

Vertical Relationships

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Vertical Relationships

- Firm to firm transactions
- Overview: Lee, Whinston, and Yurukoglu (2021)
- Insurers and hospitals: Ghili (2022), Ho and Lee (2019), Ho and Lee (2017)
- Suppliers and assemblers: Fox (2018)
- Retailers and wholesalers: Hristakeva (2022)
- Foundations for Nash-in-Nash model: Collard-Wexler, Gowrisankaran, and Lee (2019) and Horn & Wolinsky (198?)

Ho and Lee (2017)

“Insurer Competition in Health Care Markets”

- Employer sponsored private health insurance in US (60% of non-elderly)
- Model premium and hospital prices with Nash bargaining between employer and insurer and insurer and hospital

Vertical Relationships

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Ho and Lee (2017)

Model

Empirical
Specification

Ho and Lee (2019)

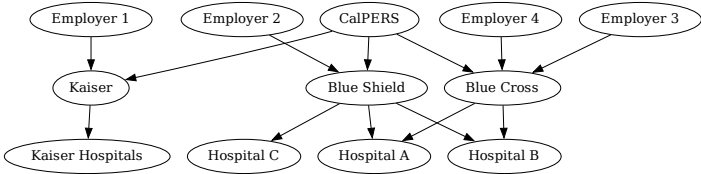
Model

Data

Estimation

Results

References



Notation

- $\mathcal{M} = \{ \text{Kaiser, Blue Cross, Blue Shield} \}$ set of insurers offered by CalPERS
- insurance premiums ϕ_j
- $\mathcal{G} =$ hospitals covered by each insurer
- price of hospital i for insurer j p_{ij}
- Insurance demand $D_j(\mathcal{G}, \phi)$
- Hospital demand $D_{ij}^H(\mathcal{G}, \phi)$

Model

- 1a. Employer and insurers bargain over ϕ
- 1b. Insurers and hospitals bargain over p
 2. Households choose insurance plans $\rightarrow D_j(\mathcal{G}, \phi)$
 3. Sick individuals choose hospitals $\rightarrow D_{ij}^H(\mathcal{G}, \phi)$

Payoffs

- MCO/insurer j :

$$\pi_j^M(\mathcal{G}, p, \phi) = D_j(\cdot)(\phi_j - \eta_j) - \sum_{h \in \mathcal{G}_j^M} D_{hj}^H(\cdot) p_{hj}$$

- Hospital i :

$$\pi_i^H(\mathcal{G}, p, \phi) = \sum_{n \in \mathcal{G}_i^H} D_{in}^H(\cdot)(p_{in} - c_i)$$

- Employee welfare:

$$W(\mathcal{M}, \phi)$$

Premium Bargaining

- Nash bargaining
- τ^ϕ = bargaining weight of insurer for premiums

$$\phi_j = \arg \max_{\varphi} \pi_j^M(\mathcal{G}, p, (\varphi, \phi_{-j}))^{\tau^\phi} \times \\ \times [W(\mathcal{M}, (\varphi, \phi_{-j})) - W(\mathcal{M} \setminus j, \phi_{-j})]^{(1-\tau^\phi)}$$

Hospital Price Bargaining

$$p_{ij} = \arg \max_p \left[\pi_j^M(\mathcal{G}, (p, p_{-ij}), \phi) - pi_j^M(\mathcal{G} \setminus ij, p_{-ij}, \phi) \right]^{\tau_j} \\ \times \left[\pi_i^H(\mathcal{G}, (p, p_{-ij}), \phi) - pi_i^H(\mathcal{G} \setminus ij, p_{-ij}, \phi) \right]^{1-\tau_j}$$

- Equilibrium effect of insurer competition on negotiated prices & premiums is complicated and cannot be signed a priori

TABLE I
SUMMARY STATISTICS^a

		BS	BC	Kaiser
Premiums (per year)	Single	3782.64	4192.92	3665.04
	2-Party	7565.28	8385.84	7330.08
	Family	9834.84	10,901.64	9529.08
	Revenues (per individual)	2860.34	3179.39	2788.05
Insurer Characteristics	# Hospitals in Network	189	223	27
	# Hospital Systems in Network	119	149	–
	Hospital Prices (per admission)	7191.11	6023.86	–
	Hospital Payments (per individual)	623.20	554.00	–
	Hospital Costs (per admission)	1709.56	1639.92	–
Household Enrollment	Single	19,313	8254	20,319
	2-Party	16,376	7199	15,903
	Family	35,058	11,170	29,127
	Avg. # Individuals/Family	3.97	3.99	3.94

^aSummary statistics by insurer. The number of hospitals and hospital systems in network for BS and BC are determined by the number of in-network hospitals or systems with at least 10 admissions observed in the data. Hospital prices and costs per admission are average unit-DRG amounts, weighted across hospitals by admissions. Hospital payments per individual represent average realized hospital payments made per enrollee (not weighted by DRG).

