Demand and supply of differentiated products

Applications - Hospital Mergers

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UBC
Economics 567

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Section 1

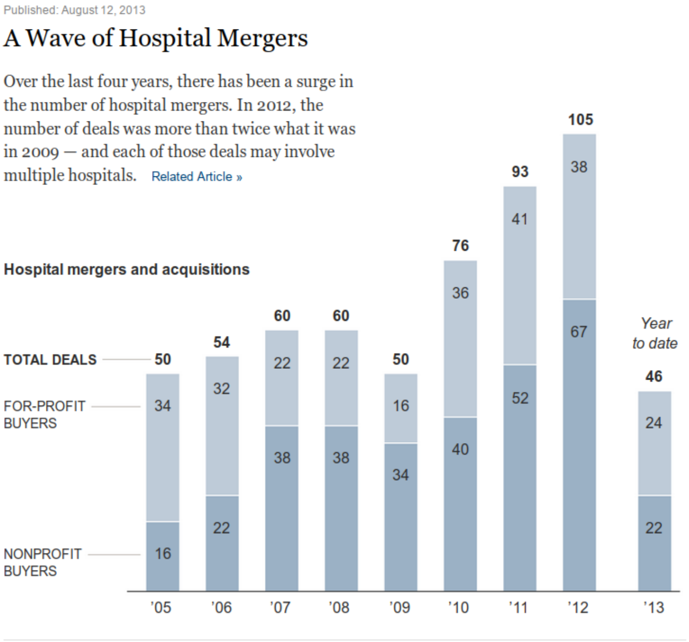
Gaynor and Vogt (2003)

Gaynor and Vogt (2003) “Competition Among Hospitals”

- California hospitals
- Structural model of demand & pricing
- Merger simulation

Motivation

- Many hospital mergers, 900 from 1994-2000 (among 6100 hospitals)
- Profit vs non-profit plays role in antitrust decisions
    - 1993-2002: 6 federal anti-trust cases, one initially won (but lost on appeal)
    - Non-profit hospitals have argued that they will not raise prices — court reaction mixed, generally sympathetic



Published: August 12, 2013

A Wave of Hospital Mergers

Over the last four years, there has been a surge in the number of hospital mergers. In 2012, the number of deals was more than twice what it was in 2009 — and each of those deals may involve multiple hospitals. Related Article »

Hospital mergers and acquisitions

- Source.

Continued relevance

- “Regulators Tamp Down on Mergers of Hospitals” NYTimes Dec 18, 2015
- “The Future of Health Care Mergers Under Trump” NYTimes Nov 20, 2016
- “How Nonprofit Hospitals Put Profits Over Patients” NYTimes The Daily Jan 25, 2023

Prior literature

- Structure-conduct-performance
  - Regress market performance (price) on market structure

$$price_{mt} = \beta concentration_{mt} + \epsilon_{mt}$$

  - Typically find $\beta > 0$
  - Results mixed when concentration interacted with non-profit
- Other contemporaneous (in 2003) structural work

Model: Utility

- Utility of consumer *i* from hospital *j*:

$$V_{ij} = -\alpha_i^P \overset{\text{Price}}{p_j} \underset{\text{Quantity}}{q_i} + v(q_i, \underset{\text{Consumer Chars}}{R_i}, \underset{\text{Hospital Chars}}{S_j})$$

- Aggregate to get demand, $D_j(p)$

Model: Profits

- Hospital profits:

$$\pi_j = \overbrace{p_j D_j(p)}^{\text{Revenue}} - \underbrace{C(D_j(p); Z_j, \zeta_j, W)}_{\text{Cost Function}}$$

Model: For-Profit Pricing

- For-profit pricing: $\max_{p_j} \pi_j$

$$p_j = \overbrace{\frac{\partial C_j}{\partial D_j}}^{\text{Marginal Cost}} - \underbrace{\frac{D_j}{\partial D_j / \partial p_j}}_{\text{Markup}}$$

Model: Non-Profit Pricing

- Non-profit maximizing utility: $\max_{p_j} U_j(\pi_j, D_j)$ s.t. $\pi_j \geq \pi_L$

$$p_j = \text{MC} - \underbrace{\frac{\partial U_j / \partial D_j}{\partial U_j / \partial \pi_j + \mu_j}}_{\text{Non-profit Adjustment}} - \frac{D_j}{\partial D_j / \partial p_j}$$

- Merged hospital systems maximize sum of profits or utility

Data

- California OSHPD `https://www.oshpd.ca.gov/HID/Find-Hospital-Data.html`
- annual discharge, annual financial, & quarterly financial data for 1995
- 913,660 discharges (*i*) and 374 hospitals

TABLE 2 **Variable Descriptions**

Name	Description	Mean	Standard Deviation
X	**Consumer Characteristics**		
q	E(quantity) from equation (9)	1.24	1.61
HMO	Membership in HMO	.50	
PPO	Membership in PPO	.31	
Unscheduled	Unscheduled admission	.53	
d	**Distance**		
$d_{i \to j}$	Distance to (chosen) hospital (miles)	11.56	27.78
$d_{i \to j}^2$	Distance^2		
Z	**Hospital Characteristics**		
p	E(price) from equation (9)	4696	1603
FP	For-profit status	.28	
NFP	Not-for-profit status	.52	
Teach	Teaching hospital	.21	
Tech Index	Technology index	15.02	6.06
System	Multihospital system member	.49	
W	**Input Prices**		
W	Wage index	.99	.15

Econometric Model : Hospital Choice

- **Step 1:** Estimate parameters from individual choice data.
- Indirect Utility (V_{ij}) of patient i for hospital j:

$$V_{ij} = -\overbrace{\tilde{\alpha}_i^P p_j E[q_i]}^{\text{Exp. Cost (Price} \times \text{Quantity)}} + \underbrace{\tilde{\alpha}_i^d d_{ij} + \tilde{\alpha}_i^{d^2} d_{ij}^2}_{\text{Distance Effect}} + \underbrace{\sum_k \tilde{\alpha}_{ik} Z_{jk}}_{\text{Hospital Characteristics}} + \overbrace{\xi_j}^{\text{Unobserved Quality}} + \epsilon_{ij}$$

- Quantity Equation (Health Status):

$$q_i = \underbrace{\exp\left(X_i \beta + \nu_i\right)}_{\text{Patient Severity / Complexity}}$$

- Heterogeneity in coefficients:
  - Price Sensitivity:

$$\tilde{\alpha}_i^P = \exp(\alpha_0^P + X_i \alpha^P)$$

  - Distance Sensitivity:

$$\tilde{\alpha}_i^d = \rho + X_i \rho^X$$

Econometric Model: Hospital Choice

- Decomposition for Estimation:

$$V_{ij} = \delta_j + \mu_{ij}(X_i, Z_j, p_j) + \epsilon_{ij}$$

  - δ_j: Mean utility (Hospital Fixed Effect)
  - μ_{ij}: Individual-specific deviations
- Estimate $\hat{\delta}$, $\hat{\alpha}^P$, $\hat{\rho}^X$, etc by logit on individual choices

Econometric Model: Demand 1

Step 2: estimate $\bar{\alpha}$ (include α^p) by 2SLS

$$\delta_j = \overbrace{\boxed{Z_j\bar{\alpha}}}^{\text{Observed Characteristics}} + \underbrace{\boxed{\xi_j}}_{\text{Unobserved Quality}}$$

- Instruments: wages, exogenous product characteristics, consumer characteristics
    - Functional form of instruments: from FOC,

      $$p_j = \frac{\partial C_j}{\partial D_j} - \frac{D_j}{\partial D_j / \partial p_j}$$

      use estimate of D_j and $\frac{D_j}{\partial D_j / \partial p_j}$ (with $\alpha^p = 0$ and $\xi = 0$)
    - D_j depends on coefficients first assume 0, get initial estimates, then redo to get final estimates

