determined in the private sector.

Table 4 contains the results of these counterfactual calculations. We present means and standard deviations of the inpatient spending measures and a number of measures of dispersion: the coefficient of variation, the Gini coefficient, and the 90th-10th percentile range. Column (1) of Table 4 presents the raw spending per beneficiary for the privately insured, which has a mean of

[33] To do so, we identify the mix of DRGs at a national level and set every HRR to have that mix of DRGs.

$793, a standard deviation of $348, and a coefficient of variation of 0.44. Note that the dispersion in spending for the privately insured is higher than that in the Medicare population (column (6)). Column (2) illustrates that when prices are fixed nationally, the coefficient of variation is reduced to 0.32. The Gini coefficient falls from 0.20 to 0.15 and the 90^{th}-10^{th} percentile range falls from 1.85 to 1.64. The effects of fixing quantity are in columns (4) and (5). As can be seen, the impact of fixing quantity on the coefficient of variation is about the same as that of fixing price. The impact on the Gini coefficient is smaller, and the impact on the 90^{th}-10^{th} percentile range is smaller still. These results imply that for the privately insured, prices play a bigger (or at least as big) a role as quantity in accounting for the dispersion of spending.

Column (6) of Table 4 presents the raw inpatient spending per Medicare beneficiary, which has a mean of $3,704, a standard deviation of $1,281, and a coefficient of variation of 0.35. Column (7) presents the results of holding prices fixed across HRRs. This does not substantially reduce the variation in Medicare spending. The coefficient of variation falls from 0.35 to 0.30. The Gini coefficient only falls from 0.18 to 0.17, and the 90^{th}-10^{th} percentile range falls slightly from 1.81 to 1.72. In contrast, fixing quantity (column (9)) and allowing price to be the only factor driving spending variation reduces the coefficient of variation by almost half, from 0.35 to 0.18. Similarly the Gini coefficient falls from 0.18 to 0.10. Consistent with the existing literature, these results illustrate that the quantity of health care delivered is the primary reason for variation in health care spending for Medicare beneficiaries across HRRs. The news from our analysis is that this is decidedly not the case for the privately insured.

Figure 5 presents the decomposition graphically. Panel A shows the distribution of inpatient spending per privately insured beneficiary using the raw data (solid blue line), when prices are fixed (small hashed red line), and when volume is fixed (bigger hashed red line). As Panel A illustrates, fixing price and fixing quantity have roughly the same effect on reducing inpatient spending per beneficiary for the privately insured. In contrast, Panel B shows that fixing the quantity of care provided across markets substantially reduces the variation in inpatient spending per Medicare beneficiary.[34]

[34] We also calculate counterfactuals for individual years 2008 through 2010. These are qualitatively similar and are available upon request from the authors. In addition, we also look at the correlation of Medicare spending and spending on the privately insured in our samples where price is fixed. This approximates the correlation between the

We also developed an alternative approach for understanding the role of price and quantity for driving spending by decomposing the natural log of spending per beneficiary into the variances of the ln(price), ln(quantity), and a covariance term (details are in Appendix B and Table A5). This has the advantage of being an exact decomposition. The qualitative results from this exercise are very similar to results from our earlier decomposition presented in Table 4.[35]

V. National-Level and Within HRR Variation in Health Care Providers' Prices

V.A Private Price Variation across HRRs

Figure 6 presents maps of (risk and inflation-adjusted) private-payer inpatient prices averaged 2008 to 2011.[36] Panel A presents risk-adjusted prices, and Panel B normalizes risk-adjusted prices using the Medicare wage index. There is substantial variation in prices across geographic areas, even after risk-adjustment. As Panel B illustrates, normalizing prices using the local Medicare wage index does little to reduce this variation. To illustrate the extent of the variation, Santa Rosa, California has the highest average inpatient private-payer prices and is more than four times as expensive as the least expensive HRR (Montgomery, Alabama). Within the state of Texas, all five quintiles of the price distribution are represented.

The seven procedures we examine in this analysis also display substantial variation.[37] The private-payer price ratio of the most expensive to the least expensive hospital prices across the nation for knee replacements, hip replacements, vaginal deliveries, cesarean deliveries, PTCAs, colonoscopies, and MRIs are 8.04, 7.84, 6.91, 7.40, 6.13, 9.49, and 11.99, respectively. In contrast, the Medicare base payment rate is allowed by CMS to vary by a factor of 2.26 across the U.S.

V.B Within HRR Variation in Health Care Providers' Prices

spending that results from the quantity of care provided in each market. The correlation between price fixed spending at the HRR-level between Medicare and the privately insured is 0.428.

[35] Results from the formal decomposition illustrate that, for the privately insured, 46 percent of variation is driven by price, 36 percent by quantity, and 18 percent by an interaction term. For Medicare only 9 percent of the variation is driven by price, 77 percent is driven by the quantity of care delivered and 14 percent is captured by an interaction term.

[36] Prices are put in 2011 dollars using the All Items Consumer Price Index for Urban Consumers, http://www.bls.gov/cpi/

[37] Maps of procedure-level average prices per HRR are available online at healthcarepricingproject.org

We now examine price variation within geographic areas. Table 5 presents the within HRR coefficients of variation in private-payer prices for the twenty-five most populated HRRs in the HCCI data in 2011 for our inpatient price index and the seven procedures. The national average of the within HRR coefficient of variation is in the final row and ranges between 0.197 (vaginal delivery) to 0.289 (MRI). It is striking that the within-HRR coefficient of variation is largest for lower-limb MRI, the least differentiated procedure in our analysis. Indeed, the variation is such that if, rather than attending their current provider, each patient paying above median for any inpatient service in their HRR chose to attend the hospital with the median price for their DRG, it would result in a reduction in inpatient spending for the privately insured of 20.3 percent.[38]

In Figure 7 we show the extensive within-HRR variation in private-payer prices for knee replacement, lower-limb MRI, and PTCA in three example cities: Denver, Atlanta, and Columbus.[39] In Denver, the ratio of maximum to minimum provider average prices is 3.09, 2.83, and 2.87, respectively, for knee replacement, PTCA, and MRI. In Atlanta, these ratios are 6.10, 2.52, and 3.77, and in Columbus, they are 2.77, 2.12, and 6.65, respectively. It is worth noting that for all three surgical procedures, there is virtually no variation in Medicare's administered payments across providers within HRRs. We observe similar levels of variation when we include hospital and physician fees.

VI. Factors Associated with Variation in Provider Prices

VI.A What Explains Providers' Price variation?

The most important hospital cost shifter is geographic variation in wages, since labor is the largest component of hospital costs (Edmunds and Sloan 2012). To account for these differences, CMS adjusts Medicare hospital payments using a hospital wage index, which is calculated based on a hospital's metropolitan statistical area (MSA) or statewide non-MSA. In

[38] To create this calculation, we took data for 2011. We identified the median DRG-price per HRR. For any patient who paid a price per DRG over the median, we substituted the median price for their true price and then recalculated average spending per beneficiary. This counterfactual ignores behavioral responses.

[39] We produced within market graphs for all seven procedures in all HRRs with five or more providers. Within market graphs for our sever procedures in Atlanta, Georgia, Columbus, Ohio, Denver, Colorado, Houston, Texas, Manhattan, New York, and Philadelphia, Pennsylvania, are presented in Figures A7 through A13. The within market graphs for the remaining HRRs with five or more providers is accessible at www.healthcarepricingproject.org.

addition, a hospital's base rate is adjusted to attempt to compensate hospitals for the additional costs associated with teaching activity and treatment of indigent patients.[40] For example, Medicare reimbursed Stanford Hospital, in Palo Alto, California $12,699.13 in 2011 for a stroke with complications (MS-DRG 065) and reimbursed the Medical Center Enterprise in Enterprise, Alabama, $5,365.09 for the same episode.[41]

Price variation may also reflect variation in hospital quality. Quality is likely both a cost and a demand shifter. Higher quality requires greater investments or greater effort, both of which are costly. In addition, we expect patients to be attracted to better hospitals (Chandra et al. 2015). There is evidence of substantial (two to threefold) variation in hospital mortality rates, readmission rates, and complication rates across hospitals (Yale Center for Outcomes Research and Evaluation 2013).[42] Hospitals also differ substantially in non-clinical domains, e.g., in the availability of technology, "hotel-style" amenities, and reputation (which may be based on clinical quality). However, there is little academic evidence showing strong correlations between prices and clinical quality.[43]

There are a number of other hospital characteristics that may also affect price, either by increasing demand or by increasing costs. These factors include the number of high tech services a hospital provides, which are certainly costly and may also attract patients. In addition, hospital characteristics such as ownership type and teaching status may affect costs or demand, and therefore prices. Not-for-profit, for-profit, and public hospitals have different tax liabilities, and ownership type may also affect incentives and therefore costs. In addition, ownership type may serve as a signal to consumers about trustworthiness or quality.[44] Similarly, teaching hospitals

[40] These adjustments are the indirect medical education (IME) adjustment and disproportionate share (DSH) payments.

[41] See Edmunds and Sloan (2012) for details on the differences in how these two hospitals are paid. CMS assumes that 68.8 percent of the Stanford Hospital's costs are labor and assigns them a wage index of 1.6379. They assume 62.0 percent of costs for Medical Center Enterprise come from labor and assigned them a wage index of 0.7436.

[42] Mortality rates for general and vascular surgery vary by a factor of two from 3.5 to 7 percent (Ghaferi, Birkmeyer, and Dimick 2009); Rogowski, Staiger, and Horbar (2004) found that risk-adjusted 28-day mortality in neonates varied three-fold across hospitals.

[43] White, Reschovsky, and Bond (2014) find that high priced hospitals in the Midwest have higher U.S. News & World Report rankings, but not better-observed measures of clinical quality.

[44] See Sloan (2000) for a survey of the literature on not-for-profits in health care. Overall, while there may theoretically be differences as indicated, the empirical literature for the most part does not find significant differences in costs or quality.

likely have higher costs than non-teaching hospitals, and consumers may view teaching status as a signal of quality.

Hospital size, measured as the number of beds, is known to affect costs through scale economies (Carey 1997; Gaynor, Kleiner, and Vogt 2013; Vita 1990). Further, there is a well-documented relationship between hospital volume of surgical procedures and patient outcomes, so hospital size may also be associated with the quality of care (Birkmeyer et al. 2002; Gaynor, Seider, and Vogt 2005). Moreover, larger hospitals may have more negotiating power over their transaction prices with insurers (Ho 2009; Sorenson 2003).

Population characteristics such as county-level insurance coverage and average county-level income may affect demand and are thereby candidates to affect price. Insurance lowers the cost of care to the patient, so we expect greater coverage to increase demand.

Market power is another important candidate that potentially affects price variation. Hospital markets are likely to be characterized by provider and insurer market power. There have been over 1,200 hospital mergers and acquisitions in the US since 1994, leading to a dramatic increase in concentration during this period (Dafny 2014), so much so that most large urban areas are dominated by one to three large hospital systems. As a consequence, hospitals, particularly those in highly concentrated markets, likely have substantial bargaining power relative to insurers.[45] Therefore, we construct a number of measures of hospital market structure such as indicators for the number of hospitals (monopoly, duopoly, etc.). Similarly, we also construct several proxies for the concentration of insurers, since insurers with more market power could negotiate lower prices from providers (Ho and Lee 2015).

