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), Prager and Tilipman (2020)
- Suppliers and assemblers: Fox (2018)
- Retailers and wholesalers: Hristakeva (2022)
- Foundations for Nash-in-Nash model: Collard-Wexler, Gowrisankaran, and Lee (2019) and Horn & Wolinksy (198?)

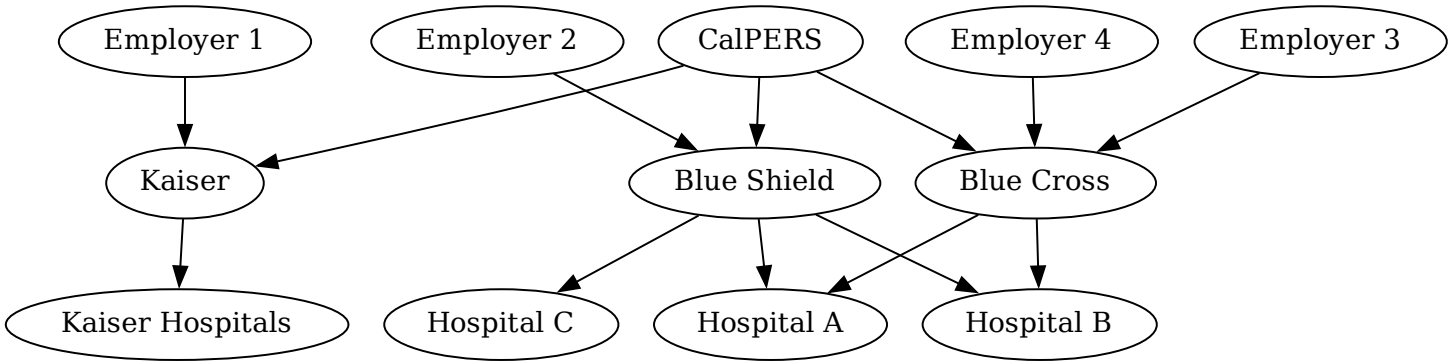
Section 1

Ho and Lee (2017)

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
- Bargaining leads to novel implications for effect of removal of an insurer


Employer 1
Employer 2
CalPERS
Employer 4
Employer 3
Kaiser
Blue Shield
Blue Cross
Kaiser Hospitals
Hospital C
Hospital A
Hospital B

Premium Setting	*Insurer Removed* BC (Small)	*Insurer Removed* K (Large)
Unconstrained (Nash–Bertrand)	+11.0% [10.8%, 11.3%]	+19.3% [19.1%, 19.6%]
Constrained (Bargaining)	−3.4% [−4.0%, −3.3%]	+16.6% [15.8%, 16.8%]

(a) Premium Changes

	Insurer Removed BC (Small)	*Insurer Removed* K (Large)
Unconstrained (Nash–Bertrand)	−1.1% [−1.5%, −0.8%]	+3.0% [2.1%, 3.9%]
Constrained (Bargaining)	−8.9% [−13.3%, −7.7%]	+0.6% [−3.1%, 1.8%]

(b) Hospital Price Changes

FIGURE 1.—Predicted (a) premium and (b) hospital price per admission changes for Blue Shield upon the removal of either Blue Cross (BC) or Kaiser (K), when insurers set premiums according to Nash–Bertrand competition or bargain with the employer. 95% confidence intervals are reported below estimates. See Section 4 for details.

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

[a]Summary 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]

	Individual Plan Enrollment						Hospital Concentration			
	Enrollment			Market Share			# Systems		HHI (Adm)	
HSA Market	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

[a]Individual 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.

[b]Total (statewide) HHI accounts for hospital system membership across HSAs.

Notation

- $\mathcal{M} = \{$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

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

$$\times \left[\underbrace{W(\mathcal{M}, (\varphi, \phi_{-j})) - W(\mathcal{M} \setminus j, \phi_{-j})}_{GFT_j^E(\cdot)} \right]^{(1-\tau^{\phi})}$$

Premium First Order Condition

$$\frac{\partial \pi_j^M(\cdot)}{\partial \phi_j} = \frac{1-\tau^\phi}{\tau^\phi} \times \frac{\pi_j^M(\cdot) \times \left(-\partial GFT_j^E(\cdot)/\partial \phi_j\right)}{GFT_j^E(\cdot)} \quad \forall j \in \mathcal{M}$$

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

Hospital Price First Order Condition

$$\underbrace{p^*_{ij} D^H_{ij}}_{\text{total hospital payments}} = (1-\tau_j)\Bigg[\underbrace{[\Delta_{ij} D_j](\phi_j - \eta_j)}_{\substack{\text{(i) "premium and enrollment effects"} \\ (\Delta \text{ MCO revenues net of non-hosp costs})}} - \underbrace{\left(\sum_{h \in \mathcal{G}^M_j \setminus ij} p^*_{hj}\left[\Delta_{ij} D^H_{hj}\right]\right)}_{\substack{\text{(ii) "price reinforcement effect"} \\ (\Delta \text{ MCO } j \text{ payments to other hospitals})}}\Bigg]$$

$$+ \tau_j\Bigg[\underbrace{c_i D^H_{ij}}_{\substack{\text{(iii) "hospital cost effect"} \\ \text{(total hospital costs)}}} - \underbrace{\sum_{n \in \mathcal{G}^H_i \setminus ij}\left[\Delta_{ij} D^H_{in}\right]\left(p^*_{in} - c_i\right)}_{\substack{\text{(iv) "recapture effect"} \\ (\Delta \text{ Hospital } i \text{ profits from other MCOs})}}\Bigg] \quad \forall ij \in \mathcal{G},$$

Hospital Demand & Consumer Surplus

- Discrete choice model of hospitals

hospital characteristics; person k & diagnosis l

$$u^H_{k,i,l,m} = \delta_i + z_i \nu_{k,l} \beta^z + d_{i,k} \beta^d_m + \epsilon^H_{k,i,l,m}$$

hospital; distance; T1EV

- Willingness to pay:

P(admission); P(diagnosis|admit)

$$WTP_{k,jm}(\mathcal{G}) = \gamma^a_{\kappa(k)} \sum_{l \in \mathcal{L}} \gamma_{\kappa(k),l} \log\left(\sum_{h \in \mathcal{G}} \exp(\delta_h + z_h \nu_{k,l} \beta^z + d_{h,k} \beta^d_m) \right)$$

$EU(\mathcal{G})$

Insurance Plan Demand

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

$$u^M_{f,j,m} = \underbrace{\delta_{j,m}}_{\text{insurer} \times \text{market}} + \alpha^{\phi}_f \underbrace{(0.2\phi_j \Phi_{\lambda(f)})}_{\text{premium paid by household}} + \sum_{\kappa} \underbrace{\alpha^W_\kappa}_{\text{age-sex categories}} \sum_{k \in f : \kappa(k) = \kappa} \underbrace{WTP_{k,j,m}}_{\text{family members}} + \epsilon^M_{f,j,m}$$

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

[a]Estimated own-price elasticities for each insurer using insurer demand estimates from Table A.IV.

