Do Higher-Priced Hospitals Deliver Better Quality?

Zack Cooper, Joseph J. Doyle Jr., John A. Graves, Jonathan Gruber
(January 2023)

Jason Buxbaum, PhD Program in Health Policy

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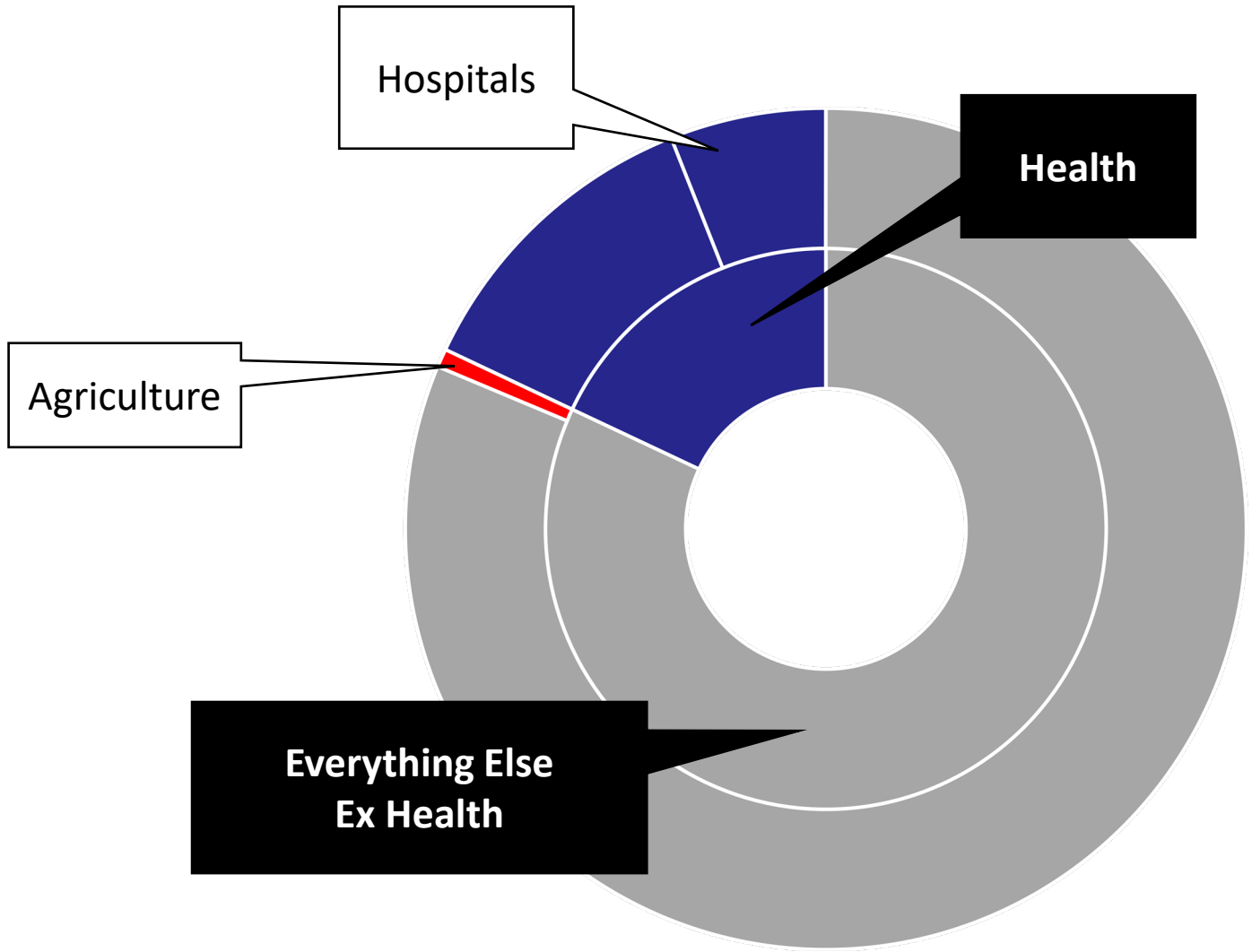
The Hospital Industry