TABLE II
INDIVIDUAL ENROLLMENT AND HOSPITAL SYSTEM CONCENTRATION^a

HSA Market	Individual Plan Enrollment						Hospital Concentration			
	Enrollment			Market Share			# Systems		HHI (Adm)	
	BS	BC	Kaiser	BS	BC	Kaiser	BS	BC	BS	BC
1. North	5366	15,143	–	0.26	0.74	–	5	17	3686	1489
2. Sacramento	55,732	6212	59,772	0.46	0.05	0.49	6	8	4112	2628
3. Sonoma / Napa	6826	955	13,762	0.32	0.04	0.64	5	5	3489	3460
4. San Francisco Bay West	6021	926	4839	0.51	0.08	0.41	4	4	4362	3054
5. East Bay Area	7856	1200	10,763	0.40	0.06	0.54	9	10	2560	2096
6. North San Joaquin	9663	3979	4210	0.54	0.22	0.24	7	8	2482	1888
7. San Jose / South Bay	2515	762	4725	0.31	0.10	0.59	5	6	3265	2628
8. Central Coast	8028	13,365	–	0.38	0.62	–	4	9	3431	2254
9. Central Valley	27,663	7613	10,211	0.61	0.17	0.22	12	13	1863	1539
10. Santa Barbara	3973	1416	658	0.66	0.23	0.11	7	7	2459	2863
11. Los Angeles	18,205	6731	23,919	0.37	0.14	0.49	22	28	741	716
12. Inland Empire	17,499	2801	20,690	0.43	0.07	0.50	15	15	1015	1034
13. Orange	7836	2906	5430	0.48	0.18	0.34	8	9	2425	2250
14. San Diego	14,585	2298	8593	0.57	0.09	0.34	10	8	1708	2549
Total ^b	191,768	66,307	167,572	0.45	0.16	0.39	119	147	1004	551

^aIndividual enrollment and market shares (Kaiser was not an option for enrollees in HSAs 1 and 8) and hospital system membership and admission Herfindahl–Hirschman Index (HHI)—computed using the number of admissions for all hospital-insurer pairs in our sample—by insurer.

^bTotal (statewide) HHI accounts for hospital system membership across HSAs.

Hospital Demand & Consumer Surplus

- Discrete choice model of hospitals

$$u_{k,i,l,m}^H = \underbrace{\delta_i}_{\text{hospital}} + \underbrace{z_i v_{k,l} \beta^z}_{\text{distance}} + d_{i,k} \beta_m^d + \underbrace{\epsilon_{k,i,l,m}^H}_{\text{person } k \text{ \& \textit{diagnosis } } l} \Gamma_m \text{EV}$$

- Willingness to pay:

$$WTP_{k,jm}(\mathcal{G}) = \underbrace{P(\text{admission})}_{\gamma_{\kappa(k)}^a} \sum_{l \in \mathcal{L}} \underbrace{P(\text{diagnosis}|\text{admit})}_{\gamma_{\kappa(k),l}} \log \left(\sum_{h \in \mathcal{G}} \exp(\delta_h + z_h v_{k,l} \beta^z + d_{h,k} \beta_m^d) \right)$$

\uparrow $EU(\mathcal{G})$

Insurance Plan Demand

- Family f chooses among plans j offered in market m :

insurer \times market

$$u_{f,j,m}^M = \delta_{j,m} + \alpha_f^\phi (0.2 \phi_j \Phi_{\lambda(f)}) + \sum_{\kappa} \alpha_{\kappa}^W \sum_{k \in f: \kappa(k)=\kappa} WTP_{k,j,m} + \epsilon_{f,j,m}^M$$

premium paid by household

age-sex categories

family members

TABLE IV
ESTIMATES: INSURANCE PLAN HOUSEHOLD PRICE ELASTICITIES^a

	Single	2-Party	Family
BS	-1.23	-2.15	-2.53
BC	-1.62	-2.50	-2.95
Kaiser	-1.23	-2.12	-2.53

^aEstimated own-price elasticities for each insurer using insurer demand estimates from Table A.IV.

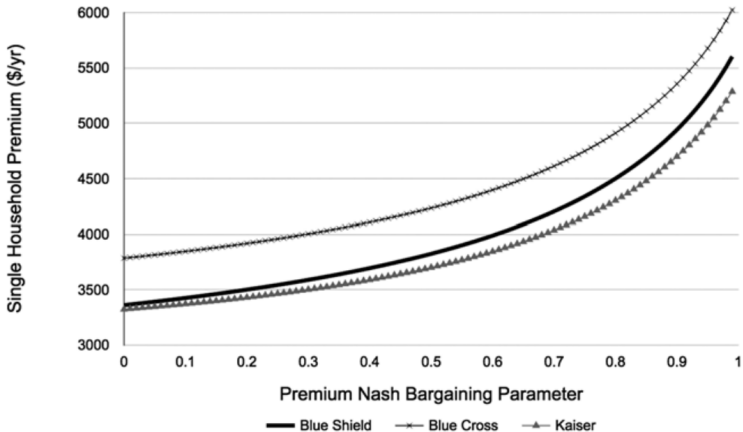


FIGURE 2.—Predicted equilibrium single household premiums at estimated parameters from specification (ii) in Table V as the premium Nash bargaining parameter (τ^{ϕ}) varies.

TABLE V

ESTIMATES: INSURER MARGINAL COSTS AND NASH BARGAINING PARAMETERS^a

		(i)	(ii)
Insurer Non-Inpatient Marginal Costs (per individual)	η_{BS}	925.78	1691.50
		11.12	10.41
	η_{BC}	1417.73	1948.61
		6.93	8.14
	η_K	1496.44	2535.14
		–	0.62
Nash Bargaining Parameters	τ_{BS}	0.33	0.31
		0.01	0.05
	τ_{BC}	0.40	0.38
		0.02	0.03
	τ^ϕ	1.00	0.47
		–	0.00
Use Margin Moments		N	Y
Number of Bilateral Pairs		268	268

^a2-step GMM estimates of marginal costs for each insurer (which do not include hospital payments for BS and BC), Nash bargaining parameters, and elasticity scaling parameter. When “margin moments” are not used, we set $\tau^\phi = 1.00$, and Kaiser marginal costs are directly obtained from (12) by setting $\omega_{\text{Kaiser}}^1 = 0$. Standard errors are computed using 80 bootstrap samples of admissions within each hospital-insurer pair to re-estimate hospital-insurer DRG weighted admission prices and re-estimating these parameters.