Variation in hospitals' private-payer prices may also be affected by changes in the Medicare market. There are a number of hypotheses as to how Medicare may affect private prices. Some have hypothesized that hospitals engage in "cost shifting," i.e., providers respond to decreases in Medicare and Medicaid payments by increasing their prices to private-payers (Frakt 2011). However, the empirical evidence for cost shifting is quite mixed.[46] An alternative view is

[45] There is also a wide literature which has found that hospital concentration raises prices (Gaynor, Ho, and Town 2015).

[46] There is very mixed empirical evidence for cost shifting. Cutler (1998) examines changes in Medicare payment policy and finds dollar for dollar cost shifts in the 1980s. However, he finds no evidence of cost shifting in response to Medicare price cuts in the 1990s. Wu (2010) studies the impact of payment changes in Medicare introduced by the Balanced Budget Act of 1998. She finds that a $1 reduction in Medicare payments increased hospital payments

that hospitals negotiate their private prices based on Medicare payments. This "cost following" model implies that pricing of privately funded services is positively related to Medicare. This could occur because hospitals use public reimbursement rates as a benchmark to set their own rates due to the complexity of setting prices in isolation (Clemens and Gottlieb 2013).[47] Alternatively, hospitals that treat predominantly publicly funded patients may optimize their overall production to be profitable with Medicare or Medicaid payments.[48] This may lead them to have lower private-payer prices (Stensland, Gaumer, and Miller 2010).

VI.B Data on Factors Influencing Price

Hospital Characteristics and Hospitals' Local Area Characteristics: In our price regressions, we include controls for hospital characteristics drawn from the AHA annual survey: the number of hospital beds, ownership type (not-for-profit, for-profit, government), teaching status, and indicators for the technologies available at a hospital in a specific year. In addition, we link hospitals' zip codes to local area characteristics from the Census Bureau's Small Area Health Insurance Estimates and Small Area Income and Poverty Estimates, including the proportions of the population who are uninsured and the median income in the county where the hospital is located.

Technology Index: We follow Acemoglu and Finkelstein (2008) in using a count of hospital technologies offered by a hospital as recorded in the AHA survey data. The AHA data include binary indicators for whether a hospital has various technologies and services, such as computer-tomography (CT) scanners, electron beam computed tomography, or proton beam therapy. A full list of these technologies is available in Table A6. We sum the number of these technologies available at each hospital in each year.

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by $0.21 cents on the dollar (Wu, 2010). In addition, Wu (2010) finds that hospitals with greater market power were able to make larger private price increases in response to cuts in public reimbursement rates. Along the same lines, Dranove, Garthwaite, and Ody (2013) analyze hospitals' responses to negative financial shocks to their endowments from the most recent recession. They find that, on average, hospitals do not respond to negative financial shocks by raising prices, but that highly ranked hospitals are able to respond to negative financial shocks by raising prices.

[47] Clemens and Gottlieb (2013) study the impact of changes in Medicare payments on physician prices by exploiting a change in payment policy that made physician payments more generous for surgical procedures. They find that a $1 increase in Medicare payment results in a $1.20 dollar increase in private-payer physician prices. These Medicare/private-payer price transmissions are highest in markets where there is low provider consolidation. Similarly,White (2013) finds that markets with high growth in Medicare payments from 1995 through 2009 also have high growth in private-payer prices.

[48] Medicaid is another important government insurance program that mainly covers low-income individuals.

Hospital Quality: To capture reputational quality, we include a yearly indicator for whether or not a hospital was ranked by the U.S. News & World Report as a top hospital. We indicate a hospital was ranked in the U.S. News and World Report if it was ranked as an overall top hospital or received a ranking as a top hospital for cancer care; gastrointestinal care; ear nose and throat; geriatric care; gynecology; cardiology; orthopedics; rheumatology; or urology. In total, from 2008 through 2011, the U.S. News & World Report ranked 231 hospitals in our sample in their annual 'Best Hospital' rankings across clinical specialties and the overall ranking.

To measure clinical performance, we merge in data on hospital quality from https://data.medicare.gov/, which includes the hospital quality scores reported publicly on the CMS Hospital Compare webpage (https://medicare.gov/hospitalcompare). These include measures of patient safety, patient outcomes, and process measures of care captured from public and private claims data. We included rankings for 2008 through 2011 for four measures: the percentage of heart attack patients given aspirin upon arrival to the hospital; the percentage of surgery patients given an antibiotic prior to surgery; the percentage of patients treated within twenty-four hours of surgery to prevent blood clots; and the 30-day risk adjusted mortality from heart attacks.[49] These are widely acknowledged measures of the quality of care and they are all available with the greatest frequency for hospitals in our sample from 2008 through 2011 (Yale Center for Outcomes Research and Evaluation 2013). Nevertheless, we do not have CMS quality measures for 168 hospitals (7.5 percent) from our inpatient sample. As a result, we present analysis of these measures separately from our main analysis. In our analysis, we break quality scores into quartiles and report the relationship between price and being a hospital being ranked in the lowest performing quartile of quality.

Hospital Market Structure: We construct our measures of market structure in a two-step process. The first step is to define a hospital's market area.[50] We define both fixed- and variable-radius markets. For our fixed-radius markets, we draw a radius around each hospital, which places hospitals in the center of circular markets of radius z. We construct hospital markets using five-mile, ten-mile, fifteen-mile, and thirty-mile radii extending outwards from hospitals'

[49] For the technical descriptions of the measures of performance we used in this analysis, see http://www.medicare.gov/hospitalcompare/Data/Measures.html.

[50] These are approximations to hospitals' geographic markets, not precise antitrust markets. Since these are not precise markets, we test the robustness of our results to various market delineations and find that we obtain the same results.

locations.[51] Previous analysis of Medicare beneficiaries found that 80 percent of patients were admitted to hospitals within ten miles of their home (Tay 2003). We generally report statistics for markets with a radius z of fifteen-miles drawn around each hospital, so that we capture the travel distance of most patients. We illustrate our results are robust to using radii of longer and shorter distances. The second step is to measure market structure within our defined market areas. We do so in two ways. First, we identify whether the geographically defined markets are monopolies, duopolies, triopolies, or include four or more providers. Second, we calculate either counts of hospitals or Herfindahl-Hirschman Indexes (HHIs) calculated within our various market definitions.

The HHI for each hospital-centered market is:

$$Hospital\ HHI_{m,t} = \sum_{h=1}^{H} (s_{h,t}^{m})^2, \quad (7)$$

where $Hospital\ HHI_{m,t}$ is concentration in market m at time t, where $s_{h,t}^{m}$ is the market share of hospital h in market m at time t, calculated using hospital bed count.[52]

There are well-known endogeneity concerns about the use of concentration measures in pricing equations (e.g., Bresnahan 1989). For example, higher quality hospitals may attract more patients and have higher market shares, resulting in a higher HHI for their market. Since they will likely also have higher prices, this can lead to an estimated positive relationship between price and concentration driven by omitted quality scores rather than by market power. It is also possible that hospitals with higher shares may be lower cost, which could create a negative association between price and concentration, again due to an omitted variable. This may be less of a problem in this application, since we have a number of observable measures of quality and of cost. Nonetheless, the estimates should be interpreted as associations, not causal effects.[53]

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[51] We also calculate a variable radius market where the radius that defines a hospitals' market is a function of the urban-rural classification defined by the US census. Hospitals located in 'large urban' areas are assigned a market defined by a ten-mile radius; hospitals located in 'urban' have a market defined around them using a fifteen-mile radius; and hospitals located in 'rural' areas have a market defined around them using a twenty-mile radius. For details on the census definitions, see: https://www.census.gov/geo/reference/ua/uafaq.html.

[52] We also compute HHIs using hospital discharges and total days of care delivered. All measures are correlated at over 98 percent.

[53] Kessler and McClellan (2000) propose one strategy to mitigate endogeneity by using a choice model to predict patient flows and then calculate market concentrations using predicted rather than actual patient flows. We cannot use this strategy because we do not see every patient treated at each hospital; we only see patients at a hospital who are insured by one of the three payers in our dataset. Moreover, as Cooper et al. (2011) note, fixed-radius HHIs measured using actual patient flows are correlated at over 0.90 with Kessler and McClellan (2000) style predicted flow HHIs. Instead, we measure hospital market size and hospital market share based on the total number of beds

Insurance Market Structure: There are limited data and few reliable sources of information on market concentration in the health insurance industry (Dafny et al. 2011). The most reliable data with coverage of the entire country are only available at the state level. We construct state-level measures of insurance market concentration using data from the Center for Consumer Information & Insurance Oversight (CCIIO) at CMS. Under regulations created in the Affordable Care Act, insurance companies are required to report data on the number of beneficiaries per state that they cover in the small, medium, and large group markets.[54] We use these data to construct insurance market concentration as $Insurer\ HHI_s = \sum_{i=1}^{I}(s_i^s)^2$, where s_i^s is insurer i's market share of enrollment in state s in 2011.[55] Because the CCIIO data are only available from 2011 onwards, we apply the 2011 state insurance HHIs to 2008, 2009, and 2010.

In order to construct a sub-state level of insurer negotiating strength, we use the share of total privately insured lives at the county level covered by the three insurers in our HCCI data. We use data on the total number of privately insured lives at the country level from the Census Bureau's Small Area Health Insurance Estimates and calculate the share of those covered lives that received insurance coverage from the HCCI payers annually. Although this does not capture all private insurers like the CCIIO data, the measure is both county specific and is most relevant for the prices negotiated with the HCCI insurers (our dependent variable).

Medicare and Medicaid: We include the Medicare base payment rate for hospitals, as described previously, since this may proxy for hospital costs. In addition, the hospital cost-shifting hypothesis is that lower Medicare prices should lead to higher private prices. The cost following hypothesis is that higher Medicare prices lead to higher private prices. All of these are encompassed by including the Medicare base payment rate. The hospital's shares of patients that are Medicare and Medicaid are included to capture whether hospitals with large Medicare or Medicaid patient populations price services differently for the privately insured.

VI.C Bivariate Correlations of Price

within a market and a facility, respectively. We also note that the number of hospital beds is a measure potentially less subject to endogeneity than patient flows because it is costly for hospitals to alter the number of beds.

[54] These data are used by the federal government, together with data on insurers' spending on their beneficiaries, to calculate medical loss ratios. The CCIIO data only include fully insured plans, which face medical loss reporting requirements from the federal government (as opposed to self-insured plans).

[55] In addition to measuring insurance market concentration using data from CCIIO, we also use data from 2008 through 2011 from the National Association of Insurance Commissioners.

We first examine simple patterns in the data by looking at bivariate correlations between the potential drivers identified above and prices. Figure 8 presents these correlations graphically. Clearly, hospitals in monopoly and duopoly markets have higher prices. There is a small negative but insignificant correlation between state-level insurer HHI and price. However, prices are lower in counties where HCCI insurers have a higher share of covered lives. Hospitals with more technologies, those that are ranked by the U.S. News & World Report, larger hospitals, and teaching hospitals all have higher prices. Government hospitals have lower prices than for-profits (with not-for-profits in between). Both the proportion of the county that is uninsured and the county median income are positively correlated with price. Hospitals with higher Medicare base payment rates have substantially higher private-payer prices. Hospitals with higher shares of Medicare patients have lower prices, although hospitals with higher Medicaid shares have somewhat higher prices. We find the expected correlations between four measures of quality and inpatient hospital prices. Here, our quality indicators indicate that a hospital was in the worst performing quartile of hospitals on that quality score. Hospitals in the worst performing quartile based on the percentage of patients given aspirin at arrival, percent of surgery patients treated to prevent blood clots, and thirty-day risk-adjusted AMI mortality all have lower prices. There is a small negative, but not precise, correlation for hospitals in the worst performing quartile based on the percentage of patients given an antibiotic one hour before surgery to prevent an infection.