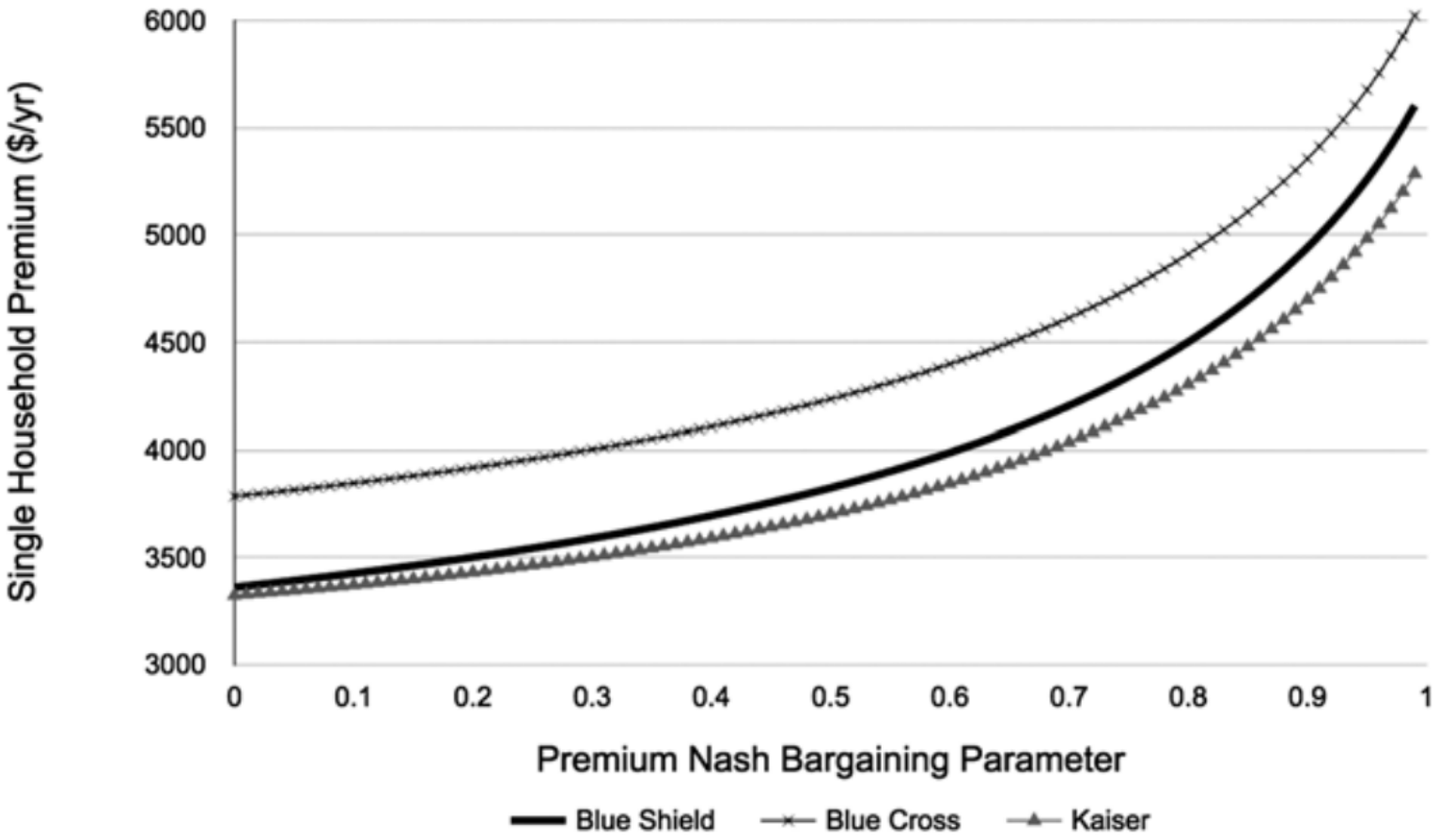


FIGURE 2.—Predicted equilibrium single household premiums at estimated parameters from specification (ii) in Table V as the premium Nash bargaining parameter (τ^{ϕ}) varies.

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

[a]2-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 $\omega^{1}_{\text{Kaiser}} = 0$. 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%]

[a]Weighted 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 [3.76, 3.79]	4.41 [4.36, 4.43]	16.6% [15.8%, 16.8%]	3.65 [3.62, 3.66]	−3.4% [−4.0%, −3.3%]
	BC	4.19 [4.18, 4.20]	4.80 [4.75, 4.81]	14.4% [13.7%, 14.6%]	–	–
	Kaiser	3.67 [3.66, 3.67]	–	–	3.62 [3.60, 3.62]	−1.4% [−1.6%, −1.3%]
Household Enrollment	BS	73.91 [73.65, 74.34]	124.16 [124.13, 124.25]	68.0% [67.1%, 68.6%]	87.73 [87.44, 88.51]	18.7% [18.4%, 19.3%]
	BC	27.49 [27.49, 27.50]	38.56 [38.47, 38.59]	40.2% [39.9%, 40.4%]	–	–
	Kaiser	61.31 [60.88, 61.58]	–	–	64.99 [64.21, 65.27]	6.0% [5.2%, 6.3%]
Hospital Payments (per individual)	BS	0.66 [0.65, 0.68]	0.66 [0.64, 0.68]	0.5% [−3.1%, 1.7%]	0.60 [0.57, 0.62]	−8.5% [−12.7%, −7.5%]
	BC	0.56 [0.55, 0.58]	0.68 [0.67, 0.72]	21.2% [20.0%, 24.8%]	–	–
Hospital Prices (per admission)	BS	7.19 [7.06, 7.35]	7.23 [6.92, 7.43]	0.6% [−3.1%, 1.8%]	6.55 [6.19, 6.74]	−8.9% [−13.3%, −7.7%]
	BC	6.02 [6.04, 6.40]	7.29 [7.14, 7.64]	21.0% [19.8%, 24.6%]	–	–
Surplus (per individual)	Insurer	0.44 [0.44, 0.44]	0.99 [0.99, 0.99]	125.9% [124.6%, 126.6%]	0.38 [0.38, 0.39]	−13.3% [−13.8%, −11.7%]
	Hospitals (Non-K)	0.30 [0.29, 0.31]	0.51 [0.49, 0.52]	69.7% [63.0%, 72.3%]	0.27 [0.26, 0.28]	−9.0% [−13.8%, −7.6%]
	Δ Cons.	–	−0.19 [−0.19, −0.18]	–	−0.01 [−0.01, −0.01]	–

[a]Results 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)				
		Fix Premiums		Adjust Premiums						
	Baseline	CF	% Change	CF	% Change	(ia) Prem Effect	(ib) Enroll Effect	(ii) Price Reinforce	(iii) Cost Effect	(iv) Re-Capture
(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

[a]Average (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 predicted 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
Premiums (per year)	BS	3.78 [3.76, 3.79]	4.20 [4.17, 4.22]	11.0% [10.8%, 11.3%]
	BC	4.19 [4.18, 4.21]	–	–
	Kaiser	3.67 [3.66, 3.67]	3.98 [3.97, 4.00]	8.7% [8.4%, 8.9%]
Household Enrollment	BS	73.91 [73.53, 74.56]	82.99 [82.71, 83.39]	12.3% [11.8%, 12.5%]
	BC	27.49 [27.06, 27.77]	–	–
	Kaiser	61.31 [61.10, 61.44]	71.13 [70.78, 71.38]	16.0% [15.8%, 16.2%]
Hospital Payments (per individual)	BS	0.66 [0.65, 0.68]	0.66 [0.65, 0.67]	−0.4% [−0.7%, −0.1%]
	BC	0.56 [0.55, 0.58]	–	–
Hospital Prices (per admission)	BS	7.19 [7.06, 7.36]	7.11 [6.96, 7.29]	−1.1% [−1.5%, −0.8%]
	BC	6.02 [6.03, 6.40]	–	–
Surplus (per individual)	Insurer	1.27 [1.27, 1.27]	1.57 [1.57, 1.58]	24.1% [23.4%, 24.7%]
	Hospitals (Non-K)	0.30 [0.29, 0.31]	0.29 [0.28, 0.30]	−2.8% [−3.9%, −1.9%]
	Δ Cons.	–	−0.09 [−0.09, −0.08]	–

[a]Results 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.

Section 2

Ho and Lee (2019)

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

1

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

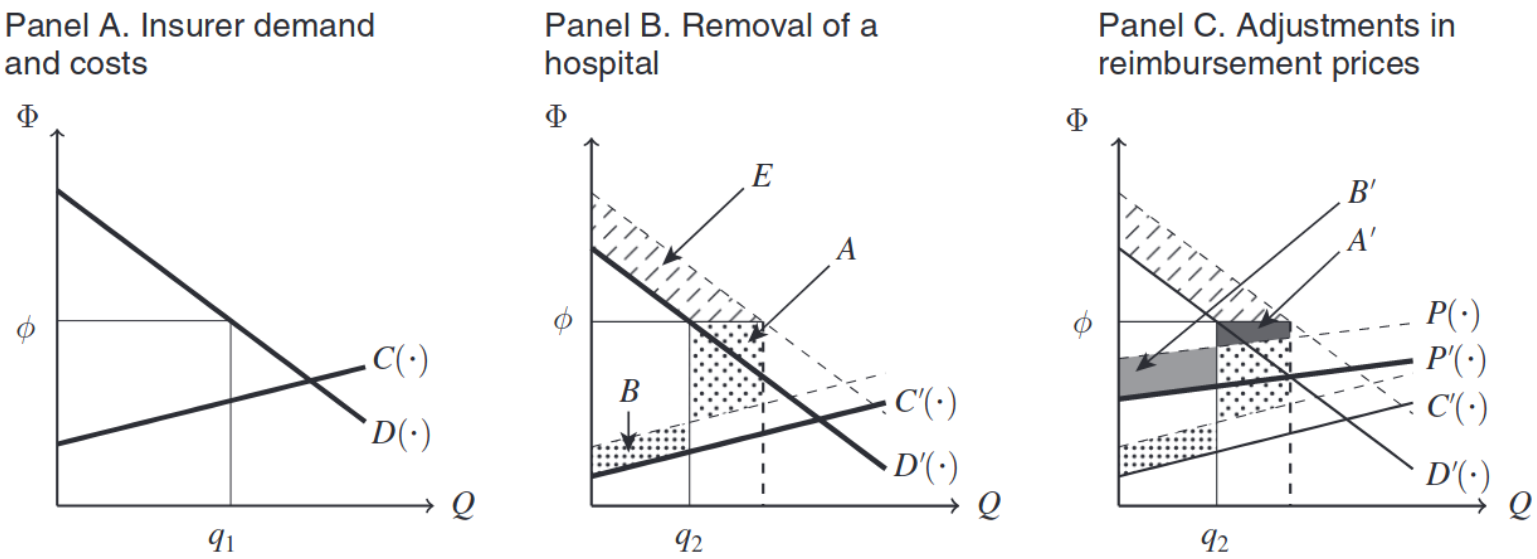


FIGURE 1. REMOVING A HOSPITAL FROM AN INSURER'S NETWORK

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 Threat of Replacement (NNTR)