TABLE VI
ESTIMATES: NEGOTIATED HOSPITAL PRICE DECOMPOSITION^a

	Price	(i) Premium & Enrollment	(ii) Price Reinforcement	(iii) Hospital Costs	(iv) Recapture Effect
BS	7191.11	24.2% [23.6%, 25.5%]	66.3% [64.9%, 69.3%]	8.9% [5.1%, 10.6%]	0.6% [0.4%, 0.8%]
BC	6023.86	32.3% [31.8%, 33.7%]	52.6% [51.8%, 55.1%]	12.1% [9.2%, 13.1%]	3.0% [2.3%, 3.3%]

^aWeighted average (by hospital admissions) decomposition of negotiated hospital prices into the components provided in (A.3) for each insurer and hospital system (omitting residuals, and scaling by τ_j or $1 - \tau_j$ where appropriate). 95% confidence intervals, reported below estimates, are constructed using 80 bootstrap samples of admissions within each hospital-insurer pair to re-estimate hospital-insurer DRG weighted admission prices, re-estimate insurer marginal costs and Nash bargaining parameters, and re-compute price decompositions.

TABLE VII
REMOVING AN INSURER: SUMMARY RESULTS^a

		Baseline	(i) Remove Kaiser		(ii) Remove BC	
		Amount	Amount	% Change	Amount	% Change
Premiums (per year)	BS	3.78	4.41	16.6%	3.65	-3.4%
		[3.76, 3.79]	[4.36, 4.43]	[15.8%, 16.8%]	[3.62, 3.66]	[-4.0%, -3.3%]
	BC	4.19	4.80	14.4%	-	-
Household Enrollment	Kaiser	[4.18, 4.20]	[4.75, 4.81]	[13.7%, 14.6%]	3.62	-1.4%
		3.67	-	-	[3.60, 3.62]	[-1.6%, -1.3%]
	BS	73.91	124.16	68.0%	87.73	18.7%
Hospital Payments (per individual)		[73.65, 74.34]	[124.13, 124.25]	[67.1%, 68.6%]	[87.44, 88.51]	[18.4%, 19.3%]
	BC	27.49	38.56	40.2%	-	-
	Kaiser	[27.49, 27.50]	[38.47, 38.59]	[39.9%, 40.4%]	64.99	6.0%
Hospital Prices (per admission)		61.31	-	-	[64.21, 65.27]	[5.2%, 6.3%]
	BS	0.66	0.66	0.5%	0.60	-8.5%
		[0.65, 0.68]	[0.64, 0.68]	[-3.1%, 1.7%]	[0.57, 0.62]	[-12.7%, -7.5%]
Surplus (per individual)	BC	0.56	0.68	21.2%	-	-
		[0.55, 0.58]	[0.67, 0.72]	[20.0%, 24.8%]		
	BS	7.19	7.23	0.6%	6.55	-8.9%
Surplus (per individual)		[7.06, 7.35]	[6.92, 7.43]	[-3.1%, 1.8%]	[6.19, 6.74]	[-13.3%, -7.7%]
	BC	6.02	7.29	21.0%	-	-
		[6.04, 6.40]	[7.14, 7.64]	[19.8%, 24.6%]		
Surplus (per individual)	Insurer	0.44	0.99	125.9%	0.38	-13.3%
		[0.44, 0.44]	[0.99, 0.99]	[124.6%, 126.6%]	[0.38, 0.39]	[-13.8%, -11.7%]
	Hospitals (Non-K)	0.30	0.51	69.7%	0.27	-9.0%
	Δ Cons.	[0.29, 0.31]	[0.49, 0.52]	[63.0%, 72.3%]	[0.26, 0.28]	[-13.8%, -7.6%]
		-	-0.19	-	-0.01	-
			[-0.19, -0.18]		[-0.01, -0.01]	

^aResults from simulating removal of Blue Cross or Kaiser from all markets using estimates from specification (iv) in Table V. All figures are in thousands. Baseline numbers (including premiums, hospital prices, and enrollment) are recomputed from model estimates. Average insurer payments to hospitals and average DRG-adjusted hospital prices are weighted by the number of admissions each hospital receives from each insurer under each scenario. Surplus figures represent total insurer, hospital, and changes to consumer surplus per insured individual. 95% confidence intervals, reported below estimates, are constructed by using 80 bootstrap samples of admissions within each hospital-insurer pair to re-estimate hospital-insurer DRG weighted admission prices, re-estimate insurer marginal costs and Nash bargaining parameters, and re-compute counterfactual simulations.