The correlations in Figure 8 illustrate the underlying (bivariate) patterns in the data. In what follows, we estimate these relationships using multiple regression analysis. We find that most of the patterns illustrated here are largely sustained in the regression results.

VI.D Factors Associated with Providers' Inpatient Private-Payer Prices

Econometric Approach. To examine the factors associated with hospital prices we run OLS regressions on 2008 through 2011 hospital prices.[56] Our basic regressions are of the form:

(8) $$\ln(PRICE_{h,m,r,c,s,t}) = H_{m,t}\alpha + \beta I_s + \varphi S_{c,t} + Z_{h,t}\gamma + D_{c,t}\theta + M_{h,t}\mu + \tau_t + u_{h,m,r,s,t},$$

where *PRICE* is the adjusted hospital price ($\hat{p}_{h,t}$), as described in equation (2) and is measured for hospital h, in hospital market m, in HRR r, in county c, in state s, in year t. We also estimate

[56] We exclude 2007 from our analysis because our price indexes require six months of a patient's medical history to generate the Charlson Index we use for risk-adjustment.

equation (8) with prices for each of the seven procedures as the dependent variable. A key variable of interest is hospital market structure (H), measured using dummies for market type (monopoly, duopoly, and triopoly), HHIs, or hospital counts. We also include state level HHIs of insurers (I_s) and a county level measure of the percent of privately insured lives covered by the HCCI insurers ($S_{c,t}$) as controls for insurers' bargaining power with hospitals. $Z_{h,t}$ is a vector of hospital characteristics. This includes proxies for hospital quality measured by U.S. News & World Report and quality scores from the Medicare Hospital Compare webpage, the technology index, hospital size, and indicators for whether a hospital is a teaching facility, government-owned facility, or a not-for-profit. $D_{c,t}$ contains the demand shifters: the median income of a hospital's county and the percent of the population who are uninsured in the county. M_{ht} contains the Medicare base payment rate, the share of hospitals' discharges that are Medicare patients, and the share of a hospitals' discharges that are Medicaid patients. Year fixed effects are denoted by τ_t, and in some specifications we also include HRR fixed effects, δ_h. The error terms are clustered by HRR. In our analysis, we estimate equation (8) using the natural log of hospital prices and the natural log of our continuous, independent variables.[57]

Results of The Private-Payer Inpatient Hospital Price Index Regressions: Table 6 contains OLS estimates of equation (8) where the dependent variable is the logged inpatient price index (or the charge in column (4)). Column (1) includes indicators for hospital market structure (monopoly, duopoly, and triopoly), hospital characteristics, information on public payers, local area characteristics, and year dummies. We consistently find that find that prices decline monotonically as the number of rival hospitals per market increases. The point estimates in Column (1) imply that being in a monopoly market is associated with 26.1 percent (= $e^{0.232}-1$) higher prices relative to markets with four or more hospitals. In column (2), we add HRR fixed effects, so our measures of market structure are estimated using only within HRR variation. Here, we also find that being in a monopoly is associated with a significant price premium, although the coefficient falls from 0.232 to 0.169. In column (3), in addition to HRR fixed effects, we add in two controls for insurance market structure (insurer HHI at the state level and HCCI share at the county level). We find that hospitals in monopoly duopoly, and triopoly

[57] In all specifications we add one to continuous right hand side variables before taking logs as there are a small number of zeroes.

markets are associated with statistically significant price increases of respectively 15.3 percent, 6.4 percent, and 4.8 percent relative to markets with four or more hospitals.[58] Note these correlations are robust to specifications using alternative measures of market concentration such as continuous or discretized HHIs and/or counts of hospitals in markets of several geographic sizes.[59]

The coefficients on the two insurer concentration measures in column (3) of Table 6 take their expected negative signs, but only the share of the privately insured in each county that receive coverage from the HCCI insurers is significant. When HCCI insurers account for a larger share of a county's insured population, the HCCI insurers likely have increased negotiating power. A 10 percent increase in the HCCI insurers' share is associated with a 1.4 percent decrease in hospital prices. The insignificance of insurers' HHI is likely to be because the state level is too highly aggregated to adequately proxy insurer market concentration.

Turning to the covariates reflecting quality, both the technology index and whether the hospital was publicly ranked as a high performer have positive and significant coefficients. Our point estimates in column (3) in Table 6 imply that doubling the number of technologies at a hospital is associated with a 1 percent increase in price. Being ranked as a top hospital by U.S. News & World Report is associated with a significant price premium of 12.7 percent. Bigger hospitals also have higher prices. Interestingly, teaching hospitals, which are often thought of as higher quality and had a significant price premium in the bivariate correlations of Figure 8, are not significantly associated with higher prices when other characteristics are included as

[58] The results are robust to other ways of measuring price. First, we obtain similar and precisely estimated coefficients when we include the sum of facilities and physician prices as our price variable, instead of just facilities prices. Second, we obtain similar results when we estimate the regression with price in levels instead of logs (see Table A7). For example, the magnitude of the coefficient on the monopoly dummy in column (3) of Table A7 implies that prices are $1,524.50 higher in these markets. This 12.3 percent increase over the average inpatient price is similar to the 15.3 percent magnitude monopoly effect in our ln(price) regressions in column (3) in Table 6. Our results also remain qualitatively similar when we measure both the independent variables in levels instead of logarithms.

[59] Full results are in Table A8. We measure HHIs and vary the size of the radii that defines hospitals' markets in first three columns. We also measure HHI in markets surrounding each hospital and define using radii that are larger in rural areas and smaller in urban areas; use counts instead of HHIs measured in fifteen mile radii markets; use dummy variables to indicate hospitals that are located in markets that are in the first, second, and third quartiles of HHIs measured in fifteen mile radii markets relative to the least concentrated quartile; and use a dummy to indicate hospitals are located in hospitals in the most concentrated quartile of HHI. The relationship between hospital market structure and price remains precisely measured and qualitatively unchanged across each measure of market structure.

controls. We discuss the impact of introduce the Medicare Hospital Compare quality scores in the next sub-section.

We find significant associations of public payers with private prices. In particular, hospitals treating more Medicare patients have lower prices. Our estimates in column (3) of Table 6 imply that a 10 percent increase in the share of Medicare patients is associated with a 1 percent reduction in inpatient hospital prices. Medicaid patient share is also negatively associated with private prices, but the effect is statistically insignificant. In the column (1) specification without HRR fixed effects, hospitals with higher Medicare reimbursement rates have higher prices (consistent with the idea of rates being a proxy for local wages costs). These are not significant when we include HRR fixed effects because Medicare payment rates do not vary much within HRRs.

For-profit hospitals (the omitted base ownership form) have higher prices than government hospitals, but there is not a significant difference between the prices of for-profit and not-for-profit hospitals. The coefficients on the characteristics of the county population (percent uninsured, and median income) are precisely estimated in the absence of HRR fixed effects in column (1) and are associated with higher prices as expected, but become insignificant when HRR fixed effects and insurer controls are included.

In column (4) of Table 6, we repeat the specification from column (3) but use the facilities charge (the list price) as the dependent variable instead of the transaction price. There are some large changes in coefficients in this specification. In particular the coefficient on being a hospital located in a monopoly market falls from a precisely estimated coefficient of 0.142 to negative and insignificant coefficient of -0.006. Although hospitals in concentrated markets do not seem to set significantly higher list prices, their actual transaction prices are significantly higher. Similarly, when using facilities charge as an outcome the coefficient on HCCI share becomes insignificant and the coefficient on non-profits becomes significant. This strongly suggests that using list prices, as is commonly done the literature, instead of actual transaction prices can generate a misleading pattern of correlations.

Additional quality measures: In Table 7, we re-estimate the main inpatient price regression of Table 6, using indicators for whether or not a hospital was ranked in the lowest performing quartile of a series of CMS hospital quality measures as discussed above. Because

CMS cannot calculate quality scores for each hospital, we do not have quality scores for 8.6 percent of our observations (7.5 percent of hospitals). As a result, we condition on the sub-sample of hospitals from our inpatient sample that have non-missing values on all four quality measures. This change in the sample accounts for the minor change in the coefficients from column (3) of Table 6.

Column (1) of Table 7 presents estimates of equation (8) with insurance market controls and HRR fixed effects, but does not include an important control for quality (i.e. including no control for a U.S. News & World Report Ranking). Columns (2) – (6) then add in each measure of quality separately and column (7) includes every measure of quality together. It is reassuring that including a battery of measures of hospital quality has essentially no impact on the market structure coefficients. If unobserved quality mattered a great deal, one would expect conditioning on observed quality to make a larger difference to the concentration coefficient. We find significant (albeit small) relationships for three out of four measures of quality and price. These suggest that being in the worst performing quartile of hospitals based on the share of patients with a heart attack given aspirin on admission to the hospital, being in the worst performing quartile of hospitals based on the percentage of patients given an antibiotic to prevent infection before surgery, and being in the worst performing quartile of hospitals based on the percentage of surgery patients given treatment to prevent blood clots have inpatient prices 4.4 percent, 3.1 percent and 3.8 percent lower respectively than hospitals in the top three quartiles of clinical performance.[60]

Other robustness checks: We have conducted robustness checks on our functional form, market area definitions, and parameterization of equation (8). For example, to address the concern that there may be systematic differences in results in areas where the HCCI data has a higher (or lower) coverage of the privately insured, we re-estimate equation (8) on sub-samples where the HCCI insurers cover a high share and low share of the state's population.[61] The point estimates are qualitatively similar across the two samples and the hospital market structure

[60] A version of Table 7 with coefficients and standard errors estimates for every covariate is presented on our webpage, www.healthcarepricingproject.org.

[61] All results in this paragraph are contained in Table A9. For each state, we measure the share of individuals with employer-sponsored insurance who receive coverage from the HCCI data contributors. States with high shares have HCCI coverage rates over the national median coverage rate. States with low shares have HCCI coverage rates below the national median coverage rate.

variables in the two samples are not statistically different from one another. In addition, we re-estimated equation (8) on sub-samples where Blue Cross Blue Shield insurers have a high and low share of employer-sponsored coverage at the state-level. Again there were similar results across the samples. Finally, we were concerned that market structure may just proxy for a location in a rural area. Therefore, we present results where we estimate Equation (8) separately in urban and rural areas. We find that while hospital HHI is associated with higher hospital prices in urban areas, the relationship is insignificant in the rural sample. This is consistent with the fact that there is very little variation in hospital HHIs across rural areas.[62]

VI.E Results for individual procedure prices:

Table 8 presents our estimates using procedure level private-payer prices using the same specification presented in column (3) of Table 6 (Table A10 has results without HRR effects). Looking across the different procedures, it is striking that despite the smaller sample sizes (we condition on having a minimum number of ten cases per procedure per year, as discussed above), the results look qualitatively consistent with the overall inpatient results. For all procedures, we find that markets with a monopoly hospital have higher prices than those with four or more hospitals, and this positive association is significant at the 10% level or greater for five of the seven procedures. The point estimates imply that, at the procedure level, a hospital located in a monopoly market has prices that are between 8.7 percent and 18.9 percent higher than hospitals in markets with four or more hospitals. For example, being in a monopoly market is associated with having 18.9 percent higher prices for lower limb MRIs relative to markets with four or more hospitals.[63]

We also re-estimate our procedure-level (and inpatient) regressions measuring prices as the sum of hospital and physician prices in Table A11. We do this because of the concern that sometimes these prices are bundled together (e.g. when the physicians are salaried employees of the hospitals). Our results are qualitatively similar using this measure of price.

