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Market Power and Hospital Prices: Evidence from New Hampshire

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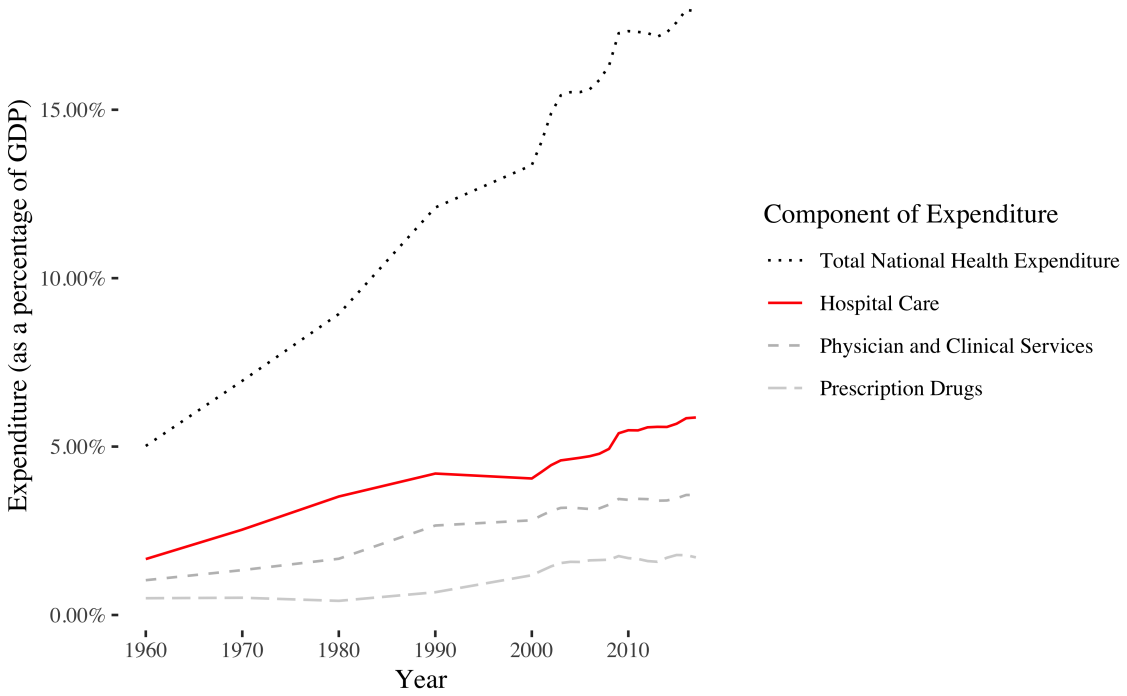
Abstract

This thesis evaluates how insurers and hospitals are able to exert market power in negotiating prices for hospital care, contributing new additional evidence to the literature on hospital and insurer market power. Using insurer-hospital-procedure-level prices for outpatient radiology services from New Hampshire's HealthCost website, I compare the prices for the same service first across insurers and then across hospitals to evaluate how this relates to the insurer or hospital's market share using linear fixed effects models. I find that on average Anthem, the largest commercial insurer in New Hampshire, pays the lowest private prices, Harvard Pilgrim, the second largest insurer, pays 13.9% more than Anthem, and CIGNA, the smallest major insurer, pays 21.2% more than Anthem. These results are all statistically significant at the 1% level. I also estimate that a hospital with one fewer competitor in its local market is able to charge 13% higher prices for each procedure after controlling for the insurer, quality, typical patient complexity, and socioeconomic characteristics. However, the effect of hospital density on negotiated prices varies heterogenously across different insurers, with Harvard Pilgrim prices being the most sensitive to hospital competition. These results are consistent with the hypothesis that hospital prices are inefficiently influenced by the market power of the negotiating parties, and that policy solutions that can decrease the relative market power of each hospital and increase the market power of insurers may help to reduce prices.

I Introduction

The United States' expenditure on health care has grown rapidly since World War II and has outpaced that of many peer countries without significant returns to quality (OECD 2017; Etehad and Kim 2017; Reinhardt et al., 2004). From 1960 to 2017, the growth rate of health care spending has surpassed that of GDP, averaging 6.3% annually, and although this rate recently slowed to only 3.9% in 2017 (Center for Medicare and Medicaid Services 2018), it remains positive and continues to outpace the annual growth rate of real GDP (Bureau of Economic Advisors 2019). Given that the $3.5 trillion spent on health care (17.9% of GDP) in 2017 (CMS 2018) erodes the budgets of households and governments, exploring the sources of spending has generated a large body of relevant research in health economics. Hospital care, physician services, and pharmaceutical drugs are the largest sources of spending, with hospital care constituting the largest share at 32.7% ($1.1 trillion) of total national health expenditure in 2017 (CMS 2018) as shown in Figure 1. Hospital care expenditures are also one of the faster growing components of total health care spending, growing on average over the last decade at 5.8% annually, while spending of physician services and prescription drugs over the same period grew on average at 4.8% and 4.1%, respectively (CMS 2018). While the prevalence of third party payers and certain unhealthy behaviors of the American lifestyle may encourage higher utilization of medical care, the biggest driver behind the U.S.'s spending on hospital care and total health expenditure is not greater utilization or social spending but simply higher prices (Anderson et al., 2003; Papanicolas et al., 2018).

Due to the size and relevance of hospital care spending, an important health economics literature investigates the sources of hospital price variation. However, the process of determining and defining hospital prices has long been a challenging element of this research as the list prices hospitals put on their "chargemasters" have little systematic



Notes: All dollar amounts are nominal. National Health Expenditure data up to 2017 comes from CMS 2018 NHE Estimates; GDP data from Bureau of Economic Advisors 2019.

Figure 1: Health Care Expenditure in the U.S. over time

relation to what payers actually pay (Reinhardt 2006). The actual hospital transaction prices for private payers have largely been considered commercially sensitive, but relatively recently a select number of states have begun to require that these prices be reported to the state. What has been discovered as these price data have become more available is that these prices vary dramatically for different payers. Public payers such as Medicare and Medicaid set their prices at the federal or state level, which may vary somewhat across regions to reflect costs but usually do not vary within region. Because Medicare and Medicaid account for 20% and 17% of total national health expenditure respectively (CMS 2018), they are able to exert significant monopsony power and pay the lowest prices for hospital services as hospitals would stand to lose significant revenues if they refused to serve Medicaid and particularly Medicare patients. Private payers, on the other hand, account for 34% of total national health

spending (CMS 2018) but because there are many of them, no one payer accounts for more than 5% of total spending. Thus commercial insurers negotiate price contracts separately with each hospital they choose to and often pay an additional 50-200% of the Medicare price (Selden et al. 2015; Cooper et al. 2018; Bai and Anderson 2018), a gap that has only been growing in recent decades (Selden et al. 2015). In addition to the public-private gap, a few studies (Cutler et al., 2000; Bai and Anderson, 2018; Cooper et al. 2019) have also identified price gaps between different private payers and private payer types, such that for the same care at the same hospital, different insurers are paying significantly different prices. Considering the fact that 49% of Americans receive health care coverage from their employer through private insurance plans rather than through Medicare (21%) and Medicaid (14%) (Kaiser Family Foundation 2017), this price variation in different private insurer-hospital contracts affects what many Americans pay out of pocket and in premiums for their health care. Moreover, Cooper et al. (2019) finds some evidence that this variation persists even when costs and quality are arguably held constant.

The literature has largely evaluated the potential impacts of market power on price negotiations by studying hospital competition or insurer competition separately. The growth in hospital consolidation in the past three decades has fueled significant research as to the price effects of mergers and the formation of large hospital systems (e.g. Capps and Dranove 2004; Dafny 2009; Bai and Anderson 2015; Melnick and Fonkych 2016), but relatively little work has been done to examine the heterogeneity of these effects between different insurers. Hospital price negotiations with commercial insurers have been modeled in several papers.

