The Impact of Regional Competition on the Health Care Industry

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Abstract

We investigate factors that determine firm markups by employing data on prices and quantities of various medical procedures at major hospitals in the US. We focus on the impact of hospital quality, rival competition, and the number of medical procedures upon the health care demand. Our analysis covers health care markets across the US with the market definition based upon the Hospital Referral Regions (HRRs). Our findings highlight potential implications of the relationship between hospital markups and market structure.

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Keywords: Health; Spatial Competition; Markups; Hospital Referral Regions.

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1 Introduction

Personal health care expenditure in the US rose from 18% to 27% of per capita income in the past decade. Changes in the size and structure of the health care industry have attracted the attention of economists due to its profound impact on social welfare. The US health care expenditure accounted for 17.9% of the GDP in 2010 with the amount spent per capita reaching $8,417. Expenditure remained relatively steady for the next three years due to the sluggish economic recovery until the Affordable Care Act came into effect that was projected to create a growth in spending of 6.1%.[1] Extensive consolidations among health care providers on the other hand have contributed to industry concentration. In a recent wave, 162 hospital mergers occurred between 2010 and 2011 (Gaynor *et al.* 2014) . A study of competitive forces within the current structure of the health care markets is therefore essential for uncovering the drivers of a substantial wedge between costs and prices.

We investigate factors that determine firm markups - the difference between price and cost - by employing data on prices and quantities (number of discharges) of various medical procedures at major hospitals in the US. We focus on the effects of hospital quality, rival competition, and other determinants on health care demand. Our analysis covers the health care industry across the US with the market definition based upon the Hospital Referral Regions (HRRs). We also estimate the effect on markups of an increase in the number of hospitals in the market.

The remainder of this paper is organized as follows. In the next section, we outline

[1]Source: Centers for Medicate & Medical Services, http://www.cms.gov/Research-Statistics-Data-and-Systems/Statistics-Trends-and-Reports/NationalHealthExpendData/Downloads/Proj2012.pdf.

findings from the literature and describe the data. In section 3, we present empirical results and in section 4, we offer concluding remarks.

2 Background and Data

Research on health care markets using techniques from the Industrial Organization toolkit is picking up in recent years. Bresnahan and Reiss (1991) study the relationship between market structure and market size in five retail and professional industries including health services. Their empirical results suggest that beyond five competitors, successive entrants have little effect on competition. In geographical isolated markets, the effects of competitive entry dissipate soon after the third firm enters the market in Abraham *et al.* (2007). Using a dynamic model of entry and exit, Dunne *et al.* (2013) investigate the role of entry costs and fixed costs on long-run firm values and market structure for dentists and chiropractors. Their simulation exercises show that an entry cost subsidy increases price competition, leading to higher firm turnover.

While the impact of competition on price is relatively clear, there is no concrete conclusion in the literature about the impact of competition on quality.[2] Kessler and McClellan (2000) find that the probability of death for heart attack patients is significantly higher in a more competitive market. Propper *et al.* (2004) and Propper *et al.* (2008) look at mortality in the UK health service industry, and find that hospitals facing more competition have higher death rates. In Beckert *et al.* (2012) the choices for hip replacement patients increase with

[2]See Gaynor and Town (2012) for summaries of the previous literature.

hospital quality while hospital mergers may lead to decreased quality. In contrast, two recent studies (Bloom *et al.* 2010; Beckert *et al.* 2012) show that competition improves hospital quality. Bloom *et al.* (2010) find that adding another competitor increases management quality and reduces mortality rates due to heart attack by 10.7%.

The Patient Protection and Affordable Care Act (PPACA), signed in March 2010, increased the use of primary care for the uninsured-lower income patients. This policy expanded health insurance coverage and affected competition among insurers. Starc (2014) shows that the Medicare Supplement insurance market is highly concentrated. She finds evidence that substantial market power with strong brand royalty is associated with high premiums. An increase in competition could result in higher consumer welfare.