[62] The coefficient of variation in HHI in urban areas is 0.688. The coefficient of variation in HHI in rural areas is 0.332.
[63] These results are robust when we include the four Medicare Hospital Compare quality scores into our estimators as controls.

The similarity of results using our seven detailed procedure prices in Table 8 compared to the overall inpatient price index in Table 6 is reassuring.

VII. Conclusions

This paper analyzes the most comprehensive data to date on health spending on the privately insured and health care providers' transaction prices. We find substantial variation in spending per privately insured beneficiary across the nation. Moreover, there is a low correlation (0.14) between private and Medicare spending per beneficiary across geographic areas (HRRs). Crucially, whereas the variation in Medicare spending is overwhelmingly due to differences in the quantity of care provided across HRRs, price variation across HRRs is the primary driver of spending variation for the privately insured. Hospitals' negotiated transaction prices routinely vary by over a factor of eight or more across the nation and by a factor of three within HRRs. We observe this variation within and across HRRs for procedures like colonoscopy and lower-limb MRI that are fairly undifferentiated.

We also find a large number of observable factors relating to costs and quality are systematically correlated with higher hospital prices. However, hospital market structure stands out as one of the most important factors associated with higher prices, even after controlling for costs and clinical quality. We find that hospitals located in monopoly markets have prices that are about 15.3 percent higher than hospitals located in markets with four or more providers. This result is robust across multiple measures of market structure and is consistent in states where the HCCI data contributors (and/or Blue Cross Blue Shield insurers) have high and low coverage rates.

We draw a number of conclusions for future research. First, information about Medicare spending and the factors that drive it to vary are of limited use in understanding health spending on the privately insured. There has been a general assumption both by policy-makers and in the literature that what we observe for Medicare broadly applies to spending on the privately insured. Our work shows that this is clearly not the case. Indeed, many geographic areas that have received public attention for being low spending on the Medicare population, such as Grand Junction, Colorado, La Crosse, Wisconsin, and Rochester, Minnesota, have high spending on the privately insured. Second, much more research is needed in order to analyze the spending and prices facing the privately insured. Our work represents an initial foray into understanding the cross sectional variation in health care spending, but more work is needed to better understand the factors driving the growth in private spending over time. Third, it is important to assess the causal drivers of hospital transaction prices, particularly the role of provider market structure and public payment rates.

In terms of policy, our work suggests that vigorous antitrust enforcement is important and that hospital prices could be made more transparent. There is evidence that higher deductibles and cost sharing alone will not likely encourage shopping by patients (Brot-Goldberg et al. 2015). However, more information, such as recent efforts in Massachusetts to make hospitals' prices public, could help patients and their agents make more informed choices over treatment and put downward price pressure on more expensive hospitals in a sector of the economy where consumers (patients) presently know almost nothing about what they or their insurer will pay for care. Going forward, we believe that research advances using the kind of data described in this study will help inform such policy decisions.

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Table 1: Annual Patients, Claims, and Spending From HCCI Data, 2007 - 2011

	Distinct Members	Claims	Inpatient Spending ($)	Total Spending ($)
2007	44,869,397	573,964,225	28,703,216,810	126,439,637,925
2008	45,064,977	591,194,317	29,796,787,559	131,711,103,920
2009	44,780,736	606,366,864	32,288,419,203	141,932,049,143
2010	43,642,097	575,523,477	31,829,518,213	140,894,344,384
2011	42,976,359	571,954,170	31,829,841,920	141,110,226,944
Total	*88,680,441*	*2,919,003,053*	*154,447,783,705*	*682,087,362,316*

Notes: This is from the entire HCCI database. All spending values have been inflation adjusted to 2011 dollars using the BLS All Items Consumer Price Index.

Table 2: Hospital and Patient Characteristics

	Mean	SD	Min	Max
Hospital Characteristics				
Hospital in Monopoly Market, 15 Mile Radius	0.126	0.332	0	1
Hospital in Duopoly Market, 15 Mile Radius	0.145	0.352	0	1
Hospital in Triopoly Market, 15 Mile Radius	0.097	0.296	0	1
Hospital HHI Defined by Beds in a 15 Mile Radius	0.416	0.292	0.041	1.000
Insurer HHI Measured at the State Level	0.212	0.095	0.088	0.664
HCCI Market Share Measured at the County Level	0.187	0.103	0.014	0.571
Number of Technologies	60	30	0	138
Ranked in US News & World Reports	0.059	0.236	0	1
Beds	278	217	5	2,264
Teaching Hospital	0.389	0.488	0	1
Government Owned	0.106	0.308	0	1
Non-Profit	0.683	0.465	0	1
Local Area Characteristics				
Percent of County Uninsured	0.172	0.060	0.031	0.389
Median Income	52,208	13,142	23,863	119,525
Rural	0.127	0.333	0	1
Other Payers				
Medicare Payment Rate	6,435	1,272	4,590	14,292
Share Medicare	0.439	0.107	0.000	0.923
Share Medicaid	0.183	0.100	0.000	0.950
Quality Scores				
30-day AMI Survival Rate	0.840	0.016	0.751	0.898
% of AMI Patients Given Aspirin at Arrival	0.978	0.041	0.330	1.000
% of Patients Given Antibiotics 1 Hour Before Surgery	0.937	0.078	0.170	1.000
% of Surgery Patients Given Treatment to Prevent Blood Clots Within 24 Hours	0.885	0.102	0.030	1.000
Patient Characteristics				
Age 18-24	0.074	0.261	0	1
Age 25-34	0.274	0.446	0	1
Age 35-44	0.203	0.402	0	1
Age 45-54	0.208	0.406	0	1
Age 55-64	0.241	0.428	0	1
Female	0.699	0.459	0	1
Charlson Comorbidity Index	0.521	1.201	0	6

Notes: These are descriptive statistics for the inpatient sample from HCCI. There are 2,252 unique hospitals and 3,544,320 unique patients.

Table 3: Private Prices and Medicare Base Payment Rate at the Hospital Level, 2008-2011

	Summary Statistics				Correlation								
	Mean	Standard Deviation	Max/ Min	# Hospitals	Inpatient	Hip Replacement	Knee Replacement	Cesarean Section	Vaginal Delivery	PTCA	Colonoscopy	Lower Limb MRI	*Medicare Base*
Inpatient	12,361	4,473	193	2,252	1								
Hip Replacement	24,046	7,444	6	477	0.732	1							
Knee Replacement	23,104	7,592	17	937	0.760	0.932	1						
Cesarean Section	7,612	2,511	7	1,113	0.794	0.531	0.569	1					
Vaginal Delivery	4,986	1,548	7	1,214	0.715	0.531	0.506	0.866	1				
PTCA	25,010	8,820	11	598	0.691	0.602	0.598	0.408	0.345	1			
Colonoscopy	1,694	624	9	1,195	0.370	0.237	0.282	0.361	0.327	0.229	1		
Lower Limb MRI	1,332	509	12	1,584	0.423	0.275	0.305	0.295	0.246	0.347	0.307	1	
Medicare Base	*6,405*	*1,254*	*3*	*2,252*	*0.165*	*0.217*	*0.144*	*0.232*	*0.298*	*0.059*	*0.091*	*-0.001*	*1*

Notes: These are the regression corrected transaction prices as discussed in Section III and the Medicare base reimbursement averaged 2008-11 using inflation adjusted prices in 2011 dollars. Correlation coefficients are pairwise correlations between multiple procedures at the same hospital. The inpatient prices come from the inpatient sample (equation (2) in the text). The procedure prices come from the procedure samples (equation (3) in the text). The Max/Min is the ratio of the maximum national hospital price divided by the minimum hospital price.

Table 4: Counterfactual Measures of Medicare and Private Spending per Beneficiary, 2011, HRR Level

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Private Spending					**Medicare Spending**				
	Raw	**Fix Price at National Level**	*Effect of fixing price*	**Fix Quantity at National Level**	*Effect of fixing quantity*	**Raw**	**Fix Price at National Level**	*Effect of fixing price*	**Fix Quantity at National Level**	*Effect of fixing quantity*
Mean	793	862		680		3,704	3,820		3,544	
SD	348	273		223		1,281	1,157		655	
Coefficient of Variation	0.44	0.32	*-0.12*	0.33	*-0.11*	0.35	0.30	*-0.04*	0.18	*-0.16*
Gini	0.20	0.15	*-0.05*	0.18	*-0.02*	0.18	0.17	*-0.01*	0.10	*-0.08*
p90/p10	1.85	1.64	*-0.21*	1.76	*-0.09*	1.81	1.72	*-0.09*	1.39	*-0.41*
Number of HRRs	306	306		306		306	306		306	

Notes: Counterfactuals are calculated at the HRR level using 2011 spending data—see section IV B for details of methodology. Spending is measured in 2011 dollars and is drawn from the spending sample. Columns (1) and (6) present raw inpatient spending per beneficiary for the Medicare population and privately insured populations, respectively. Columns (2) and (7) present spending per privately insured and Medicare beneficiary when DRG-level prices are fixed to be the national average in all regions. Columns (3) and (8) report the reduction in measures of spending variation that result from fixing price. Columns (4) and (9) present spending per privately insured and Medicare beneficiary when the quantity of care (i.e. mix of DRG's as well as rate at which beneficiaries are admitted across DRGs) is fixed to the national average. Columns (5) and (10) report the reductions in measures of spending variation that result from fixing quantity.