In this paper, I examine how prices for outpatient radiology services in New Hampshire vary with the market share of the insurer and the market share of the hospital, including an analysis of whether the effects of hospital market share are heterogeneous across

insurers, using multivariate linear regressions with fixed effects. New Hampshire has been a pioneer of price transparency in health care among the U.S. states and therefore provides the opportunity to more closely evaluate the forces shaping hospital prices. I use publicly available data on insurer-hospital-procedure-level prices from the NH HealthCost website, information on state-level health insurance coverage from the New Hampshire Insurance Department, and geographical data from Dartmouth Atlas and HealthCost to construct various measures of hospital density. While much of the previous literature analyzes inpatient care or physician practices (Clemens and Gottlieb 2016), I choose to focus my analysis on hospitals' outpatient radiology services for several reasons. In terms of relevance, outpatient services have expanded in recent decades (Fuchs 2012), and out of the 82 most common outpatient procedures in New Hampshire, 17 are radiology services (New Hampshire Hospital Association 2017). Due to both their high demand and high per-unit revenue to per-unit cost ratio, radiology services often constitute the largest source of outpatient profit for many hospitals at roughly 35% (Becker's Hospital Review 2015). In addition to being relevant, the quality of radiology services is more constant across hospitals compared to other types of services, like surgical procedures, and particularly within hospitals, the quality of radiology services is fixed. Upon examining the prices for these services, as available through NH HealthCost, I find statistically significant differences between the prices different insurers face across the state as well as statistically significant effects of hospital density on prices, although this effect varies somewhat across insurers.

This paper is most closely related to Cooper et al. (2019), but differs in several key respects: first, this analysis will focus a set of price data for hospital care in New Hampshire, while Cooper et al. (2019) relies on HCCI data which is a national cross-section sample and relies on claims data from Aetna, Humana, and United Health. While the HCCI data is a rich set of data that is perhaps nationally representative in a broad sense, none of these insurers are major players in the New Hampshire

market; secondly, this paper will devote more attention to insurers' relative market power although a formal analysis of insurer market power is not possible; lastly, I also examine whether the effect of hospital competition is different across different private insurers.

Section II of this paper lays out the conceptual framework motivating this analysis, and Section III provides background on the New Hampshire market for health services. Section IV supplies an explanation of the data sources being used, how they were obtained, and the relevant information contained therein. Section V describes the empirical approach and Section VI presents the results. A discussion of the results takes place in Section VII and the paper concludes with Section VIII.

II Conceptual Framework

The market for hospital services is deviates from perfect competition in several ways. Only about 14% of total health spending is out-of-pocket (Fuchs 2012), and therefore most consumers do not face the full costs of the services they require due to health insurance coverage. Health insurance is made necessary because the market for health care involves a large amount of risk; care is both highly expensive and unpredictable as an individual consumer does not know how much care she will need and when. Thus, insurance helps distribute the risk associated with each consumer across a pool of plan enrollees by bearing some of the costs of care in exchange for monthly premiums. However, this structure leads to reduced pressure on hospitals to offer competitive prices as consumers rarely "shop" for care on the basis of price. Because most patients do not observe the full prices for the care they receive, their hospital utilization choices are not based on the true costs of care (Manning et al., 1987; Finkelstein et al., 2012). Instead, they "shop" for insurance plans or employers who provide insurance plans on

the basis of plan premiums and the convenience of the hospital networks offered by each plan (Ho 2006).

Thus, private insurers and other third-party payers are the most proximate agents to the price setting process with hospitals, particularly for expensive technologically advanced services, and each hospital and private insurer negotiate explicit contracts of the insurer's reimbursement rates, often on an annual basis. This process is highly detailed–a price is usually negotiated for each service the hospital offers–and only possible because there are relatively few hospitals and relatively few insurers present in each market for health care. Because of the small number of payers and providers, the norm of bilateral contract negotiations, and the lack of price transparency for the consumer, the market for hospital care deviates from a perfectly competitive model. In standard micro-economic theory, resources are optimally allocated in a perfectly competitive market via the mechanism of price, which results from the intersection of the supply and demand curves, which are aggregations of many producers' cost functions and many consumers' preferences. The resulting price is equivalent to the marginal cost of production and the value of the marginal consumer's marginal unit of utility, but no one consumer's consumption decision or one producer's production decsion will effect the market price as there are so many consumers and producers. Thus in this standard model, both producers and consumers are price takers, making their production or consumption decisions based on an exogenous price, and economic profits are equivalent to zero. However, if there is a small number of suppliers or consumers in the market, individual agents' production or consumption decisions can affect price such that it is no longer exogenous. In this scenario, the agent is no longer a price taker but also a price setter and can exercise market power, allowing for profits. When profits are introduced, the price is no longer welfare maximizing as a less than optimal amount of the good is consumed. The most extreme example of supplier market power is the monopolist, which sets its price to maximize non-zero profits

given the demand curve for the good.

Unlike the perfectly competitive market where all agents are price takers, insurers and hospitals are both price setters in the health care market because the decision of the marginal producer or consumer affects the price for hospital services. An insurer can threaten not to include a hospital in its network, thereby reducing the likelihood that the patients it covers will go there for care. If the insurer covers many potential patients in that hospital's market, this threat could result in reduced volume and revenues for the hospital, so hospitals may concede lower prices in order to attract the insurer's plan members. However in return, hospitals can threaten not to be included in the insurer's network, making the insurer's plan less attractive to potential enrollees. If the hospital is a major hospital or the only hospital in a large geographic region, this threat can generate significant bargaining leverage as potential enrollees may be willing to pay more to have convenient or well-known hospitals in their network. Therefore, the prices that result from these negotiations may reflect the relative bargaining power of the insurer and the hospital rather than the marginal cost and marginal utility of the services provided.

In these bilateral negotiations, I assume the following: both the provider and the payer want to maximize the number of health consumers they serve while maximizing their profit margins per consumer, even if the provider is a non-profit (Horwitz 2005). Providers want to receive higher prices for their services but also to be included in payers' networks, as patients face lower out-of-pocket costs when going to providers in network. Payers want to pay lower prices for providers' services to minimize their costs but also want to attract enrollees by including convenient providers in their network as this is an important aspect of plan selection for individuals. Thus, insurers or hospitals that can exercise market power are expected to negotiate more favorable prices for themselves in the bargaining process. The most intuitive source of market

power is market share, and most of the analysis that follows explores whether prices are indeed more favorable for the hospitals or insurers with greater market shares. Additionally, I examine whether there is heterogeneity in the sensitivity of prices to hospital market share across insurers to investigate whether there may be additional sources of market power from market share present in the market for hospital services.

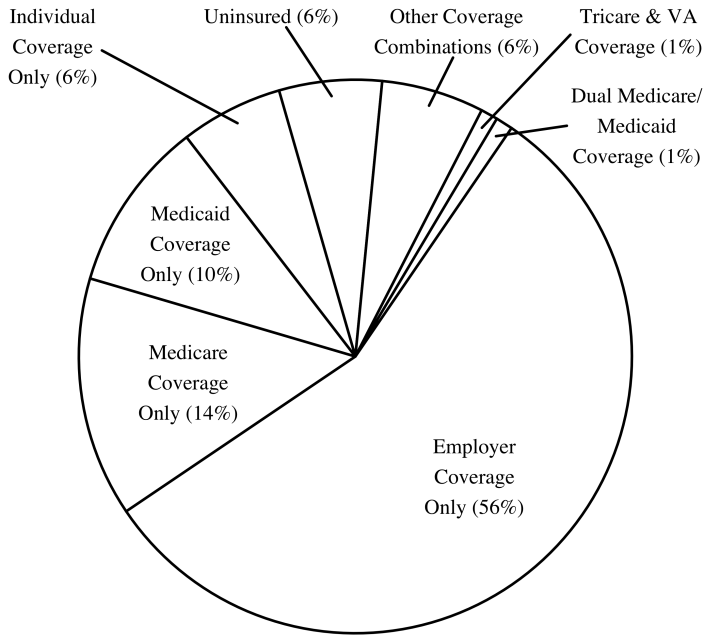
III Background on the New Hampshire Market

The state of New Hampshire has been a pioneer of price transparency through the creation of the Comprehensive Health Care Information System (CHIS), and in the same legislation that created CHIS, the state enacted statutes that mandated that health insurance carriers submit their encrypted health care claims data and Health Employer Data and Information Set (HEDIS) data to the state. This has led to a rich set of health claims data that has allowed for the creation of an online public tool NH HealthCost, which allows individuals to find estimates for what the total price for certain services will be at each hospital given their insurance carrier and from which I construct most of my data set as described in further detail in Section IV. The following subsections describe the New Hampshire insurance landscape as well as the provider landscape.