Econometric Model: Marginal Costs

Step 3 : estimate marginal cost function by 2SLS

$$\underbrace{P + \left(\Theta \cdot \times \frac{\partial D}{\partial p}\right)^{-1} D}_{\text{Marginal Revenue}} = \underbrace{\omega_0 + D\omega_D + W\omega_W + Z\omega_Z + \zeta}_{\text{Marginal Cost}}$$

- D endogenous, same instruments as step 2

- Results as expected
- How to do inference?
    - 913,660 patients
    - 374 hospitals
    - 413 parameters

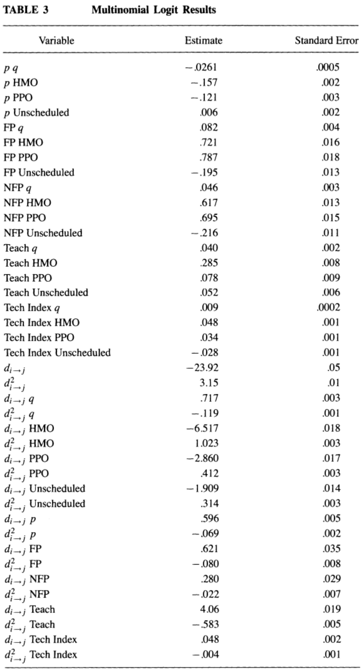


TABLE 3 **Multinomial Logit Results**

Variable	Estimate	Standard Error
$p\ q$	−.0261	.0005
p HMO	−.157	.002
p PPO	−.121	.003
p Unscheduled	.006	.002
FP q	.082	.004
FP HMO	.721	.016
FP PPO	.787	.018
FP Unscheduled	−.195	.013
NFP q	.046	.003
NFP HMO	.617	.013
NFP PPO	.695	.015
NFP Unscheduled	−.216	.011
Teach q	.040	.002
Teach HMO	.285	.008
Teach PPO	.078	.009
Teach Unscheduled	.052	.006
Tech Index q	.009	.0002
Tech Index HMO	.048	.001
Tech Index PPO	.034	.001
Tech Index Unscheduled	−.028	.001
$d_{i\to j}$	−23.92	.05
$d^2_{i\to j}$	3.15	.01
$d_{i\to j}\ q$	.717	.003
$d^2_{i\to j}\ q$	−.119	.001
$d_{i\to j}$ HMO	−6.517	.018
$d^2_{i\to j}$ HMO	1.023	.003
$d_{i\to j}$ PPO	−2.860	.017
$d^2_{i\to j}$ PPO	.412	.003
$d_{i\to j}$ Unscheduled	−1.909	.014
$d^2_{i\to j}$ Unscheduled	.314	.003
$d_{i\to j}\ p$	.596	.005
$d^2_{i\to j}\ p$	−.069	.002
$d_{i\to j}$ FP	.621	.035
$d^2_{i\to j}$ FP	−.080	.008
$d_{i\to j}$ NFP	.280	.029
$d^2_{i\to j}$ NFP	−.022	.007
$d_{i\to j}$ Teach	4.06	.019
$d^2_{i\to j}$ Teach	−.583	.005
$d_{i\to j}$ Tech Index	.048	.002
$d^2_{i\to j}$ Tech Index	−.004	.001

First stage

- This paper was written at same time the weak identification literature was developing

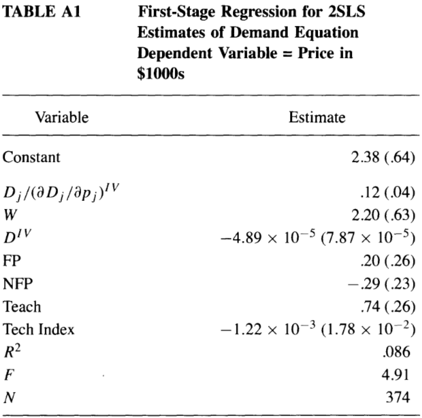


TABLE A1 **First-Stage Regression for 2SLS Estimates of Demand Equation Dependent Variable = Price in \$1000s**

Variable	Estimate
Constant	2.38 (.64)
$D_j/(\partial D_j/\partial p_j)^{IV}$	.12 (.04)
W	2.20 (.63)
D^{IV}	-4.89×10^{-5} (7.87×10^{-5})
FP	.20 (.26)
NFP	−.29 (.23)
Teach	.74 (.26)
Tech Index	-1.22×10^{-3} (1.78×10^{-2})
R^2	.086
F	4.91
N	374

Demand

- Average elasticity -4.85 (2.03)

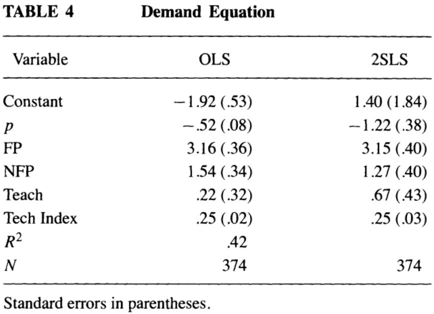


TABLE 4 **Demand Equation**

Variable	OLS	2SLS
Constant	−1.92 (.53)	1.40 (1.84)
p	−.52 (.08)	−1.22 (.38)
FP	3.16 (.36)	3.15 (.40)
NFP	1.54 (.34)	1.27 (.40)
Teach	.22 (.32)	.67 (.43)
Tech Index	.25 (.02)	.25 (.03)
R^2	.42	
N	374	374

Standard errors in parentheses.

- For-profit prices \$248 (187) higher
  - Behavioral marginal cost \$592 (329) higher
  - Markup 1183 (587) for profit, 948 (345) non-profit
- First-stage F-stat p-value < 0.01
- What is being assumed about dependence of ξ_j when calculating standard errors?

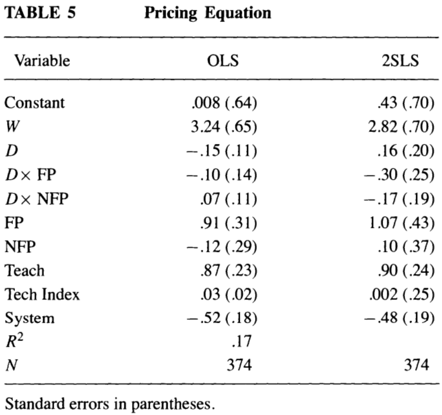


TABLE 5 **Pricing Equation**

Variable	OLS	2SLS
Constant	.008 (.64)	.43 (.70)
W	3.24 (.65)	2.82 (.70)
D	−.15 (.11)	.16 (.20)
$D\times$ FP	−.10 (.14)	−.30 (.25)
$D\times$ NFP	.07 (.11)	−.17 (.19)
FP	.91 (.31)	1.07 (.43)
NFP	−.12 (.29)	.10 (.37)
Teach	.87 (.23)	.90 (.24)
Tech Index	.03 (.02)	.002 (.25)
System	−.52 (.18)	−.48 (.19)
R^2	.17	
N	374	374

Standard errors in parentheses.

Cross-price elasticities

FIGURE 1

SPATIAL DIFFERENTIATION

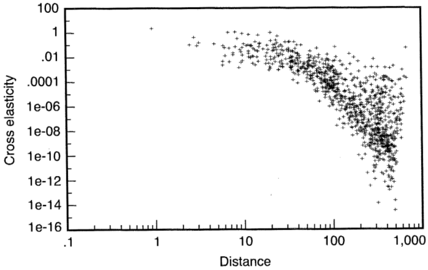
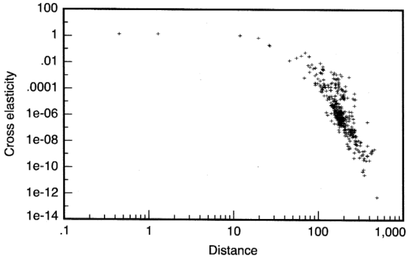


FIGURE 2

SUBSTITUTION WITH FRENCH HOSPITAL



Merger simulation

- Tenet & Ornda merged in 1997
- FTC required Tenet divest French Hospital (bought by Vista)
- Simulate assuming:
    - No divestiture of French
    - With divestiture of French
    - No divestiture, but assuming non-profit

