

Willingness to Pay and Healthcare

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Grad IO

In recent years, IO has made inroads into questions related to healthcare:

- ▶ How do hospital (systems) and insurers interact?
- ▶ What is the value of adding a hospital to an insurer's network?
- ▶ What determines the market power of insurers? hospitals?
- ▶ Can steering incentives (in network/out of network) be effective in reducing costs?

Today's Reading:

In recent years, IO has made inroads into questions related to healthcare:

- ▶ Capps, Dranove, Satterthwaite (2003)
- ▶ Ho AER (2009)

The Government keeps losing hospital mergers (basically all of them):

- ▶ Some people travel enormous distances to get treatment at hospitals (Mayo Clinic, Cleveland Clinic, Johns Hopkins, Mass General, etc.)
- ▶ These cases are lost at the stage of **market definition** under the **hypothetical monopolist test**.
 - Recall: SSNIP of 5% price increase for all products. If this is not profitable – include next closest substitute. Continue adding products to define relevant market.
 - Resulting markets are so large (and unconcentrated) that mergers always lead to negligible changes in market share
- ▶ What if we could measure relevant markets better?

What is the value that i places on having hospital j included in network G ?

$$\begin{aligned} U_{ij} &= \alpha R_j + H_j' \Gamma X_i + \tau_1 T_{ij} + \tau_2 T_{ij} \cdot X_i + \tau_3 T_{ij} \cdot R_j - \gamma(Y_i, Z_i) P_j(Z_i) + \varepsilon_{ij} \\ &= U(H_j, X_i, \lambda_i) - \gamma(X_i) P_j(Z_i) + \varepsilon_{ij} \end{aligned}$$

- ▶ $H_j = [R_j, S_j]$ is partitioned into generic R and diagnosis specific S characteristics.
- ▶ $X_i = [Y_i, Z_i]$ is partitioned into demographic Y and diagnosis specific Z characteristics.
- ▶ $T_{ij} = T_j(\lambda_i)$ distance from i 's home to hospital j
- ▶ This paper: ignore $\gamma(X_i) P_j(Z_i)$ since $P_{j'}(Z_i) \approx P_j(z_i)$
- ▶ Parameters: $[\alpha, \Gamma, \tau]$ and $\gamma(X_i)$.

Assume that $\varepsilon_{ij} \sim \text{Type I EV}$:

$$s_j(G, X_i, \lambda_i) = \frac{\exp[U(H_j, X_i, \lambda_i)]}{\sum_{g \in G} \exp[U(H_g, X_i, \lambda_i)]}$$

And

$$V^{IU}(G, Y_i, Z_i, \lambda_i) = \mathbb{E} \max_{j \in G} [U(H_j, Y_i, Z_i, \lambda_i) + \varepsilon_{ij}] = \ln \left[\sum_{j \in G} \exp(U(H_j, Y_i, Z_i, \lambda_i)) \right] + 0.577$$

What happens to utility when we remove j from the choice set?

- ▶ **After** you know your diagnosis Z_i
- ▶ **Before** you draw your ε_{ij}

$$\begin{aligned}\Delta V_j^{IU}(G, Y_i, Z_i, \lambda_i) &= V^{IU}(G, Y_i, Z_i, \lambda_i) - V^{IU}(G/j, Y_i, Z_i, \lambda_i) \\ &= \left[\frac{1}{1 - s_j(H_j, Y_i, Z_i, \lambda_i)} \right]\end{aligned}$$

To get dollars we need $\gamma(X_i)$ so that $\Delta W_{ij}^{IU}(G, Y_i, \lambda_i) = \frac{\Delta V_j^{IU}(G, Y_i, Z_i, \lambda_i)}{\gamma(X_i)}$

But at the beginning of the year (when you choose insurance) you don't observe Z_i :

$$\begin{aligned}\Delta W_{ij}^{EA}(G, Y_i, \lambda_i) &= \int_Z \Delta W_j^{IU}(G, Y_i, Z_i, \lambda_i) f(Z_i|Y_i, \lambda_i) dZ_i \\ &= \int_Z \frac{\Delta V_j^{IU}(G, Y_i, Z_i, \lambda_i)}{\gamma(Y_i, Z_i)} f(Z_i|Y_i, \lambda_i) dZ_i\end{aligned}$$