- US GDP $23 trillion+



Motivation

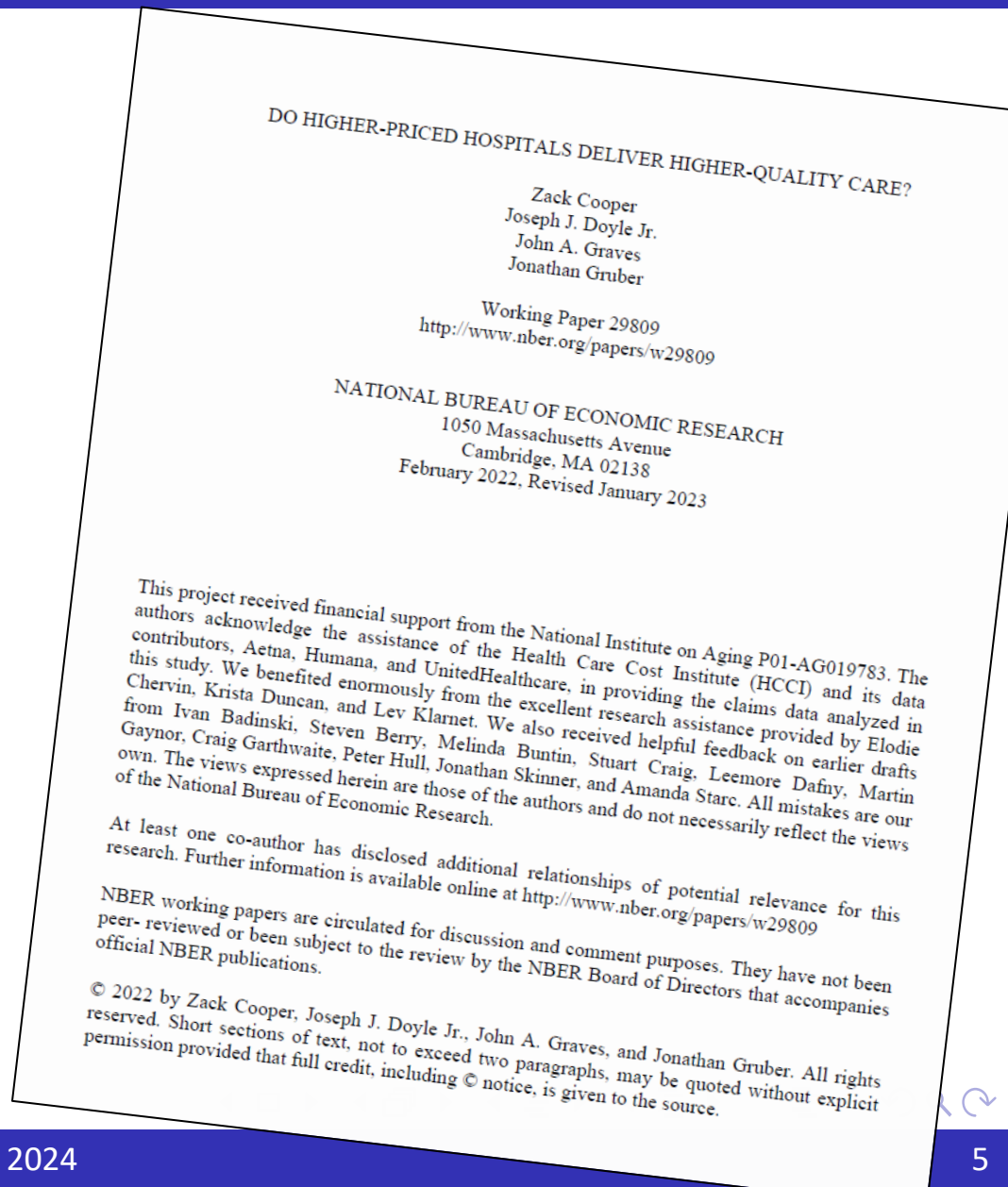
- US Hospital spending is internationally exceptional
- If spend is (historically) p*q:
  - q – not clearly outlier
  - p – suspicious
    - Year-over-year growth
    - Inter-market variation
    - Intra-market variation

Motivation

- Reasonable to scrutinize hospital spend and its determinants
- Nevertheless, difficult to know if marginal dollar “worth it”

Research Questions

- Do higher-priced hospitals deliver better quality?
  - Mortality as “canary in the coal mine”; (arguably) most patient-centered of quality measures
  - Consider concentrated vs unconcentrated treatment effects



DO HIGHER-PRICED HOSPITALS DELIVER HIGHER-QUALITY CARE?

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Working Paper 29809
http://www.nber.org/papers/w29809

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1050 Massachusetts Avenue
Cambridge, MA 02138
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This project received financial support from the National Institute on Aging P01-AG019783. The authors acknowledge the assistance of the Health Care Cost Institute (HCCI) and its data contributors, Aetna, Humana, and UnitedHealthcare, in providing the claims data analyzed in this study. We benefited enormously from the excellent research assistance provided by Elodie Chervin, Krista Duncan, and Lev Klarnet. We also received helpful feedback on earlier drafts from Ivan Badinski, Steven Berry, Melinda Buntin, Stuart Craig, Leemore Dafny, Martin Gaynor, Craig Garthwaite, Peter Hull, Jonathan Skinner, and Amanda Starc. All mistakes are our own. The views expressed herein are those of the authors and do not necessarily reflect the views of the National Bureau of Economic Research.