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

where

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

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, enrollemnt, 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)
- Hosptial 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 (Ho and Lee, 2017)	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 (NNTR)	Consumer (NNTR)	Blue Shield (NNTR)	Blue Shield (NN)	Complete (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 payents	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]	

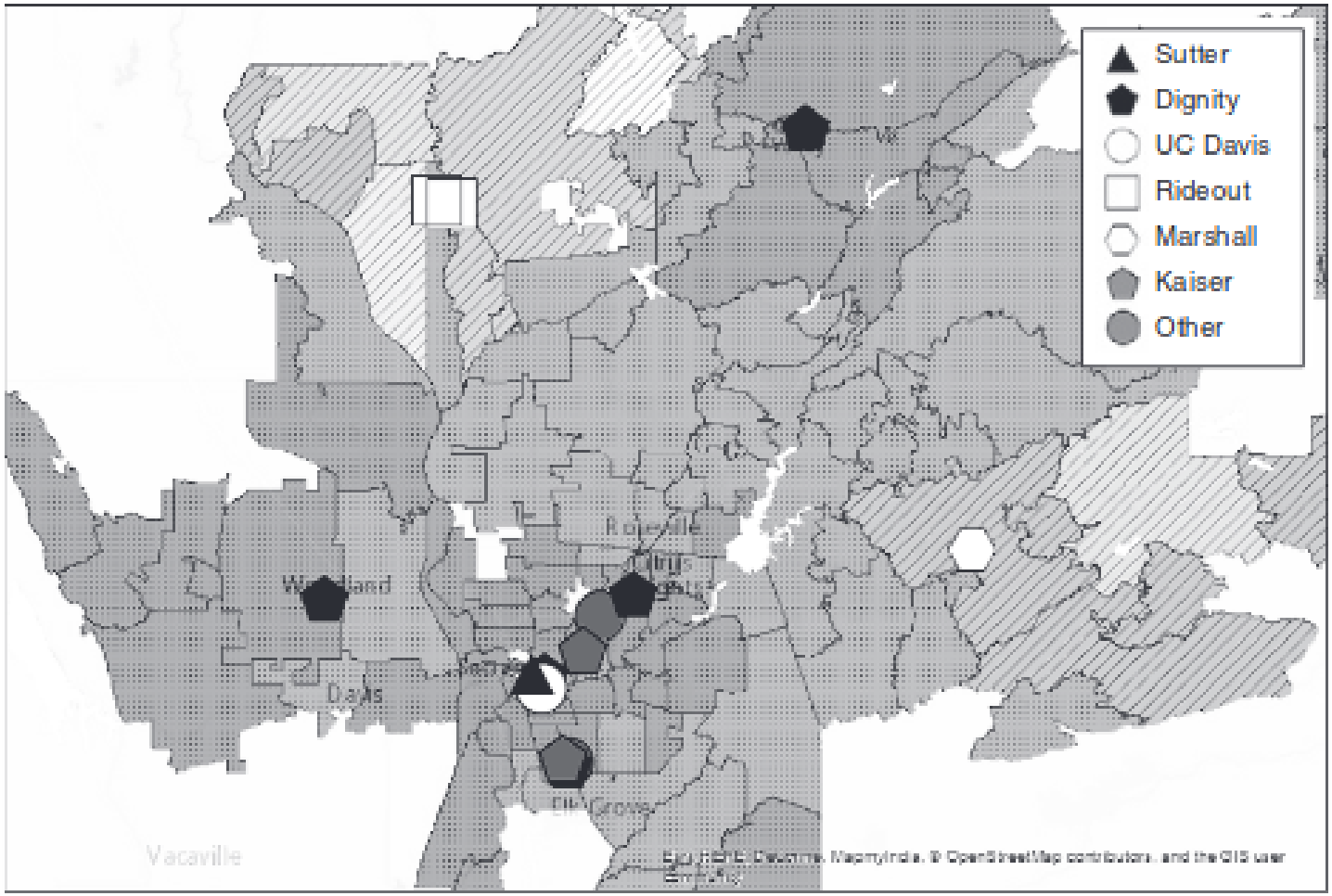
Notes: Simulation results from Sacramento HSA. First three columns report outcomes for the stable network that maximizes social surplus, consumer welfare, or Blue Shield's profits, under Nash-in-Nash with Threat of Replacement (NNTR) bargaining over hospital reimbursement rates. Percentages and welfare 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.

TABLE 3—SIMULATION RESULTS FOR SANTA BARBARA/VENTURA

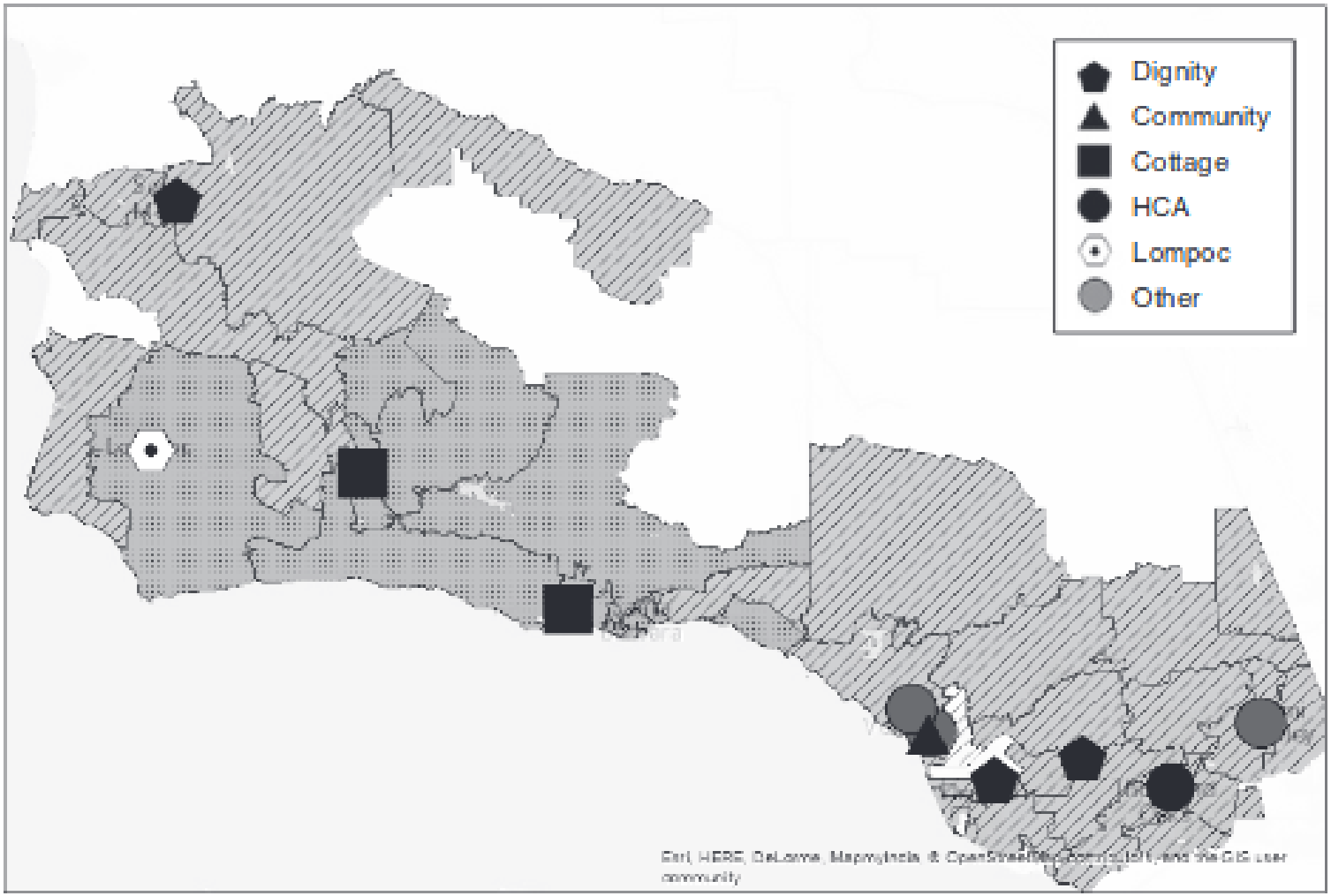
Objective	Social	Consumer	Blue Shield	Complete
Surplus (per capita)				
BS profits	−0.3% [−0.3%, 0.1%]	−5.0% [−5.2%, −0.3%]	0.0% [0.0%, 0.1%]	397.7 [382.9, 403.3]
Hospital profits	0.0% [−1.5%, 0.4%]	−1.5% [−15.3%, 0.4%]	0.0% [−1.5%, 0.0%]	240.4 [224.0, 299.9]
Total hospital costs	−1.0% [−1.0%, −0.9%]	−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.