Integrate out (expected) health Z_i conditional on demographics Y_i and location λ_i .

$$\begin{aligned}\Delta W_j^{EA}(G) &= N \int_{y, \lambda} \Delta W_j^{IU}(G, Y_i, Z_i, \lambda_i) f(Y_i|\lambda_i) dY_i d\lambda_i \\ &= N \int_{Y, Z, \lambda} \frac{1}{\gamma(Y_i, Z_i)} \ln \left[\frac{1}{1 - s_j(G, Y_i, Z_i, \lambda_i)} \right] f(Y_i, Z_i, \lambda_i) dY_i dZ_i d\lambda_i\end{aligned}$$

Aggregate over N consumers and integrate out heterogeneity in the population.

If the insurer includes hospital j in the network they gain:

$$\pi_j = \alpha (\Delta W_j^{EA}(G) - \Delta C_j(G)) + u_j$$

- ▶ $\Delta W_j^{EA}(G)$ comes from extra willingness to pay of consumers
- ▶ $\Delta C_j(G)$ comes from extra costs (could be negative).
- ▶ α is assumed to be a fixed constant (share of surplus) → **bargaining weight**.

In practice CDS have to cut some corners

- ▶ Big problem is that they can't identify $\gamma(X_i)$ and assume $\gamma(X_i) = \gamma_P$.
 - “True” model puts most weight on **inelastic** consumers who value income little
 - People who are very sick; people who are very rich.
- ▶ They assume $\Delta C_j(G) = 0$ so that they can regress

$$\pi_j = \frac{\alpha}{\gamma_P} \left(\overline{\Delta W}_j^{EA}(G) \right) + u_j = a \left(\overline{\Delta W}_j^{EA}(G) \right) + u_j$$

- ▶ Probably worry that high quality hospitals are costly ie: $Cov(\xi_j, \omega_j) > 0$ in BLP.

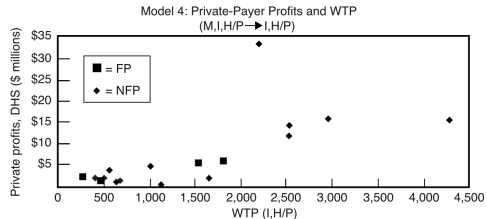
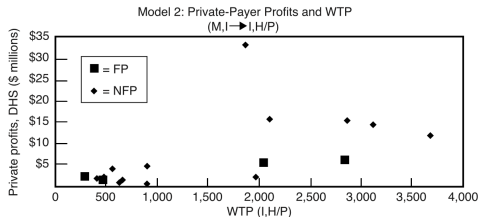
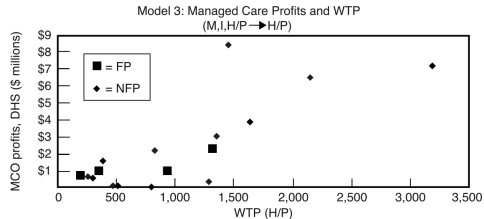
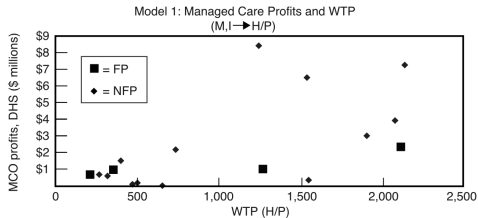
TABLE 3 Patient Variables ($N = 41,083$)