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Favorite Related Study

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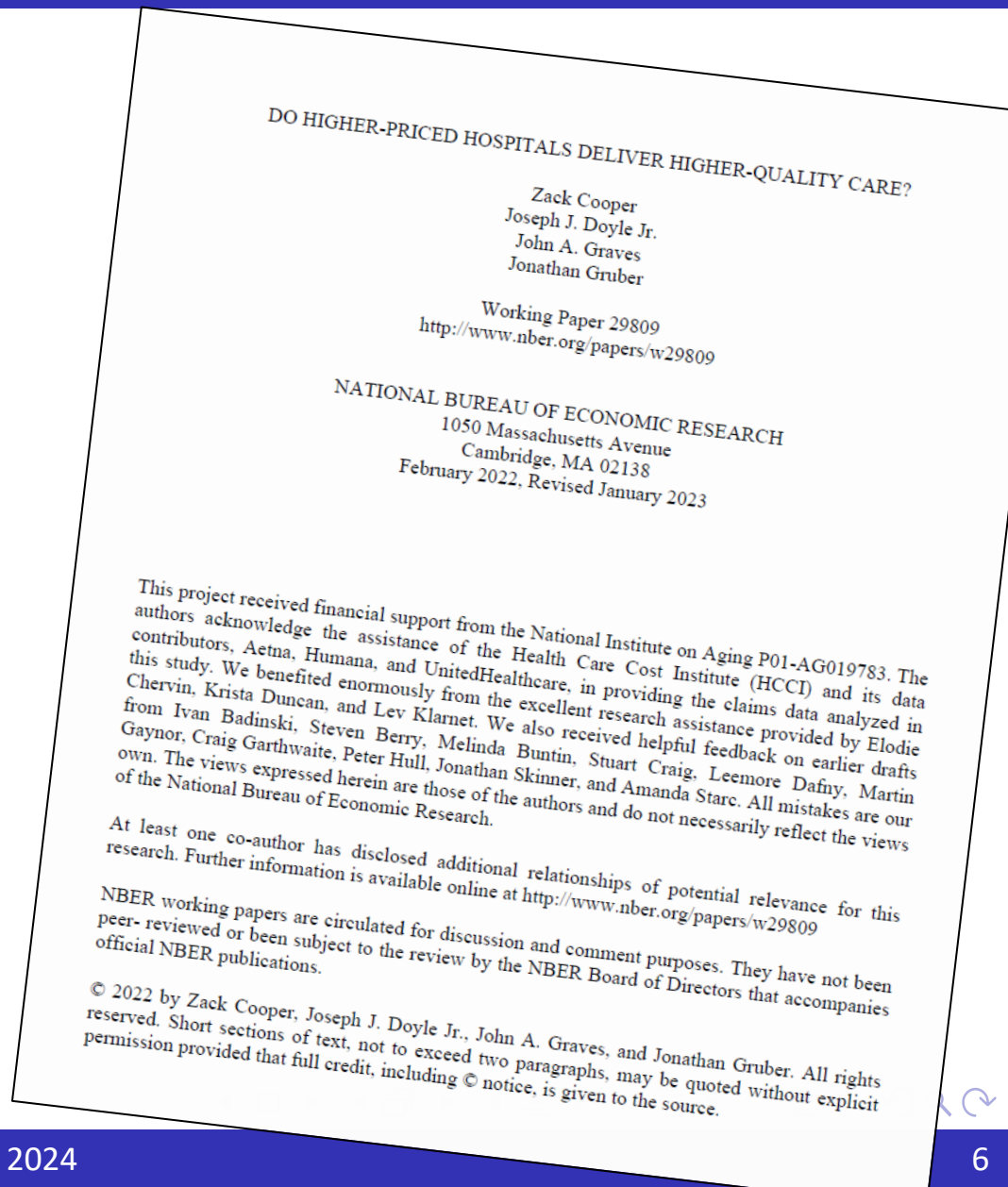