Merger simulation

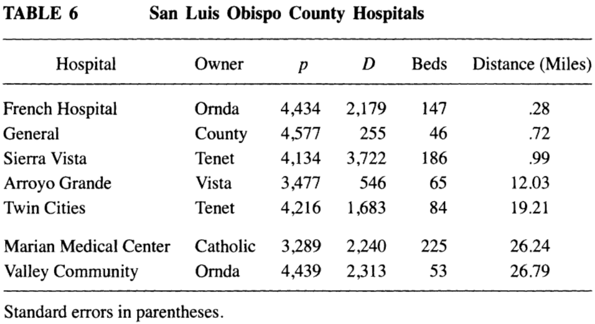


TABLE 6 **San Luis Obispo County Hospitals**

Hospital	Owner	p	D	Beds	Distance (Miles)
French Hospital	Ornda	4,434	2,179	147	.28
General	County	4,577	255	46	.72
Sierra Vista	Tenet	4,134	3,722	186	.99
Arroyo Grande	Vista	3,477	546	65	12.03
Twin Cities	Tenet	4,216	1,683	84	19.21
Marian Medical Center	Catholic	3,289	2,240	225	26.24
Valley Community	Ornda	4,439	2,313	53	26.79

Standard errors in parentheses.

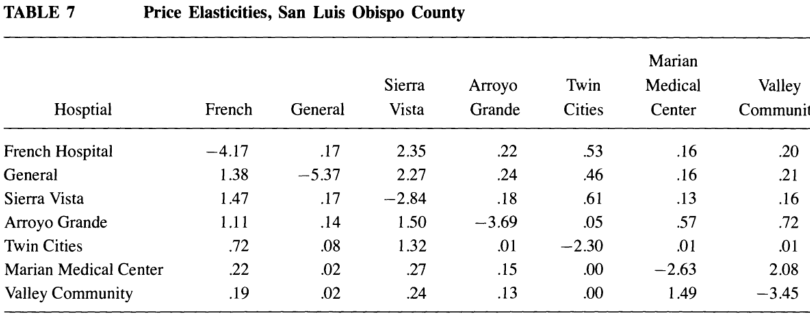


TABLE 7 **Price Elasticities, San Luis Obispo County**

Hosptial	French	General	Sierra Vista	Arroyo Grande	Twin Cities	Marian Medical Center	Valley Communit
French Hospital	−4.17	.17	2.35	.22	.53	.16	.20
General	1.38	−5.37	2.27	.24	.46	.16	.21
Sierra Vista	1.47	.17	−2.84	.18	.61	.13	.16
Arroyo Grande	1.11	.14	1.50	−3.69	.05	.57	.72
Twin Cities	.72	.08	1.32	.01	−2.30	.01	.01
Marian Medical Center	.22	.02	.27	.15	.00	−2.63	2.08
Valley Community	.19	.02	.24	.13	.00	1.49	−3.45

Merger simulation

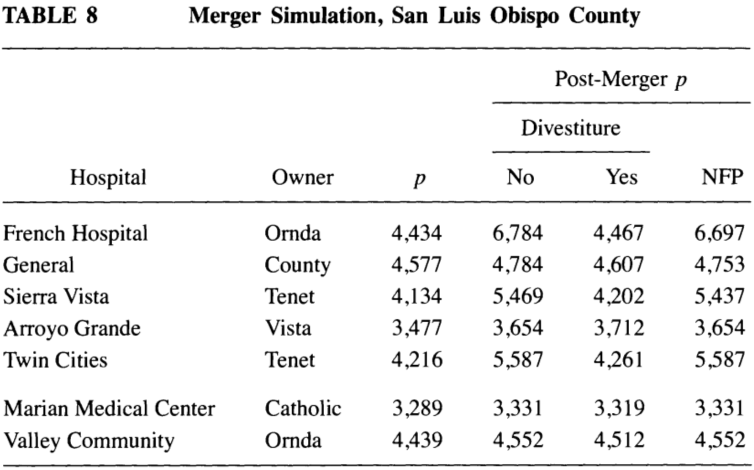


TABLE 8 **Merger Simulation, San Luis Obispo County**

			Post-Merger *p*		
			Divestiture		
Hospital	Owner	*p*	No	Yes	NFP
French Hospital	Ornda	4,434	6,784	4,467	6,697
General	County	4,577	4,784	4,607	4,753
Sierra Vista	Tenet	4,134	5,469	4,202	5,437
Arroyo Grande	Vista	3,477	3,654	3,712	3,654
Twin Cities	Tenet	4,216	5,587	4,261	5,587
Marian Medical Center	Catholic	3,289	3,331	3,319	3,331
Valley Community	Ornda	4,439	4,552	4,512	4,552

Merger simulation

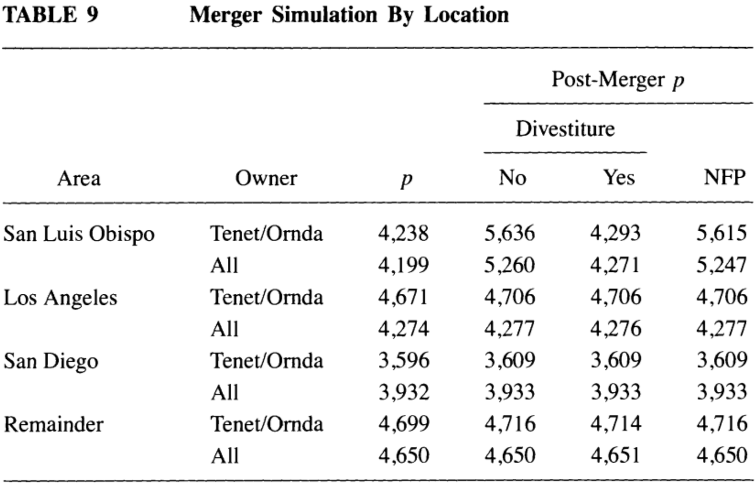


TABLE 9 **Merger Simulation By Location**

			Post-Merger p		
			Divestiture		
Area	Owner	p	No	Yes	NFP
San Luis Obispo	Tenet/Ornda	4,238	5,636	4,293	5,615
	All	4,199	5,260	4,271	5,247
Los Angeles	Tenet/Ornda	4,671	4,706	4,706	4,706
	All	4,274	4,277	4,276	4,277
San Diego	Tenet/Ornda	3,596	3,609	3,609	3,609
	All	3,932	3,933	3,933	3,933
Remainder	Tenet/Ornda	4,699	4,716	4,714	4,716
	All	4,650	4,650	4,651	4,650

Related papers

- Gowrisankaran, Nevo, and Town (2015): BLP model of hospital demand, but hospital prices set through negotiations with MCOs
- Bundorf, Levin, and Mahoney (2012), Starc (2014): BLP model of insurance demand
- Goto and Iizuka (2016): BLP model of flu vaccine demand

Section 2

Gowrisankaran, Nevo, and Town (2015)

Gowrisankaran, Nevo, and Town (2015) “Mergers When Prices Are Negotiated: Evidence from the Hospital Industry”

- Hospital-MCO price bargaining model
- Estimates impact of hospital mergers on prices
- Northern Virginia case study: Inova-Prince William merger
- Key finding: MCO bargaining significantly restrains prices

Motivation: Why Bargaining Matters

- Standard Bertrand model implies: negative marginal costs (implausible)
  - Because patients pay only 2–3% out-of-pocket, demand is inelastic
- Bargaining model captures:
  - MCOs negotiate on behalf of employers
  - Patients steered via coinsurance
  - Patient demand influences bargaining power, not just prices

Two-Stage Game Structure

Stage 1: Price Negotiation

- MCOs and hospital systems negotiate base prices per MCO-hospital pair
- Uses Nash bargaining solution

Stage 2: Patient Hospital Choice

- Patient receives illness draw
- Chooses hospital to maximize utility (multinomial logit)
- Pays coinsurance fraction of negotiated price