The goal of our empirical model is to estimate demand and markups for different medical procedures within the health care industry assessing the impact of a potential increase in coverage and consolidation. We use aggregated level information as well as detailed information on quantity and prices on 100 different medical procedures from the Dartmouth Atlas of Health Care between 2010 and 2011.[3] The market for hospital services is highly localized in the US. Dranove *et al.* (1992) emphasize that properly defining the geographic market is critical in empirical analysis in the health care industry. The unit of our health care markets is HRR. Under the HRR system, hospitals have significant market power, as patients in an HRR are referred to particular hospitals within that region. The defined markets are ade-

[3]According to the Centers for Medicare & Medicaid Services, prices refer to the average total payments to all providers for the MS-DRG (Medicare Severity Diagnosis Related Groups) "including the MS-DRG amount, teaching, disproportionate share, capital, and outlier payments for all cases. Also included in average total payments are co-payment and deductible amounts that the patient is responsible for and any additional payments by third parties for coordination of benefits."

quate to examine geographic variation in health care utilization, quality, and expenditures.[4] While most previous studies use the sample of geographically concentrated markets only containing some of health care industry, our dataset covers the entire 306 referral areas in the US. It provides us with significant geographic variation in different medical procedures.

Our dataset contains measures of market characteristics such as median household income and number of insured people in the geographic market obtained from the Census Bureau. Each county-level demographic variable is aggregated to HRRs. In particular, household income is weighted by the population within a county. We divide the weighted income and number of insured people by number of HRRs within the county if there are multiple HRRs within a county. Then, we construct the regression demographic variables by summing up the values within the same HRR. Finally, we use crosswalks to convert all county based data to the HRR level. The use of a variety of demographic covariates could explain significant geographic variations. In the regressions, we include a measure of the rival's minimum price charged to control for the relative strengths of competition a hospital faces within an HRR. This variable summarizes the competitiveness in the local market and is widely accepted in the empirical IO literature. Similar measures have been constructed in industries to identify a competitor's minimum distance to a work site, minimum worklog etc (for example see De Silva *et al.* 2003, Bajari *et al.* 2014, and Jung *et al.* 2018).

[4]HRRs represent natural markets for tertiary care and are defined on the basis of where patients are referred for cardiovascular surgical procedures or neurosurgery. See http://www.dartmouthatlas.org/data/region/ for detailed descriptions of HRRs.

Table 1: Descriptive Statistics for Hospital Referral Regions

Variable	Mean	Standard Deviation	Min	Max
Average price	$ 9,607.58	$1,721.86	$6,521.39	$17,065.39
Average number of discharges	41.84	9.65	22.46	86.53
Number of hospitals	5.41	5.19	1.00	36.94
Household income	$48,958.62	$9,841.60	$30,554.00	$96,340.23
Number of insured people	863,057.20	902,065.70	111,228.50	6,358,225.00

There are 306 Hospital Referral Regions in the US.

Quality differentiation can lead to persistent differences in price and demand across hospitals. To control for qualitative effects, we include major hospitals' quality scores listed on U.S. News & World Report. U.S. News & World Report releases its annual rankings and quality scores of hospitals in 16 different adult specialties listed in Table 4. It considers almost 5,000 hospitals and approximately the top 150 hospitals are ranked in at least one specialty. Quality criteria include a sufficient number of beds, specialized staff, sufficient medical technology, survival rates, patient safety, hospital reputation, and whether it is a teaching hospital or not.[5] Thus, the ranked hospitals offer high quality of care in the HHRs. In our empirical analysis, we control for each referral hospital quality based on their scores on the report. Our study also includes the number of insured people as one of the covariates in our regression model to account for the effects of a potential expansion of coverage based on existing plans. We estimate these models with HHR fixed effects to control for unobserved idiosyncratic characteristics of demand across markets. Summary statistics of these regression variables are presented in Table 1. The average price and average number of discharges per hospital per Diagnosis Related Groups (DRG) are about $9,607 and 42,

[5]See Olmsted *et al.* (2017) for more details about current methodology and criteria for ranking hospitals by U.S. News & World Report.

respectively. There are on average 6 hospitals in an HRR during the sample period.

3 Empirical Analysis

In the empirical analysis that follows, we estimate the demand in the health care industry. By directly estimating the demand, we are able to obtain also consistent hospital markup estimates.[6] The estimated demand parameters are reported in Table 2. The first column has a basic set of covariates, and the next three columns successively add hospital's number of medical procedures, number of insured people, and household income. The coefficients of the log of price across all our regressions are in line with expectations. The log of rival's minimum price is positive and statistically significant indicating that patients are likely to pay higher prices at a hospital if rival hospitals charge high prices.