| Variable | Type | Mean | Standard Deviation | Minimum | Maximum |
|--|------|--------|-----------------------|---------|---------|
| Male | Y | .336 | .472 | 0 | 1 |
| Elderly | Y | .314 | .464 | 0 | 1 |
| White | Y | .794 | .404 | 0 | 1 |
| Income, \$1,000's | Y | 16,640 | 5,999 | 0 | 40,268 |
| Expected Length of Stay | Y | 5.539 | 7.533 | 0 | 415 |
| %Travel (<i>pcttravel</i>) | Y | .219 | .060 | .128 | .581 |
| Number of Other Procedures | Y | 1.448 | 1.391 | 0 | 4 |
| Number of Other Diagnoses | Y | 2.092 | 1.442 | 0 | 4 |
| Driving Time (minutes to chosen hospital) | — | 15.801 | 9.995 | 1 | 79 |
| Travel Distance (miles to chosen hospital) | — | 8.884 | 7.525 | .3 | 61.1 |
| Driving Time (minutes to all hospitals) | — | 29.346 | 16.751 | 1 | 92 |
| Travel Distance (miles to all hospitals) | — | 19.848 | 13.775 | .2 | 69.3 |
| Medicare Dummy | — | .268 | .443 | 0 | 1 |
| Blue Cross/Blue Shield Dummy | — | .046 | .210 | 0 | 1 |
| Indemnity Dummy | — | .206 | .405 | 0 | 1 |
| HMO/PPO Dummy | — | .479 | .500 | 0 | 1 |
| Neurological Diagnosis | Z | .031 | .174 | 0 | 1 |
| Respiratory Diagnosis | Z | .036 | .186 | 0 | 1 |
| Cardiac Diagnosis | Z | .115 | .319 | 0 | 1 |
| Labor/Delivery | Z | .285 | .452 | 0 | 1 |
| MRI/CT Admission | Z | .042 | .200 | 0 | 1 |
| Psychiatric Admission | Z | .025 | .157 | 0 | 1 |

1. Estimate individual choice logit via MLE (no endogeneity) on different samples (MCO alone, MCO plus indemnity)
2. Estimate the WTP measure ΔV_j^{IU} (MCO only, MCO+Idemnity) for each hospital.
3. Try to compute cost estimates using admission data.
4. Compute hospital profits using (Revenue - Costs).
5. Regress profits on the WTP measure.

Idea is that high WTP hospitals add more value to network and command more profits.

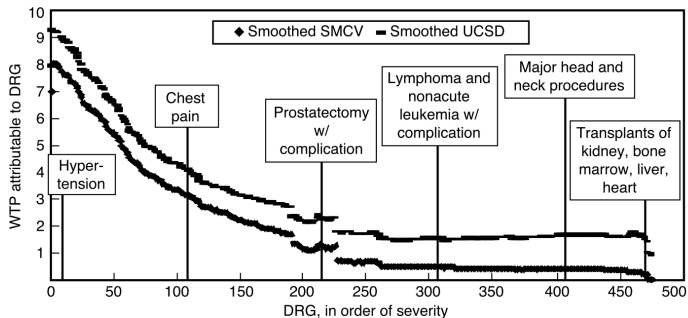
Do not-for profits exploit market power? (Yes)



Decomposing WTP: UCSD vs. SCV

FIGURE 2

ITEMIZATION OF WTP BY DRG FOR UCSD AND SCRIPPS MEMORIAL CHULA VISTA (SCV)



UCSD's value is driven by most severe diagnoses.

What might a merger do?

The merger allows the seller to **bundle** hospitals

$$\overline{\Delta W}_{j+k}^{EA}(G) = N \int_{Y,Z,\lambda} \ln \left[\frac{1}{1 - s_j(G, Y_i, Z_i, \lambda_i) - s_k(G, Y_i, Z_i, \lambda_i)} \right] f(Y_i, Z_i, \lambda_i) dY_i dZ_i d\lambda_i$$
$$\Delta \hat{\pi}_{j+k} = \hat{a} \left[\overline{\Delta W}_{j+k}^{EA}(G) - \overline{\Delta W}_j^{EA}(G) - \overline{\Delta W}_k^{EA}(G) \right]$$

Where \hat{a} is the coefficient from regression of profits on WTP.

- Will be largest when products are close substitutes or affect same customers.

- ▶ Three hospitals (Scripps: SCV, Community Hospital: CHCV, Paradise Valley (PVH)
- ▶ Because 30% of patients leave Chula Vista SSNIP tests tend to say Chula Vista is not its own market.
- ▶ But WTP says otherwise