Stage 2 choices (demand) determine Stage 1 disagreement values in bargaining

Patient Utility and Hospital Choice

Utility of patient *i* choosing hospital *j* for illness *d*:

$$u_{ijd} = \overbrace{\beta^p c_{id} w_d p_{mj}}^{\text{Out-of-pocket cost}} + \underbrace{\beta^d d_{ij}}_{\text{Distance to hospital}} + \underbrace{\sum_k \beta_k z_{jk}}_{\text{Hospital characteristics}} + \overbrace{\xi_j}^{\text{Unobs. quality}} + \epsilon_{ij}$$

- c_{id}: coinsurance rate for patient-illness pair
- w_d: disease weight (relative intensity)
- p_{mj}: negotiated base price (Stage 1 outcome)
- Logit choice probabilities: $s_{ijd}(p_m) = \frac{\exp(u_{ijd})}{\sum_k \exp(u_{ikd})}$

Bargaining: MCO Objective

MCO *m* acting on behalf of employers maximizes:

$$V_m(\mathcal{N}_m, p_m) = \overbrace{\tau \sum_i W_i(\mathcal{N}_m, p_m)}^{\text{Employee welfare weight}} - \underbrace{TC_m(\mathcal{N}_m, p_m)}_{\text{Payments to hospitals}}$$

where

- $W_i(\mathcal{N}_m, p_m) = \sum_{d=1}^{D} f_{id} \log \sum_{j \in \mathcal{N}_m} \exp(u_{ijd})$ is expected utility (surplus)
- $TC_m = \sum_i \sum_d (1 - c_{id}) f_{id} w_d p_m^T s_{id}(p_m)$ is expected cost
- $\tau \geq 0$: relative weight on employee welfare vs. cost control

Bargaining: Hospital Objective

Hospital system s maximizes weighted sum of profits and quantity:

$$\pi_s(\mathcal{M}_s, p_s) = \sum_{m \in \mathcal{M}_s} \sum_{j \in s} \left[\overbrace{q_{mj}(p_m)(p_{mj} - mc_{mj})}^{\text{Hospital } j \text{ profit from MCO } m} \right]$$

here $q_{mj}(p_m) = \sum_i \sum_d 1_{m(i)=m} f_{id} w_d s_{ijd}(p_m)$ is normalized quantity

- Note: not-for-profit hospitals may have alternative objectives
- Perceived marginal cost mc_{mj} can vary by MCO (care approach, paperwork)

Nash Bargaining Solution

For each MCO m and hospital system s, prices solve:

$$\max_{p_{mj}} \left[V_m(\mathcal{N}_m, p_m) - V_m(\mathcal{N}_m \setminus s, p_m^{-s})\right]^{b_{ms}} \times \left[\pi_s(\mathcal{M}_s, p_s) - \pi_s(\mathcal{M}_s \setminus m, p_s^{-m})\right]^{b_{sm}}$$

MCO bargaining weight

Hospital bargaining

- Exponentiated product of gains from agreement
- Normalized: $b_{ms} + b_{sm} = 1$
- Conditional on all other prices

Equilibrium Pricing Formula

Solving FOCs from Nash bargaining:

$$p = mc - \overset{\text{Effective price sensitivity}}{\boxed{(\Omega + \Lambda)^{-1}}} q$$

where

- $\Omega_{jk} = \frac{\partial q_{mj}}{\partial p_{mj}}$ is **actual** price sensitivity (demand)
- $\Lambda_{jk} = q_{mj} \frac{b_{ms}}{b_{sm}} \frac{A}{B}$ incorporates bargaining effects
  - A: marginal value of price to MCO (steers patients)
  - B: MCO surplus from including hospital in network

Markup equation, but with effective elasticity $\Omega + \Lambda$ instead of Ω

Coinsurance and Patient Steering

Coinsurance ($0 < c_{id} < 1$) allows MCO to steer patients:

$$\frac{\partial V_m}{\partial p_{mj}} = \overbrace{-q_{mj}}^{\text{Direct demand effect}} + \underbrace{\alpha \sum_i (1 - c_{id}) c_{id} w_{id}^2 f_{id} s_{ijd} \left(\sum_k p_{mk} s_{ikd} - p_{mj} \right)}_{\text{Steering effect}}$$

- Steering term > 0 if hospital j is *cheaper* than weighted average
- At $c = 0$ or $c = 1$: steering effect disappears
  - $c = 0$ (full insurance): patient bears no cost, MCO can't steer
  - $c = 1$ (no insurance): patient bears full cost anyway

Merger Effects Mechanism

Pre-merger: MCO plays hospitals against each other in bargaining

Post-merger: Combined hospital system has reduced threat of exclusion

$$\text{price-cost} = \frac{1}{\boxed{\Omega + \Lambda}}$$

Effective price sensitivity

Merger effect: Both *B* (system value) and disagreement values increase

- Term *B* increases in system size
- *B* enters effective elasticity (via Λ)
- Result: lower effective elasticity $\Rightarrow$ higher markups

Data: Northern Virginia 2003–2006

- **Claims data** from 4 large MCOs:
    - Hospital-payor-year base prices (p_{mj})
    - Patient-specific coinsurance rates
- **Discharge data** (Virginia Health Information):
    - Inpatient admissions: 913,660 discharges
    - 374 hospitals, focus on Northern Virginia $\Rightarrow$ 11 hospitals
- **Coinsurance construction:**
    - Average coinsurance: 2.4% (range 1.7–3.3%)
    - Estimated via Tobit on out-of-pocket / allowed amounts
    - Varies by age, gender, DRG weight
- **Key case:** Inova Health System proposed acquisition of Prince William Hospital (2008)
    - FTC challenge (HHI of revenues from 5,635 to 6,174)
    - Transaction abandoned

Northern Virginia Hospitals

FIGURE 1. 2003 NORTHERN VIRGINIA HOSPITAL LOCATIONS

Hospitals

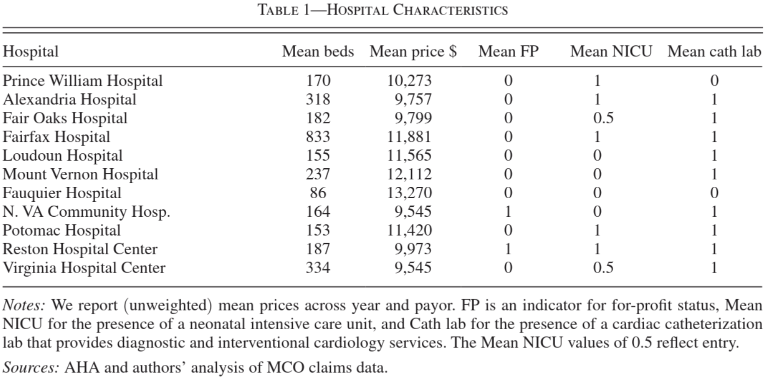


TABLE 1—HOSPITAL CHARACTERISTICS

Hospital	Mean beds	Mean price $	Mean FP	Mean NICU	Mean cath lab
Prince William Hospital	170	10,273	0	1	0
Alexandria Hospital	318	9,757	0	1	1
Fair Oaks Hospital	182	9,799	0	0.5	1
Fairfax Hospital	833	11,881	0	1	1
Loudoun Hospital	155	11,565	0	0	1
Mount Vernon Hospital	237	12,112	0	0	1
Fauquier Hospital	86	13,270	0	0	0
N. VA Community Hosp.	164	9,545	1	0	1
Potomac Hospital	153	11,420	0	1	1
Reston Hospital Center	187	9,973	1	1	1
Virginia Hospital Center	334	9,545	0	0.5	1

Notes: We report (unweighted) mean prices across year and payor. FP is an indicator for for-profit status, Mean NICU for the presence of a neonatal intensive care unit, and Cath lab for the presence of a cardiac catheterization lab that provides diagnostic and interventional cardiology services. The Mean NICU values of 0.5 reflect entry.

Sources: AHA and authors' analysis of MCO claims data.