III.I Health Insurance Coverage

New Hampshire is a small state (8,953 square miles) with a population of 1.3 million (90.5% white) and median household income of $71,305 (Census Bureau 2017). Additionally, 17.6% of the population is over the age of 65, which is slightly higher than the national average of 15.6% (Census Bureau 2017). Figures 2 and 3 show the insurance status of New Hampshire residents in 2017 and the market share of major

private insurers, respectively. In 2017, 62% of residents (approximately 820,000 individuals) received health insurance through the private insurance market, 56% through employer-sponsored insurance and 6% through individual private insurance, and this translates to 543,900 enrolled members (New Hampshire Health Insurance Department 2018).[1] Of the privately insured, 81% received coverage through employer-sponsored insurance plans (12.6% Small Group, 19.8% Large Group Fully Insured, and 48.9% Large Group Self Insured) and the remainder either purchase their coverage individually (11.0%) or received subsidies for private coverage through New Hampshire's Premium Assistance Program (7.7%). This paper concerns only the prices faced by members of employer-based insurance plans (group insurance).



Source: New Hampshire Health Insurance Department, Nov. 2018

Figure 2: Health Insurance Status of New Hampshire Residents in 2017

The three major private insurers are Anthem/Matthew Thorton (39%), Harvard

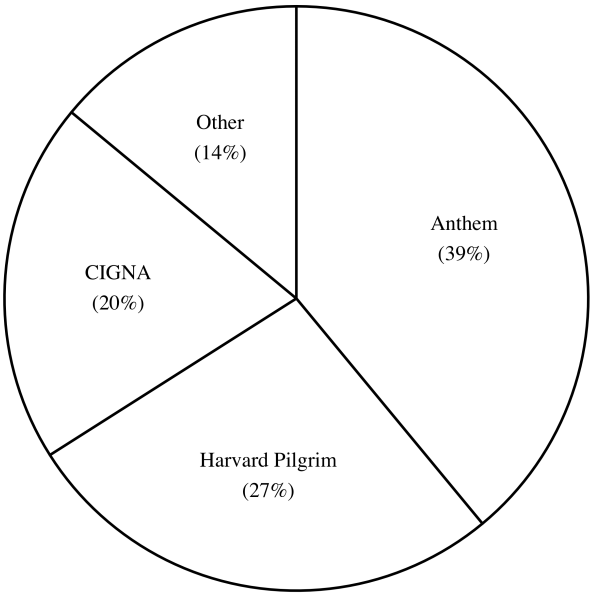
[1] A plan member can be a household or an individual; these estimates exclude individuals covered by the Federal Employees Health Benefits Program (FEHBP)

Pilgrim Healthcare (27%), and CIGNA (20%). Other insurers include Ambetter (3.5%), Minuteman Health (3.4%), Tufts (3.0%), Community Health Options (2.1%), United (1.2%), and Aetna (0.2%) and each constitute less than 5% of the commercial market. The NH HealthCost website does not distinguish between these other insurers and often does not provide prices for them at all, so I do not include them in my analysis. Anthem plans are underwritten by Matthew Thorton Health Plan, Inc. in New Hampshire, a fully owned subsidiary of Anthem, but are referred to as "Anthem" throughout the paper. Of the three major insurers, both Anthem and CIGNA have a significant national presence, Anthem being the larger of the two with 40.2 million members compared to CIGNA's 15.9 million members (Becker's Hospital Review, 2019). Thus group insured New Hampshire residents constitute roughly 0.5% of Anthem's total membership and 0.7% of CIGNA's total membership. Harvard Pilgrim Health Care is a non-profit private company that primarily operates in the northeastern United States (Crunchbase, 2019) and has only 1.2 million members, so while it is the second largest insurer in New Hampshire, it is a relatively small national player. As a result, group insured New Hampshire residents constitute 12.2% of total Harvard Pilgrim membership, a significantly larger portion than for Anthem or CIGNA.

III.II New Hampshire Providers

My analysis examines prices at New Hampshire's 26 acute-care hospitals. New Hampshire has a total of 31 hospitals and 3,503 beds, and of these hospitals, 13 with 2,704 beds are Prospective Payment Systems (PPS) Hospitals, 13 with 301 beds are Critical Access Hospitals (CAH), and 5 with 498 beds are Specialty Hospitals. PPS hospitals are normal acute-care hospitals that are reimbursed by Medicare through prospective payments[2] for inpatient stays. CAHs are acute-care hospitals that serve

[2]Medicare prospective payments are predetermined, fixed amounts based on the classification system of the care received. For example, acute-care hospitals are reimbursed for inpatient stays



Source: New Hampshire Health Insurance Department, Nov. 2018

Figure 3: Distribution by Insurer for NH Commercial Market in 2017

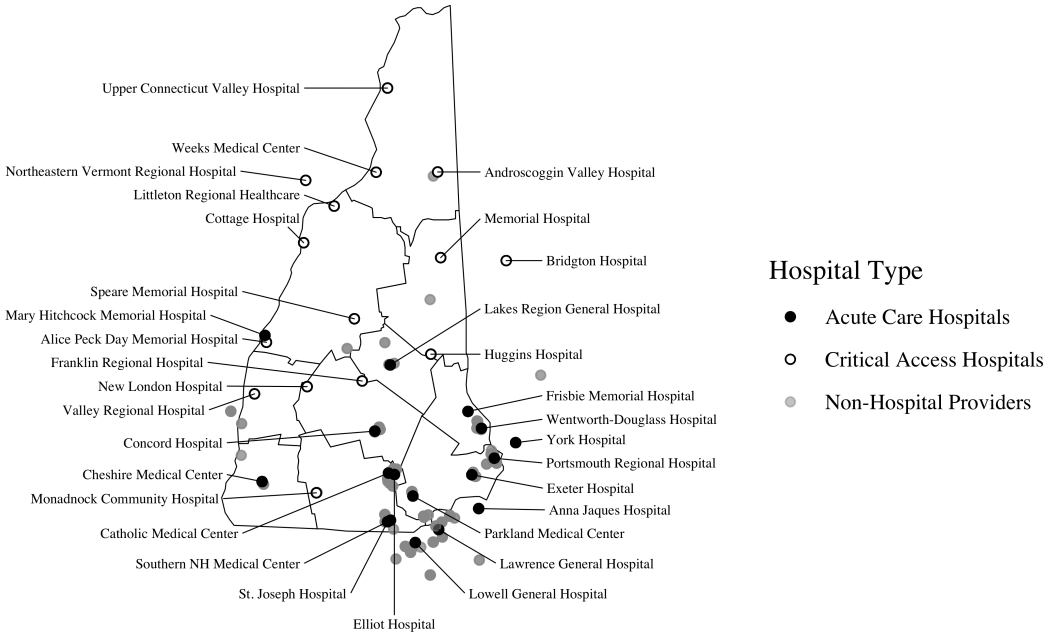
rural populations and are therefore eligible to receive cost-based reimbursements from Medicare for inpatient stays. Specialty hospitals provide a specialized category of services (such as children's hospitals, orthopedic hospitals, cancer hospitals, etc.) and are omitted from my analysis for lack of price information. While the way these hospitals are reimbursed for inpatient hospital stays by Medicare may differ, these distinctions are largely irrelevant in the outpatient setting where physician and clinical services are reimbursed on a service level basis through Medicare Part B, and the structure of Medicare reimbursement does not affect how hospitals are reimbursed by private insurers.

In addition to the 26 New Hampshire hospitals, there are 6 out-of-state hospitals

according to the patient's diagnosis, corresponding to a diagnosis-related group (DRG), rather than according to the services provided to that patient.

relevant to my analysis that are located close to New Hampshire's borders: Anna Jaques Hospital, Lawrence General Hospital, and Lowell General Hospital (Massachusetts); Bridgton Hospital and York Hospital (Maine); and Northeastern Vermont Regional Hospital (Vermont). I do not evaluate the prices each insurer pays at these hospitals because I only have access to the statewide market shares of each insurer within New Hampshire and this share may differ substantially across state lines. Furthermore, there are 99 non-hospital providers such as ambulatory surgical centers, clinics, and private physician groups both in- and out-of-state that also provide some of the relevant outpatient procedures. Though the focus of my analysis is on hospitals, I include these non-hospital providers in a secondary analysis of provider, rather than hospital density, and plot them in Figure 4 for context. Non-hospital providers are often highly concentrated in certain areas and some even exist on the same campus as other non-hospital providers, clinics, or hospitals, so it is difficult to tell whether they are competing with hospitals or a part of the hospital's system.

There has only been one official hospital merger involving a hospital in New Hampshire: Massachusetts General Hospital (MGH)/Partners HealthCare from Massachusetts acquired Wentworth-Douglass on January 1, 2017. However, if two pending quasi-mergers go through, "22 out of New Hampshire's 26 acute-care hospitals will have established some kind of organizational connection with other institutions, often mergers in all but name" (Concord Monitor Jan 26, 2019). In May 2018 Partners HealthCare also made a bid to acquire Exeter Health Resources, and this merger is still pending approval.