With regard to hospital's quality, patients would pay more to well-known hospitals that provide high quality care and to large hospital organizations. This variable shifts the demand curve outwards in the health care market. The higher the log of the number of medical procedures is, the higher the price paid, indicating that patients are likely to pay higher prices to a hospital offering broad tertiary medical care. The impacts of the population size, the number of insured people, and household income on the market demand are not statistically significant across our specifications. Columns (5) and (6) of Table 2 report the estimates from regressions based on the parsimonious model of column (1) controlling for

[6]Note that, Bresnahan and Reiss (1991) draw inferences about price-cost margins by observing the number of firms relative to the size of their market.

Table 2: Estimation Results

Log (number of discharges)	(1)	(2)	(3)	(4)	(5)	(6)
Log (average price)	-0.034***	-0.094***	-0.094***	-0.094***	-0.067***	-0.139***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Log (rivals' minimum price)	0.020***	0.040***	0.040***	0.040***	0.039***	0.060***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Log (hospital quality score)	0.137***	0.107***	0.107***	0.107***	0.107***	0.039***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)
Log (population)	0.050	0.035	-0.118	-0.118	-0.109	0.149
	(0.332)	(0.319)	(0.635)	(0.635)	(0.624)	(0.302)
Log (number of procedures)		0.394***	0.394***	0.394***	0.423***	
		(0.003)	(0.003)	(0.003)	(0.003)	
Log (number of insured people)			0.131	0.132	0.102	
			(0.464)	(0.465)	(0.457)	
Log (income)				0.005	0.016	
				(0.128)	(0.126)	
Cardiology & Heart Surgery					-0.095***	
					(0.006)	
Diabetes & Endocrinology					-0.381***	
					(0.009)	
Ear, Nose & Throat					-0.315***	
					(0.007)	
Gastroenterology & GI Surgery					-0.035***	
					(0.007)	
Nephrology					-0.043***	
					(0.007)	
Neurology & Neurosurgery					-0.173***	
					(0.007)	
Orthopedics					-0.013*	
					(0.008)	
Pulmonology					0.171***	
					(0.006)	
Rehabilitation					0.051***	
					(0.008)	
Urology					0.081***	
					(0.008)	
HRR Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
Hospital Fixed Effects	No	No	No	No	No	Yes
Time Dummy	Yes	Yes	Yes	Yes	Yes	Yes
Observations	317,453	317,453	317,453	317,453	317,453	317,453

*** Denotes statistical significance at the 1% level, ** denotes significance at the 5% and * denotes significance at the 10% level. Standard errors are in parentheses.

different specialties (in column (5)) and hospital fixed effects (in column (6)).[7]

In order to examine the impact of patient travel distance to hospitals on markups, we approximate the distance of a patient from a hospital by calculating the distance of the county center to the hospital location. After calculating distances between each referral hospital and the center of every county within an HRR we take the average of the distances to each location in the regression. Table A1 in the appendix presents those additional empirical results. Our empirical analysis reveals that the coefficient estimate on travel distance is negative across models and statistically significant only in the most basic specification.[8] The findings are consistent with our expectations. According to more reliable estimation results (columns (5) and (6)), there is no significant difference in the payment between local patients and distant patients within the same HRRs. Patients seeking tertiary care are often referred to a major hospital in the HRRs rather than choosing a tertiary hospital.

Table 3: Overall Lerner Index in the US Health Care Industry between 2010 and 2011

	Number of Health Care Providers					
	1	2	3	4	5	More than 5
Lerner Index	0.622	0.367	0.292	0.253	0.253	0.251

Our next step in the analysis is to estimate the Lerner index ($\mathbb{L}$) as $\mathbb{L} = \frac{(p-c)}{p} = |\frac{1}{\varepsilon}|$, and then estimate the markup factor as $\frac{1}{1-\mathbb{L}}$. For all six demand specifications, the estimates indicate that the demand for health care is inelastic. Table 3 and Figure 1 indicate that, during the sample period, there is a clear pattern of variation in markups as a function of the level of competition. As competition increases the estimated markups gradually decline.

[7] The omitted group is miscellaneous treatments for minor conditions.

[8] Note that we exclude the fixed effects regression model due to the time-invariant variable of distance.