Patients

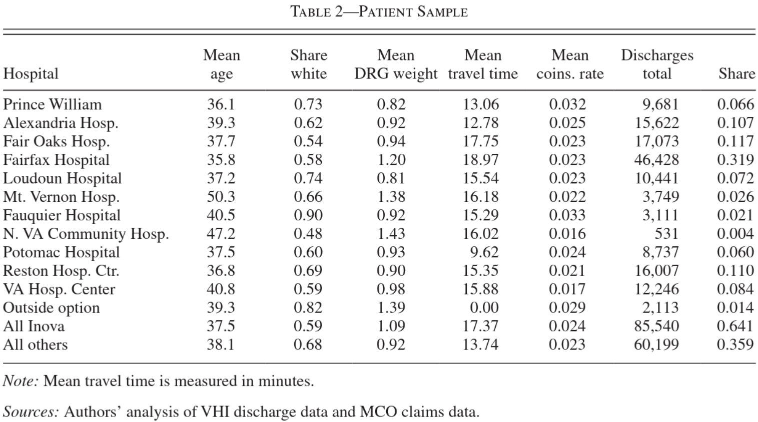


TABLE 2—PATIENT SAMPLE

Hospital	Mean age	Share white	Mean DRG weight	Mean travel time	Mean coins. rate	Discharges total	Share
Prince William	36.1	0.73	0.82	13.06	0.032	9,681	0.066
Alexandria Hosp.	39.3	0.62	0.92	12.78	0.025	15,622	0.107
Fair Oaks Hosp.	37.7	0.54	0.94	17.75	0.023	17,073	0.117
Fairfax Hospital	35.8	0.58	1.20	18.97	0.023	46,428	0.319
Loudoun Hospital	37.2	0.74	0.81	15.54	0.023	10,441	0.072
Mt. Vernon Hosp.	50.3	0.66	1.38	16.18	0.022	3,749	0.026
Fauquier Hospital	40.5	0.90	0.92	15.29	0.033	3,111	0.021
N. VA Community Hosp.	47.2	0.48	1.43	16.02	0.016	531	0.004
Potomac Hospital	37.5	0.60	0.93	9.62	0.024	8,737	0.060
Reston Hosp. Ctr.	36.8	0.69	0.90	15.35	0.021	16,007	0.110
VA Hosp. Center	40.8	0.59	0.98	15.88	0.017	12,246	0.084
Outside option	39.3	0.82	1.39	0.00	0.029	2,113	0.014
All Inova	37.5	0.59	1.09	17.37	0.024	85,540	0.641
All others	38.1	0.68	0.92	13.74	0.023	60,199	0.359

Note: Mean travel time is measured in minutes.

Sources: Authors' analysis of VHI discharge data and MCO claims data.

Estimation: Two Stages

Stage 1: Patient Choice (MLE)

- Multinomial logit with hospital-year fixed effects
- Identify price sensitivity β^p from within-hospital-year variation
- Also variation in coinsurance rates across MCOs at same hospital

Stage 2: Bargaining Model (GMM)

- Moment condition: $\mathbb{E}[\varepsilon_{mj}(b, \lambda, \tau) \mid Z_{mj}] = 0$ where $\varepsilon_{mj} = mc(b, \lambda) - \left[p - ((\Omega + \Lambda)^{-1}q\right]$
- Instruments: cost fixed effects, predicted WTP, predicted quantities
- Identify: bargaining weights b_{ms}, cost fixed effects λ, MCO welfare weight τ

Demand Estimates

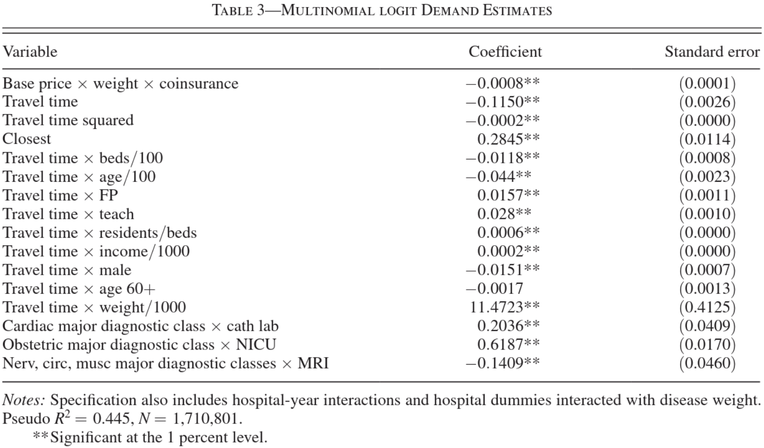


TABLE 3—MULTINOMIAL LOGIT DEMAND ESTIMATES

Variable	Coefficient	Standard error
Base price × weight × coinsurance	–0.0008**	(0.0001)
Travel time	–0.1150**	(0.0026)
Travel time squared	–0.0002**	(0.0000)
Closest	0.2845**	(0.0114)
Travel time × beds/100	–0.0118**	(0.0008)
Travel time × age/100	–0.044**	(0.0023)
Travel time × FP	0.0157**	(0.0011)
Travel time × teach	0.028**	(0.0010)
Travel time × residents/beds	0.0006**	(0.0000)
Travel time × income/1000	0.0002**	(0.0000)
Travel time × male	–0.0151**	(0.0007)
Travel time × age 60+	–0.0017	(0.0013)
Travel time × weight/1000	11.4723**	(0.4125)
Cardiac major diagnostic class × cath lab	0.2036**	(0.0409)
Obstetric major diagnostic class × NICU	0.6187**	(0.0170)
Nerv, circ, musc major diagnostic classes × MRI	–0.1409**	(0.0460)

Notes: Specification also includes hospital-year interactions and hospital dummies interacted with disease weight. Pseudo $R^2 = 0.445$, $N = 1{,}710{,}801$.

**Significant at the 1 percent level.

Demand Elasticities

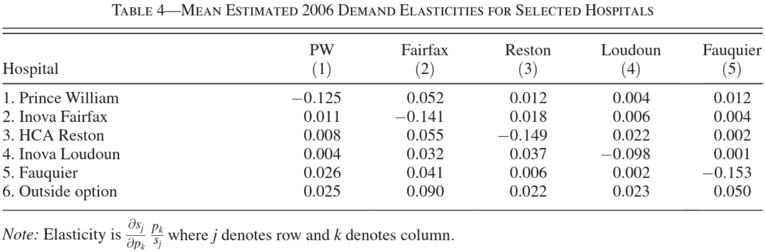


Table 4—Mean Estimated 2006 Demand Elasticities for Selected Hospitals

Hospital	PW (1)	Fairfax (2)	Reston (3)	Loudoun (4)	Fauquier (5)
1. Prince William	−0.125	0.052	0.012	0.004	0.012
2. Inova Fairfax	0.011	−0.141	0.018	0.006	0.004
3. HCA Reston	0.008	0.055	−0.149	0.022	0.002
4. Inova Loudoun	0.004	0.032	0.037	−0.098	0.001
5. Fauquier	0.026	0.041	0.006	0.002	−0.153
6. Outside option	0.025	0.090	0.022	0.023	0.050

Note: Elasticity is $\frac{\partial s_j}{\partial p_k}\frac{p_k}{s_j}$ where j denotes row and k denotes column.