Panel A. Sacramento



Panel B. Santa Barbara/Ventura



Section 3

Dorn (2024b)

Six Stylized Facts From Ten Years of Vertical Market Contract Data

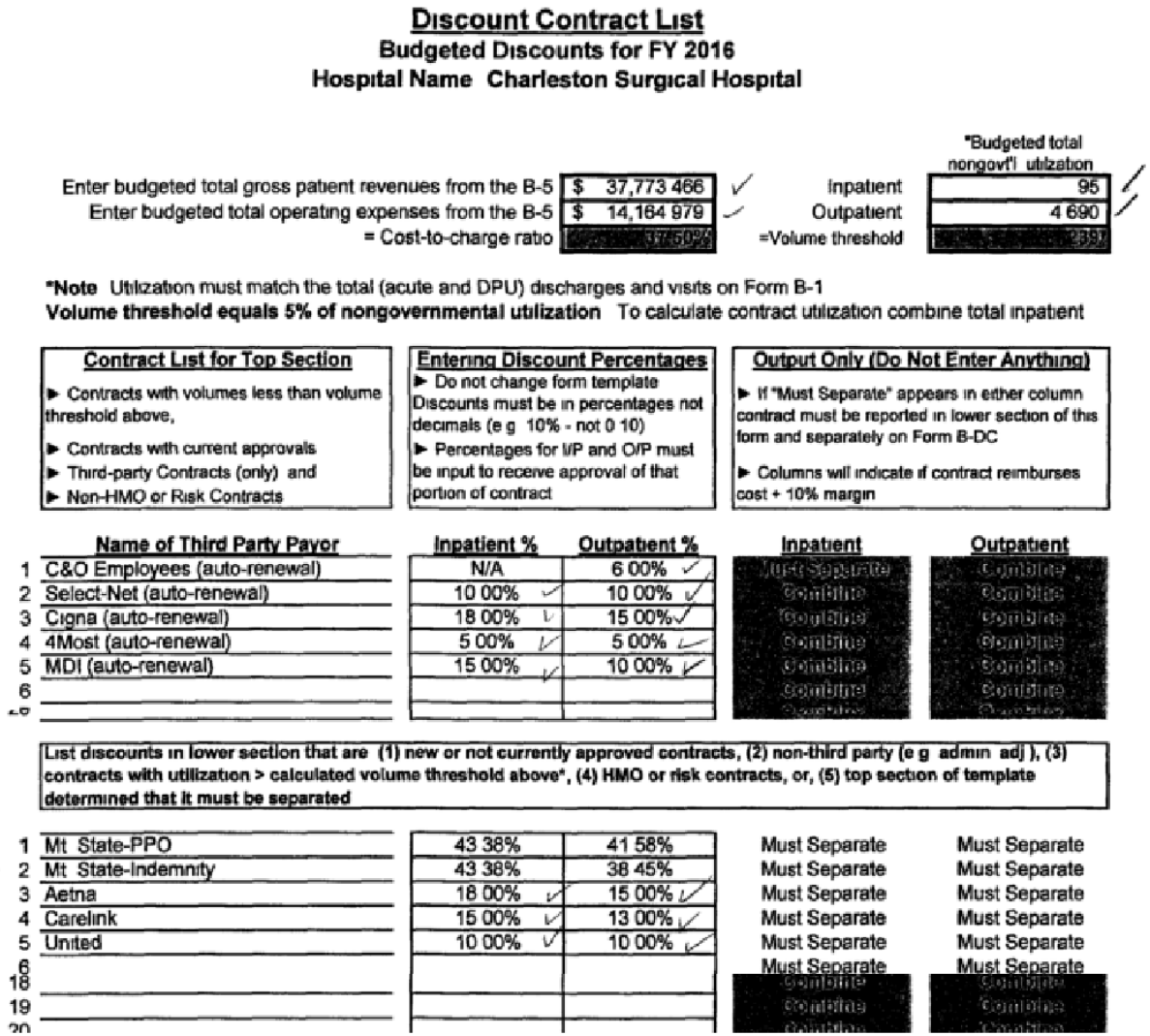
Dorn (2024b)

- Novel data of hospital-insurer contracts from WV 2005-2015
  - Payment rates, contract formation, scale
- Document six stylized facts

WV Regulatory Environment

- "corridor" system regulating hospital list prices
- Hospital specific price cap on list price increases
  - Lower costs, list prices allow large list price increases
  - Excessive list prices lead to reduction in future approve list prices
  - Private insurer contracts required to pay more than hospital average costs (generally not a binding constraint)
  - WV Health Care Authority (HCA) made contracts public (unusual)

Data



Discount Contract List
Budgeted Discounts for FY 2016
Hospital Name Charleston Surgical Hospital

Enter budgeted total gross patient revenues from the B-5	$ 37,773 466	✓	Inpatient	95
Enter budgeted total operating expenses from the B-5	$ 14,164 979	✓	Outpatient	4 690
= Cost-to-charge ratio	37 50%		=Volume threshold	5%

*Budgeted total nongovt'l utilization

***Note** Utilization must match the total (acute and DPU) discharges and visits on Form B-1
Volume threshold equals 5% of nongovernmental utilization To calculate contract utilization combine total inpatient

Contract List for Top Section
- Contracts with volumes less than volume threshold above,
- Contracts with current approvals
- Third-party Contracts (only) and
- Non-HMO or Risk Contracts

Entering Discount Percentages
- Do not change form template
Discounts must be in percentages not decimals (e g 10% - not 0 10)
- Percentages for I/P and O/P must be input to receive approval of that portion of contract

Output Only (Do Not Enter Anything)
- If "Must Separate" appears in either column contract must be reported in lower section of this form and separately on Form B-DC
- Columns will indicate if contract reimburses cost + 10% margin

	Name of Third Party Payor	Inpatient %	Outpatient %	Inpatient	Outpatient
1	C&O Employees (auto-renewal)	N/A	6 00% ✓	Must Separate	Combine
2	Select-Net (auto-renewal)	10 00% ✓	10 00% ✓	Combine	Combine
3	Cigna (auto-renewal)	18 00% ✓	15 00% ✓	Combine	Combine
4	4Most (auto-renewal)	5 00% ✓	5 00% ✓	Combine	Combine
5	MDI (auto-renewal)	15 00% ✓	10 00% ✓	Combine	Combine
6				Combine	Combine
18				Combine	Combine
19				Combine	Combine
20				Combine	Combine

List discounts in lower section that are (1) new or not currently approved contracts, (2) non-third party (e g admin adj), (3) contracts with utilization > calculated volume threshold above*, (4) HMO or risk contracts, or, (5) top section of template determined that it must be separated

1	Mt State-PPO	43 38%	41 58%	Must Separate	Must Separate
2	Mt State-Indemnity	43 38%	38 45%	Must Separate	Must Separate
3	Aetna	18 00% ✓	15 00% ✓	Must Separate	Must Separate
4	Carelink	15 00% ✓	13 00% ✓	Must Separate	Must Separate
5	United	10 00% ✓	10 00% ✓	Must Separate	Must Separate
6				Must Separate	Must Separate

Figure 1: Discount Contract List scan for Charleston Surgical Hospital in fiscal year 2016. The top panel of contracts lists smaller contracts that do not fall in any of a set of special exceptions. I omit white space and a handwritten note reading, "New contract is Highmark, not Mt State," which reflects the 2011 renaming of Mountain State Blue Cross Blue Shield

Data

- Hospital discount contract lists (DCL) 2006-2015
  - % each insurer paid below list price in previous year
  - Separates smaller (top panel) and larger payees (bottom panel)
- Hospital Discount Contract forms 2010-2015
  - For larger payers
  - Includes revenue, contract acceptance & expiration dates, etc

Data

Summary Information of Discount Contracts
Total - FY 2016 Budget
Hospital Name ___ Charleston Surgical Hospital