TABLE VIII
REMOVING AN INSURER: COUNTERFACTUAL BLUE SHIELD AND BLUE CROSS HOSPITAL PRICE CHANGES ACROSS MARKETS^a

	Avg. Hospital Price (\$/Admission)					Decomposition of Change (\$/Admission)				
	Baseline	Fix Premiums		Adjust Premiums		(ia) Prem Effect	(ib) Enroll Effect	(ii) Price Reinforce	(iii) Cost Effect	(iv) Re-Capture
		CF	% Change	CF	% Change					
(ia) REMOVE KAISER: BS PRICES										
All Mkts	7191.13	6451.01	-10.29%	7175.65	-0.22%	624.97	-1149.39	473.70	0.65	34.59
2. Sacramento	8204.98	7318.75	-10.80%	7751.96	-5.52%	605.39	-1572.02	491.33	1.83	20.45
4. SF Bay W.	8825.62	7994.95	-9.41%	8589.65	-2.67%	616.37	-1439.98	533.81	-0.86	54.69
5. E. Bay	7368.50	5967.77	-19.01%	6537.55	-11.28%	717.37	-1820.40	229.04	0.15	42.89
9. C. Valley	6591.73	6369.72	-3.37%	7329.03	11.19%	556.42	-550.32	681.83	0.00	49.36
10. S. Barbara	7934.89	7779.92	-1.95%	8709.83	9.77%	402.15	-187.53	533.88	2.55	23.90
11. LA	5878.37	4829.25	-17.85%	5661.03	-3.70%	662.05	-1163.77	258.83	0.43	25.12
14. SD	6673.04	6038.49	-9.51%	6634.70	-0.57%	472.14	-908.62	380.01	-0.04	18.16
(ib) REMOVE KAISER: BC PRICES										
All Mkts	6023.83	5988.53	-0.59%	7219.85	19.85%	671.85	-130.41	580.01	0.24	74.33
2. Sacramento	6651.31	6703.09	0.78%	8186.10	23.08%	839.58	-137.89	728.48	2.05	102.58
4. SF Bay W.	7602.06	7734.73	1.75%	9189.30	20.88%	836.40	-157.26	747.50	-0.70	161.29
5. E. Bay	7158.45	7150.76	-0.11%	8570.60	19.73%	835.46	-220.00	684.32	0.18	112.19
9. C. Valley	5210.75	5215.51	0.09%	6763.68	29.80%	875.55	-134.94	700.05	0.00	112.27
10. S. Barbara	5130.74	5094.60	-0.70%	6395.60	24.65%	699.55	-84.34	599.56	2.52	47.55
11. LA	6084.19	5803.18	-4.62%	6960.25	14.40%	687.32	-386.22	540.62	0.21	34.12
14. SD	5381.70	5482.36	1.87%	6841.04	27.12%	807.95	-143.63	719.75	-0.02	75.29
(ii) REMOVE BLUE CROSS: BS PRICES										
All Mkts	7191.13	6898.64	-4.07%	6620.28	-7.94%	-129.81	-247.77	-167.38	0.01	-25.89
2. Sacramento	8204.98	8098.96	-1.29%	7799.41	-4.94%	-125.74	-131.81	-134.28	-0.02	-13.72
4. SF Bay W.	8825.62	8643.19	-2.07%	8370.37	-5.16%	-128.03	-195.86	-95.34	0.10	-36.12
5. E. Bay	7368.50	7252.44	-1.58%	6913.99	-6.17%	-149.00	-113.83	-170.56	0.00	-21.11
9. C. Valley	6591.73	5945.62	-9.80%	5781.16	-12.30%	-115.57	-485.97	-152.72	-0.02	-56.29
10. S. Barbara	7934.89	7248.92	-8.65%	7170.32	-9.64%	-83.53	-610.90	-17.78	-0.28	-52.08
11. LA	5878.37	5623.27	-4.34%	5304.90	-9.76%	-137.51	-216.72	-200.27	-0.02	-18.94
14. SD	6673.04	6373.32	-4.49%	6161.37	-7.67%	-98.07	-239.34	-160.35	0.00	-13.91

^aAverage (DRG-adjusted) hospital prices for Blue Shield from simulating the removal of Blue Cross or Kaiser across all HSAs, or within a selected sample of HSAs, using estimates from specification (iv) in Table V. Baseline numbers are recomputed from model estimates. Average hospital prices are weighted by the number of admissions each hospital receives from each insurer under each scenario. Decomposition effects correspond to terms in equation (A.4), and are weighted by the number of admissions under the baseline scenario; their sum equals the overall change in hospital prices.

TABLE IX
REMOVING AN INSURER: SUMMARY RESULTS (NASH-BERTRAND PREMIUM SETTING)^a

		Baseline	(iii) Remove BC (Nash-Bertrand)			
		Amount	Amount	% Change		
Ho and Lee (2017) Model	Premiums (per year)	BS	3.78	4.20	11.0%	
			[3.76, 3.79]	[4.17, 4.22]	[10.8%, 11.3%]	
		BC	4.19	–	–	
Empirical Specification			[4.18, 4.21]			
		Ho and Lee (2019) Model	Kaiser	3.67	3.98	8.7%
					[3.66, 3.67]	[3.97, 4.00]
BC	–			–	–	
Data Estimation Results	Household Enrollment	BS	73.91	82.99	12.3%	
			[73.53, 74.56]	[82.71, 83.39]	[11.8%, 12.5%]	
		BC	27.49	–	–	
References			[27.06, 27.77]			
		Kaiser	61.31	71.13	16.0%	
				[61.10, 61.44]	[70.78, 71.38]	[15.8%, 16.2%]
Hospital Payments (per individual)	BS		0.66	0.66	–0.4%	
		[0.65, 0.68]	[0.65, 0.67]	[–0.7%, –0.1%]		
	BC	0.56	–	–		
Hospital Prices (per admission)	BS	7.19	7.11	–1.1%		
			[7.06, 7.36]	[6.96, 7.29]	[–1.5%, –0.8%]	
		BC	6.02	–	–	
Surplus (per individual)	Insurer	1.27	1.57	24.1%		
			[1.27, 1.27]	[1.57, 1.58]	[23.4%, 24.7%]	
		Hospitals (Non-K)	0.30	0.29	–2.8%	
	Δ Cons.	[0.29, 0.31]	[0.28, 0.30]	[–3.9%, –1.9%]		
		–	–0.09	–		
			[–0.09, –0.08]			