TABLE 6 **Effects of Chula Vista Mergers**

| Merger | Model | | | |
|--|----------------|----------------|----------------|----------------|
| | 1 ^a | 2 ^b | 3 ^a | 4 ^b |
| Increase in WTP | | | | |
| SCV and PVH | 274.64 | 33.6 | 222.84 | 27.66 |
| SCV and CHCV | 59.88 | 78.05 | 62.74 | 82.15 |
| PVH and CHCV | 55.7 | 73.2 | 47 | 62.35 |
| All three | 422.96 | 524.38 | 361.59 | 453.31 |
| Profit Increase Per Private Discharge | | | | |
| SCV and PVH | \$144.48 | \$172.68 | \$126.99 | \$153.97 |
| SCV and CHCV | \$28.94 | \$41.56 | \$32.84 | \$47.64 |
| PVH and CHCV | \$77.17 | \$77.15 | \$7.53 | \$71.57 |
| All three | \$18.28 | \$221.19 | \$166.96 | \$208.26 |
| Percentage Increase in Profit | | | | |
| SCV and PVH | 8.94% | 14.07% | 9.36% | 14.74% |
| SCV and CHCV | 4.26% | 7.23% | 4.94% | 8.40% |
| PVH and CHCV | 2.23% | 3.76% | 2.63% | 4.41% |
| All three | 12.12% | 19.50% | 13.30% | 21.45% |
| Percentage Increase in Price | | | | |
| SCV and PVH | 10.97% | 12.46% | 9.64% | 11.11% |
| SCV and CHCV | 1.95% | 2.74% | 2.22% | 3.15% |
| PVH and CHCV | 3.52% | 3.65% | 3.22% | 3.38% |
| All three | 11.39% | 13.98% | 10.55% | 13.16% |

^aProfit computed as $Q^{MCO}AR(Q^{Private}) - AC(Q)Q^{MCO}$.

^bProfit computed as $Q^{Private}AR(Q^{Private}) - AC(Q)Q^{Private}$.

Merger Results

TABLE 7 Other Mergers (Based on Model-4 Results)

| Merger | WTP Gain | % Increase Profit | Patient- Weighted Premerger AR | % Increase in Price | Per Discharge Increase in Private-Pay Profit | Miles (Minutes) | Number Teaching | Number Transplant | Number Delivery |
|---|-------------|-------------------------|---|---------------------------|---|--------------------|--------------------|----------------------|--------------------|
| Sharp Memorial ^a and UCSD | 463.3 | 7.15% | 27,18.4 | 3.42% | \$93.11 | 5.2 (10) | 2 | 2 | 2 |
| Scripp's La Jolla and HCA ^b | 233.8 | 5.78% | 2,322.5 | 5.98% | \$106.44 | 1.5 (3) | 1 | 1 | 1 |
| San Miguel and Mercy ^c | 115.7 | 2.83% | 2,175.9 | 2.53% | \$55.00 | 1.2 (3) | 2 | 0 | 1 |
| Paradise and HCA ^d | 36.1 | 1.14% | 2,339.7 | 1.15% | \$26.90 | 19.6 (26) | 1 | 2 | 1 |
| Villa View and Coronado ^e | 17.8 | 1.35% | 2,189.6 | 1.90% | \$41.55 | 9.9 (22) | 0 | 1 | 1 |
| Scripps Chula Vista and Mission Bay ^f | 4.3 | .34% | 1,509.1 | .17% | \$2.54 | 16.4 (23) | 0 | 0 | 1 |

^aSharp Memorial and UCSD are near downtown San Diego.

^bScripps La Jolla and HCA are a northern satellite-pair.

^cSan Miguel and Mercy are both near downtown San Diego.

^dParadise and HCA are on opposite sides of downtown San Diego.

^eVilla View is in northeast San Diego and Coronado is near downtown.

^fScripps and Mission Bay are on opposite sides of downtown San Diego.

**Ho AER 2009: Insurer-Provider
Networks in the Medical Care
Market**

- ▶ How do insurers and healthcare providers (hospitals) divide profits?
- ▶ How is the division of profits related to the networks of hospitals offered by insurers?
- ▶ Given we know about WTP and **demand**, how can we treat **supply** decisions of endogenous networks and negotiations between firms seriously?

Timing of the game

1. Hospitals make price offers to plans
2. Plans choose their hospital networks
3. Plans set premiums
4. Consumers and employers jointly choose plans
5. Sick consumers visit hospitals; plans pay hospitals for services provided

Plan choice of quality and products, together with the hospital's choices of capacity, location, services, and quality are outside the model (exogenous).