Table 5: Hospital Procedure Prices (Mean and Coefficient of Variation) for the 25 Most Populated HRRs, 2008-2011

	Inpatient		Hip Replacement		Knee Replacement		Cesarean Section		Vaginal Delivery		PTCA		Colonoscopy		Lower Limb MRI	
	Mean	CoV	Mean	CoV	Mean	CoV	Mean	CoV	Mean	CoV	Mean	CoV	Mean	CoV	Mean	CoV
Phoenix, AZ	13,322	0.511	16,220	0.101	20,160	0.405	7,183	0.255	5,156	0.313	16,419	0.408	1,730	0.592	1,161	0.621
Los Angeles, CA	13,114	0.322	25,342	0.367	23,600	0.406	8,680	0.322	5,771	0.292	21,573	0.525	2,574	0.310	1,493	0.277
Denver, CO	14,363	0.294	21,147	0.256	23,498	0.383	8,650	0.244	5,055	0.243	24,510	0.278	1,956	0.370	1,314	0.318
Washington, DC	9,834	0.185	20,472	0.235	19,357	0.277	7,565	0.219	5,594	0.132	21,533	0.296	1,233	0.416	1,022	0.339
Ft Lauderdale, FL	10,920	0.280	23,093	0.380	21,920	0.321	6,446	0.241	4,531	0.205	24,696	0.285	1,624	0.374	817	0.475
Miami, FL	11,670	0.260	20,767	0.366	24,325	0.217	6,411	0.161	4,886	0.160	25,035	0.410	1,861	0.411	1,249	0.629
Orlando, FL	12,874	0.259	23,884	0.284	22,841	0.280	7,717	0.172	4,574	0.284	24,503	0.412	2,046	0.301	1,270	0.285
Atlanta, GA	10,473	0.248	23,081	0.243	20,797	0.317	6,082	0.255	4,295	0.247	19,709	0.256	1,653	0.449	1,034	0.347
Louisville, KY	8,719	0.258	18,305	0.211	15,554	0.160	5,666	0.268	4,269	0.367	14,895	0.203	1,347	0.241	1,254	0.429
Minneapolis, MN	12,778	0.172	23,054	0.208	22,111	0.184	8,463	0.199	4,918	0.123	23,584	0.121	1,543	0.185	1,348	0.368
Kansas City, MO	9,943	0.263	18,540	0.330	18,967	0.256	6,029	0.239	4,053	0.207	21,259	0.289	1,430	0.174	1,165	0.313
St. Louis, MO	9,285	0.335	15,456	0.073	14,581	0.136	4,934	0.261	3,975	0.396	18,129	0.191	1,208	0.211	1,182	0.302
Camden, NJ	12,283	0.519	20,482	0.223	20,713	0.232	8,945	0.305	6,575	0.254	22,958	0.340	1,640	0.393	1,019	0.073
E Long Island,NY	12,914	0.199	40,696	0.145	33,487	0.240	8,838	0.110	6,231	0.130	32,177	0.170	2,031	0.236	1,407	0.285
Manhattan, NY	13,162	0.267	34,093	0.232	32,151	0.261	8,142	0.252	5,497	0.226	28,169	0.304	1,744	0.407	1,308	0.444
Cincinnati, OH	11,057	0.132	24,628	0.108	22,896	0.127	6,426	0.033	4,488	0.084	22,093	0.131	1,744	0.147	1,211	0.457
Columbus, OH	13,025	0.195	30,340	0.155	27,203	0.262	7,684	0.291	5,336	0.219	24,305	0.278	1,686	0.442	1,460	0.312
Philadelphia, PA	12,047	0.311	28,100	0.252	25,213	0.292	9,233	0.281	6,286	0.260	28,553	0.260	1,945	0.339	1,681	0.486
Austin, TX	10,664	0.316	23,618	0.200	23,203	0.157	6,465	0.077	4,605	0.051	28,614	0.215	1,378	0.247	1,091	0.339
Dallas, TX	14,146	0.575	31,648	0.204	31,731	0.205	6,938	0.208	5,031	0.146	29,661	0.193	1,704	0.184	1,286	0.283
Fort Worth, TX	13,379	0.265	40,935	0.064	34,720	0.218	6,948	0.135	5,279	0.157	28,723	0.228	1,591	0.191	1,220	0.349
Houston, TX	12,208	0.538	27,682	0.283	23,151	0.305	6,322	0.203	4,145	0.265	30,108	0.290	1,373	0.321	1,218	0.421
San Antonio, TX	14,072	0.657	29,767	0.154	23,871	0.198	6,511	0.331	3,181	0.264	22,374	0.163	1,245	0.240	1,055	0.283
Arlington, VA	12,040	0.113	24,603	0.089	24,938	0.056	7,867	0.122	5,407	0.137	23,172	0.208	1,704	0.168	1,464	0.179
Milwaukee, WI	12,853	0.143	24,421	0.150	24,256	0.157	8,518	0.153	5,100	0.111	25,089	0.242	2,395	0.208	1,539	0.247
National Average	*12,671*	*0.239*	*24,226*	*0.197*	*23,433*	*0.220*	*7,700*	*0.203*	*4,970*	*0.205*	*25,727*	*0.249*	*1,723*	*0.263*	*1,371*	*0.289*
Medicare Average	*6,448*	*0.092*	*13,179*	*0.081*	*13,035*	*0.080*	*4,956*	*0.084*	*3,186*	*0.092*	*12,925*	*0.092*	*658*	*0.059*	*353*	*0.024*

Notes: Prices are averaged 2008-11 using inflation adjusted prices in 2011, drawn from our procedure samples, and are regression adjusted transaction prices. CoV = coefficient of variation. In regions where we only observe 1 provider, the standard deviation is undefined. Therefore, the national average CoV is calculated over regions with two or more providers. The national averages present the mean within HRR CoVs and the average within HRR price.

Table 6: Hospital Overall Inpatient Price Regression

	(1)	(2)	(3)	(4)
Dependent Variable:	Ln(Facilities Price)			Ln(Facilities Charge)
Market Characteristics				
Monopoly	0.232***	0.169***	0.142***	-0.006
	(0.027)	(0.033)	(0.029)	(0.024)
Duopoly	0.162***	0.084***	0.062**	0.004
	(0.024)	(0.027)	(0.025)	(0.024)
Triopoly	0.121***	0.063**	0.047*	-0.004
	(0.028)	(0.029)	(0.028)	(0.026)
Ln Insurer HHI			-0.249	0.163
			(0.312)	(0.318)
Ln Share HCCI			-0.138***	-0.028
			(0.034)	(0.030)
Hospital Characteristics				
Ln Technologies	0.009	0.009**	0.009*	0.013**
	(0.005)	(0.004)	(0.004)	(0.006)
Ranked by US News and World Reports	0.115***	0.125***	0.127***	0.012
	(0.034)	(0.036)	(0.036)	(0.038)
Ln Number of Beds	0.051***	0.069***	0.069***	0.044***
	(0.013)	(0.013)	(0.013)	(0.012)
Teaching Hospital	-0.003	0.008	0.008	-0.028
	(0.018)	(0.016)	(0.016)	(0.017)
Government Owned	-0.107***	-0.119***	-0.122***	-0.298***
	(0.035)	(0.036)	(0.036)	(0.026)
Non-Profit	-0.007	-0.031	-0.033	-0.204***
	(0.026)	(0.029)	(0.029)	(0.024)
County Characteristics				
Ln Percent Uninsured	0.108**	-0.122*	-0.099	0.021
	(0.043)	(0.063)	(0.062)	(0.098)
Ln Median Income	0.199***	-0.129**	0.004	0.144*
	(0.059)	(0.058)	(0.059)	(0.086)
Other Payers				
Ln Medicare Base Payment Rate	0.333***	0.017	0.035	0.101
	(0.08)	(0.088)	(0.089)	(0.099)
Ln Share Medicare	-0.097***	-0.107***	-0.105***	-0.093***
	(0.028)	(0.03)	(0.03)	(0.026)
Ln Share Medicaid	-0.027	-0.011	-0.015	0.046***
	(0.022)	(0.024)	(0.025)	(0.014)
HRR FE	No	Yes	Yes	Yes
Observations	8,176	8,176	8,176	8,176
R-square	0.117	0.382	0.388	0.555

Notes: * p<0.10, ** p<0.05, *** p<0.01. OLS estimates of equation (8) with standard errors clustered at the HRR-level in parentheses. Facilities prices are regression adjusted transaction prices. Facilities charges are regression adjusted list prices. All regressions include yearly fixed effects. The omitted ownership category is private hospitals.

Table 7: Inpatient Results with Multiple Measures of Quality

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Dependent Variable	Ln(Facilities Price)						
In bottom quartile of quality for:							
% AMI pats. given aspirin at arrival			-0.043***				-0.037***
			(0.009)				(0.009)
% of surgery pats. given antibiotic 1 hour before surgery				-0.031***			-0.020**
				(0.009)			(0.008)
% of surgery pats. given treatment to prevent blood clots within 24 hours					-0.040***		-0.031***
					(0.010)		(0.009)
30-day death rate for heart attack patients						-0.010	-0.007
						(0.010)	(0.010)
Other Characteristics							
Monopoly	0.135***	0.132***	0.134***	0.134***	0.132***	0.133***	0.134***
	(0.026)	(0.026)	(0.026)	(0.026)	(0.026)	(0.026)	(0.026)
Duopoly	0.076***	0.073***	0.073***	0.074***	0.074***	0.073***	0.074***
	(0.025)	(0.025)	(0.025)	(0.025)	(0.025)	(0.025)	(0.025)
Triopoly	0.043	0.041	0.041	0.041	0.042	0.041	0.041
	(0.028)	(0.028)	(0.028)	(0.028)	(0.028)	(0.028)	(0.028)
Ln Insurer HHI	-0.327	-0.336	-0.352	-0.332	-0.346	-0.338	-0.357
	(0.329)	(0.327)	(0.317)	(0.326)	(0.329)	(0.327)	(0.319)
Ln Share HCCI	-0.143***	-0.144***	-0.145***	-0.144***	-0.144***	-0.144***	-0.144***
	(0.033)	(0.033)	(0.033)	(0.033)	(0.033)	(0.033)	(0.033)
Ranked in US News & World Reports		0.139***	0.137***	0.137***	0.134***	0.138***	0.133***
		(0.031)	(0.031)	(0.031)	(0.031)	(0.031)	(0.031)
Ln Technologies	0.014***	0.013***	0.013***	0.012**	0.012**	0.013***	0.012**
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
Observations	7,472	7,472	7,472	7,472	7,472	7,472	7,472
R-Square	0.461	0.469	0.472	0.470	0.471	0.469	0.474

Notes: * p<0.10, ** p<0.05, *** p<0.01. OLS estimates of equation (8) with the addition of alternative quality measures. Standard errors are clustered at the HRR-level and are in parentheses. Facilities prices are regression adjusted transaction prices. All regressions include HRR and yearly fixed effects. All regressions also include insurance market controls, controls for beds, teaching status, government ownership, non-profit status, percent county uninsured and median income, Medicare payment rates, and share of hospitals' admits covered by Medicare and Medicaid (as in Table 6). Full results online at www.healthcarepricingproject.org.