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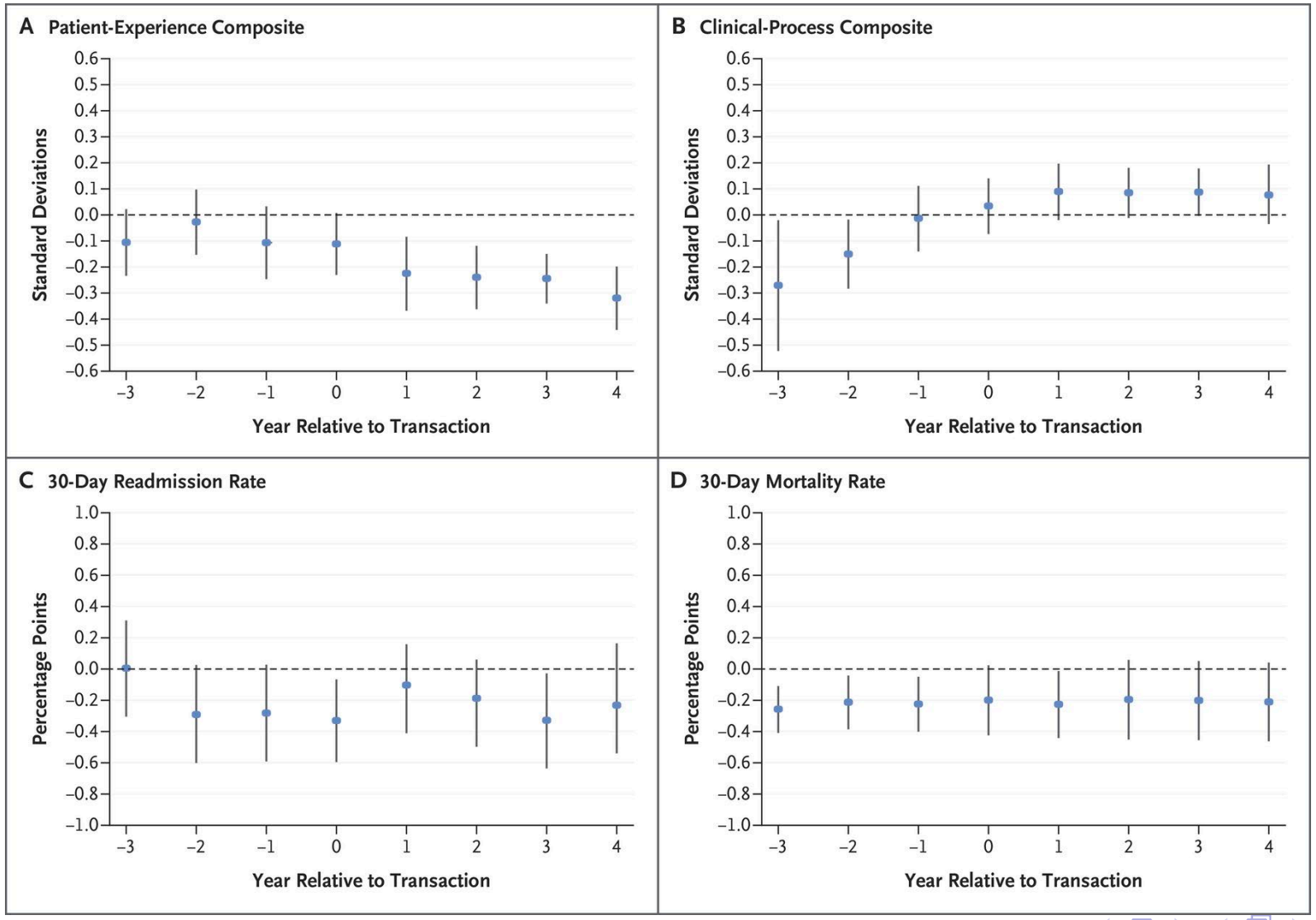
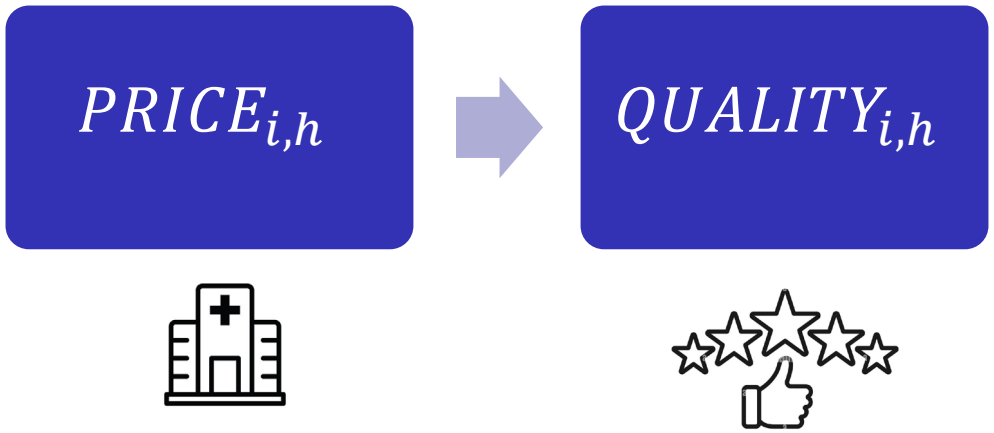
Beaulieu et al: Changes in Quality of Care after Hospital Mergers and Acquisitions



Approach



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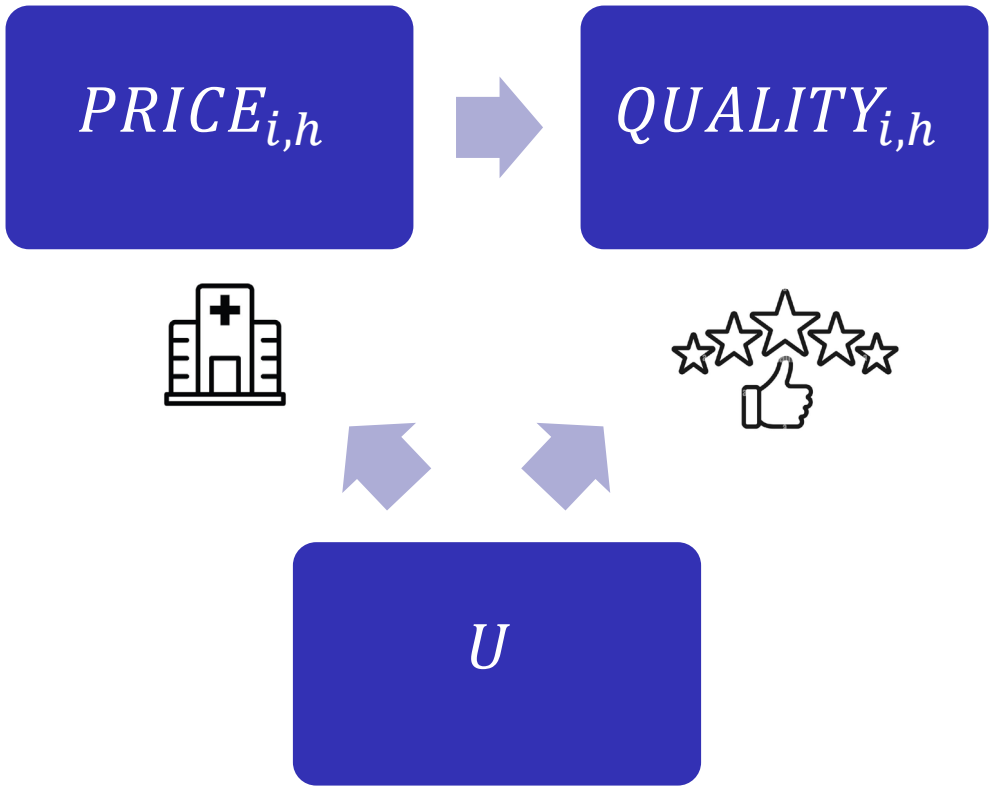