^aResults from simulating removal of Blue Cross or Kaiser, using estimates from specification (i) in Table V (without insurer margin moments) and assuming Nash-Bertrand premium setting. All figures are in thousands. Baseline numbers are recomputed from model estimates. Average insurer payments to hospitals and average (DRG-adjusted) hospital prices are weighted by the number of admissions each hospital receives from each insurer under each scenario. Surplus figures represent total insurer, hospital, and changes to consumer surplus per insured individual. 95% confidence intervals, reported below estimates, are constructed by using 80 bootstrap samples of admissions within each hospital-insurer pair to re-estimate hospital-insurer DRG weighted admission prices, re-estimate insurer marginal costs and Nash bargaining parameters, and re-compute counterfactual simulations.

Ho and Lee (2019)

“Equilibrium provider networks: bargaining and exclusion in health care markets”

- “narrow network” health insurance plans annoy consumers, concern policy makers
 - Insurers with market power underproviding quality?
 - Provider network design as a mechanism to “cream skim”
- Model of provider network formation
 - Bargaining between insurer and hospitals
 - Use to simulate effect of proposed “network adequacy” regulation

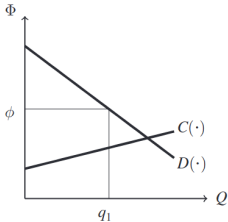
Model

- 1a Network formation & rate determination : MCOs (insurers) bargain with hospitals
- 1b Premium setting : MCOs and employers bargain over premiums
- 2 Insurance demand : households choose insurance plans
- 3 Hospital demand : sick households choose hospitals

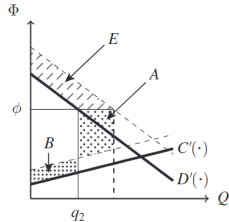
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¹1b-3 similar to [Ho and Lee \(2017\)](#), 1a new to this paper

Panel A. Insurer demand and costs



Panel B. Removal of a hospital



Panel C. Adjustments in reimbursement prices

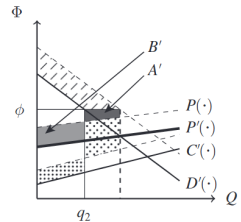


FIGURE 1. REMOVING A HOSPITAL FROM AN INSURER'S NETWORK

Notes: Panel A provides demand $D(\cdot)$ and costs $C(\cdot)$ for a hypothetical monopolist insurer offering a product with a given hospital network at fixed premium ϕ . Panel B illustrates new demand $D'(\cdot)$ and costs $C'(\cdot)$ upon the removal of a hospital from the network: areas A and B represent reduction in premium revenues and savings in costs (if the insurer reimburses hospitals at cost); area E represents the reduction in consumer surplus. Panel C depicts potential adjustment in reimbursement prices $P(\cdot)$ to $P'(\cdot)$ upon removal of a hospital: areas A' and B' represent reduction in insurer premium revenues and savings in payments to hospitals.

Model : rate determination 1

- MCOs \mathcal{M} index j , hospitals \mathcal{H} , network G
- Profits

$$\pi_j^M(G, p) \equiv \tilde{\pi}_j^M(G) - \sum_{i \in G} D_{ij}^H(G) p_{ij}$$

$$\pi_i^H(G, p) \equiv \tilde{\pi}_i^H(G) + \sum_{n \in \mathcal{M}} D_{in}^H(G) p_{in}$$

- Gains from trade

$$\Delta_{ij} \pi_j^M(G, p) \equiv \pi_j^M(G, p) - \pi_j^M(G \setminus i, p_{-ij})$$

$$\Delta_{ij} \pi_i^H(G, p) \equiv \pi_i^H(G, p) - \pi_i^H(G \setminus i, p_{-ij})$$

Model : rate determination 2

- Nash-in-Nash with Thread of Replacement (NNTR)

$$p_{ij}^*(G) = \min\{p_{ij}^{Nash}(G, p_{-ij}^*), p_{ij}^{OO}(G, p_{-ij}^*)\}$$

where

$$p_{ij}^{Nash}(G, p_{-ij}^*) \arg \max_p \left[\Delta_{ij} \pi_j^M(G, p, p_{-ij}^*) \right]^\tau \left[\Delta_{ij} \pi_i^H(G, p, p_{-ij}^*) \right]^{(1-\tau)}$$

and

$$\pi_j^M(G, p_{ij}^{OO}, p_{-ij}) = \max_{k \notin G} \pi_j^M(G \setminus i \cup k, p_{kj}^{res}, p_{-ij})$$

with

$$\pi_k^H(G \setminus i \cup k, p_{kj}^{res}, p_{-ij}) = \pi_k^H(G \setminus i, p_{-ij})$$

- Show that equilibrium prices exist for any G

Model : rate determination 3

- First order conditions for p given observed G used to estimate τ
- Model used to say what prices would be under counterfactual G
- Formation of observed G not used in estimation – observed G constrained by regulators

Data

- California Public Employees' Retirement System (CalPERS) in 2004
- Three MCOs : Kaiser (vertically integrated HMO), Blue Cross (PPO), Blue Shield (HMO)
- Focus on Blue Shield : in 2004 had close to full networks in markets considered (forced to do so by regulation), but then reduced network
- Observe premiums, enrollment, admissions, demographics, prices paid by insurers to hospitals