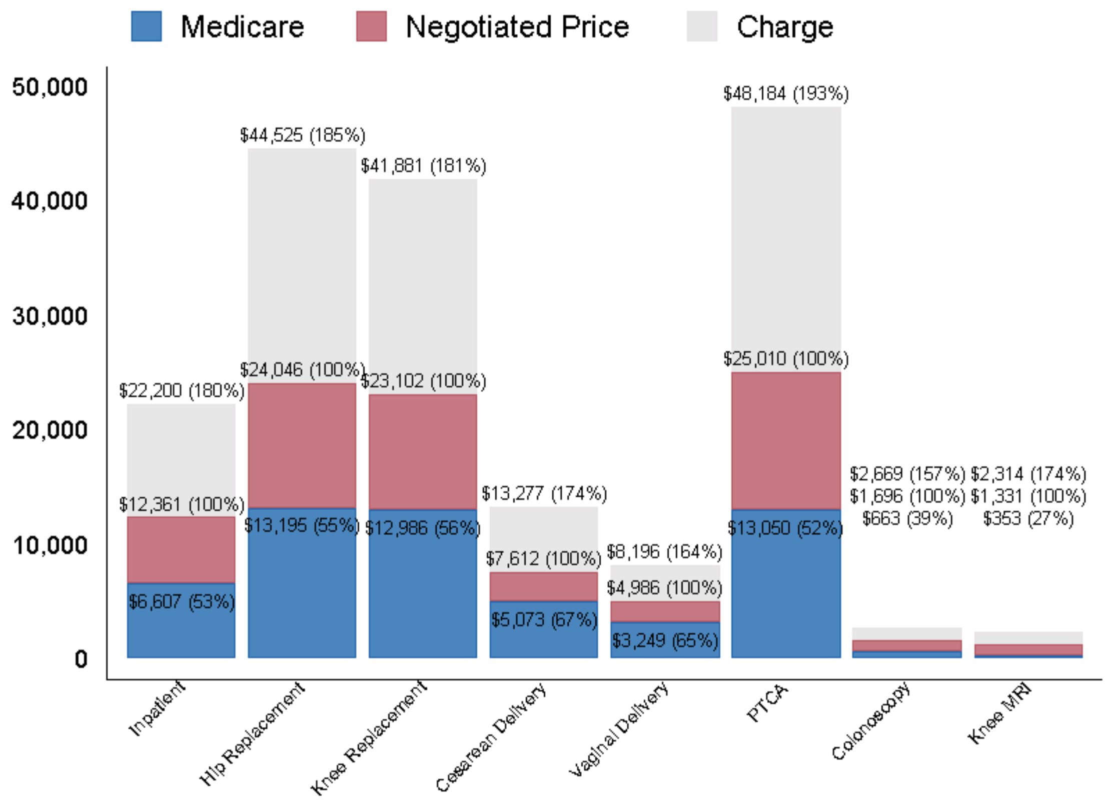
Table 8: Procedure-level Regressions, 2008-2011

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent Variable	Ln(Facilities Price)							
Procedure	Inpatient	Hip Replacement	Knee Replacement	Cesarean Section	Vaginal Delivery	PTCA	Colonoscopy	Lower Limb MRI
Market Characteristics								
Monopoly	0.142***	0.096	0.137**	0.170***	0.098**	0.113	0.083*	0.173***
	(0.029)	(0.096)	(0.063)	(0.054)	(0.039)	(0.119)	(0.047)	(0.037)
Duopoly	0.062**	-0.134	-0.082	0.019	0.017	0.147	0.077*	0.123***
	(0.025)	(0.081)	(0.051)	(0.048)	(0.032)	(0.099)	(0.045)	(0.032)
Triopoly	0.047*	0.026	-0.006	0.018	0.015	0.103	0.080	0.114***
	(0.028)	(0.076)	(0.063)	(0.044)	(0.036)	(0.065)	(0.052)	(0.037)
Ln Insurer HHI	-0.249	-0.692	-0.704	-0.303	-0.612	-1.548**	-0.530	-0.099
	(0.312)	(0.608)	(0.464)	(0.426)	(0.414)	(0.710)	(0.612)	(0.445)
Ln Share HCCI	-0.138***	-0.168	-0.103	0.023	-0.057	-0.124	-0.064	-0.092**
	(0.034)	(0.117)	(0.078)	(0.070)	(0.058)	(0.101)	(0.056)	(0.046)
Hospital Characteristics								
Ln Technologies	0.009*	-0.001	0.003	0.012*	0.003	0.017*	0.023***	0.010
	(0.004)	(0.008)	(0.009)	(0.006)	(0.006)	(0.009)	(0.006)	(0.009)
Ranked by US News and World Reports	0.127***	0.018	0.051	0.085***	0.072**	0.025	0.055	0.061
	(0.036)	(0.043)	(0.039)	(0.032)	(0.029)	(0.049)	(0.042)	(0.041)
Ln Number of Beds	0.069***	0.038	0.018	0.037**	0.041***	0.089***	-0.01	0.006
	(0.013)	(0.033)	(0.020)	(0.016)	(0.013)	(0.026)	(0.016)	(0.014)
Teaching Hospital	0.008	0.011	0.001	0.013	0.017	-0.045	0.034	-0.007
	(0.016)	(0.041)	(0.025)	(0.018)	(0.020)	(0.033)	(0.032)	(0.022)
Government Owned	-0.122***	-0.200**	-0.117	-0.125**	-0.141***	-0.187**	-0.193***	0.091
	(0.036)	(0.098)	(0.072)	(0.049)	(0.047)	(0.075)	(0.068)	(0.061)
Non-Profit	-0.033	0.003	0.042	-0.026	-0.012	-0.083	-0.125***	0.075
	(0.029)	(0.047)	(0.046)	(0.028)	(0.027)	(0.051)	(0.033)	(0.055)
County Characteristics								
Ln Percent Uninsured	-0.099	-0.127	-0.118	-0.227***	-0.070	-0.119	-0.028	-0.055
	(0.062)	(0.113)	(0.137)	(0.070)	(0.071)	(0.108)	(0.108)	(0.109)
Ln Median Income	0.004	-0.053	-0.142	-0.269***	-0.038	-0.125	0.056	-0.056
	(0.059)	(0.132)	(0.140)	(0.094)	(0.090)	(0.140)	(0.120)	(0.110)
Other Payers								

Ln Medicare Base	0.035	0.009	-0.007	-0.063	-0.040	-0.217	-0.073	0.050
Payment Rate	(0.089)	(0.165)	(0.121)	(0.097)	(0.088)	(0.171)	(0.143)	(0.125)
Ln Share Medicare	-0.105***	-0.014	-0.027	-0.065***	-0.052***	-0.006	0.007	0.0001
	(0.030)	(0.056)	(0.028)	(0.021)	(0.016)	(0.052)	(0.028)	(0.025)
Ln Share Medicaid	-0.015	0.005	-0.006	-0.002	-0.008	0.059***	0.015	-0.024
	(0.025)	(0.027)	(0.017)	(0.018)	(0.015)	(0.022)	(0.024)	(0.026)
HRR FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	8,176	1,250	2,677	3,578	3,837	1,607	3,350	4,854
R-square	0.388	0.622	0.521	0.584	0.59	0.597	0.466	0.385

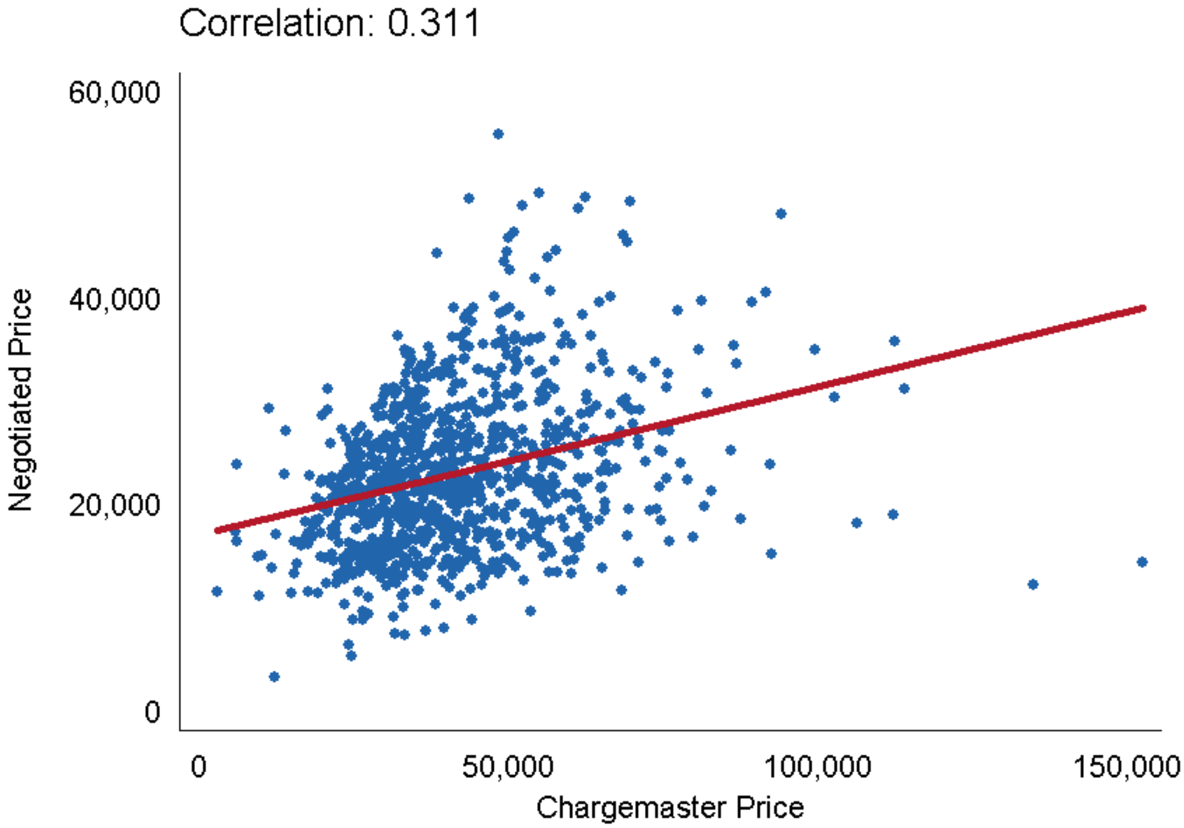
Notes: * p<0.10, ** p<0.05, *** p<0.01. OLS estimates of (8) with standard errors clustered at the HRR-level in parentheses. Facilities prices are regression adjusted transaction prices. All regressions yearly fixed effects. The omitted ownership category is private hospitals. All specifications are the same as column (3) in Table 6.

Figure 1: Average Hospital Facilities Charges, Negotiated Prices, and Medicare Reimbursements, 2008-2011



Notes: The height of the grey bar (top) is the average hospital charge price. The height of the red shaded bar (middle) is the negotiated (transaction) price, which is regression adjusted. The blue bar (bottom) captures the Medicare reimbursement. All prices are given as a percentage of the negotiated prices. Note that we only include hospital-based prices – so we exclude, for example, colonoscopies performed in surgical centers and MRIs that are not carried out in hospitals.