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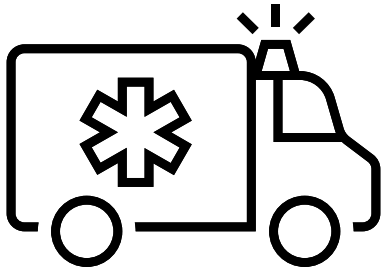

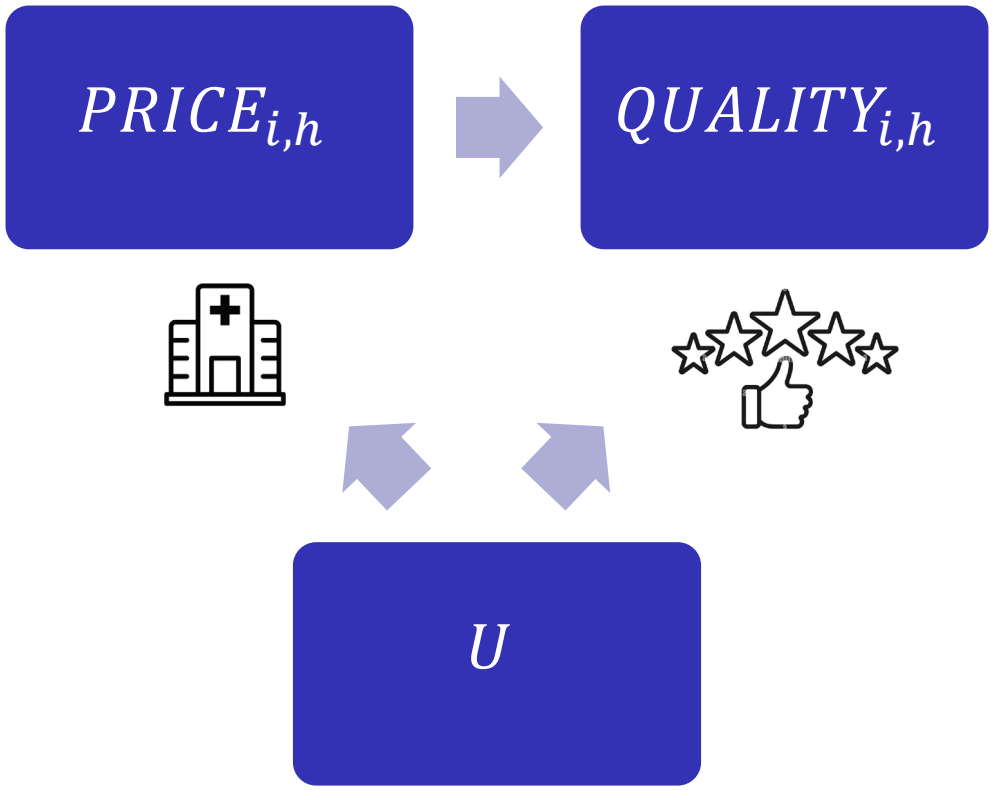

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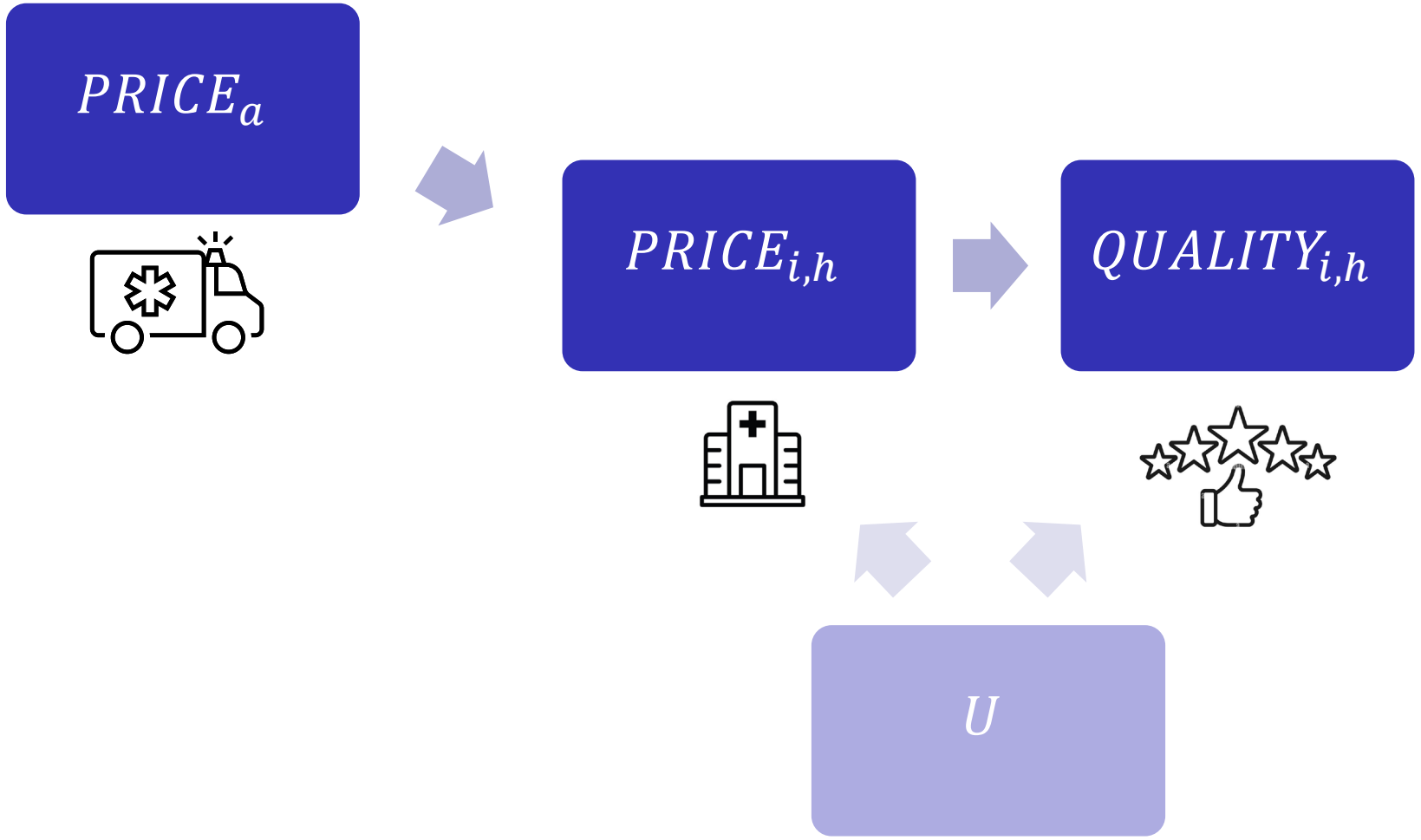

Data

- Sources
  - Health care claims from Health Care Cost Institute (HCCI) database
    - Employer-sponsored coverage from Aetna, Humana, or United
  - AHA survey, CMS Physician Compare, USNWR rankings

Data

- Sample
  - Inpatient admissions for “nondeferrable” conditions where patients arrive by ambulance
    - ~1/3 of inpatient admits in HCCI data
  - 2008 through 2014
  - Exclude admits at hospitals in Maryland, without price indices, low volume, far from patient home ZIP

Key Variables

- Z: Ambulance-level index of hospital prices
- X: Price index at hospital of admission
- Y: Predicted mortality at hospital h
- HHI: Concentration of beds in 30-min radius of hospital h

In practice, for patient i assigned to ambulance company a_i, we calculate the average hospital price among patients in our sample for each ambulance company.

$$Z_{a_i} = \frac{1}{N_{a_i} - 1} \sum_{j \neq i}^{N_{a_i}-1} P_{h_j} \tag{1}$$