Fiscal Year Ending 12/31/2016
Submission Date 11/2/2015

	Name of Purchaser or Third Party Payor	Total	=	Combined Contracts	+	Mt State-PPO	Mt State-Indemnity	Aetna
2	Date of Contract					8/1/2015	8/1/2015	11/1/1994
3	Date Contract Expires					12/31/2018	12/31/2018	Auto Renewal
4	Projected Inpatient Discharges	92		16		50	2	17
5	Projected Gross Inpatient Revenue	2 878 926		417 403		1 627 278	65 091	567 464
6	Inpatient Discount Percent	31 54%		12 00%		43 38%	43 38%	18 00%
7	Projected Amount of Inpatient Discount	908 049		50 088		705 865	28 235	102 144
8	Projected Net Inpatient Revenue	1 970 877		367 315		921 413	36 857	465 320
9	Projected Inpatient Cost	1 079 592		156 525		610 226	24 409	212 798
10	Projected Inpatient Charge per Discharge					32 545 55	32 545 55	33 380 24
11	Projected Inpatient Cost per Discharge					12 204 52	12 204 52	12 517 53
12	**Projected Cost to Charge Ratio**	37 50%				37 50%	37 50%	37 50%
13	Projected Outpatient Visits	3 985		619		2 594	136	388
14	Projected Gross Outpatient Revenue	12 312 629		1 276 012		8 755 454	459 037	1 162 818
15	Outpatient Discount Percent	34 27%		12 00%		41 58%	38 45%	15 00%
16	Projected Amount of Outpatient Discount	4 219 778		153 121		3 640 518	176 500	174 423
17	Projected Net Outpatient Revenue	8 092 852		1 122 890		5 114 936	282 537	988 395
18	Projected Outpatient Cost	4 617 213		478 502		3 283 279	172 138	436 055
19	Projected Outpatient Charge Per Visit					3 375 27	3 375 27	2 996 95
20	Projected Outpatient Cost Per Visit					1 265 72	1 265 72	1 123 85
21	**Projected Cost to Charge Ratio**	37 50%				37 50%	37 50%	37 50%
22	Uncompensated Care Percent of Gross Patient Revenue							
23	Will Contract(s) Provide a Quantifiable Economic Benefit to the Hospital? *Circle*			Yes		Yes	Yes	Yes
24	Is the Discount Amount Below Actual Cost of Service? *Circle*			No		No	No	No
25	Will Cost Be Shifted to Any Other Purchaser of Third Party Payor as a Result of this Contract? *Circle*			No		No	No	No
26	Date contract submitted to HCA					7/8/2015	7/8/2015	10/31/2014
27	the Authority? (If yes please submit revised contracts) *Circle*			No		No	No	No

NOTE This page should include only the total combined and **3 (three)** separate contract columns Use this form in its current version only **Any modifications will be returned**

Figure 2: The first page of detailed contract data for Charleston Surgical Hospital in fiscal year 2016. (A second page reports data for Carelink and UnitedHealth.) The data includes unusual information on contract formation and scale. The existence of cross-column totals and cross-row formulas imply valuable restrictions for data cleaning.

Largest Insurer Paid the Lowest Prices

	Highmark BCBS	Aetna	HPUOV	Carelink	UnitedHealth	Cigna	Nonmodeled
Inpatient	58.4%	6.1%	3.2%	3%	3.3%	2.5%	23.5%
Outpatient	58.5%	6.2%	4%	3.2%	2.6%	2.8%	22.8%
Total	58.5%	6.1%	3.8%	3.1%	2.9%	2.7%	23%

Table 2: Estimated hospital–insurer payment market shares for fiscal year 2011 and later.

Largest Insurer Formed Multiyear Contracts

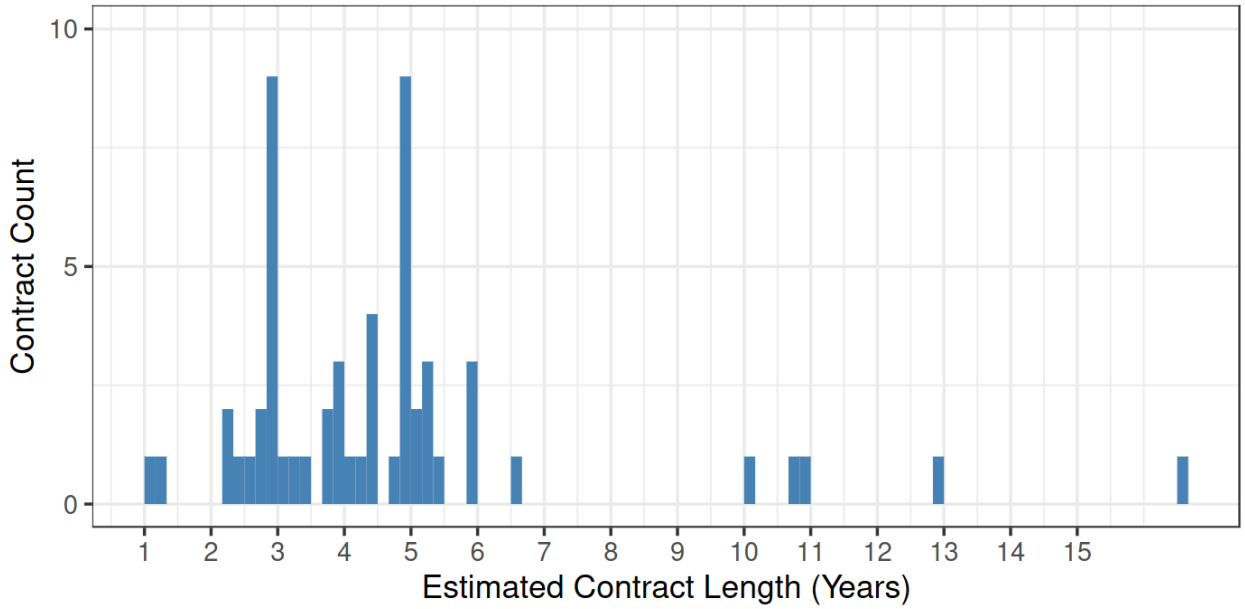


Figure 5: Distribution of reported contract term lengths (hospital-insurer-start-end tuples) for contracts with fixed expiration dates for Highmark BCBS. Ten hospitals' auto-renew contracts with reported formation dates are not contained in this figure.

Smaller Insurers Generally Formed Auto-Renew Contracts

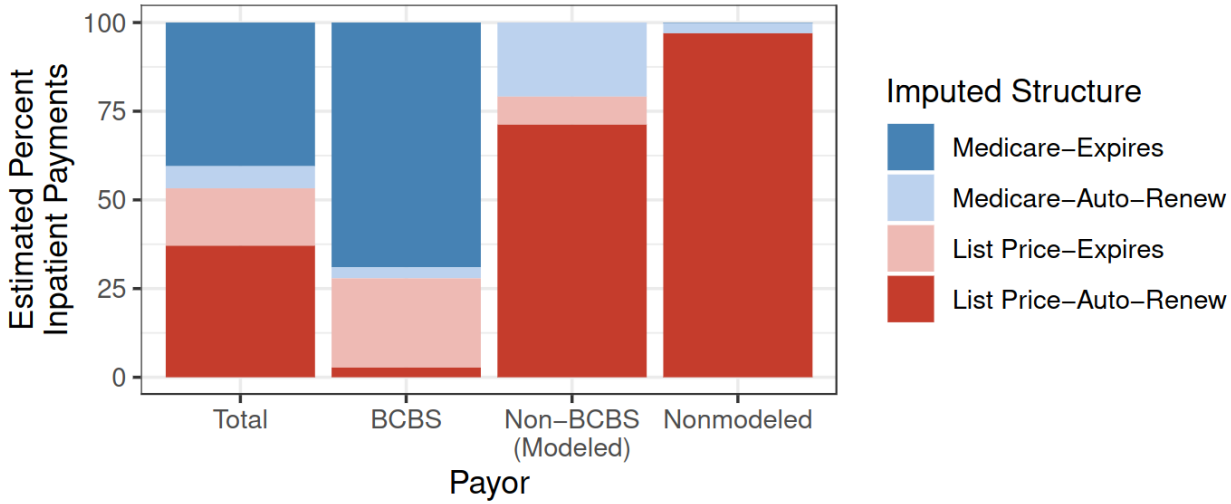


Figure 7: Estimated percentage of inpatient payments accounted for by imputed contract structure by insurer. Color indicates inferred payment benchmark. Transparency indicates contract expiration type. Highmark Blue Cross, the largest insurer, generally used prospective ("Medicare") diagnosis weights in contracts with fixed expiration dates. Smaller insurers generally used list price-based formulas under auto-renew contracts.