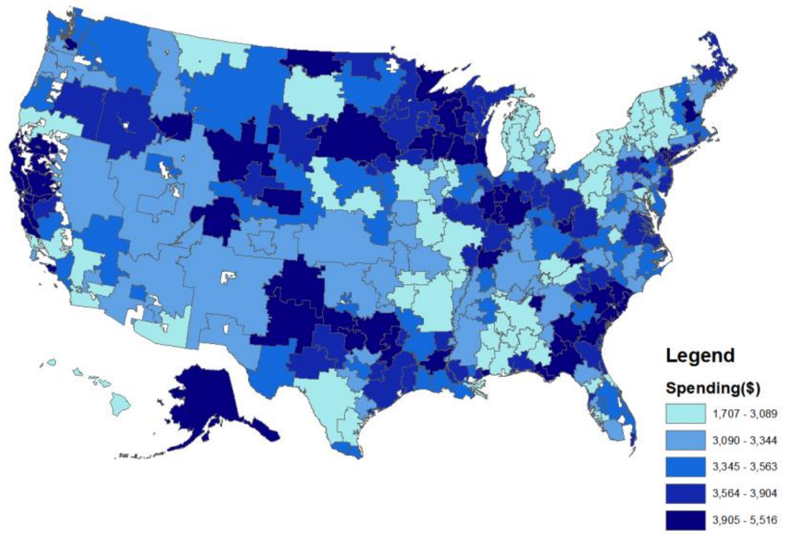
Figure 2: Relationship between Charge and Price for Knee Replacements, 2008-2011



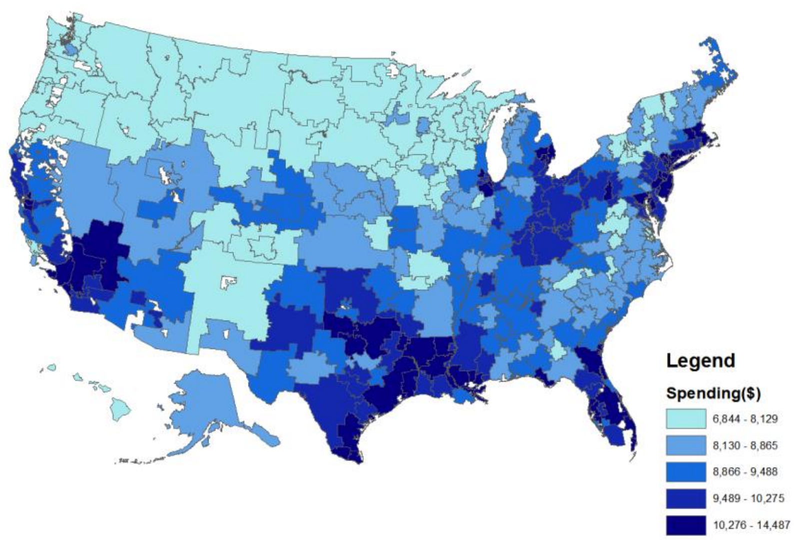
Notes: This is a scatter plot of hospital regression-adjusted list prices for knee replacements ("Chargemaster prices") and regression-adjusted transaction prices ("negotiated price"). There are 937 unique providers included in this analysis who deliver 10 or more knee replacements to HCCI funded patients annually. We include prices from 2008 through 2011 that are inflation adjusted into 2011 dollars and averaged across the three years.

Figure 3: Spending per Medicare and Private Beneficiary

Panel A: HCCI Private Insurer Total Spending Per Beneficiary, 2011

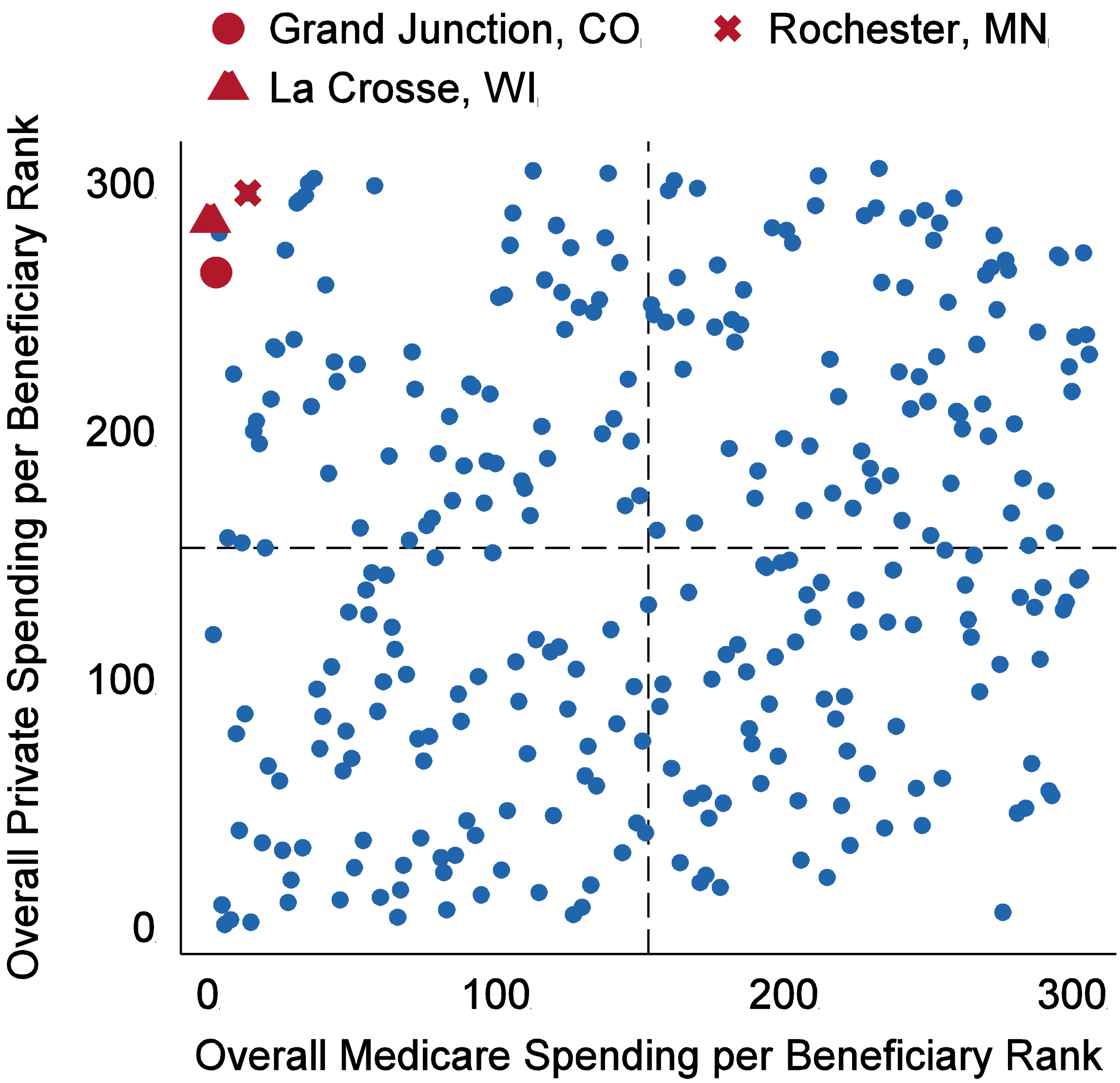


Panel B: Medicare Total Spending Per Beneficiary, 2011



Notes: This figure presents average total spending per beneficiary (exclusive of drug spending) per HRR for 2011 for Medicare beneficiaries and privately insured beneficiaries with coverage from the HCCI insurers. Medicare spending data was accessed from http://www.dartmouthatlas.org/.

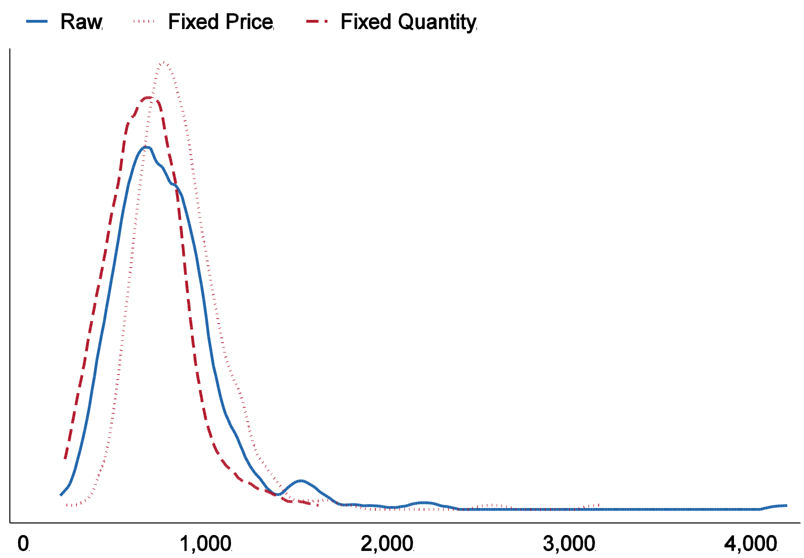
Figure 4: Relationship between 2011 Medicare and Private Overall Spending per Beneficiary



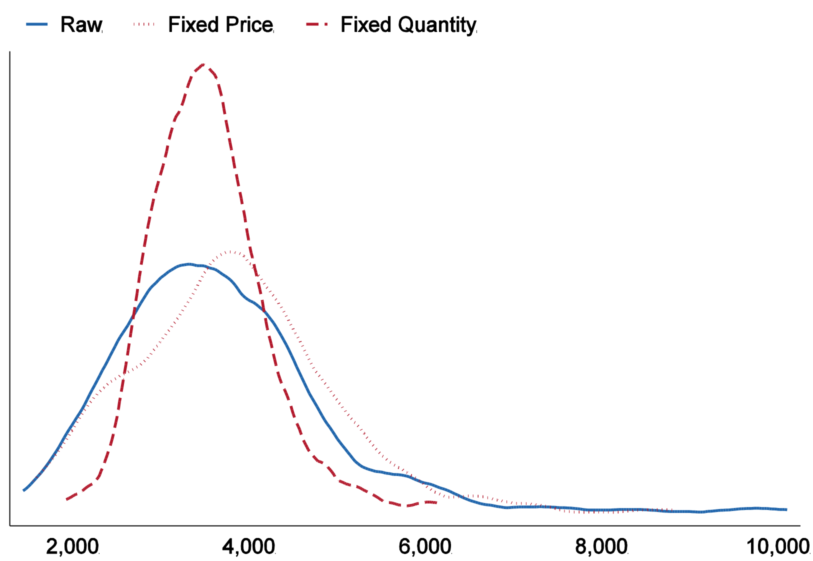
Notes: This is a scatter plot of HRRs rankings (1-306) on 2011 overall spending per Medicare beneficiary and spending per privately insured beneficiary. Data on Medicare spending was downloaded from the Dartmouth Atlas http://www.dartmouthatlas.org/. An HRR with a rank of 1 has the lowest spending per beneficiary of all HRRs. An HRR with a rank of 306 has the highest spending per beneficiary of all HRRs. Overall spending does not include drug spending.