This measure, Z_{a_i}, is the ambulance company fixed effect in a model predicting P_h that leaves out patient i. P_h is an inpatient price index constructed following Cooper et al. (2019). The price index, which we describe in more detail

IV

- Challenge: (unobservable) sicker patients select into higher-priced hospitals
- Monotonicity
  - Probability of treatment increases with instrument
  - IV: LATE, weights proportional to effect of instrument on probability of receiving treatment)
- Exclusion restriction

Estimation

$$(3) \qquad P_{h_i} = \alpha_0 + \alpha_1 Z_{a_i} + \alpha_2 X_{i,t} + \alpha_3 A_i + \alpha_4 D_i + \theta_{z_i} + \phi_{o_i} + \lambda_{t_i} + \upsilon_i$$

$$(2) \qquad Outcome_{i,t} = \pi_0 + \pi_1 P_{h_i} + \pi_2 X_{i,t} + \pi_3 A_i + \pi_4 D_i + \theta_{z_i} + \phi_{o_i} + \lambda_{t_i} + \epsilon_i$$

Subgroup analysis: stratify sample into high v. low concentration (HHI > 4000)

Limitations

- Can’t make inferences about whether higher prices would increase quality
- Outcome excludes Medicare benes
- Doesn’t examine possibility of heterogenous treatment effects across populations served
- Uses 2SLS estimation for outcome notwithstanding relative rareness of mortality
  - Sensitivity analysis?