TABLE 4—DEFINITION OF HOSPITAL SERVICES

| Cardiac | Imaging | Cancer | Births |
|--------------------------------|---------------|----------------------|-------------------|
| 1. Cardiac catheterization lab | 1. Ultrasound | 1. Oncology services | 1. Obstetric care |
| 2. Cardiac intensive care | 2. CT scans | 2. Radiation therapy | 2. Birthing room |
| 3. Angioplasty | 3. MRI | | |
| 4. Open heart surgery | 4. SPECT | | |
| | 5. PET | | |

Notes: This table sets out the definition of the hospital service variables summarized in Table 1. Hospitals were rated on a scale from 0 to 1 within four service categories, where 0 indicates that no services within this category are provided by the hospital, and a higher rating indicates that less common (assumed to be higher-tech) service in the category is offered. The categories are cardiac, imaging, cancer, and births. The services included in each category are listed in Table 5. The exact methodology for rating hospitals is as follows. If the hospital provides none of the services, its rating = 0. If it provides the least common service, its rating = 1. If it offers some service X but not the least common service, its rating = $(1 - x)/(1 - y)$, where x = the percent of hospitals offering service X and y = the percent of hospitals offering the least common service.

Key characteristic: how sophisticated services are for particular diagnoses.

TABLE 1—DESCRIPTIVE STATISTICS FOR HOSPITALS

| | Mean | Standard deviation |
|-------------------------------------|--------|--------------------|
| Number of beds (set up and staffed) | 338.66 | 217.19 |
| Teaching status | 0.195 | 0.397 |
| For-profit | 0.202 | 0.401 |
| Registered nurses per bed | 1.263 | 0.498 |
| Cardiac services | 0.812 | 0.310 |
| Imaging services | 0.539 | 0.287 |
| Cancer services | 0.647 | 0.402 |
| Birth services | 0.857 | 0.348 |

Notes: $N = 665$ hospitals. Cardiac, imaging, cancer, and birth services refer to four summary variables defined in Table 4. Each hospital is rated on a scale from 0 to 1, where 0 indicates that no procedures in this category are provided by the hospital, and a higher rating indicates that a less common service is offered.

TABLE 2—DESCRIPTIVE STATISTICS FOR HMO/POS PLANS

| Variable | Definition | N | Mean | Standard deviation |
|---------------------------------|--|-----|--------|--------------------|
| Market share | Plan share of nonelderly market | 516 | 0.03 | 0.04 |
| Premium pmpm (\$) | Premiums earned per member per month | 478 | 140.75 | 44.27 |
| Physicians per 1,000 population | Number of physician contracts per 1,000 population in markets covered by plan | 418 | 1.56 | 1.51 |
| Breast cancer screening | Percent of women age 52–69 who received a mammogram within last 2 years | 352 | 0.73 | 0.05 |
| Cervical cancer screening | Percent of adult women who received pap smear within last 3 years | 352 | 0.72 | 0.07 |
| Check-ups after delivery | Percent of new mothers receiving a check-up within 8 weeks of delivery | 351 | 0.72 | 0.11 |
| Eye exams for diabetics | Percent of adult diabetics receiving eye exam within last year | 350 | 0.45 | 0.11 |
| Adolescent immunization 1 | Percent of children receiving all required doses of MMR and Hep B vaccines before 13th birthday | 346 | 0.31 | 0.16 |
| Adolescent immunization 2 | Percent of children receiving all required doses of MMR, Hep B, and VZV vaccines before 13th birthday | 313 | 0.15 | 0.11 |
| Advice on smoking | Percent of adult smokers advised by physician to quit | 213 | 0.63 | 0.07 |
| Mental illness checkup | Percent of members seen as outpatient within 30 days of discharge after hospitalization for mental illness | 307 | 0.68 | 0.15 |
| Care quickly | Composite measure of member satisfaction re: getting care as soon as wanted | 304 | 0.75 | 0.05 |
| Care needed | Composite measure of member satisfaction re: getting authorizations for needed/desired care | 304 | 0.72 | 0.06 |
| Age 0–2 | Dummy for plans age 0–2 years | 516 | 0.01 | 0.08 |
| Age 3–5 | Dummy for plans age 3–5 years | 516 | 0.06 | 0.23 |
| Age 6–9 | Dummy for plans age 6–9 years | 516 | 0.17 | 0.37 |
| Aetna | Plan fixed effect | 516 | 0.15 | 0.36 |
| CIGNA | Plan fixed effect | 516 | 0.10 | 0.31 |
| Kaiser | Plan fixed effect | 516 | 0.03 | 0.16 |
| Blue Cross/Blue Shield | Dummy for ownership by BCBS | 516 | 0.16 | 0.36 |
| POS plan | Dummy for POS plan | 516 | 0.35 | 0.49 |