Auto-Renew Contracts Generally Renewed

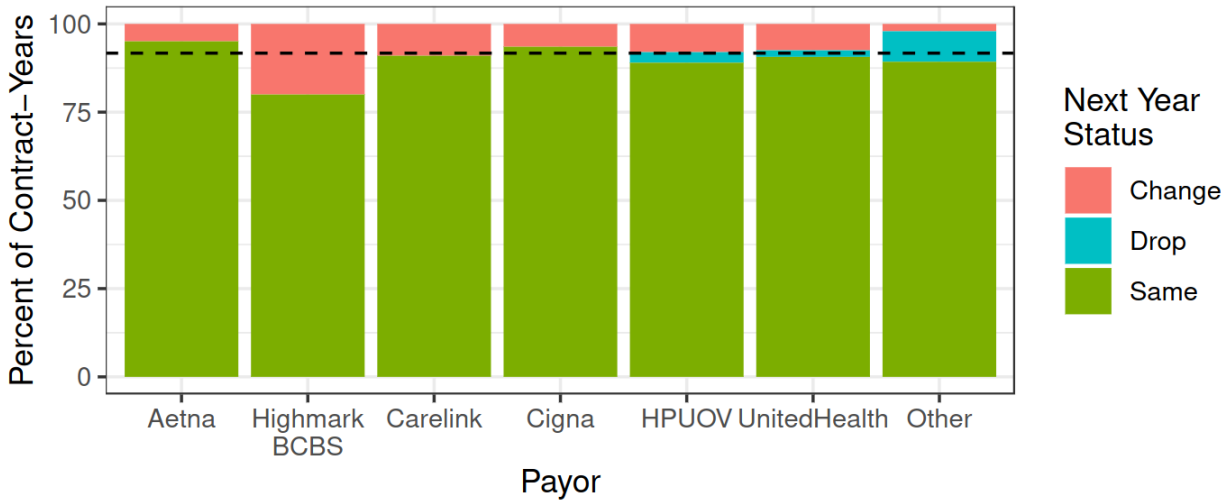


Figure 9: Percentage of auto-renew share of charges contract-years that remained in place (green), were renegotiated (red), or were dropped (blue) for each insurer. The insurers all generally allowed auto-renew contracts to renew, with the average renewal probability of 93.4% indicated by dashed line.

Auto-Renew Contracts Generally Renewed, Especially for Smaller Insurers

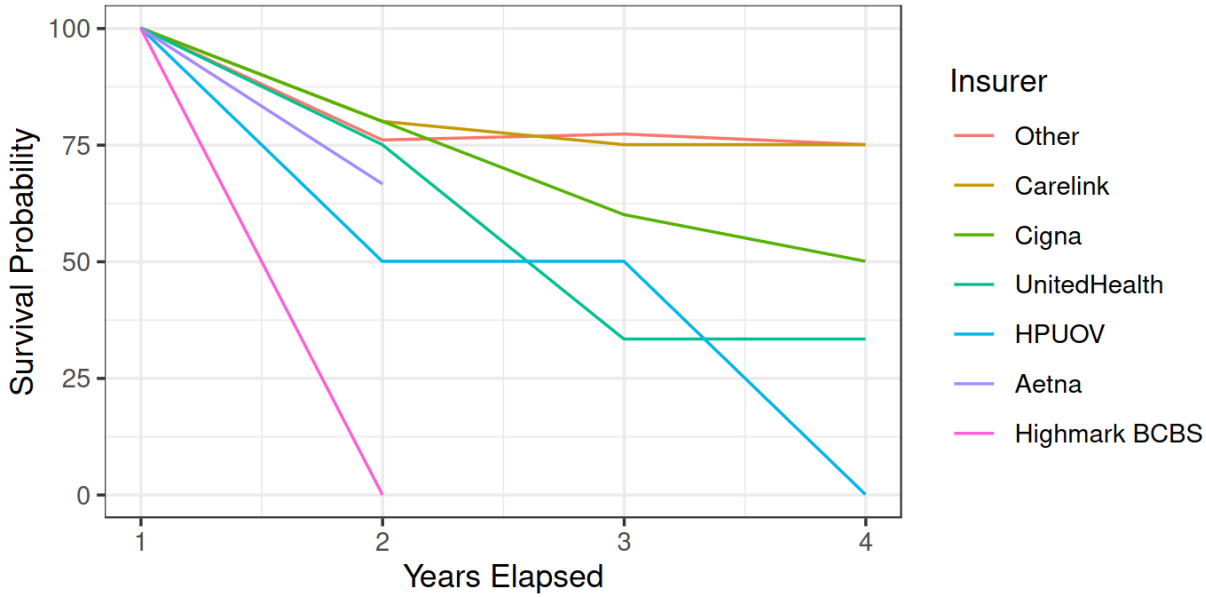


Figure 11: Probability of a new auto-renew share of charges contract remaining in place after a given number of fiscal years of contract data elapsed by insurer. The smaller insurers in the "Other" category were more likely to see contracts renew than the larger insurers, especially Highmark BCBS which rarely used auto-renew contracts in this era.

Short-Term Data May Underestimate Small Insurer Bargain- ing Power

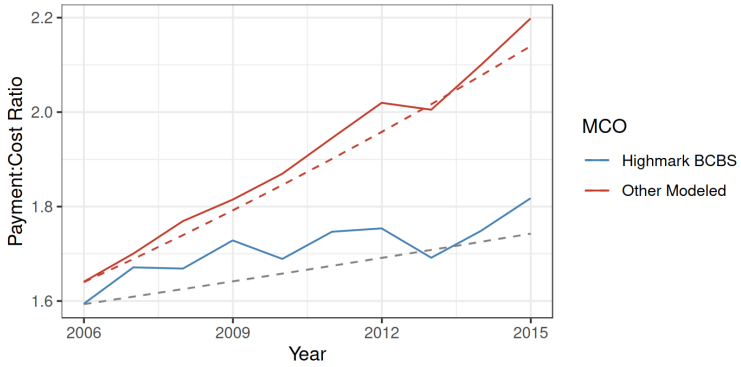


Figure 12: The ratio of payments to reported costs over time for Highmark BCBS (blue) and the other, small and medium-sized, insurers I model (red). Dashed lines indicate one percentage point and three percentage point annual increases, respectively.

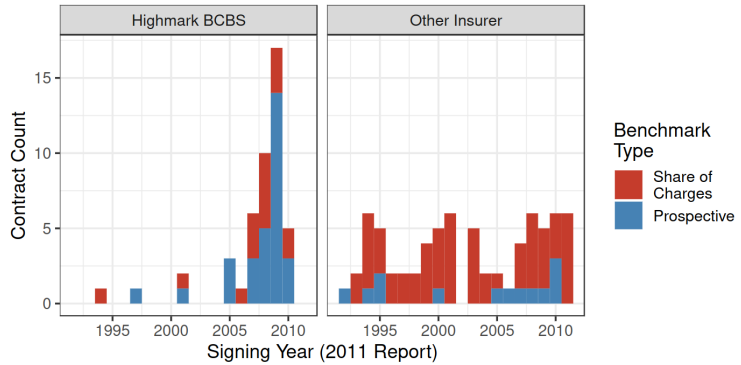


Figure 13: Histogram of reported elapsed contract lengths for contracts with detailed information available in fiscal year 2011 for Highmark BCBS (left) and other insurers (right). Colors represent inferred payment benchmark of list prices (red) or diagnosis weights (right). Highmark BCBS contracts were shorter-lived and more likely to be linked to slow-growing diagnosis weights.

Contract Formation Was Staggered

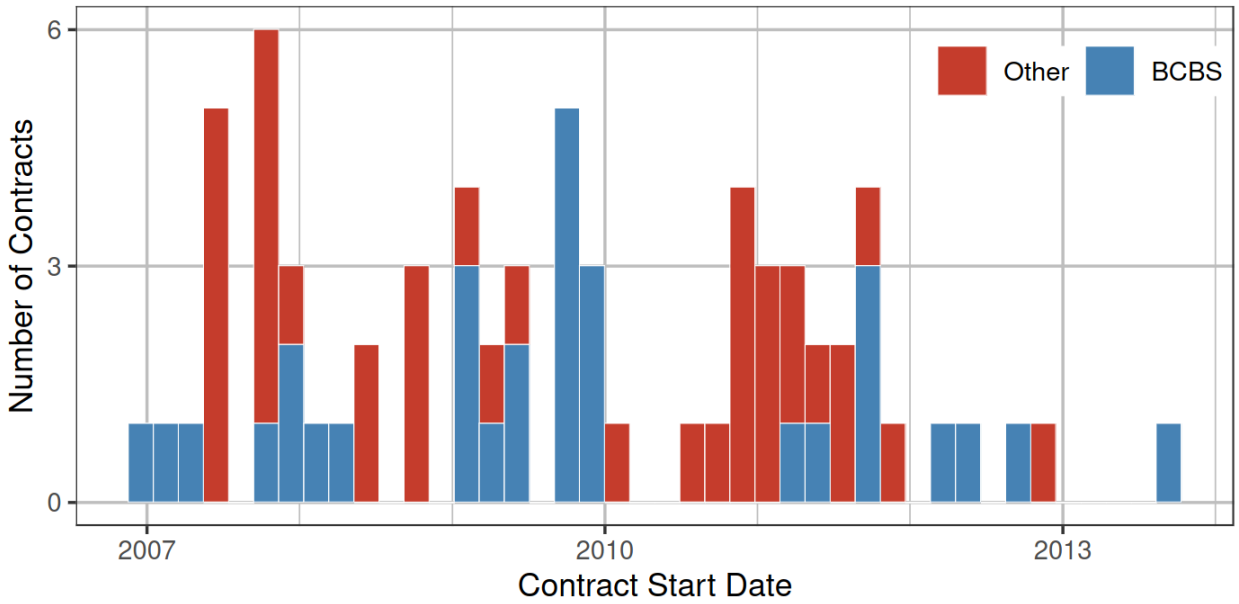


Figure 14: Histogram of contract start dates for contracts used in the estimation sample in Dorn (2024) and introduced 2007–2014 for Highmark BCBS (blue) and other modeled insurers (red). Vertical lines indicate January 1 of a given year. Contracts were not systematically introduced on the same dates.