Table C1: Hospitals Proposed to Be Removed from Blue Shield in 2005

Market Name	Hospital Name	System Name	Decision
Central California	Selma Community Hospital		Approved
	Sierra View District Hospital		Denied
	Delano Regional Medical Center		Withdrawn
	Madera Community Hospital		Withdrawn
East Bay	Eden Hospital Medical Center	Sutter	Approved
	Sutter Delta Medical Center	Sutter	Approved
	Washington Hospital		Approved
Inland Counties	Desert Regional Medical Center	Tenet	Approved
Los Angeles	Cedars Sinai Medical Center		Approved
	St. Mary Medical Center	Dignity	Approved
	USC University Hospital	Tenet	Approved
	West Hills Hospital Medical Center		Approved
	Presbyterian Intercommunity Hospital		Denied
	City of Hope National Medical Center		Withdrawn
	St. Francis Memorial Hospital	Verity	Withdrawn
	St. Vincent Medical Center	Verity	Withdrawn
North Bay	Sutter Medical Center of Santa Rosa	Sutter	Approved
	Sutter Warrack Hospital	Sutter	Approved
North San Joaquin	Memorial Hospital Medical Center - Modesto	Sutter	Approved
	Memorial Hospital of Los Banos	Sutter	Approved
	St. Dominics Hospital	Dignity	Approved
	Sutter Tracy Community Hospital	Sutter	Approved
Orange	Hoag Memorial Hospital Presbyterian		Approved
Sacramento	Sutter Davis Hospital	Sutter	Approved
	Sutter General Hospital	Sutter	Approved
	Sutter Memorial Hospital	Sutter	Approved
	Sutter Roseville Medical Center	Sutter	Approved
San Diego	Sharp Chula Vista Medical Center	Sharp	Withdrawn
	Sharp Coronado Hospital and Healthcare Center	Sharp	Withdrawn
	Sharp Grossmont Hospital	Sharp	Withdrawn
	Sharp Mary Birch Hospital for Women	Sharp	Withdrawn
	Sharp Memorial Hospital	Sharp	Withdrawn
Santa Barbara/Ventura	St John's Pleasant Valley Hosp	Dignity	Denied
	St John's Regional Med Center	Dignity	Denied
Santa Clara	OConnor Hospital	Verity	Approved
West Bay	California Pacific Medical Center Campus Hospital	Sutter	Approved
	Seton Medical Center	Verity	Approved
	St. Lukes Hospital	Sutter	Approved

Notes: List of hospitals that Blue Shield proposed to exclude in its filing to the California Department of Managed Health Care (DMHC) for the 2005 year. Source: DMHC "Report on the Analysis of the CalPERS/Blue Shield Narrow Network" (Zaretsky and pmpm Consulting Group Inc (2005)). "Market name" denotes the Health Service Area of the relevant hospital; the two HSAs in California that are not listed here did not contain hospitals that Blue Shield proposed to exclude. "Decision" is the eventual outcome of the proposal for the relevant hospital.

Estimation

- See [Ho and Lee \(2017\)](#)
- Hospital demand and insurance demand by MLE
- Insurer non-inpatient hospital costs (η_j) and bargaining weights from first order conditions for Nash bargaining

Table C2: Summary Statistics and Parameter Estimates

		Blue Shield	Blue Cross	Kaiser
Premiums (per year)	Single	3782.64	4192.92	3665.04
	2 party	7565.28	8385.84	7330.08
	Family	9834.84	10901.64	9529.08
Hospital Network	# Hospitals in network	189	223	27
	# Hospital systems in network	119	149	-
Avg. hospital price per admission		6624.08 (3801.24)	5869.26 (2321.57)	-
	Avg. hospital cost per admission	1693.47 (552.17)	1731.44 (621.33)	-
Household Enrollment	Single	19313	8254	20319
	2 party	16376	7199	15903
	Family	35058	11170	29127
	Avg # individuals per family	3.97	3.99	3.94
Parameter Estimates	η (Non-inpatient cost per enrollee)	1691.50 (10.41)	1948.61 (8.14)	2535.14 (0.62)
	τ^H (Hospital bargaining weight)	0.31 (0.05)	0.38 (0.03)	-
	τ^ϕ (Premium bargaining weight)		0.47 (0.00)	

Notes: The first three panels report summary statistics by insurer. The number of hospitals and hospital systems for Blue Shield and Blue Cross are determined by the number of in-network hospitals or systems with at least 10 admissions observed in the data. Hospital prices and costs per admission are averages of unit-DRG amounts, unweighted across hospitals (with standard deviations reported in parentheses). The fourth panel reports estimates from [Ho and Lee \(2017\)](#) of marginal costs for each insurer (which do not include hospital payments for Blue Shield and Blue Cross), and (insurer-specific) hospital price and (non-insurer specific) premium Nash bargaining weights; standard errors are reported in parentheses. For Blue Shield and Blue Cross, as we are explicitly controlling for prices paid to hospitals, the estimated cost parameters $\{\eta_j\}_{j \in \{BS, BC\}}$ represent non-inpatient hospital marginal costs per enrollee, which may include physician, pharmaceutical, and other fees. Since we do not observe hospital prices for Kaiser, η_{Kaiser} also include Kaiser's inpatient hospital costs.