- If all hospitals contract with all plans – we can't tell who has bargaining power.

| Category | Definition | Number of markets | Examples |
|----------|---|-------------------|----------------------------------|
| 1 | The 5 largest plans (by enrollment) contract with all 8 largest hospitals (by number of admissions) | 5 | San Antonio, TX Atlanta, GA |
| 2 | One plan excludes at least one hospital | 10 | Boston, MA Columbus, OH |
| 3 | Two plans exclude at least one hospital or three plans exclude exactly one hospital each | 6 | Detroit, MI San Francisco, CA |
| 4 | Three plans exclude at least one hospital; one of them excludes more than one | 13 | Houston, TX Miami, FL |
| 5 | Four or more plans exclude at least one hospital each | 8 | Portland, OR New Orleans, LA |

TABLE 3—SUMMARY DATA FOR SELECTIVE AND UNSELECTIVE MARKETS

| | Unselective markets (category 1 and 2) mean (std dev) | Selective markets (category 4 and 5) mean (std dev) | <i>p</i> -value for difference in means |
|--|---|---|---|
| Market population (million) | 2.36 (1.11) | 2.36 (1.96) | 1.00 |
| Number of HMO/POS plans with over 1 percent market share | 6.80 (1.70) | 6.57 (1.89) | 0.71 |
| Number of hospitals | 19.80 (11.40) | 21.24 (20.53) | 0.78 |
| Beds per 1,000 population | 2.78 (1.00) | 2.90 (0.99) | 0.74 |
| Managed care penetration | 0.33 (0.17) | 0.35 (0.15) | 0.66 |
| Average age of population | 34.76 (2.19) | 34.31 (1.39) | 0.49 |
| Percent of under 65 population age 55–64 | 0.09 (0.01) | 0.09 (0.01) | 0.75 |
| Median total family income of population | \$48,890 (\$8,460) | \$46,130 (\$8,642) | 0.35 |
| Standard deviation of total family income of population | \$53,687 (\$9,805) | \$52,797 (\$6,511) | 0.76 |
| Mean distance between hospitals (miles) | 11.71 (5.60) | 13.41 (5.12) | 0.36 |
| Standard deviation of distances between hospitals (miles) | 7.67** (3.37) | 10.30** (4.06) | 0.04 |
| Number hospitals with open heart surgery | 8.07 (3.67) | 10.19 (8.59) | 0.31 |
| <i>N</i> | 15 | 21 | |

**Significant difference in means at the 5 percent level.

Plain logit MLE (no random coefficients, no endogeneity)

- ▶ Similar to CDS (2003)
- ▶ individual i , hospital h and diagnosis l , and market m
- ▶ Consumer characteristics $\nu_{i,l}$ (diagnosis, location, etc.)
- ▶ $[x_h, \eta_h]$ hospital characteristics (obs, unobs)

$$u_{i,h,l} = \eta_h + x_h \alpha + x_h v_{i,l} \beta + \varepsilon_{i,h,l}$$
$$EU_{i,j,m} = \sum_l p_{i,l} \log \left(\sum_{h \in H_j} \exp \left(\eta_h + x_h \hat{\alpha} + x_h v_{i,l} \hat{\beta} \right) \right)$$

- ▶ $p_{i,l}$ is ex-ante probability that consumer i receives diagnosis l .

Hospital Demand Results

TABLE 5—RELATION OF HOSPITAL CHARACTERISTICS TO MARKET SHARES

| | Coefficient estimate | |
|-------------------|----------------------|--------------------|
| Cardiac services | 0.732** (0.104) | 0.676** (0.072) |
| Imaging services | 0.233** (0.107) | 0.224** (0.074) |
| Cancer services | 0.158** (0.079) | 0.299** (0.054) |
| Birth services | 0.507** (0.082) | 0.394** (0.056) |
| Teaching hospital | 0.243** (0.074) | 0.461** (0.051) |
| Constant | −4.484** (0.097) | −0.005 (0.007) |
| Market FEs? | No | Yes |
| Adjusted R^2 | 0.27 | 0.69 |

Notes: Regression of the log of hospital market shares on hospital characteristics. $N = 633$ hospitals (the 665 providers in the full dataset less 14 Kaiser hospitals and 18 hospitals in Baltimore, MD, which were excluded from the supply-side analysis). Standard errors are reported in parentheses. Cardiac, imaging, cancer, and birth services refer to the four hospital service variables defined in Table 4.