Note: Location of hospitals and non-hospital providers provided by NH HealthCost. County divisions are shown.

Figure 4: Location of New Hampshire Hospitals

IV Data

I use two main sources of data to obtain information on insurer-procedure-hospital prices: for private payers, the NH HealthCost website and for Medicare, CMS's Physician Fee Schedule. I also include data from multiple other sources to provide further controls and to allow me to construct multiple definitions of a hospital's market.

IV.I NH HealthCost Data

The primary source of data on hospital prices comes from the New Hampshire Insurance Department's HealthCost website, which is a publicly available tool that provides insurer-hospital specific estimations of costs for roughly 150 services and procedures.

New Hampshire is one of the few states that makes such information publicly available, hence why I use it as a case study for my analysis. The prices are calculated using claims data from the New Hampshire Comprehensive Healthcare Information System (NHCHIS) to determine the median amount that insurance carriers and patients pay for each service. The estimated costs therefore reflect the rates negotiated between health care providers and insurance carriers (often referred to as the "allowable amount") rather than provider charges, which have been shown to have little relation to what most privately insured individuals actually pay for a given service.

For the services relevant to this paper (outpatient procedures and radiology services), the reported prices may be "bundled" to include multiple services or independent providers; that is, they aggregate the costs for what may be treatment received from several providers (billing separately) under the "lead provider" rather than distinguishing between what is paid to the facility versus the physicians who treat the patient. Reported prices for radiology services use a modified bundle that includes the facility and the professional fees associated with the patient receiving that service but not any other costs that the patient may have incurred on the same day.

Each service on HealthCost is identified with a description (e.g. "X-Ray - Abdomen") and one of the American Medical Association's Current Procedural Terminology (CPT) codes. However, there are multiple CPT codes for an abdominal x-ray (different codes for different numbers of views), so the CPT codes for similar services are counted and the most common ones identified through the frequency distribution. From there, the representative CPT code and description is chosen based on what will be the simplest and most easily recognized procedure, and, when available, clinical insight is also considered. This means that in some cases, multiple CPT codes may be combined, as long as the cost is similar, under a single service.

Additionally, HealthCost includes indicators of variability for each estimate under the

"Precision of the Cost Estimate" field, where "High" corresponds to cost estimates with little variability from one patient to the next, and risk-adjustment indicators under the "Typical Patient Complexity" field, which are evaluated for each hospital within that procedure. I restrict my analysis only to cost estimates where the precision of the cost estimate is "Medium" or "High," and keep the the measure of typical patient complexity as a useful control for care intensity and quality in my analysis. The typical patient complexity control attempts to account for how a hospital may attract an average population when considering all procedures but a more complex population when only considering a specific procedure such as brain MRIs when compared to other hospitals. Thus, for brain MRIs, this hospital would have a "High" typical patient complexity. Lastly, HealthCost does not include visits where an infrequent and high cost procedure is performed in conjunction with the reported service on the website because the more expensive procedure may have also impacted the cost for performing the more routine services.

These data allowed me to construct a data set containing the price for many procedures and each provider-insurer combination for which data was available, and I restrict these procedures only to radiology services.

IV.II Medicare Prices

In order to make the prices for each service comparable, I also include Medicare prices to provide a base measure of the procedure's expensiveness and to standardize the prices paid by private insurers as reported on NH HealthCost. However, because the HealthCost prices are "bundled" and I want to standardize these prices according to unbundled Medicare prices, I deflate the private prices by a certain factor per procedure. This factor is equal to the amount I would have to multiply the price faced by each of the major private insurers such that the median price for the procedure as

paid by these insurers is equivalent to 200% of the Medicare price for that procedure. This standardization factor is 0.2-0.6 for most of the procedures I consider.

I calculate the Medicare prices using data from the Center for Medicaid and Medicare Services (CMS). CMS sets all of it prices centrally, allowing for some variation across regions, and reimburses outpatient services through Medicare Part B based on the services provided, defined at the CPT code level. This information is made public in the Physician Fee Schedule (PFS) 2018 Relative Value file, allowing me to construct the Medicare reimbursement rates at each hospital for each service observed in the HealthCost data by matching each hospital to a locality in the CMS data. I am able to calculate the 2018 Medicare Facility Pricing Amount $p_{2018}^{Medicare}$ for each procedure j at the locality level l using the following formula:

$$p_{jl,2018}^{Medicare} = [(RVU_j^{work} * GPCI_l^{work}) + (RVU_j^{PE} * GPCI_l^{PE}) + (RVU_j^{MP} * GPCI_l^{MP})] * CF_{2018}$$

where RVU_j^{work} denotes the Relative Value Unit (RVU) for the physician work involved in providing procedure j, RVU_j^{PE} denotes the RVU for the resource-based practice expense for the facility setting, and RVU_j^{MP} denotes the RVU for the malpractice expense. $GPCI_l^{work}$ denotes the Geographic Practice Cost Index (GPCI) corresponding to locality l and the work RVU, $GPCI_l^{PE}$ corresponds to the practice expense RVU, and $GPCI_l^{MP}$ corresponds to the malpractice RVU. CF_{2018} denotes the 2018 conversion factor ($35.996). For example, a foot x-ray has a work RVU of 0.17, a facility practice expense RVU of 0.64, and a malpractice RVU of 0.02 while an arthroscopic shoulder surgery has a work RVU of 8.843, a facility practice expense RVU of 7.997, and a malpractice RVU of 1.612 to capture how the arthroscopic shoulder surgery is a much more technical, expensive, and high-risk procedure to provide than a foot x-ray. These RVUs are then weighted by the locality l's corresponding GPCIs (values that range from 0.950 to 1.925 in the 2018 data) to account for labor costs, equipment costs, and

malpractice expenses in that region. As a result, Medicare pays $30.90 for a foot x-ray and $677.26 for an arthroscopic shoulder surgery in in most New Hampshire hospitals but $34.25 for a foot x-ray and $729.84 for an arthroscopic shoulder surgery in the Boston metropolitan area.

Medicare treats all of New Hampshire as one locality, meaning that all hospitals in New Hampshire that are reimbursed through prospective payments are reimbursed the same amount for outpatient services through Medicare Part B. However, 13 out of the 32 hospitals in my dataset are Critical Access Hospitals (CAHs) that are eligible to receive cost-based reimbursements from Medicare. I was unable to obtain data on exactly how much these CAHs are reimbursed by CPT code and therefore use the prospective payment rates as an approximation for what they are reimbursed by Medicare. This should not have a major impact on the analysis as the focus is on private insurers, and I primarily use Medicare prices for the purposes of standardization of the private insurer prices available through NH HealthCost.

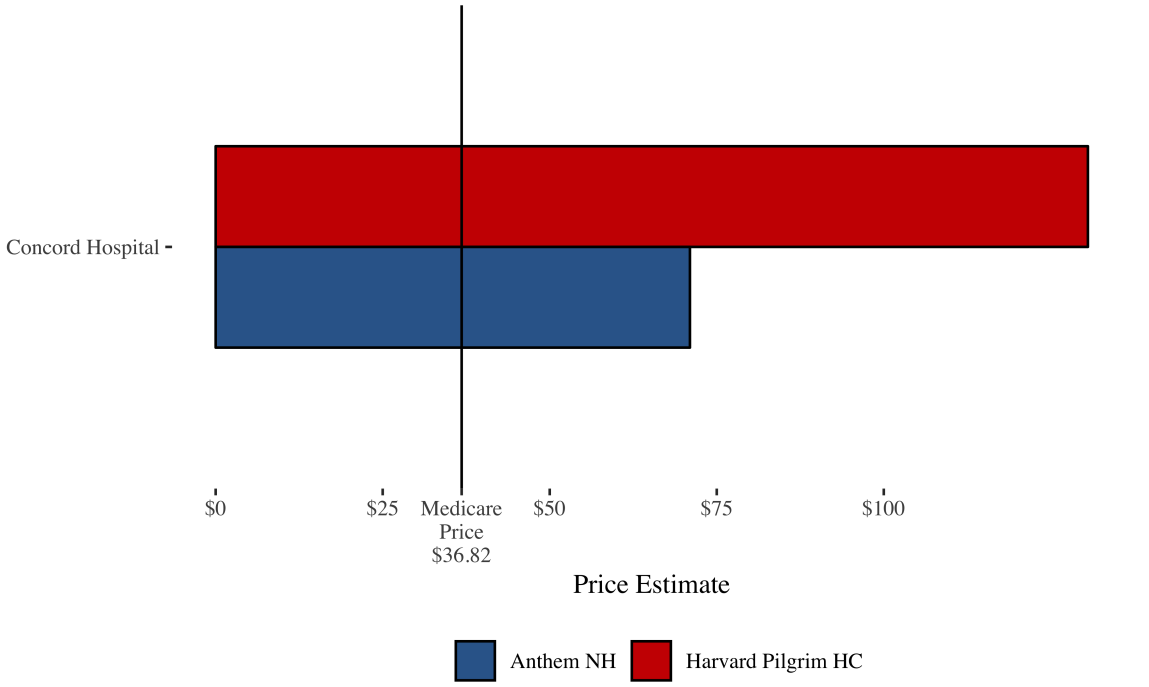
IV.III Price Variation in the New Hampshire Market