TABLE 1—SIMULATION RESULTS FOR ALL MARKETS (Averages)

Objective	Social	Consumer	Blue Shield		Complete
	(NNTR)	(NNTR)	(NNTR)	(NN)	(NNTR/NN)
Surplus (\$ per capita)					
BS profits	1.5% [1.1%, 6.9%]	1.4% [0.9%, 8.0%]	2.6% [1.8%, 8.6%]	0.0% [0.0%, 0.0%]	304.7 [287.5, 312.1]
Hospital profits	-6.4% [-24.9%, -4.9%]	-22.9% [-37.7%, -15.0%]	-14.7% [-33.0%, -12.8%]	0.0% [0.0%, 0.0%]	170.0 [159.4, 209.4]
Total hospital costs	0.2% [0.0%, 1.9%]	0.7% [0.0%, 2.5%]	0.5% [0.4%, 2.0%]	0.0% [0.0%, 0.0%]	95.6 [94.1, 96.3]
Total insurance costs	-0.1% [-0.4%, -0.1%]	0.1% [-0.3%, 0.2%]	-0.1% [-0.5%, -0.1%]	0.0% [0.0%, 0.0%]	2,008.5 [1,990.4, 2,025.7]
Transfer/cost (\$ per enrollee)					
BS premiums	-0.6% [-2.7%, -0.5%]	-2.1% [-4.1%, -1.2%]	-1.2% [-3.6%, -1.0%]	0.0% [0.0%, 0.0%]	2,640.1 [2,615.8, 2,695.1]
BS hospital payments	-5.6% [-22.4%, -4.4%]	-19.9% [-34.1%, -12.7%]	-11.9% [-29.6%, -10.1%]	0.0% [0.0%, 0.0%]	369.3 [347.5, 449.3]
BS hospital costs	-0.3% [-0.3%, 0.1%]	0.9% [0.0%, 1.2%]	0.0% [-0.1%, 0.2%]	0.0% [0.0%, 0.0%]	146.2 [146.1, 146.3]
BS market share	0.4% [0.2%, 1.7%]	-1.8% [-2.0%, 0.5%]	0.2% [-0.2%, 1.7%]	0.0% [0.0%, 0.0%]	0.52 [0.51, 0.53]
Welfare Δ (\$ per capita)					
Consumer	11.7 [8.8, 50.3]	27.8 [17.3, 69.2]	19.9 [15.4, 60.9]	0.0 [0.0, 0.0]	
Total	1.0 [0.5, 4.4]	-11.5 [-12.1, -4.2]	-1.1 [-3.4, 2.0]	0.0 [0.0, 0.0]	
Number of complete network markets (out of 12)	6 [1, 7]	1 [0, 2]	4 [0, 4]	12 [12, 12]	
Number of systems excluded	0.5 [0.4, 1.3]	2.3 [1.8, 2.6]	1.2 [1.2, 1.8]	0.0 [0.0, 0.0]	
Number of systems excluded conditional on exclusion	1.0 [1.0, 1.4]	2.5 [2.1, 2.6]	1.8 [1.8, 2.0]	0.0 [0.0, 0.0]	

Notes: Unweighted averages across markets. First four columns report outcomes for the stable network that maximizes social surplus, consumer welfare, or Blue Shield's (BS) profits, under Nash-in-Nash with Threat of Replacement (NNTR) or Nash-in-Nash (NN) bargaining over hospital reimbursement rates. Percentages and welfare calculations represent changes relative to outcomes under the complete network; outcome levels for the complete network (where all five major hospital systems are included) are presented in right-most column. Ninety-five percent confidence intervals, reported below all figures, are constructed by using 80 bootstrap samples of admissions within each hospital-insurer pair to re-estimate hospital-insurer DRG weighted admission prices, re-estimate insurer marginal costs and Nash bargaining parameters, and re-compute simulations (see Ho and Lee 2017 for further details).

TABLE 2—SIMULATION RESULTS FOR SACRAMENTO

Objective	Social	Consumer	Blue Shield	Complete
Surplus (per capita)				
BS profits	0.0% [0.0%, 10.3%]	3.1% [1.7%, 10.3%]	3.1% [1.7%, 10.3%]	316.2 [290.2, 325.9]
Hospital profits	0.0% [-40.1%, 0.0%]	-26.0% [-40.1%, -21.3%]	-26.0% [-40.1%, -21.3%]	115.5 [102.2, 170.7]
Total hospital costs	0.0% [0.0%, 3.6%]	1.6% [1.2%, 3.6%]	1.6% [1.2%, 3.6%]	98.5 [96.1, 99.4]
Total insurance costs	0.0% [-0.6%, 0.0%]	-0.1% [-0.6%, 0.0%]	-0.1% [-0.6%, 0.0%]	2,049.8 [2,032.6, 2,068.5]
Transfers (per enrollee)				
BS premiums	0.0% [-3.5%, 0.0%]	-1.5% [-3.5%, -1.1%]	-1.5% [-3.5%, -1.1%]	2,619.7 [2,593.9, 2,688.7]
BS hospital payments	0.0% [-30.4%, 0.0%]	-16.8% [-30.4%, -12.9%]	-16.8% [-30.4%, -12.9%]	333.8 [307.4, 444.8]
BS hospital costs	0.0% [0.0%, 1.2%]	1.2% [1.1%, 1.3%]	1.2% [1.1%, 1.3%]	165.5 [165.4, 165.7]
Δ Welfare (per capita)				
Consumer	0.0 [0.0, 60.1]	23.3 [15.7, 60.1]	23.3 [15.7, 60.1]	
Total	0.0 [0.0, 5.0]	-3.4 [-5.0, 5.0]	-3.4 [-5.0, 5.0]	
BS market share	0.0% [0.0%, 2.6%]	0.2% [-0.2%, 2.6%]	0.2% [-0.2%, 2.6%]	0.53 [0.52, 0.54]
Network				
Number of systems excluded	0 [0, 3]	3 [3, 3]	3 [3, 3]	
System 1 (Sutter)	1 [1, 0]	1 [1, 0]	1 [1, 0]	
System 2 (Dignity)	1 [1, 0]	1 [1, 0]	1 [1, 0]	
System 3 (UCD)	1 [0, 9]	0 [0, 0]	0 [0, 0]	
System 4 (Rideout)	1 [0, 9]	0 [0, 0]	0 [0, 0]	
System 5 (Marshall)	1 [0, 9]	0 [0, 0]	0 [0, 0]	