Section 4

Dorn (2024a)

Dynamic Bargaining between Hospitals and Insurers

Dorn (2024a)

- Vertical market bargaining over multi-year contracts
- Motivated by stylized fact that small insurers agree to long term contracts that set price to 100+X% of Medicare reimbursement rate (or other benchmark price)
- Negotiators are forward looking and adjust negotiations based on expected benchmark price growth
- Results imply 1% increase in Medicare reimbursement rate (to match hospital cost growth) would increase national hospital spending by $5 billion

Model

Each period:

1. Hospital and insurer demand revealed
2. Auto-renew decisions
3. Contract bargaining and premium setting
4. Profits realized

Demand

- Insurer:

$$D^M_{nt}(\underbrace{\mathcal{G}}_{\text{network}}, \underbrace{\phi}_{\text{premiums}})$$

- Hospital h demand from enrollees in insurer n:

$$D^H_{hnt}(\mathcal{G}, \phi)$$

Auto-renew

- Contracts specify price as proportion of benchmark (either Medicare or list price)
- Choose to renew or not at beginning of year

New Contract Bargaining

- Contract = (benchmark b_{hnt_0}, length ℓ_{hnt_0}, initial price p_{hnt_0})
  - After t_0, $p_{hnt+1} = b_{hnt+1}\frac{p_{hnt}}{b_{hnt}}$
- Bellman equation

contract state

flow profits

$$V(\mathbb{C}_t, S_t) = \pi(\mathbb{C}_t, S_t) + \beta E\left[V(\mathbb{C}_{t+1}, S_{t+1})|S_t\right]$$

bargaining state (includes demand, benchmark prices

Kalai Bargaining

- Gains from trade:

$$GFT_{ij}(\mathbb{C}_t, S_t) = V(\mathbb{C}_t, S_t) - V(\mathbb{C}_t/ij, S_t)$$

contracts with i, j contract removed

- Kalai bargaining

$$\frac{GFT^M_{ij}(\mathbb{C}_t, S_t)}{GFT^H_{ij}(\mathbb{C}_t, S_t)} = \frac{\tau_{ij}}{1 - \tau_{ij}}$$

  - Dynamic Nash bargaining faces technical challenge – disagreement now affects all future bargaining
  - Axiomatic, intuitive, and lab evidence for Kalai bargaining (see references in paper)
  - Generalizes static Nash-in-Nash bargaining

Flow Profits

$$\pi_{it}^H = \sum_{n \in \mathcal{G}_{it}^H} D_{int}^H(\mathcal{G}_t, \phi_t)(p_{int} - c_i) - r_i^H R_{int}$$

$$\pi_{jt}^M = D_{jt}^M(\mathcal{G}_t, \phi_t)(\phi_{jt} - \eta_j) - \sum_{h \in \mathcal{G}_{jt}^M} D_{hnt}^H(\mathcal{G}_t, \phi_t) p_{hjt} - r_j^M R_{hjt}$$

rR negotiation costs

Theorem 1. *Suppose hospital i and insurer j form a contract in a subgame period t_0 through the (potentially random) terminal date t^* that yields (potentially random) realized prices p^*_{ijt}. Then the expected net present value of realized payments at the moment of contract formation is equal to the sum of the expected net present value of flow period Nash-in-Nash payments, a negotiation cost payment, and an impasse repricing payment term:*

$$\mathbb{E}_{t_0}\left[\sum_{t=t_0}^{t^*}\beta^{t-t_0}D^H_{ijt}(\mathcal{G}_t,\phi_t)p^*_{ijt}\right] = \text{Pay}_{NiN} + \text{Pay}_{NC} + \text{Pay}_{IRT}, \tag{3}$$

where the expected net present value of static Nash-in-Nash payments is:

$$\text{Pay}_{NiN} = \mathbb{E}_{t_0}\left[\sum_{t=t_0}^{t^*}\beta^{t-t_0}\left(-\tau_{ij}\left[\Delta_{ij}\pi^H_{it}\right] + (1-\tau_{ij})\left[\Delta_{ij}\pi^M_{jt}\right]\right)\right], \tag{4}$$

the negotiation cost payment Pay_{NC} *is equal to* $-\tau_{ij}r^H_i + (1-\tau_{ij})r^M_j$*, and the impasse repricing payment* Pay_{IRT} *is defined in footnote 4.*[4]

Empirical Specification

- Bargaining weights as function of hospital size

$$\log(\tau_{ij}/(1-\tau_{ij})) = \log(\tau_j/(1-\tau_j)) + \tau^{Size}\log(hospSize_i/\overline{size})$$

- Hospital h demand from person i with diagnosis ℓ

$$u_{i,h,\ell} = \delta_{h,\ell} + \nu_{i,h,\ell}\rho + \epsilon_{i,h,l}$$

- Insurer demand j from person i in county c, market m, age k

$$u^M_{i,j,c,m} = \tilde{\delta}^M_{j,m} + \gamma_k WTP_{j,k,c} + \xi_{j,k,c} + \epsilon_{i,j,c,m}$$

Hospital Demand

	Dependent variable:					
	choice					
	Cancer	Cardiac	Digestive	Labor	Neurological	Other
	(1)	(2)	(3)	(4)	(5)	(6)
Distance	−0.115***	−0.113***	−0.117***	−0.121***	−0.077***	−0.108***
	(0.014)	(0.004)	(0.005)	(0.004)	(0.003)	(0.002)
Distance Squared	0.0004***	0.0004***	0.0004***	0.0003***	0.0002***	0.0003***
	(0.0001)	(0.00002)	(0.00002)	(0.0001)	(0.00002)	(0.00001)
Distance x Emergency	−0.010	−0.012***	−0.024***	0.020***	−0.013***	−0.015***
	(0.015)	(0.003)	(0.004)	(0.005)	(0.004)	(0.001)
Observations	284	2,469	2,048	4,143	1,094	10,053
R^2	0.555	0.577	0.615	0.646	0.497	0.555
Log Likelihood	−286.987	−2,722.077	−2,324.572	−3,923.918	−1,297.677	−12,578.030
Note:						*p<0.1; **p<0.05; ***p<0.01

Table 2: Estimated consumer valuation of distance in hospital choice (in utility units) by diagnosis category. Consumers generally are admitted to closer hospitals, have a diminishing loss from travel, and — with the exception of labor cases — are especially unlikely to travel distances for emergency care.

Insurer Demand

	MCO:				
	Aetna	Highmark BCBS	HPUOV	Cigna	UnitedHealth
	-1.39***	1.33***	-0.8***	-3.54***	-2.43***
	(0.13)	(0.13)	(0.13)	(0.11)	(0.11)
Note:					*p<0.1; **p<0.05; ***p<0.01

Table 3: Estimated average 2016 insurer value including premiums ($\tilde{\delta}^M_{j,m}$) after accounting for variation in inpatient network quality.

Table 6: Insurer demand coefficient on network willingness to pay by age group. Consumers are generally more likely to purchase insurance from insurers with better networks. The coefficients are largest for young groups with smaller standard deviations in network quality.