Balance

Table 1: Hospital- and Ride-Level Characteristics

Panel A: Hospital Level	Mean	SD	p5	p25	p50	p75	p95	N
Price Index	14,865	4,698	8,765	11,713	14,335	17,045	23,520	1,857
Hospital HHI	4,388	2,614	1,225	2,366	3,773	5,464	10,000	1,857

Table 2: Balance Test of Patient Characteristics and Diagnoses Across Quartiles of the IV

	1st Quartile	2nd Quartile	3rd Quartile	4th Quartile	1st vs. 4th Difference	Below vs. Above Median
Ambulance Instrument	14,567	14,820	14,981	15,328	760.442***	461.393***
Male	0.51	0.51	0.51	0.51	0.001	-0.001
0–17 Years Old	0.05	0.05	0.05	0.05	-0.001	0.000
18–24 Years Old	0.05	0.05	0.05	0.05	0.002	0.001
25–34 Years Old	0.07	0.07	0.07	0.07	0.002	0.001
35–44 Years Old	0.13	0.13	0.13	0.13	0.002	0.001
45–54 Years Old	0.27	0.27	0.27	0.27	-0.001	-0.000
55–64 Years Old	0.43	0.43	0.43	0.43	-0.002	-0.002
Charlson Comorbidity Score	1.11	1.12	1.13	1.11	-0.001	0.009
General Symptoms	0.60	0.60	0.60	0.60	0.000	-0.000
Other Lung Diseases	0.25	0.25	0.25	0.25	0.001	0.001
Injury Neck, Nose	0.17	0.16	0.16	0.17	0.004*	0.001
Penumonia, Unspecified Organism	0.11	0.11	0.11	0.10	-0.002	-0.001
Acute Myocardial Infarction	0.08	0.09	0.08	0.08	-0.000	-0.001
Other Urinary Tract Infection	0.08	0.08	0.08	0.08	0.000	0.000
Septicemia	0.07	0.07	0.07	0.07	-0.000	0.000
Cerebral Artery Occlusion	0.07	0.07	0.07	0.07	-0.001	-0.001
Diseases of Esophagus	0.05	0.06	0.06	0.05	-0.000	-0.000
Transient Cerebral Ischemias	0.05	0.05	0.05	0.05	0.000	0.000
Disorder of Muscle Ligament and Fascia	0.04	0.04	0.04	0.04	-0.000	-0.001
Precerebral Occlusion	0.04	0.04	0.04	0.04	-0.001	-0.000
Psychotropic Agent Poisoning	0.03	0.03	0.03	0.03	-0.000	-0.000
Intestinal Obstruction	0.03	0.03	0.03	0.03	-0.001	0.000
Ankle Fracture	0.03	0.03	0.03	0.03	0.000	0.000
Observations	48,052	47,548	47,739	47,706		

Note: Values are adjusted for zip code fixed effects. Our comorbidity score is measured via a Charlson Index constructed using six months of prior health claims. The diagnoses listed represent 87 percent of non-discretionary diagnoses in our sample. For full list see Appendix Table 1. The data are at the patient-ride level. * p <0.1; ** p <0.05; *** p <0.01.

Table 3: First- and Second- Stage Regressions Estimating the Relationship Between Hospital Prices, Episode Spending, and Mortality

Panel A: First Stage

	Inpatient Price Index (1)
Ambulance Average Hospital Price Index	0.6683***
	(0.0226)
First-Stage F Stat	877
Outcome mean	14,865
Observations	191,045

Panel B: OLS

	Log Admission Spending (1)	In-Hospital Mortality (2)	Predicted Mortality (3)
Inpatient Price Index	0.5427***	0.0018	0.0026***
	(0.0145)	(0.0011)	(0.0005)
Outcome Mean	28,232	0.0275	0.0275
Observations	191,045	191,045	191,045

Panel C: Second Stage of 2SLS

	Log Admission Spending (1)	In-Hospital Mortality (2)	Pre ality (3)
Inpatient Price Index	0.5349***	-0.0102***	0.0005
	(0.0360)	(0.0037)	(0.0013)
Outcome Mean	28,232	0.0275	0.0275
Observations	191,045	191,045	191,045

2 SD Increase

1 - (0.0275–-0.0102)/0.0275 = -37%

Table 7: Estimating the Relationship Between Hospital Prices and Mortality in Concentrated and Unconcentrated Markets

Panel A: OLS

	Log Admission Spending		In-Hospital Mortality		Predicted Mortality	
	(1)	(2)	(3)	(4)	(5)	(6)
Inpatient Price Index	0.5427***	0.5359***	0.0018	0.0007	0.0026***	0.0026***
	(0.0145)	(0.0163)	(0.0011)	(0.0013)	(0.0005)	(0.0006)
Inpatient Price Index * HHI Above 4,000		0.0386		0.0053**		-0.0001
		(0.0314)		(0.0026)		(0.0012)
Outcome Mean	28,232	28,232	0.0275	0.0275	0.0275	0.0275
Observations	191,045	191,045	191,045	191,045	191,045	191,045