Take estimated EU_{ijm} and include as a regressor in another logit for plan choice:

$$\tilde{u}_{i,j,m} = \xi_{j,m} + z_{j,m}\lambda + \gamma_1 EU_{i,j,m} + \gamma_2 \frac{prem_{j,m}}{y_i} + \omega_{i,j,m}$$

- ▶ ξ_{jm} is unobserved plan quality (BLP type error)
- ▶ z_{jm} includes premium size of network, plan age, and clinical quality variables, consumer reported availability and speed scores.
- ▶ Two outside goods: Idemnity (nonmanaged care: High), and Uninsured (Low)
- ▶ Excluded IV: average hourly hospital wage, average weekly nurse wage across markets where plan is active.
[Why?]

Plan Demand Results

TABLE 6—RESULTS OF PLAN DEMAND ESTIMATION

| | Coefficient estimate |
|---|----------------------|
| Premium (\$00 pmpm) | −0.94 (1.13) |
| Expected utility from hospital network ($EU_{rep_{js}}$ or $EU_{(js)}$) | 0.59** (0.21) |
| Premium (\$00 pmpm) / Income (\$000 per year) | 0.002 (43.9) |
| Physicians per 1,000 population | 0.21** (0.09) |
| Breast cancer screening | −0.38 (2.66) |
| Cervical cancer screening | 4.40** (2.09) |
| Check-ups after delivery | 0.18 (1.38) |
| Eye exams for diabetics | −1.19 (1.60) |
| Adolescent immunization 1 | −4.11** (1.17) |
| Adolescent immunization 2 | 3.08 (3.76) |
| Advice on smoking | 6.17** (2.08) |
| Mental illness check-ups | 2.70** (1.30) |
| Care quickly | 0.78 (5.63) |
| Care needed | 0.85 (3.99) |
| Plan age: 0–2 years | 1.36 (0.97) |
| Plan age: 3–5 years | −0.64 (1.97) |
| Plan age: 6–9 years | −0.25 (0.58) |
| POS plan | −1.11** (0.13) |
| Constant | −10.50* (5.65) |
| Large plan fixed effects | Yes |
| Market fixed effects | Yes |

Notes: $N = 559$ plans (the 516 HMO/POS plans in the full dataset plus one indemnity/PPO option in each market). Standard errors (adjusted for the three-stage estimation process) are reported in parentheses.

Producer Surplus for Network

Surplus generated by plan j in market m with network H_j is:

$$S_{j,m}(H_j, H_{-j}) = \sum_i \left(n_i s_{i,j,m}(H_j, H_{-j}) \left[prem_{j,m} - p_i \sum_{h \in H_j} s_{i,h}(H_j) cost_h \right] \right)$$

- ▶ n_i population per (ZCTA, age, gender) bin
- ▶ p_i admission probability of type i individual
- ▶ Plan j offers network H_j and rivals networks given by H_{-j}
- ▶ Prices and share (and costs) endogenously adjust. (Random re-allocation of patients at capacity constrained hospitals).

Why do not all hospitals reach agreement with all plans?

- ▶ Dropping plan j from network changes both hospital demand and plan demand.
- ▶ Star Hospitals benefit from selecting contracting (consumers have high WTP)
- ▶ Hospital may be capacity constrained without contracting with all insurers (capacity may be endogenous)
- ▶ A large single system may be very attractive to consumers and induce consumers to switch (e.g. Harvard Pilgrim problem).