	WTP Coefficient				
	γ_{0-17}	γ_{18-44}	γ_{45-64}	γ_{65-74}	γ_{75+}
	26.6***	4.94***	2.76***	2.79***	2.05***
	(2.65)	(0.67)	(0.33)	(0.27)	(0.15)
Note:					*p<0.1; **p<0.05; ***p<0.01

Bargaining

	Parameter				
	β	τ_{BCBS}	τ_{HPUOV}	τ_{FP}	$-\tau^{Size}$
Only-2015	·	0.487**	-7.54	0.694***	3.354
(Nash/Kalai)	(·)	(0.191)	(17.204)	(0.175)	(22.875)
Myopic	·	0.876***	0.825***	0.861***	1.037***
(Nash/Kalai)	(·)	(0.012)	(0.232)	(0.034)	(0.199)
Forward-Looking	0.899***	0.854***	0.877***	0.889***	0.989***
($\text{Pay}_{IRT} = 0$)	(0.03)	(0.006)	(0.026)	(0.005)	(0.028)
Note:					*p<0.1; **p<0.05; ***p<0.01

Table 4: Estimated bargaining and patience weights for the only-2015-data (first row) myopic (second row) and more general forward-looking (third row) bargaining models. The MCO τ_j bargaining weights are estimated for Highmark BCBS (BCBS), HPUOV, and the modeled for-profit insurers (FP) and are evaluated at the average bargain's hospital bargaining system log 2006 size. Estimates under alternative bargaining models are presented in Table 8.

Increasing Benchmark Price Growth by 1%

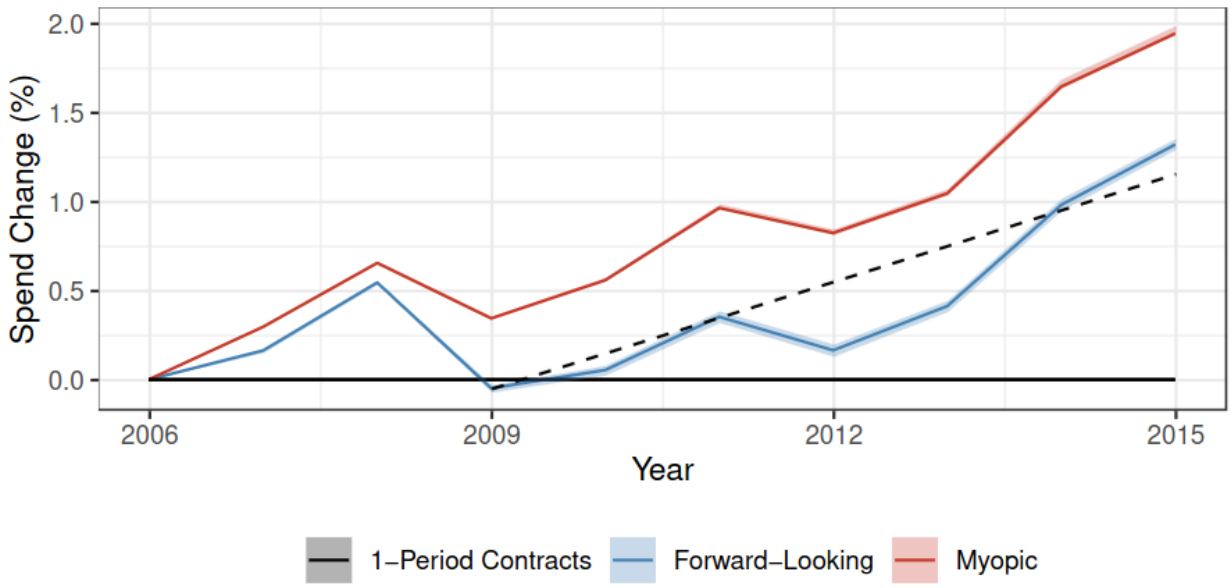


Figure 4: Estimated counterfactual spending effects from a one-percentage-point increase in Medicare payments from a myopic (blue) and dynamic (red) bargaining model. The dashed line indicates 0.20 percentage point additional annual spending increases starting in 2009.

Increasing Benchmark Price Growth by 1%

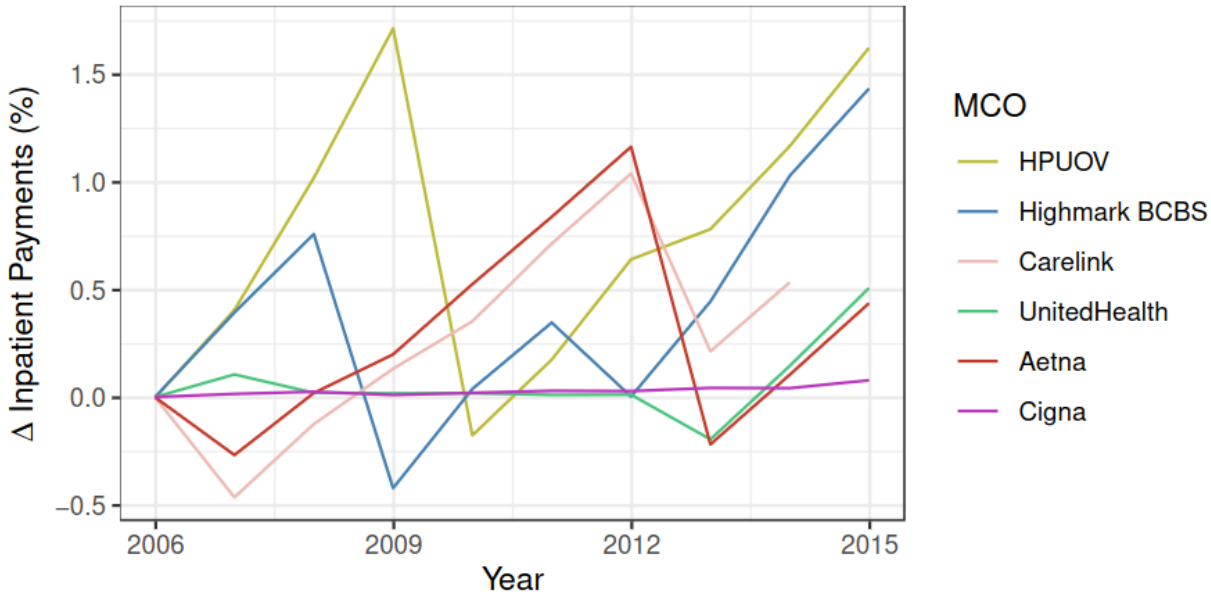


Figure 6: Estimated effects on payments by insurer from a one percentage point annual increase in Medicare payments.

Increasing Benchmark Price Growth by 1%

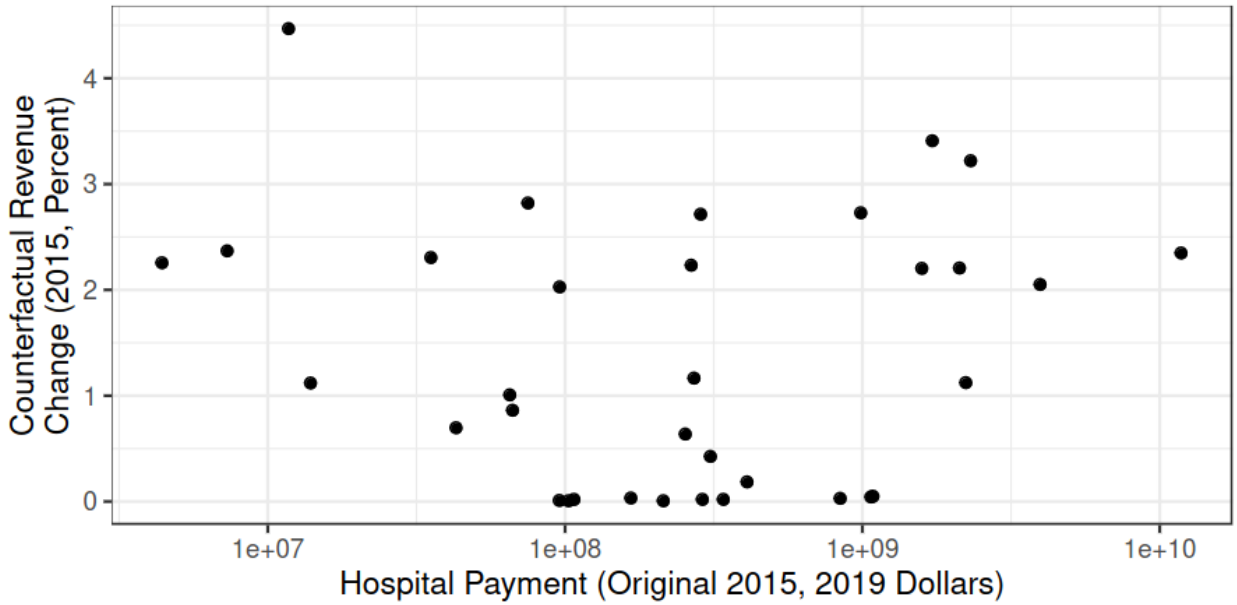


Figure 13: Estimated effects of increased Medicare cost reimbursement on each hospital's received payments in 2015. There is some indication that smaller hospitals would see larger private payment increases.

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