Demand Elasticities: Role of Insurance

	Actual	**Without Insurance**
Prince William	-0.13	-5.16
Inova (System)	-0.07	-3.10

- Actual price elasticities very small due to low coinsurance
- If patients paid full cost: elasticities 30–50x larger
- Insurance causes moral hazard, MCO bargaining partially corrects

Bargaining Weight Estimates

Two specifications: **Spec 1:** Fix $b_{ms} = 0.5$ (symmetric bargaining), estimate cost FE

- MCO welfare weight $\hat{\tau} = 2.79$: MCO values employee welfare 2.8x more than cost control
- 95% of bootstrap draws give $\tau > 0$

Spec 2: Estimate b_{ms} by MCO, omit MCO cost FE

- MCO 1: $b_{ms} \approx 0.5$
- MCOs 2, 3: $b_{ms} \approx 1.0$ (hospitals have zero bargaining weight!)
- MCO 4: $b_{ms} = 0.76$

Variation in bargaining weights suggests different MCO market power

Bargaining Estimates

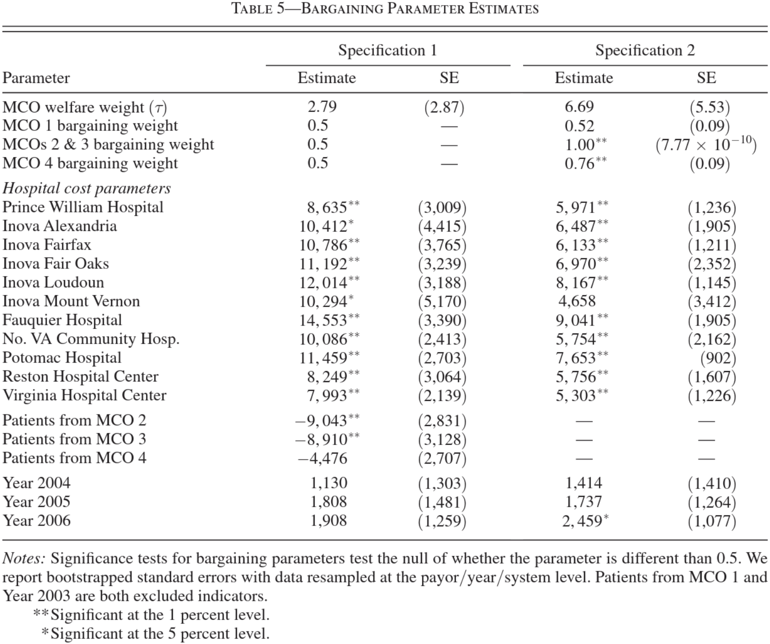


TABLE 5—BARGAINING PARAMETER ESTIMATES

	Specification 1		Specification 2	
Parameter	Estimate	SE	Estimate	SE
MCO welfare weight (τ)	2.79	(2.87)	6.69	(5.53)
MCO 1 bargaining weight	0.5	—	0.52	(0.09)
MCOs 2 & 3 bargaining weight	0.5	—	1.00**	(7.77×10^{-10})
MCO 4 bargaining weight	0.5	—	0.76**	(0.09)
Hospital cost parameters				
Prince William Hospital	8, 635**	(3,009)	5, 971**	(1,236)
Inova Alexandria	10, 412*	(4,415)	6, 487**	(1,905)
Inova Fairfax	10, 786**	(3,765)	6, 133**	(1,211)
Inova Fair Oaks	11, 192**	(3,239)	6, 970**	(2,352)
Inova Loudoun	12, 014**	(3,188)	8, 167**	(1,145)
Inova Mount Vernon	10, 294*	(5,170)	4,658	(3,412)
Fauquier Hospital	14, 553**	(3,390)	9, 041**	(1,905)
No. VA Community Hosp.	10, 086**	(2,413)	5, 754**	(2,162)
Potomac Hospital	11, 459**	(2,703)	7, 653**	(902)
Reston Hospital Center	8, 249**	(3,064)	5, 756**	(1,607)
Virginia Hospital Center	7, 993**	(2,139)	5, 303**	(1,226)
Patients from MCO 2	−9, 043**	(2,831)	—	—
Patients from MCO 3	−8, 910**	(3,128)	—	—
Patients from MCO 4	−4,476	(2,707)	—	—
Year 2004	1,130	(1,303)	1,414	(1,410)
Year 2005	1,808	(1,481)	1,737	(1,264)
Year 2006	1,908	(1,259)	2, 459*	(1,077)

Notes: Significance tests for bargaining parameters test the null of whether the parameter is different than 0.5. We report bootstrapped standard errors with data resampled at the payor/year/system level. Patients from MCO 1 and Year 2003 are both excluded indicators.

**Significant at the 1 percent level.

*Significant at the 5 percent level.

Implication for Markups

Hospital System	**Lerner Index**	**Effective Elasticity**	**Elasticity w/o I**
Prince William	0.52	-1.94	-5.16
Inova	0.39	-2.55	-3.10
Fauquier	0.22	-4.56	-6.11

- Lerner index: $\frac{p-mc}{p} = \frac{1}{\text{effective elasticity}}$
- Effective elasticities: between actual and “no insurance” elasticities
- High markups because demand is relatively inelastic even for MCO

Counterfactuals

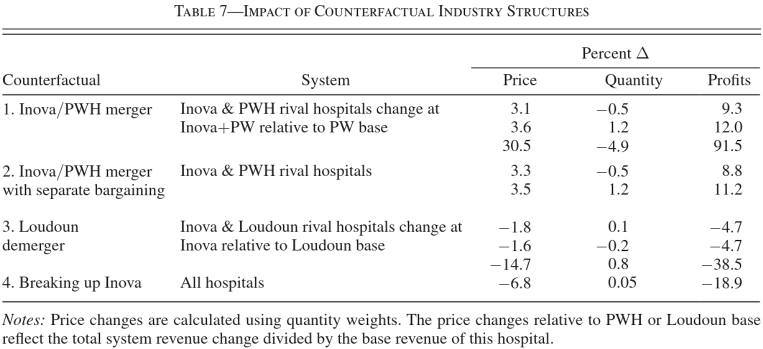


TABLE 7—IMPACT OF COUNTERFACTUAL INDUSTRY STRUCTURES

		Percent Δ		
Counterfactual	System	Price	Quantity	Profits
1. Inova/PWH merger	Inova & PWH rival hospitals change at	3.1	−0.5	9.3
	Inova+PW relative to PW base	3.6	1.2	12.0
		30.5	−4.9	91.5
2. Inova/PWH merger	Inova & PWH rival hospitals	3.3	−0.5	8.8
with separate bargaining		3.5	1.2	11.2
3. Loudoun	Inova & Loudoun rival hospitals change at	−1.8	0.1	−4.7
demerger	Inova relative to Loudoun base	−1.6	−0.2	−4.7
		−14.7	0.8	−38.5
4. Breaking up Inova	All hospitals	−6.8	0.05	−18.9

Notes: Price changes are calculated using quantity weights. The price changes relative to PWH or Loudoun base reflect the total system revenue change divided by the base revenue of this hospital.

Counterfactual 1: Inova-PWH Merger

- **PWH base revenue increase: 30.5%**
- MCO surplus drops by 27%
- Low coinsurance rates mean inelastic patient demand
- Competition effect outweighs expansion (negative cross-elasticity)

Counterfactual 2: Separate Bargaining Remedy

FTC remedy (Evanston Northwestern case): firewall between PWH and Inova negotiators

- Separate bargaining changes *both* sides' disagreement values
- If PWH excluded: MCO gains less (fewer hospital options)
- But: PWH patients still divert to Inova (not outside option)
- Result: separate bargaining nearly as harmful as unrestricted merger

Price increase under remedy: 3.3% (vs. 3.1% without remedy)
Conclusion: Conduct remedy ineffective because of common ownership

Role of Coinsurance

Coinsurance Level	**Price**	**Quantity**	**Profit**
Zero (full insurance)	$+3.7\%$	$\approx 0\%$	$+9.8\%$
10x current ($\approx 25\%$)	-16.1%	$+0.9\%$	-0.4%

- Zero coinsurance: MCO can't steer, prices rise
- 10x increase: strong steering effect, substantial price reduction
- Policy implication: can undo merger effects via cost-sharing design

Robustness: Posted Premium Competition Model

Alternative specification: MCOs post premiums (Bertrand-style) post-negotiation

- MCOs maximize profits, not weighted welfare
- Calibrated using base model estimates + external parameters
- Larger merger effect: 7.2% (vs. 3.1% in base model)
  - Hospitals recapture patients via MCO plan switching
  - Increases hospital disagreement value more
- Authors prefer base model: employer-MCO alignment better reflects self-insured market

Summary

1. **Bargaining matters**: MCO leverage restrains hospital prices relative to Bertrand
2. **Demand inelasticity**: Low coinsurance (≈ 2–3%) makes patient demand inelastic
3. **Mergers raise prices**: 3.1% for merged, 3.6% for rivals
4. **Conduct remedies fail**: Separate bargaining doesn't eliminate anticompetitive effects
5. **Coinsurance is powerful**: 10x increase reduces prices by 16%
6. **Effective elasticity**: Lies between actual (-0.07 to -0.13) and no-insurance elasticity (-3 to -7)

Section 3

Brot et al. (2024)

Brot et al. (2024) “Is There Too Little Antitrust Enforcement in the US Hospital Sector?”