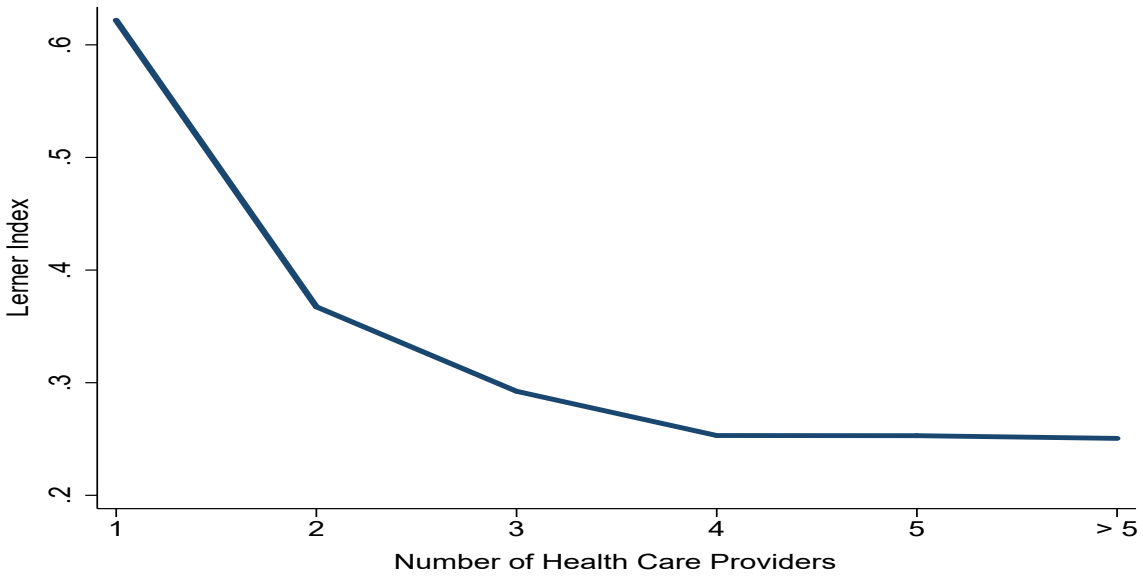

Figure 1: Overall Lerner Index in the US Health Care Industry between 2010 and 2011

For example, when there are two hospitals in an HHR, the markup is 1.58 times the cost of treatments. When there are five hospitals in an HHR, the markup is only 34% above the marginal cost.

We are also interested in controlling for price differences across medical specialties. Table 4 shows that there is naturally a considerable variation in prices across medical procedures. For example, the average price of Cardiology & Heart Surgery is $9,838 while it is $5,882 for Rehabilitation. As expected, we observe higher average prices in complex treatments as shown in Table 2. In order to capture this variations, we re-estimate the regressions for selected specialties in Table 5. The estimation results are consistent with the findings in Table 2.

Table 4: Descriptive Statistics for Average Price across Medical specialties

specialty	Number of Observations	Mean	Standard Deviation	Min	Max
Average price	317,453	$9849.84	$7856.36	$2579.00	$443966.20
Cardiology & Heart Surgery	82,155	$9838.89	$6367.99	$2579.00	$443966.20
Diabetes & Endocrinology	3,557	$5882.93	$1507.69	$3824.27	$19511.96
Ear, Nose & Throat	21,639	$13004.68	$10778.86	$3155.36	$207251.70
Gastroenterology & GI Surgery	43,438	$12482.54	$11492.81	$3091.00	$135751.10
Nephrology	20,980	$12158.43	$12356.01	$3157.82	$140255.30
Neurology & Neurosurgery	31,876	$7880.35	$3593.78	$3333.73	$142314.80
Orthopedics	29,066	$13377.86	$7852.40	$3143.67	$131187.40
Pulmonology	42,840	$7027.38	$2493.21	$3338.18	$72797.93
Rehabilitation	10,929	$5916.43	$2202.56	$3108.10	$28762.63
Urology	13,438	$7319.61	$2954.70	$3579.73	$53835.75
Other	17,535	$6547.11	$3397.20	$3040.73	$247728.90

The other specialty group includes the following medical procedures: Syncope & Collapse, Poisoning & Toxic Effects of Drugs, Cellulitis, and Psychoses.