Having constructed price estimates at the insurer-procedure-hospital level using both data sources outlined above, I find that large price variation exists in New Hampshire, and I present in Table 1 the estimated prices for Medicare, the three major private insurers, and the uninsured for the procedures included in my analysis. All price data presented reflect 2018 prices, and the price estimates for private payers have been adjusted to be comparable to Medicare's non-bundled prices. Significant variation exists in the prices paid for the same procedure or service, even when only considering the privately insured. This variation may be efficient if costs and quality vary across hospitals for complex procedures but may be inefficient for services where cost and quality are plausibly constant.

Table 1: Median Hospital Prices for Radiology Services by Payer

Procedure	Medicare	Anthem	HP	CIGNA	Uninsured
Myocardial Imaging	$519.79	$964.25	$901.76	$1,265.12	$1,552.74
MRI - Pelvis	$449.82	$1,028.85	$829.60	$1,192.77	$1,637.16
MRI - Brain	$398.48	$698.92	$940.34	$1,062.96	$1,635.29
CT - Abdomen/Pelvis, with contrast	$328.29	$621.93	$793.12	$889.18	$1,426.38
MRI - Knee	$250.57	$432.41	$528.89	$580.45	$868.77
MRI - Shoulder, Elbow, or Wrist	$250.57	$423.08	$504.70	$599.41	$839.07
MRI - Back	$236.78	$320.58	$496.77	$518.01	$787.87
CT - Chest	$206.77	$367.01	$347.67	$445.00	$638.77
Ultrasound - Pregnancy	$150.83	$212.14	$216.33	$231.85	$420.51
Mammogram	$145.25	$332.64	$228.78	$297.02	$447.79
Ultrasound - Abdominal, Complete	$129.73	$243.13	$237.92	$224.46	$396.58
Ultrasound - Transvaginal	$129.58	$252.27	$242.05	$259.17	$455.56
Ultrasound - Head and Neck	$123.82	$279.23	$251.90	$233.11	$364.83
Ultrasound - Pregnancy follow-up	$122.51	$245.01	$229.27	$286.99	$358.86
CT - Head/Brain, without dye	$121.75	$172.25	$179.80	$349.16	$520.52
Ultrasound - Pelvic	$116.79	$233.59	$177.72	$165.35	$379.81
Ultrasound - Abdominal, Limited	$97.05	$192.68	$188.77	$186.11	$259.92
Ultrasound - Breast	$93.11	$186.22	$174.41	$191.70	$309.61
Bone Density Scan	$44.38	$71.85	$86.91	$97.28	$144.69
X-Ray - Hip	$43.59	$73.27	$81.58	$84.38	$117.49
X-Ray - Neck	$41.25	$72.07	$74.16	$91.05	$164.77
X-Ray - Middle Back	$37.70	$65.03	$86.42	$90.66	$141.55
X-Ray - Knee	$37.65	$70.35	$68.89	$80.98	$109.38
X-Ray - Wrist	$36.92	$67.30	$69.78	$79.97	$115.90
X-Ray - Spine	$36.82	$66.81	$74.66	$81.08	$116.48
X-Ray - Abdomen	$34.80	$58.79	$72.07	$81.87	$119.60
X-Ray - Chest	$34.33	$53.37	$59.81	$64.93	$99.52
X-Ray - Hand	$33.53	$59.34	$65.58	$67.23	$104.37
X-Ray - Pelvis	$33.53	$128.59	$103.01	$133.78	$146.57
X-Ray - Ankle	$33.15	$60.17	$63.19	$66.89	$97.90
X-Ray - Foot	$30.90	$52.30	$60.65	$66.89	$100.91
X-Ray - Shoulder	$30.88	$54.59	$60.31	$73.02	$104.06
Urine Capacity Measurement	$16.93	$32.32	$28.91	$38.81	$61.80

However, this variation persists even when costs and quality are reasonably assumed to be fixed within the same hospital. Controlling for procedure, across hospital price variation accounts for 16.4% of the total variation but *within* hospital price variation accounts for a further 17.0% of the total variation in my data. For the same service at the same hospital, different payers are charged vastly different amounts. Figure 5 shows the different prices paid by the three major private payers in New Hampshire (Anthem, Harvard Pilgrim, and CIGNA) at the same hospital for spine x-rays (a common outpatient procedure). For all of the hospitals in Figure 5, there is a difference of at least $100 between what the highest and lowest payers pay.



Note: This plot shows all hospitals for which there was an estimated price difference greaterthan $100 between the highest and lowest paying commercial insurers for spine x-rays. Price estimates come from Hea website and all prices shown are estimated with medium to high precision.

Figure 5: Prices Paid by Private Insurers for Spine X-Rays (Outpatient)

It is unlikely that the cost of providing each of these services and the quality of each of these services within the same hospital should vary with patients' insurance coverage enough to account for the different prices observed. That is, while Anthem

patients may potentially healthier on average and therefore less expensive to treat than CIGNA patients, it is not very plausible that these differences in patient populations would be sufficiently large to account for much of the price variation, particularly for radiology services. Thus my analysis explores other potential sources of this variation, particularly the level of competition among insurers and hospitals that may allow each to exert certain levels of market power in the price bargaining scenario.

IV.IV Additional Data

In order to provide controls for quality and cost variation, I include quality information from CMS's Hospital Compare data and county-level information on income and population demographics from 2017 US Census Data. CMS's hospital overall ratings attempt to capture the quality of care a hospital may provide compared to other hospitals based on the quality measures reported on Hospital Compare, summarizing into a single rating more than 60 measures in seven measure groups: mortality, safety of care, readmission, patient experience, effectiveness of care, timeliness of care, and efficient use of medical imaging. Hospitals are ranked out of five stars, and my dataset includes two hospitals with two stars, 11 hospitals with three stars, 16 hospitals with four stars, and three hospitals with five stars for their overall ratings. My primary analyses uses only the hospital's overall quality rating as a control. The US Census data I use are county level estimates of median household income, percentage of the population over 65, and population density.

In order to construct hospital markets and define hospital density therein, I use geographical information from Dartmouth Atlas of Health Care and Google Maps. Dartmouth Atlas defines and provides data for each hospital's Hospital Service Area (HSA) and Hospital Referral Region (HRR), and these definitions for hospitals' markets are commonly used throughout the literature. An HSA delineates a local market for

hospital care, composed of a collection of zip codes whose residents receive most of their hospitalizations from the hospitals in that area. For the most part, this calculation is based on assigning each zip code to the area where the greatest proportion of its Medicare patients were hospitalized. Most HSAs contain only one hospital. An HRR delineates regional health care markets for tertiary medical care and each contains at least one hospital that performs major cardiovascular procedures and neurosurgery. HRRs were largely defined by assigning HSAs to the region where the greatest proportion of major cardiovascular procedures were performed. My dataset contains 29 unique HSAs and 4 unique HRRs, and I count both the total number of hospitals within each hospital's market and the number of hospitals that provide the same service/procedure within that market. My second set of market definitions simply uses coordinate information for each hospital from Google Maps to calculate the total number of hospitals and the number of hospitals offering the same procedure within a 15-mile and 25-mile radius of each hospital.

V Empirical Approach

My analysis seeks to identify whether the market share of hospitals and insurers is related to variation in the prices private insurers pay for hospital services. The first section concerns price variation across insurers and the second concerns price variation across hospitals. I restrict my analyses only to radiology services, which are among some of the most common outpatient procedures, only to hospitals in New Hampshire,[3] and only to the three major private insurers and Medicare (to provide a base price). This leaves me with 33 services, 26 hospitals, and 1,480 observations.[4]

[3] I exclude ambulatory surgical centers, clinics, specialist practices, and private physician practices.