- Merger retrospective: 1,000+ hospital mergers (2002–2020), only 13 FTC challenges
- Question: Are predictably anticompetitive mergers being consummated?
- Data: 322 hospital mergers 2010–2015, 28% of US employer-sponsored insured population
- Result:
    - 20% of mergers could have been detected as anticompetitive ex ante
    - This 20% of mergers raised prices 5%+

Merger Guidelines

- **Herfindahl-Hirschman Index**
  $HHI = \sum_i (\text{percent market share}_i)^2 \in [0, 10000]$
- 2010 Horizontal Merger Guidelines (FTC): increase of 200 & post-merger HHI over 2500 “presumed to be likely to enhance market power”
  - Recent work relating change in HHI to merger effects: Nocke and Whinston (2022), Koh (2025)
- Hart-Scott-Rodino (HSR) reporting thresholds: merger must be reported to FTC if large enough
  - In 2015, transaction $>= \$305$ million OR (transaction $>= \$76$million AND size of firms $>= \$15$million and $>= \$150$ million)

The Enforcement Puzzle

Period	**Hospital Mergers**	**FTC Actions**
2002–2020	1,164	13
Enforcement Rate	—	1%

Low enforcement rate could mean:

- Mergers don't threaten competition; or
- Underenforcement $\Rightarrow$ preventable price increases

90% of US metro areas have HHI $> 2{,}500$

Mergers Over Time

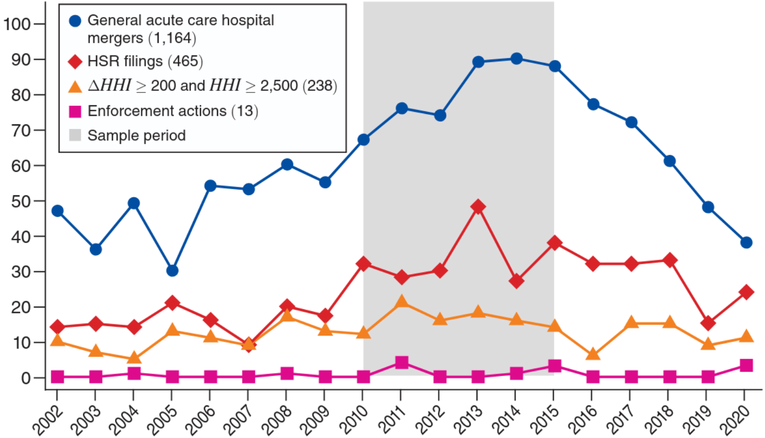


FIGURE 1. HOSPITAL MERGERS, HSR FILINGS, PRESUMPTIVELY ANTICOMPETITIVE MERGERS, AND FTC ENFORCEMENT ACTIONS BY YEAR, 2002–2020

Merger Retrospective

Question: Can mergers flagged ex ante as problematic be predicted to harm prices ex post?

Sample:

- 322 hospital mergers 2010–2015
- 702 merging hospitals within 50 miles of each other
- Claims data: Aetna, Humana, UnitedHealthcare (28% of insured population)
- Price measure: Hospital-year fixed effects controlling for case complexity

Screening Methods (FTC standards):

1. HHI changes: $\Delta HHI \geq 200$ and postmerger HHI $\geq 2,500$
2. Willingness-to-pay (WTP): merger-driven increases $\geq 5\%$

Willingness-to-Pay

- Gowrisankaran, Nevo, and Town (2015): willingness-to-pay for a hospital system is key for hospital bargaining power
- Garmon (2017): WTP changes correlated with post-merger price increases
- WTP computed based on demand model

Willingness-to-Pay: Theory

- WTP: patient’s marginal value from having hospital in network
- Following Capps, Dranove, and Satterthwaite (2003), assume logit for patient hospital choice:

$$\max_{j\in\mathcal{J}} \underbrace{U_{ij}}_{\text{mean utility}} + \underbrace{\epsilon_{ij}}_{\text{logit error}}$$

- Expected utility

$$\mathrm{E}[\max_{j\in\mathcal{J}} U_{ij} + \epsilon_{ij}] = \log(\sum_{j\in\mathcal{J}} e^{U_{ij}})$$

- Change in expected utility from removing h

$$\Delta EU(-h) = \log(\sum_{j\in\mathcal{J}} e^{U_{ij}}) - \log(\sum_{j\in\mathcal{J}\setminus\{h\}} e^{U_{ij}}) = \log\left(\frac{1}{1-P(h|\{U_{ij}\}_{j\in\mathcal{J}})}\right)$$

Willingness-to-Pay: Measurement

- Assume observe many identical patients of type g, so $P(h|\{U_{ij}\}_{j\in\mathcal{J}}) = s_{gh}$ is estimable
  - Patient subgroup g based on demographics, health, location
  - Partitioned into groups: minimum size 50, resulting in 27,525 groups
- Let γ convert expected utility to dollars, so

$$WTP(h) = \int \gamma \log\left(\frac{1}{1 - s_{gh}}\right) dF_g$$

- % change in WTP from merging h and h' is

$$\Delta WTP = 100 \frac{\int \log\left(\frac{1}{1-(s_{gh}+s_{gh'})}\right) - \int \log\left(\frac{1}{1-s_{gh}}\right) + \log\left(\frac{1}{1-s_{gh'}}\right) dF_g}{\int \log\left(\frac{1}{1-s_{gh}}\right) + \log\left(\frac{1}{1-s_{gh'}}\right) dF_g}$$

Willingness-to-Pay & Insurer-Hospital Price Bargaining

- Higher WTP $\Rightarrow$ patient values hospital more $\Rightarrow$ insurer has less leverage
- After merger, insurer must exclude merged entity to credibly exclude one hospital
- Predicts larger price increases when ΔWTP is large

Price Measurement

Construct adjusted price index for each hospital-year:

$$\log p_{idht} = \overbrace{\lambda_{ht}}^{\text{Hospital-year effect}} + \underbrace{X_i\alpha}_{\text{Patient demographics}} + \underbrace{\delta_{dt}}_{\text{Case type/complexity}} + \varepsilon_{idht}$$

- Separate regressions for inpatient and outpatient
- Use $\hat{\lambda}_{ht}$ as hospital's price index

Empirical Strategy: Conditional Parallel Trends

- Treatment group:
  - Merged hospitals 2010-2015 within 50 miles of one another (702 hospitals, 322 mergers)
- Control group:
  - Hospitals that did not merge from 2008-(year of merger + 2)
- Outcome: p^{INDEX}_{eht} price index for merger event e, hospital h, year t, merger at time τ
- Conditional parallel trends:

$$\mathrm{E}[\log(p^{INDEX}_{eh\tau+s})(0) - \log(p^{INDEX}_{eh\tau-r})(0)|\text{merger}_h = 1, \text{controls}_h] = \mathrm{E}[\log(p^{INDEX}_{eh\tau+s})(0) - \log(p^{INDEX}_{eh\tau-r})(0)|\text{merger}_h = 0, \text{controls}_h]$$

[1]

---

[1] Is this really the identifying assumption? I think so, but the paper doesn't actually say. It only gives the estimation procedure on the next page, which possibly imposes stronger assumptions. Many papers follow this style — describing an estimation procedure without clearly stating identifying assumptions or what they want to estimate.