Figure 5: Raw and Counterfactual Distributions of Inpatient Spending per Beneficiary

Panel A: Private Raw and Counterfactual Distributions of Inpatient Spending Per Beneficiary



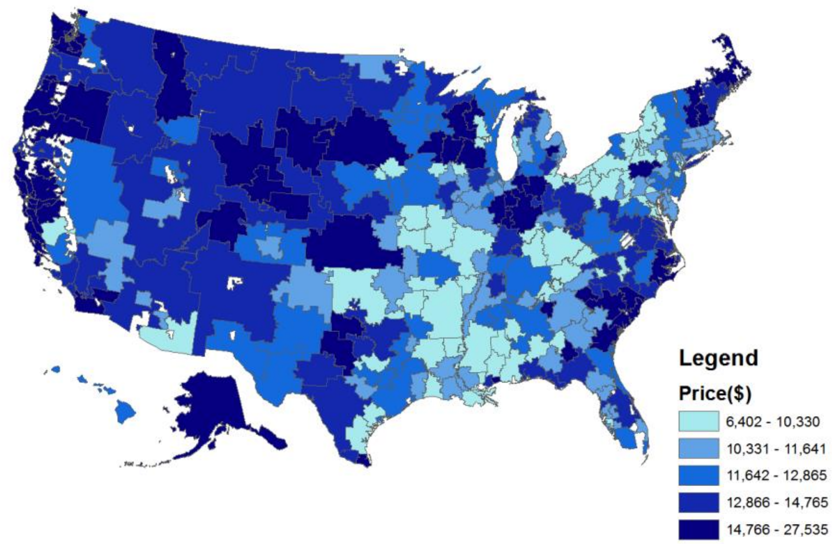
Panel B: Medicare Raw and Counterfactual Distributions of Inpatient Spending Per Beneficiary



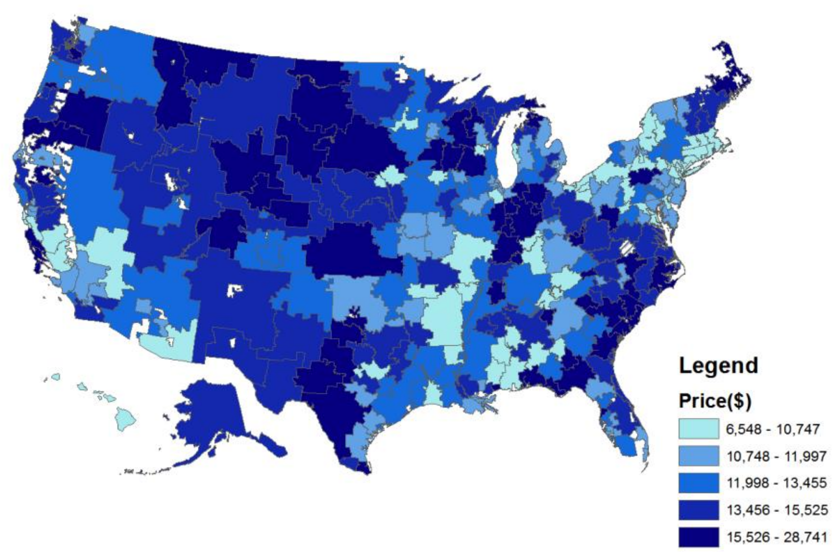
Notes: These graphs show the (smoothed kernel) densities of the distribution of spending per beneficiary in 2011 for Medicare beneficiaries and the privately insured across HRRs. The solid blue line presents the true distribution of spending. The thicker red hashed line presents spending per beneficiary where volume is fixed and each HRR delivers the same mix of care. The thinner red hashed line presents spending per beneficiary where the price of each HRR is the same across the US.

Figure 6: Regional Variation in Inpatient Hospital Price

Panel A: Regression Adjusted HRR-Level Inpatient Hospital Prices, 2008-2011



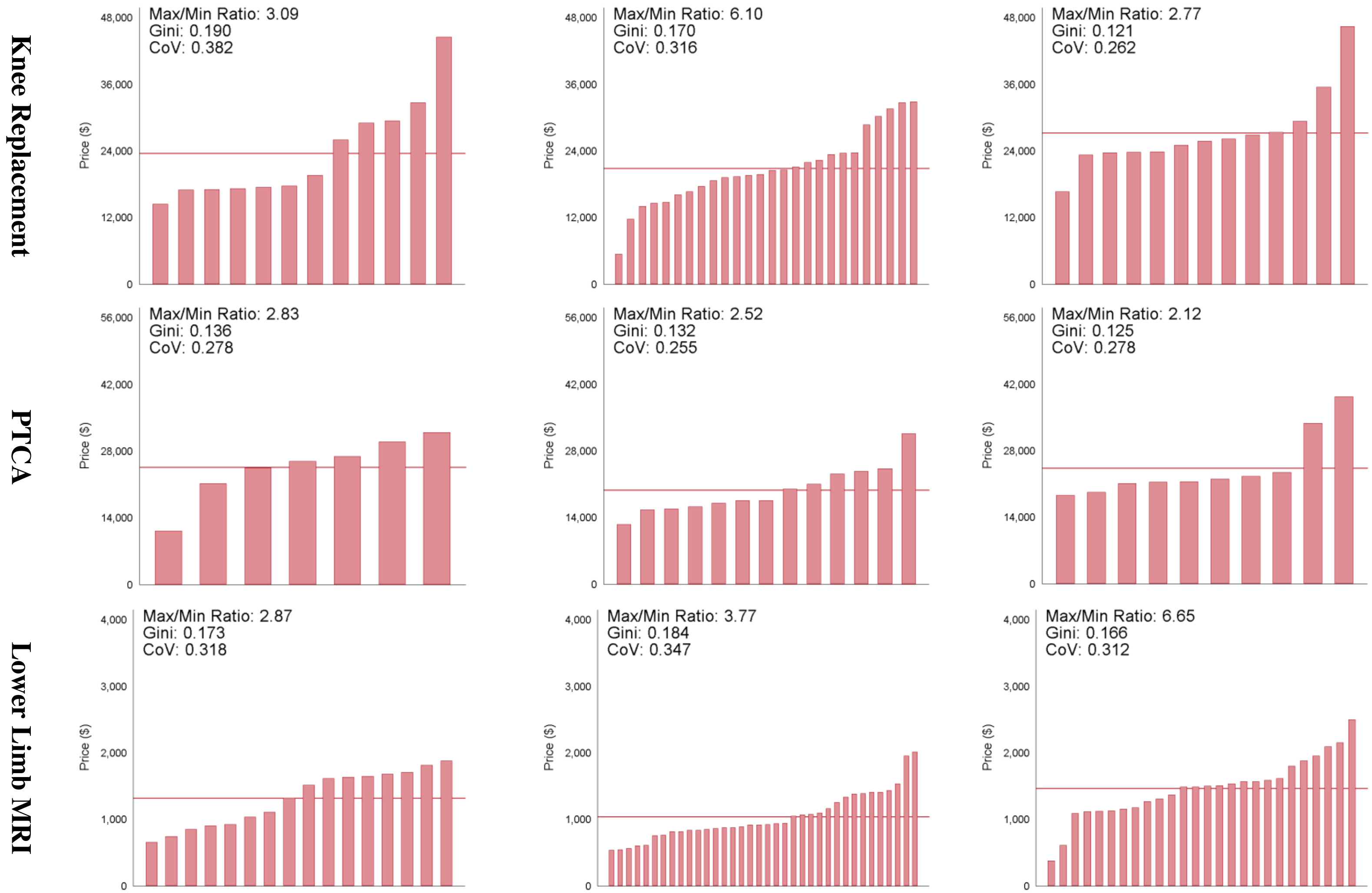
Panel B: Regression Adjusted HRR-Level Inpatient Hospital Prices Normalized using the Wage Index, 2008-2011



Notes: Panel A captures average hospital regression adjusted inpatient prices per HRR, weighted by hospital activity, using data from 2008 through 2011 adjusted for inflation into 2011 dollars. Panel B presents similar HRR level average hospital prices, but has normalized prices using the Medicare 2011 wage indexes. This therefore captures price after adjusting for the cost of care in each HRR.

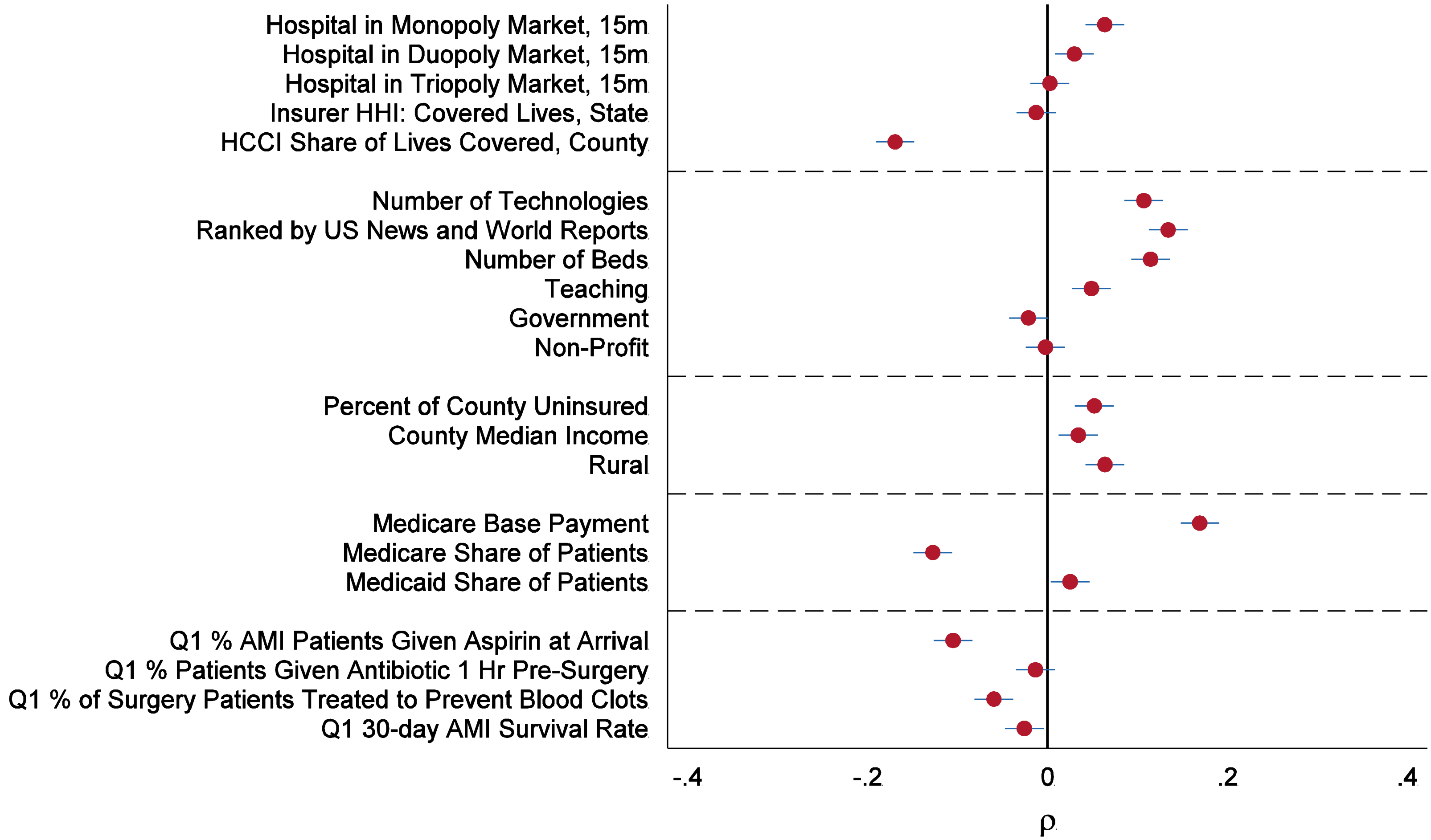
Figure 7: Within Market Price Variation for Knee Replacement, PTCA, and Colonoscopy in Denver, Atlanta, and Columbus.

Denver, CO | **Atlanta, GA** | **Columbus, OH**



Notes: These present average hospital regression corrected private-payer prices, averaged from 2008 – 2011 using inflation adjusted 2011 prices for knee replacement, PTCA, and MRI. These do not include physician fees. Each column captures a hospital within an HRR.

Figure 8: Bivariate Correlations of the Level of Inpatient Hospital Prices with Observable Factors



Notes: The x-axis captures the correlations between key variables featured in our regression and our hospitals' regression-adjusted inpatient prices averaged from 2008 – 2011 and inflation adjusted into 2011 dollars. The bars capture the 95% confidence intervals surrounding the correlations. For the hospital quality scores, the first quintile (Q1) captures hospitals in the worst performing quintile based on that quality measure.