[4] I am only able to obtain 1,347 observations of prices paid by either Anthem, Harvard Pilgrim, or CIGNA because NH HealthCost does not provide prices for all three insurers at all 26 New Hampshire Hospitals for all 33 radiology services considered. I also restrict my data to estimates that do not have "low" precision of the estimate, further reducing my total number of private price observations to 773.

Radiology services (CT scans, MRIs, ultrasounds, x-rays, etc.) generally involve the use of an imaging device to capture an image which is then read (examined) by a radiologist who reports their findings to the patient or patient's doctor. The initial cost of purchasing one of these imaging devices is expensive and may vary somewhat, but the per unit cost of procuring and reading an image is likely to be similar across providers once controlling for wages. Particularly within the same hospital, it is plausible that the per unit cost of each radiology service is constant. Similarly, within the same hospital, it is plausible that quality is constant for the same radiology service. Furthermore, across hospitals, the quality of radiology services is assumed to be relatively similar. While the number of specialized radiologists employed by each hospital may vary, the emergence of telemedicine and New Hampshire legislation encouraging its use (mHealth Intelligence, 0ct. 27, 2015) may help to mitigate these disparities as rural hospitals can send imaging to be reliably read by specialized radiologists employed by telemedicine firms. Particularly after controlling for the hospital's overall quality, I assume that imaging service quality is minimally different between hospitals.

My outcome variable of interest is the percentage of the Medicare price that insurer i negotiates for a particular procedure j at a particular hospital h, denoted as y_{ijh}. That is,

$$y_{ijh} = \frac{p_{ijh}}{p_{jh}^{Medicare}} * 100 \tag{1}$$

where p_{ijh} denotes the price a particular insurer pays for procedure j at hospital h, and $p_{jh}^{Medicare}$ denotes the price Medicare pays for the same service at the same hospital.

In the first set of regressions, I estimate whether there is a statistical difference between the prices hospitals charge Anthem, Harvard Pilgrim, and CIGNA in New Hampshire

I do have estimates for the Medicare price at every hospital for every procedure (858 observations)

for the same service, with the context that Anthem (the largest commercial insurer) composes 39% of the commercial insurance market, Harvard Pilgrim 27%, and CIGNA (the smallest major commercial insurer) 20%. I estimate what percentage of the Medicare price each insurer pays on average using the following fixed effects linear model:

$$y_{ijh} = \sum_{k \epsilon K} \gamma_k \left[insurer_k \right] + \delta_j + \lambda_h + \varepsilon_{ijh} \tag{2}$$

where K is the set of private insurers (Anthem, Harvard Pilgrim, CIGNA), and $insurer_k$ is an indicator variable that takes on the value of 1 or 0. The omitted dummy is Medicare and because Medicare always pays 100% of the Medicare price for a given procedure in a given locality, there is no variation in Medicare prices that is not explained by procedure fixed effects δ_j or a hospital's location, which is encompassed by the hospital fixed effects term λ_h. Thus, the coefficient $\hat{\gamma}_k$ estimates the percentage above the Medicare price each private insurer k pays on average, and the three resulting coefficients of the summation (one $\hat{\gamma}_k$ for each insurer) are the primary coefficients of interest. By including procedure and hospital fixed effects, I am able to compare prices for the same procedure at the same hospital among the commercial insurers. The error term is denoted by ε_{ijh}.

Equation (1) only estimates whether there are consistent differences between the prices each insurer pays and the relative magnitude of the estimated coefficients $\hat{\gamma}_k$ may suggest a possible direction to the association between insurer market share and negotiated prices. In order to investigate more closely the magnitude of this relationship, I also estimate the correlation between each insurer's statewide market share s_i and price using the following simple fixed effects regression, restricting my observations only to private insurer prices:

$$y_{ijh} = \theta_i s_i + \delta_j + \lambda_h + \varepsilon_{ijh} \tag{3}$$

Ideally, I would know the market power of each insurer within hospital h's market, and identify the relationship between the prices negotiated by insurer i and hospital h given insurer i's market share in hospital h's market to identify market share variation more precisely, but given the limitations of my dataset, I am only able to examine this relationship to statewide market shares. A negative correlation between the size of the insurer's statewide market share and the magnitude of $\hat{\gamma}_k$ would fit the narrative that larger insurers may be able to negotiate lower hospital prices.

As with the imperfect measure of insurer market share, I also am unable to obtain data on the precise market share of each hospital in the market for outpatient radiology services because my dataset does not contain the outpatient volumes of each hospital. However, I am able to construct a measure of the number of other hospitals present in hospital h's market to serve as a proxy for market share and relative concentration. This method is imperfect because while there may be several hospitals in the same market, one may perform significantly more outpatient radiology procedures than the others due to having a greater capacity or being preferred by patients. Nevertheless, I hypothesize that because there are so few hospitals present in each market, the addition of a marginal hospital to hospital h's market will appreciably subtract from hospital h's market share.

Thus in the second set of regressions, I estimate how the presence of other hospitals within each hospital's market relates to the price (as a percentage of the Medicare price) for a particular service j that hospital h negotiates with each insurer i. Essentially, the hospital fixed effects variable in Equation (2) is decomposed into various observable measures relating to a particular hospital and its market, resulting in the following linear model:

$$y_{ijh} = \sum_{k \epsilon K} \gamma_k \left[insurer_k \right] + \delta_j + \alpha m_h + \beta_1 p_{jh} + \beta_2 q_h + \beta_3 X_{c(h)} + \varepsilon_{ijh} \tag{4}$$

where the summation of the insurer dummies and δ_j (procedure fixed effects) remain the same as in Equation (2); m_h represents the number of hospitals in hospital h's market; p_{jh} denotes the typical patient complexity for procedure j at hospital h; q_h denotes overall hospital quality at hospital h as provided through the CMS Hospital Compare data; and $X_{c(h)}$ is a vector of county-level characteristics for each hospital $c(h)$ that include the median household income, the percentage of people over 65 years of age, and population density. Data for these controls come from the 2017 US Census.

A hospital's market is defined differently across several specifications, resulting in different definitions of m_h across different regressions. I first use Hospital Service Area (HSA) and Hospital Referral Region (HRR) definitions for hospitals' markets and count the total number of hospitals within each hospital's market. In another specification, I also count the number of hospitals that provide the same service/procedure within that market such that the market term in Equation (4) becomes m_{jh}. This attempts to isolate whether the hospital is truly competing with other hospitals in its market in providing procedure j or whether it may be the only hospital in its market providing that service and therefore faces no competitors. While the 33 radiology services I have restricted my analysis to are quite common, I do not observe prices for all service-hospital combinations in the HealthCost data because some hospitals provide certain services very infrequently or not at all. Thus, I restrict my estimates only to service-hospital combinations for which I observe prices. Most hospitals in the dataset do provide at least half of the relevant services and there does not appear to be a consistent set of services for which price data are missing.

The second set of market definitions I use are based on geographical radii drawn around each hospital. As with the HSA/HRR market definitions, I count the total

number of hospitals as well as the number of hospitals that also provide the same service/procedure within a 5 mile radius (local market) and a 25 mile radius (a broader market) of each hospital h. As the services being examined are all outpatient services, the HSA/HRR definitions may not truly capture the potential patient population and potential competitors because they are calculated on the basis of hospitalization (inpatient) events. For outpatient services, patients may be able to "shop" more easily among different hospitals given their insurance plan. That is, potential patients may place greater weight on convenience and distance to the hospitals they can go to in the outpatient setting rather than the intensity of care they can receive there because their health status is often not as acute as in the inpatient setting. Therefore, insurers may want to provide attractive plans that offer patients enough convenient choice in their relevant market but without facing high premiums or out-of-pocket costs. Thus, this radial measure of a hospital's market may be more applicable to consumers' choices in the outpatient setting.

The primary coefficient of interest in this second set of regressions is $\hat{\alpha}$ which estimates how hospital competition may be related to prices. If $\hat{\alpha}$ is negative, this suggests that the more hospital competition there is within a hospital's market, the lower the prices.