Table 5: Estimation Results by Medical Procedures

Log (number of discharges)	Cardiology &Heart	Gastroenterology &GI Surgery	Nephrology	Rehabilitation	Urology
Log (average price)	-0.154***	-0.158***	-0.145***	-0.490***	-1.188***
	(0.004)	(0.005)	(0.006)	(0.021)	(0.019)
Log (rivals' minimum price)	0.029***	0.052***	0.059***	0.041***	0.027***
	(0.001)	(0.002)	(0.003)	(0.005)	(0.004)
Log (hospital quality score)	0.134***	0.116***	0.093***	0.200***	0.214***
	(0.004)	(0.006)	(0.008)	(0.051)	(0.009)
Log (population)	-0.248	2.285	1.576	-2.797	-0.598
	(1.161)	(1.881)	(2.162)	(3.001)	(2.660)
Log (number of procedures)	0.523***	0.371***	0.681***	0.413***	0.553***
	(0.005)	(0.006)	(0.009)	(0.016)	(0.009)
Log (number of insured people)	0.345	-1.493	-1.536	1.845	-0.045
	(0.842)	(1.376)	(1.589)	(2.165)	(1.963)
Log (income)	0.098	-0.077	0.107	0.394	-0.200
	(0.233)	(0.385)	(0.438)	(0.580)	(0.546)
HRR Fixed Effects	Yes	Yes	Yes	Yes	Yes
Time Dummy	Yes	Yes	Yes	Yes	Yes
Observations	82,155	43,438	20,980	10,929	13,438

*** Denotes statistical significance at the 1% level, ** denotes significance at the 5% and * denotes significance at the 10% level. Standard errors are in parentheses.

4 Conclusion

In this article, we present estimates of the demand in the health care industry. The empirical results show that rivals' pricing strategy, hospital-specific quality, and the number of medical procedures are the main factors that affect firm markups in the market. Finally, we provide empirical evidence that localized competition in the health care industry is a critical factor that determines hospital markups. Indeed, an increase in the level of competition leads to a decrease in their markups in the health care industry.

It is clear that competition lowers prices. In the US, many local markets are dominated by two to three large hospital systems due to a dramatic wave of hospital consolidation. According to US Census Bureau, the rate of uninsured among the US population was almost 8.8% in 2016. Health care spending in the country was about $10,348 per person in 2016. The Peterson-Kaiser Health System Tracker finds that the quality in the US health care system has been improving in many years, but the comparable OECD countries that are similarly wealthy based on GDP per capita outperform the US in a variety of quality measures, including life expectancy at birth. As is evident from our empirical results, competition could be the root of the problem in the US health care industry. Policy makers needs to understand the nature of competition in the regional health care markets and work to promote efficiency.

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A Appendix

Table A1: Estimation Results

Log (number of discharges)	(1)	(2)	(3)	(4)	(5)
Log (average price)	-0.035***	-0.094***	-0.094***	-0.094***	-0.068***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Log (rivals' minimum price)	0.020***	0.040***	0.040***	0.040***	0.039***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Log (hospital quality score)	0.137***	0.107***	0.107***	0.107***	0.107***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Log (distance)	-0.004**	-0.002	-0.002	-0.002	-0.002
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Log (population)	0.040	0.015	-0.144	-0.145	-0.134
	(0.332)	(0.319)	(0.635)	(0.636)	(0.625)
Log (number of procedures)		0.396***	0.396***	0.396***	0.425***
		(0.003)	(0.003)	(0.003)	(0.003)
Log (number of insured people)			0.136	0.137	0.107
			(0.465)	(0.466)	(0.457)
Log (income)				0.007	0.019
				(0.128)	(0.126)
Cardiology & Heart Surgery					-0.095***
					(0.006)
Diabetes & Endocrinology					-0.381***
					(0.009)
Ear, Nose & Throat					-0.314***
					(0.007)
Gastroenterology & GI Surgery					-0.035***
					(0.007)
Nephrology					-0.043***
					(0.007)
Neurology & Neurosurgery					-0.173***
					(0.007)
Orthopedics					-0.014*
					(0.008)
Pulmonology					0.172***
					(0.006)
Rehabilitation					0.052***
					(0.008)
Urology					0.082***
					(0.008)
HRR Fixed Effects	Yes	Yes	Yes	Yes	Yes
Time Dummy	Yes	Yes	Yes	Yes	Yes
Observations	317,453	317,453	317,453	317,453	317,453

*** Denotes statistical significance at the 1% level, ** denotes significance at the 5% and * denotes significance at the 10% level. Standard errors are in parentheses.