Panel B: Second Stage of 2SLS

	Log Admission Spending		In-Hospital Mortality		Predicted Mortality	
	(1)	(2)	(3)	(4)	(5)	(6)
Inpatient Price Index	0.5349***	0.5415***	-0.0102***	-0.0129***	0.0005	0.0010
	(0.0360)	(0.0394)	(0.0037)	(0.0041)	(0.0013)	(0.0013)
Inpatient Price Index * HHI Above 4,000		0.0034		0.0115**		-0.0011
		(0.0537)		(0.0052)		(0.0021)
Outcome Mean	28,232	28,232	0.0275	0.0275	0.0275	0.0275
Observations	191,045	191,045	191,045	191,045	191,045	191,045

Table 9: Estimating the Relationship Between Hospital Prices and Care Delivered in Concentrated and Unconcentrated Markets

Panel A: OLS

	Mean of DRG Weights		Length of Stay		Procedure Preformed	
	(1)	(2)	(3)	(4)	(5)	(6)
Inpatient Price Index	0.1147***	0.1176***	0.6166***	0.6193***	0.0321***	0.0311***
	(0.0180)	(0.0208)	(0.0698)	(0.0820)	(0.0034)	(0.0038)
Inpatient Price Index * HHI Above 4,000		-0.0087		0.0100		0.0062
		(0.0411)		(0.1301)		(0.0074)
Outcome Mean	1.6340	1.6340	5.0825	5.0825	0.2442	0.2442
Observations	191,045	191,045	191,045	191,045	191,045	191,045

Panel B: Second Stage of 2SLS

	Mean of DRG Weights		Length of Stay		Procedure Preformed	
	(1)	(2)	(3)	(4)	(5)	(6)
Inpatient Price Index	0.0435	0.0476	0.2802	0.3571*	0.0100	0.0115
	(0.0531)	(0.0600)	(0.1767)	(0.2006)	(0.0100)	(0.0110)
Inpatient Price Index * HHI Above 4,000		0.0288		-0.1217		0.0040
		(0.0879)		(0.2397)		(0.0165)
Outcome Mean	1.6340	1.6340	5.0825	5.0825	0.2442	0.2442
Observations	191,045	191,045	191,045	191,045	191,045	191,045

Note: All models include 5-digit zip code and year fixed effects. The price index is based on all inpatient claims (adjusted for inflation) between 2008 and 2014. We control for point of origin (home, nursing home, or scene of accident), diagnoses, demographics and ambulance characteristics. Diagnostic controls include a list of 29 non-discretionary diagnoses codes. Demographic controls include indicators for age category and gender. Ambulance controls include payment to the company, whether the transport utilized advanced life support, and whether the transport was coded as emergency transport.

Table 10: Hospital Characteristics by Market Concentration and Price Levels

Price	HHI < 4,000		HHI ≥ 4,000		Difference in Means		
	Low	High	Low	High	(2) vs. (1)	(4) vs. (3)	(4) vs. (2)
	(1)	(2)	(3)	(4)			
Hospital Characteristics							
Number of Technologies	60	66	53	61	5.953***	7.558***	-5.418***
Number of Beds	293	340	199	262	47.271***	62.368***	-78.234***
Graduate Medical Education Accredited Program	0.44	0.47	0.19	0.26	0.028	0.068***	-0.211***
Medical School Affiliation	0.49	0.52	0.27	0.33	0.021	0.061**	-0.187***
Council of Teaching Hospital Member	0.13	0.22	0.04	0.06	0.097***	0.025*	-0.162***
Government	0.10	0.10	0.12	0.10	0.002	-0.023	-0.008
Non-Profit	0.72	0.67	0.68	0.72	-0.052*	0.037	0.051*
Medicare Share of Patient	44.65	41.29	48.05	47.15	-3.353***	-0.898	5.858***
Medicaid Share of Patient	19.37	20.45	18.19	18.10	1.080	-0.093	-2.352***
FTE Registered Nurses Per Bed	1.63	1.86	1.48	1.76	0.232***	0.284***	-0.099**
FTE Licensed Practical Nurses Per Bed	0.08	0.07	0.14	0.12	-0.009*	-0.013	0.048***
Payroll Per Bed	334,001	413,921	292,660	377,237	79,920***	84,576***	-36,685***
Physician Measures							
Years Since Graduation in 2014	21.15	20.33	20.95	20.67	-0.824***	-0.281**	0.337***
Share of Graduates From a Top 25 U.S. Medical School	0.18	0.23	0.15	0.17	0.048***	0.021***	-0.059***
Share of Male Physicians	0.74	0.73	0.78	0.77	-0.013***	-0.015***	0.036***
Observations	514	477	404	462			

Contributions

- Where to send Grandma
- Strengthens case for action re: monopolistic competition
- Give us pause before embracing rate-setting (or aggressive regulation)
- Somewhat more compelling than prior work from Beaulieu et al. (though also somewhat different question)

Reflections

- I love the research question
- I love the outcome (mortality)
- I “buy” the (well-established) instrument
  - But the explanation is difficult to follow if you aren’t familiar with the instrument
  - Tables need TLC
- I do not find the explanation very compelling
- I’d like to see an analysis of heterogenous treatment across race/ethnicity – or at least some discussion of this possibility