The last regression I perform investigates whether hospital competition is related to negotiated prices differently for different insurers. That is, one insurer may be more sensitive to the number of hospitals present in hospital h's market because leveraging hospital competition is a more prominent strategy in their price negotiations. How well an insurer is able to leverage such information may in turn be a function of their own market share. Thus, the final regression equation is otherwise the same as Equation (4) but includes an interaction between the number of hospitals in hospital h's market and an indicator for each insurer:

$$y_{ijh} = \sum_{k \epsilon K} \gamma_k \left[insurer_k\right] + \delta_j + \alpha m_h + \sum_{k \epsilon K} \zeta_k (m_h * [insurer_k]) + \beta_1 p_{jh} + \beta_2 q_h + \beta_3 X_{c(h)} + \varepsilon_{ijh} \tag{5}$$

The primary coefficient of interest is $\hat{\zeta}_k$ which estimates how the addition of one additional hospital to hospital h's market affects the price negotiated with insurer n for procedure j. The relative magnitudes of $\hat{\zeta}_k$ may indicate the ability or willingness of different insurers to leverage information on hospital competition in price negotiations.

VI Results

The first set of results presented in Table 2 demonstrate that there are statistically significant differences in the prices paid by each insurer for a particular service at a particular hospital and that prices are negatively associated with market poer. Standard errors are clustered by procedure and hospital when procedure and hospital fixed effects are included. The coefficients are presented as the average percentage *above* the Medicare price that each insurer pays as Medicare is the omitted group and therefore is expected to pay 100% of the Medicare price. In the primary specification (column 3), these estimated coefficients suggest that on average Anthem pays 181% the Medicare price, Harvard Pilgrim pays 207% the Medicare price, and CIGNA 220% the Medicare price. Alternatively, this means that on average Harvard Pilgrim pays 13.9% more than Anthem and CIGNA pays 21.2% more than Anthem. A basic fixed effects linear model of price on market share in column 4 results in a coefficient on insurer statewide market share that estimates a 1% increase in insurer statewide market share is associated with a 2% decrease in prices.

The positive direction of the coefficients in the first three columns is unsurprising

Table 2:

	Dependent variable:			
	percent_medicare			
	(1)	(2)	(3)	(4)
Anthem_NH	84.189***	84.534***	81.431***	
	(3.719)	(4.448)	(7.733)	
Harvard_Pilgrim_HC	106.979***	107.026***	106.696***	
	(3.115)	(3.881)	(9.728)	
CIGNA	121.561***	121.893***	119.815***	
	(3.467)	(3.202)	(7.147)	
commercial_market_share				−2.022***
				(0.497)
Constant	100.000***			
	(1.753)			
Procedure Fixed Effects	No	Yes	Yes	Yes
Hospital Fixed Effects	No	No	Yes	Yes
Clustered Standard Errors	No	Yes	Yes	Yes
Observations	1,480	1,480	1,480	773
R^2	0.571	0.578	0.628	0.296
Note:				*p<0.1; **p<0.05; ***p<0.01

as Medicare consistently reimburses providers at much lower rates than do private insurers. The coefficients are estimated using standardized prices that attempt to account for the bundled nature of payments and match prior literature. However, it is interesting to note that among the inpatient services they examine, Cooper et al. (2019) find the greatest disparity in Medicare versus private reimbursement for lower limb MRIs, the only radiology service they consider, estimating that private insurers pay on average four times the Medicare price, so perhaps Medicare is particularly able to set low prices for radiology services given the low per-unit cost of radiology services. Additionally, the price data from HealthCost reflects "bundled" prices as detailed in Section III, so they are likely somewhat inflated compared to the Medicare prices. Importantly however, HealthCost bundles payments in the same way across all three private insurers and therefore the variation in the prices paid by each insurer is unaffected by this imperfect standardization to the Medicare price.

The second set of results presented in Tables 3-4 suggest that the number of hospitals in a hospital's market is negatively related to price at a statistically significant level across all definitions of a hospital's market and that the magnitude of this effect decreases with distance. Standard errors are clustered by procedure across all specifications presented. Table 3 presents the results where markets are defined at the hospital level by HSA/HRR or radius, and Table 4 presents the results where markets are defined at the hospital-procedure level by HSA/HRR or radius. These coefficients estimate that the addition of one hospital to a hospital's local market (the HSA definition) is associated with a decrease in prices equivalent to 10% of the Medicare price and 13% of the Medicare price if offering the same procedure. At the broadest definition, the addition of any hospital within a hospital's 25-mile radius is associated with a price decrease equivalent to roughly 3% of the Medicare price. On the whole, these results suggest that, controlling for typical patient complexity, hospital quality, and county level characteristics, the greater the number of hospitals in a hospital's market, the

lower the prices at that hospital are, and that competitive pressures may be more intense the more local the market level.

In addition to the variables concerned with the hospitals' market share, the control variables also provide some interesting coefficients in that they are all statistically insignificant. This suggests that, in New Hampshire, hospital quality and costs have little to no relation to negotiated prices and that hospitals that are most likely to serve more Medicare patients because they have older populations in their markets do not cost shift. That is, hospitals do not appear to charge private payers more to make up for losses incurred by serving more Medicare patients or perhaps do not lose money on Medicare patients for the services considered. Of course, another possibility is that the hospital quality and cost variables contain substantial measurement error as both of these measures are extremely difficult to quantify or estimate. Lastly, the dummy variables for each private insurer remain roughly unchanged and maintain the same order of magnitudes from the insurer analysis.

To explore insurer level versus hospital level effects more closely, the last set of results presented in Table 5 shows the interaction between hospital density and each insurer, where hospital density is measured by counting the number of hospitals within h's HSA or HRR. The estimated coefficients suggest that the prices Harvard Pilgrim negotiates with hospitals are associated more strongly with the number of hospitals in that hospital's market than those for Anthem and CIGNA. The addition of one more hospital to hospital h's HSA and also has a contract with Harvard Pilgrim is associated with a price decrease for procedure j equivalent to 32.6% of the Medicare price for that procedure, and if an additional hospital is added to hospital h's HRR, this decrease is equivalent to 9.4% of the Medicare price for that procedure. Anthem prices do not appear to vary significantly by the number of hospitals in the market and CIGNA's prices are only significantly related to hospital concentration at the

Table 3:

	Dependent variable:			
	percent_medicare			
	(1)	(2)	(3)	(4)
n_hosp_hsa_total	−10.202**			
	(4.194)			
n_hosp_15mi_total		−4.478***		
		(1.346)		
n_hosp_hrr_total			−3.428***	
			(0.756)	
n_hosp_25mi_total				−3.189**
				(1.382)
typical_patient_complexity_scale	5.573	5.297	5.054	4.999
	(4.071)	(4.124)	(4.149)	(4.122)
'Hospital Quality'	1.713	−1.683	−0.704	0.854
	(2.875)	(2.984)	(2.689)	(2.787)
median_household_income	−0.262	−0.014	0.315	0.239
	(0.338)	(0.325)	(0.357)	(0.422)
percent_pop_over65	−0.295	0.037	−0.012	−0.084
	(0.591)	(0.616)	(0.570)	(0.603)
pop_density	0.018	0.030	0.001	0.017
	(0.021)	(0.023)	(0.020)	(0.020)
Anthem_NH	85.869***	84.012***	84.902***	84.448***
	(4.988)	(4.752)	(4.791)	(4.770)
Harvard_Pilgrim_HC	107.122***	107.129***	106.298***	106.897***
	(3.943)	(3.933)	(3.810)	(3.931)
CIGNA	122.232***	121.933***	121.568***	121.658***
	(3.288)	(3.217)	(3.176)	(3.167)
Procedure Fixed Effects	Yes	Yes	Yes	Yes
Clustered Standard Errors	Yes	Yes	Yes	Yes
Observations	1,480	1,480	1,480	1,480
R^2	0.582	0.582	0.591	0.582
Note:				*p<0.1; **p<0.05; ***p<0.01

Table 4:

	Dependent variable:			
	percent_medicare			
	(1)	(2)	(3)	(4)
n_hosp_hsa_p	−12.631***			
	(4.170)			
n_hosp_15mi_p		−3.557***		
		(1.342)		
n_hosp_hrr_p			−2.786***	
			(0.574)	
n_hosp_25mi_p				−2.671***
				(0.979)
typical_patient_complexity_scale	5.257	5.056	4.815	4.999
	(3.918)	(4.104)	(4.135)	(4.119)
'Hospital Quality'	1.894	−0.922	−0.788	0.640
	(2.952)	(2.965)	(2.710)	(2.809)
median_household_income	−0.297	−0.044	0.261	0.130
	(0.332)	(0.324)	(0.368)	(0.382)
percent_pop_over65	−0.300	0.038	0.176	−0.230
	(0.604)	(0.614)	(0.571)	(0.602)
pop_density	0.022	0.025	0.011	0.016
	(0.020)	(0.023)	(0.020)	(0.020)
Anthem_NH	85.800***	84.037***	84.688***	84.329***
	(4.925)	(4.789)	(4.789)	(4.820)
Harvard_Pilgrim_HC	106.963***	107.034***	106.349***	106.894***
	(3.920)	(3.931)	(3.823)	(3.926)
CIGNA	122.012***	121.856***	121.571***	121.786***
	(3.206)	(3.214)	(3.163)	(3.167)
Procedure Fixed Effects	Yes	Yes	Yes	Yes
Clustered Standard Errors	Yes	Yes	Yes	Yes
Observations	1,480	1,480	1,480	1,480
R^2	0.584	0.581	0.589	0.581
Note:				*p<0.1; **p<0.05; ***p<0.01

Table 5:

	Dependent variable:	
	percent_medicare	
	(1)	(2)
n_hosp_hsa_total	−3.750*	
	(2.182)	
n_hosp_hrr_total		−0.496
		(0.307)
Anthem_NH	80.697***	95.243***
	(14.446)	(18.652)
Harvard_Pilgrim_HC	147.896***	212.242***
	(12.146)	(24.650)
CIGNA	124.033***	160.220***
	(11.756)	(21.047)
typical_patient_complexity_scale	5.664	5.398
	(4.096)	(4.240)
'Hospital Quality'	2.032	−0.675
	(2.848)	(2.635)
median_household_income	−0.206	0.296
	(0.331)	(0.366)
percent_pop_over65	−0.295	0.036
	(0.601)	(0.592)
pop_density	0.015	0.002
	(0.021)	(0.020)
n_hosp_hsa_total:Anthem_NH	2.768	
	(8.344)	
n_hosp_hsa_total:Harvard_Pilgrim_HC	−32.605***	
	(8.117)	
n_hosp_hsa_total:CIGNA	−1.706	
	(7.649)	
n_hosp_hrr_total:Anthem_NH		−1.024
		(1.379)
n_hosp_hrr_total:Harvard_Pilgrim_HC		−9.430***
		(2.061)

HRR market level.

VII Discussion

The results as a whole suggest that the market power of insurers and hospitals is related to the prices hospitals and insurers negotiate as the theoretical framework would predict and as is consistent with prior literature. That is, the insurers and hospitals with the greatest market shares or that face the least competition are able to negotiate the most favorable prices; for the insurers, this translates into negotiating lower prices, and for hospitals, this means negotiating higher prices.

While definitive conclusions about the effect of insurer market share cannot be made from these results given the limitations mentioned in the Empirical Approach, the order of their magnitudes suggests that the larger the market share of the insurer, the more market power it is able to exert and the lower the prices that insurer pays at each hospital for a given procedure. Anthem, with the largest share of the market, pays less on average than both Harvard Pilgrim and CIGNA; Harvard Pilgrim, which is smaller than Anthem but bigger than CIGNA, pays somewhere between the Anthem and CIGNA price on average; and CIGNA, the smallest of the major insurers, consistently pays much more than both Anthem and Harvard Pilgrim.

The HSA coefficients and the radius coefficients are identical within each specification as there were no hospitals for which the number of hospitals within the market differed between the HSA and radius definitions. This speaks to the fact that especially for basic health needs, many patients choose which hospital to go to based on proximity. The relationship between price and hospital density becomes more negative in these local markets when considering competition at the hospital-procedure level, which suggests that the specificity of competition may result in more intense negative pressure on

Table 6:

	Dependent variable:				
	percent_medicare				
	(1)	(2)	(3)	(4)	(5)
n_provider_5mi_p	−5.346***			−4.138**	
	(1.033)			(1.761)	
n_provider_15mi_p		−2.591***			−2.524**
		(0.570)			(0.568)
n_provider_25mi_p			−1.071***		
			(0.295)		
typical_patient_complexity_scale	9.419*	9.636*	8.932*	5.736	5.825
	(5.204)	(5.149)	(5.179)	(4.172)	(4.130)
'Hospital Quality'				1.412	−0.234
				(2.893)	(2.855)
median_household_income	−0.308**	0.021	−0.098	−0.133	0.066
	(0.147)	(0.145)	(0.171)	(0.345)	(0.305)
percent_pop_over65	−0.581	0.155	0.073	−0.273	0.114
	(0.727)	(0.713)	(0.717)	(0.601)	(0.621)
pop_density	−0.006	0.001	−0.002	0.017	0.031
	(0.007)	(0.007)	(0.007)	(0.023)	(0.024)
Anthem_NH	59.592***	58.392***	58.574***	85.132***	84.285**
	(5.385)	(5.268)	(5.377)	(4.877)	(4.709)
Harvard_Pilgrim_HC	83.396***	83.368***	83.429***	106.912***	106.839**
	(4.667)	(4.653)	(4.671)	(3.880)	(3.939)
CIGNA	95.103***	94.775***	95.038***	121.899***	121.331**
	(4.803)	(4.788)	(4.803)	(3.193)	(3.166)
Procedure Fixed Effects	Yes	Yes	Yes	Yes	Yes
Clustered Standard Errors	Yes	Yes	Yes	Yes	Yes
Observations	2,172	2,172	2,172	1,480	1,480
R^2	0.445	0.444	0.439	0.582	0.584

Note: *p<0.1; **p<

Table 7:

	Dependent variable:	
	percent_medicare	
	(1)	(2)
n_hosp_5mi_p	−6.976	
	(8.710)	
n_hosp_25mi_p		−3.742
		(2.361)
typical_patient_complexity_scale	32.757***	33.148***
	(10.207)	(10.196)
'Hospital Quality'	13.726**	13.773**
	(5.612)	(5.378)
median_household_income	3.110***	3.537***
	(0.696)	(0.692)
percent_pop_over65	−4.960***	−5.046***
	(1.099)	(1.046)
pop_density	−0.142***	−0.139***
	(0.039)	(0.037)
Observations	700	700
R^2	0.286	0.287
Adjusted R^2	0.245	0.246
Residual Std. Error (df = 661)	93.876	93.806
Note:	*p<0.1; **p<0.05; ***p<0.01	

prices. The coefficients on HRR and 25-mile radius hospital density are also similar in magnitude and statistically significant whether looking at hospital-level or hospital-procedure-level competition. They are all smaller that the corresponding HSA and radius coefficients, suggesting that hospital competition may be less intense at the broader market definitions. This is consistent with the story that insurers attempt to find a balance between offering convenient hospital choice in their network and also keeping premiums low, such that it is harder for them to leverage broad hospital market competition compared to local market competition.

The uniquely strong interaction between hospital competition and Harvard Pilgrim may be explained by differences in company structure between Harvard Pilgrim and the other two major insurers, Anthem and CIGNA. Harvard Pilgrim is a small, private, non-profit health insurance company active mainly in the Northeast United States whereas Anthem and CIGNA are both massive, publicly traded companies that provide insurance nationally. Anthem and CIGNA may not bargain as hard with hospitals on the basis of hospital competition because the marginal payoff from getting somewhat lower prices for a relatively small portion of the population they insure in New Hampshire is less than the effort investment it requires to acquire these lower prices. Harvard Pilgrim on the other hand may exert much more effort in leveraging hospital competition in its price negotiations because the marginal benefit of lower prices is greater given that New Hampshire residents make up a greater portion of the population it insures.

There are several key limitations of this analysis in addition to the few that have been mentioned above. Namely, the analysis is limited by the lack of granularity of the data. First, the insurers' market share is only available at the state-level and therefore it cannot be explored whether the market power of each insurer within each hospital's market affects negotiated prices. Next, the hospital's true market share is also unknown as I do not have volume data for each hospital for each service, and I also do not have

data on the variation of this volume across different insurers. One hospital may serve many more Medicare patients or Anthem patients than another, but this cannot be accounted for in my analysis. Lastly, the availability of price data is very limited and somewhat aggregated. I restrict my analysis only to outpatient radiology services in order to plausibly control for cost and quality both within and across hospitals, but the results may not extend to other forms of hospital care.

VIII Conclusion

Despite the limitations of this analysis, the results as a whole suggest that private insurers and hospitals with greater market shares are able to negotiate more favorable prices for themselves but also that market share may not be the sole source of market power in price negotiations. While greater market share for insurers would provide them with better bargaining leverage, this may have harmful affects on welfare through higher premiums.

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