Matching Controls

- Related to price trends at hospitals:
  - total number of hospital beds; total inpatient admissions; full time equivalents; number of unique technologies; share of Medicare patients; share of Medicaid patients; whether the hospital is a teaching hospital; a non-profit hospital; or a government hospital; the distance to the hospital's nearest competitor; the distance to the hospital's nearest hospital in its system or not; and whether the hospital is independent or part of a system
- Local area characteristics:
  - HHI, share of the hospital's county covered by private insurance, share of the county insured by HCCI (28% of insurers included in price data) payors specifically

Estimation Procedure: Stacked Difference-in-Differences

For each merger *e*, estimate separate experiment with matched controls:

$$\log p_{eht}^{INDEX} = \overbrace{\eta_{eh}}^{\text{Experiment-specific hospital FE}} + \underbrace{\kappa_{et}}_{\text{Experiment-specific time FE}} + \underbrace{\beta_{eh}}_{\text{Treatment effect}} \cdot \text{post}_{et} \times \text{merged}_{eh} + \varepsilon_{eht}$$

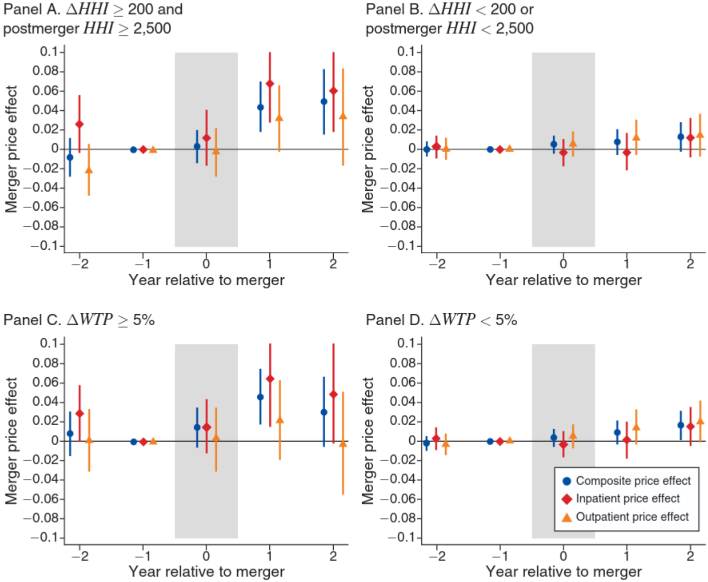
- Pool experiments maintaining experiment-specific FE
- Matched controls: propensity score matched hospitals 25 nearest neighbors
- Window: 2 years pre and post-merger
- Report average across mergers of $\hat{\beta_{eh}}$ (both unconditional and conditional on HHI and ΔWTP being large or small)
- Equal weight to each merging hospital

Average Merger Effect: All Mergers

Price Measure	**Effect**	**S.E.**
Composite	1.6%	(0.3%)
Inpatient	1.1%	(0.5%)
Outpatient	1.8%	(0.5%)

- Average merger raises hospital prices by 1.6% post-merger
- Outpatient increases as large as inpatient (novel finding)
- No pre-merger trends detected in event study
- Average year of mergers (53 deals): $204M increase in spending
    - For context: FTC annual enforcement budget $136M

Event Studies


Panel A. $\Delta HHI \geq 200$ and postmerger $HHI \geq 2{,}500$

Panel B. $\Delta HHI < 200$ or postmerger $HHI < 2{,}500$

Panel C. $\Delta WTP \geq 5\%$

Panel D. $\Delta WTP < 5\%$

Figure 3. Event Studies for Flagged and Nonflagged Mergers

Note: This figure presents event study estimates of equation (3) on mergers that generated a $\Delta HHI > 200$ and

Flagged Mergers: HHI Screening

Flag criterion: $\Delta HHI \geq 200$ AND postmerger HHI $\geq 2,500$

Flagged Status	**N Hospitals**	**Composite**	**Inpatient**
Flagged	109	5.2%	5.4%
		(0.8)	(1.1)
Not flagged	593	1.0%	0.4%
		(0.4)	(0.5)
Difference	–	4.2%	5.0%
		(0.9)	(1.2)

- 25% of mergers in analytic sample flagged by HHI criteria
- Flagged mergers: 5× larger price effects than non-flagged
- Pre-merger HHI calculation: 30-minute drive time, bed shares

Flagged Mergers: WTP Screening

Flag criterion: Merger-driven WTP increase $\geq 5\%$

WTP Category	**N Hospitals**	**Composite**	**Inpatient**
WTP $\geq 5\%$	82	3.6%	4.6%
		(0.9)	(1.3)
WTP $< 5\%$	620	1.4%	0.7%
		(0.4)	(0.5)
Difference	—	2.2%	3.9%
		(0.9)	(1.4)

- Mean WTP change across all mergers: 1.8%
- 13% of mergers (42 deals) flagged with WTP $\geq 5\%$
- WTP better predicts inpatient prices (estimated from inpatient data)
- Positive correlation: higher ΔWTP $\Rightarrow$ larger price increases

Summary of Flagged Mergers

Sample	**N Mergers**	**N Hospitals**	**Share**
Total (2010–2015)	322	702	100%
HHI-flagged	82	109	25%
WTP-flagged	42	82	13%
Either HHI or WTP	≈ 80	≈ 130	20%

- 20% of all mergers predictably anticompetitive by standard FTC screening
- HHI and WTP flags partially overlapping
- Flagged mergers produce substantially larger price increases

HSR Reportability and Visibility

Mergers may escape FTC attention if below Hart-Scott-Rodino (HSR) reporting thresholds

HSR Status	% HHI-Flagged	% WTP-Flagged
Above HSR (n=187)	21%	14%
Below HSR (n=135)	19%	6%

- 60% of hospital mergers fall below HSR thresholds
- But: flagged mergers more likely to be above HSR thresholds
- 50% of potentially anticompetitive mergers *are* visible to FTC
- Underenforcement likely due to FTC resource constraints or risk aversion, not visibility

FTC Cases vs. Flagged Mergers

Comparing FTC-litigated mergers to flagged deals:

Merger Set	**Avg ΔHHI**	**Avg ΔWTP**
FTC-litigated (n=13)	3,607	22.9%
Flagged (HHI or WTP)	1,843	9.6%
All mergers	435	2.0%

- FTC targets *worst* cases (8.3x larger HHI changes than flagged mergers)
- But: Many flagged mergers with substantial anticompetitive effects escape enforcement
- FTC's *margin for intervention* allows many harmful deals to proceed

Aggregate Welfare Impact

Average year (2010–2015): 53 mergers

$$\text{Spending increase (Year 1)} = \sum_h \text{Spending}_{h,\text{pre}} \times \beta_{eh}$$

- Average annual spending increase: **$204 million**
    - Holds quantities fixed, counts only price changes
    - Reflects only 1-year effect (price increases often persist longer)
- For comparison:
    - FTC antitrust enforcement budget 2010–2015: $136 million/year
    - Merger-driven healthcare spending exceeds FTC enforcement budget

Key Findings: Summary

1. **High merger rate, low enforcement**: 1,000+ mergers, 13 FTC challenges (1%)
2. **Average price increase**: 1.6% post-merger (inpatient 1.1%, outpatient 1.8%)
3. **Screening predicts harm**: 20% of mergers flagged ex ante as anticompetitive
4. **Flagged mergers harm prices**: 5.2% price increase (HHI-flagged), 3.6% (WTP-flagged)
5. **Visibility not the constraint**: ∼50% of flagged mergers above HSR thresholds
6. **Outpatient underappreciated**: Outpatient price increases as large as inpatient
7. **Conclusion**: Likely underenforcement due to FTC resource/risk constraints

Comparison with Gowrisankaran, Nevo, and Town (2015)

Gowrisankaran, Nevo, and Town (2015)

- Single case study (Inova-Prince William, 2008)
- Detailed structural bargaining model
- Predicted merger effect: 3.1% (system-wide)

Brot et al. (2024)

- Large-scale merger retrospective (322 mergers 2010–2015)
- Reduced-form difference-in-differences
- Average effect: 1.6%, flagged mergers: 5.2%

Complementary findings:

- Both show hospital mergers raise prices
- Gowrisankaran, Nevo, and Town (2015): Bargaining model explains mechanism (MCO leverage)
- Brot et al. (2024): Screening tools can identify problematic deals ex ante

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