Notes: Simulation results from Sacramento HSA. First three columns report outcomes for the stable network that maximizes social surplus, consumer welfare, or Blue Shield's profits, under Nash-in-Nash with Threat of Replacement (NNTR) bargaining over hospital reimbursement rates. Percentages and welfare calculations represent changes relative to outcomes under the complete network; outcome levels for the complete network (where all five major hospital systems are included) are presented in right-most column. Ninety-five percent confidence intervals are reported below all figures (except for individual hospital systems, where the fraction of bootstrap samples under which individual system members are included are reported beneath predictions); see Table 1 for additional details.

Vertical Relationships

Paul Schrimpf

Ho and Lee (2017)

Model

Empirical Specification

Ho and Lee (2019)

Model

Data

Estimation

Results

References

TABLE 3—SIMULATION RESULTS FOR SANTA BARBARA/VENTURA

Objective	Social	Consumer	Blue Shield	Complete
Surplus (per capita)				
BS profits	-0.3% [-0.3%, 0.1%]	-5.0% [-5.2%, -0.3%]	0.0% [0.0%, 0.1%]	397.7 [382.9, 403.3]
Hospital profits	0.0% [-1.5%, 0.4%]	-1.5% [-15.3%, 0.4%]	0.0% [-1.5%, 0.0%]	240.4 [224.0, 299.9]
Total hospital costs	-1.0% [-1.0%, -0.9%]	-3.5% [-3.6%, -1.0%]	0.0% [-0.9%, 0.0%]	115.8 [115.1, 116.1]
Total insurance costs	0.0% [0.0%, 0.0%]	0.5% [0.0%, 0.6%]	0.0% [0.0%, 0.0%]	1,832.9 [1,815.1, 1,849.7]
Transfers (per enrollee)				
BS premiums	-0.1% [-0.3%, 0.0%]	-0.5% [-2.5%, 0.0%]	0.0% [-0.3%, 0.0%]	2,677.8 [2,646.6, 2,751.6]
BS hospital payments	-0.5% [-2.0%, -0.2%]	-3.1% [-17.0%, -0.2%]	0.0% [-2.0%, 0.0%]	363.9 [338.0, 459.2]
BS hospital costs	-1.4% [-1.4%, -1.4%]	-4.6% [-4.6%, -1.4%]	0.0% [-1.4%, 0.0%]	126.0 [126.0, 126.1]
Δ Welfare (per capita)				
Consumer	1.6 [0.7, 7.0]	7.0 [0.7, 55.7]	0.0 [0.0, 7.0]	
Total	0.5 [0.4, 0.8]	-15.2 [-15.7, 0.5]	0.0 [0.0, 0.8]	
BS market share	-0.2% [-0.2%, -0.1%]	-4.6% [-4.7%, -0.2%]	0.0% [-0.1%, 0.0%]	0.64 [0.63, 0.64]
Network				
Number of systems excluded	1 [1, 1]	3 [1, 3]	0 [0, 1]	
System 1 (Dignity)	1 [1.0]	1 [1.0]	1 [1.0]	
System 2 (Community)	1 [1.0]	1 [1.0]	1 [1.0]	
System 3 (Cottage)	1 [1.0]	0 [0.2]	1 [1.0]	
System 4 (HCA)	1 [1.0]	0 [0.2]	1 [1.0]	
System 5 (Lompoc MC)	0 [0.0]	0 [0.0]	1 [0.9]	

Notes: Simulation results from Santa Barbara/Ventura HSA. See notes from Table 3.

Vertical Relationships

Paul Schimpf

Ho and Lee (2017)

Model

Empirical
Specification

Ho and Lee (2019)

Model

Data

Estimation

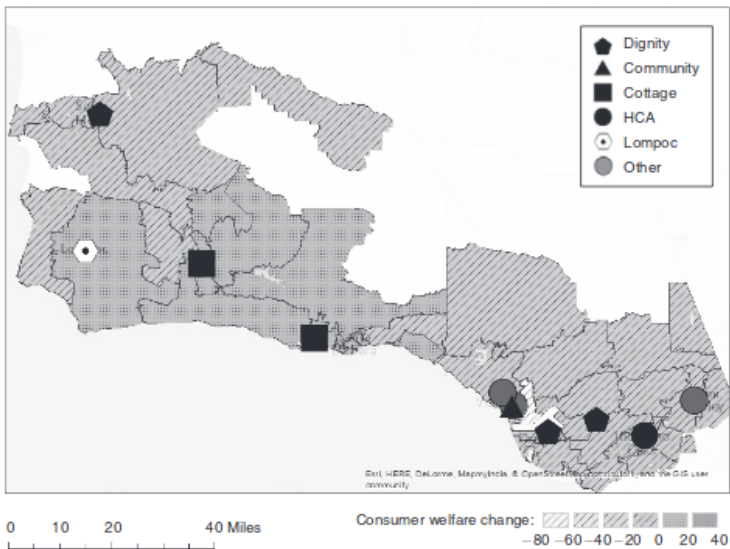
Results

References

Panel A. Sacramento



Panel B. Santa Barbara/Ventura



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