Producer Surplus for Network

Profit is surplus generated S_{jm} for network H_j less cost:

$$\begin{aligned}\pi_{j,m}^P(H_j, \mathcal{H}_{-j}, \mathcal{X}, \theta) &= S_{j,m}(H_j, \mathcal{H}_{-j}) - c_{j,m}^{HOSP}(H_j, \mathcal{H}_{-j}, \mathcal{X}, \theta) - c_{j,m}^{NONHOSP}(H_j, \mathcal{H}_{-j}, \mathcal{X}, \theta) \\ \pi_{j,m}^{P,o}(H_j, \mathcal{H}_{-j}, \mathcal{X}^o, \theta) &= \pi_{j,m}^P(H_j, \mathcal{H}_{-j}, \mathcal{X}, \theta) + u_{j,H}\end{aligned}$$

- ▶ First (eq) econometrician; second (eq) plan beliefs
- ▶ Script variables are unobserved when plan makes contracting choice
- ▶ Adds econometric error u_{j,H_j} (measurement error) (Cost data is average not per patient)

Predicted profits from choosing H_j can be written

$$E(\pi_{j,m}^P(H_j, \mathcal{H}_{-j}, \mathcal{X}, \theta) | I_{j,m}) = \pi_{j,m}^P(H_j, \mathcal{H}_{-j}, \mathcal{X}, \theta) - \varphi_{j,H_j}$$

- Plan j 's expected profits from network H_j must exceed its expected profits from alternative network where it drops/adds hospital h holding all else fixed
- This represents **necessary** but **not sufficient** conditions for equilibrium.

$$\mathbb{E} \left(\pi_{j,m}^P (H_j, \mathcal{H}_{-j}, \mathcal{X}, \boldsymbol{\theta}) | I_{jm} \right) \geq \mathbb{E} \left(\pi_{j,m}^P (H_j^h, \mathcal{H}_{-j}, \mathcal{X}, \boldsymbol{\theta}) | I_{j,m} \right)$$

Combine with both error terms:

$$\begin{aligned} & \pi_{j,m}^{P,o} (H_j, \mathcal{H}_{-j}, \mathcal{X}^o, \theta) - \pi_{j,m}^{P,o} (H_j^h, \mathcal{H}_{-j}, \mathcal{X}^o, \theta) \\ & - \left(u_{j,H_j} - u_{j,H_j^h} \right) - \left(\varphi_{j,H_j} - \varphi_{j,H_j^h} \right) \geq 0 \end{aligned}$$

Second term has expectation zero.

- ▶ Resulting estimator combines **moment equalities** $\mathbb{E}[\xi'_{jt}z_{jt}] = 0$ with **moment inequalities**

$$\frac{1}{M} \sum_m \frac{\sqrt{n_m}}{n_m} \sum_{j=1}^{n_m} \left[\left(\pi_{j,m}^{P,o} (H_j, \mathcal{H}_{-j}, \mathcal{X}^o, \boldsymbol{\theta}) - \left(\pi_{j,m}^{P,o} (H_j^h, \mathcal{H}_{-j}, \mathcal{X}^o, \boldsymbol{\theta}) \right) \otimes g(z_{j,m}) \right) \right] \geq 0$$

- ▶ Penalize violations of moment equalities in both directions
- ▶ Penalize violations of moment inequalities in only one direction.
- ▶ Parameters may be **set** rather than **point identified**
- ▶ Prof. Dickstein is the expert, but he is on sabbatical right now.

TABLE 7—RESULTS OF FULL MODEL FOR ESTIMATION

| Hospital characteristics | Star hospitals | Predicted cap con | Add number of enrollees | Multinomial logit |
|---|----------------|-------------------|-------------------------|-------------------|
| Number of enrollees | | | 0.011 | |
| Simulated 95 percent C.I. | | | (−0.06, 0.09) | |
| Conservative 95 percent C.I. | | | (−0.17, 0.11) | |
| <i>Fixed component (unit = \$ million per month)</i> | | | | |
| Hospital in system | 0.18 | 0.16 | 0.17 | −0.60 |
| Simulated 95 percent C.I. | (0.05, 0.37) | (0.03, 0.34) | (0.02, 0.34) | (0.09) |
| Conservative 95 percent C.I. | (0.18, 0.91) | (0.15, 0.75) | (0.15, 0.66) | |
| Drop same system hosp | 0.09 | 0.08 | 0.08 | 0.62 |
| Simulated 95 percent C.I. | (0.01, 0.16) | (0.01, 0.14) | (0.00, 0.15) | (0.06) |
| Conservative 95 percent C.I. | (0.04, 0.35) | (0.04, 0.28) | (0.06, 0.29) | |
| <i>Per patient component (unit = \$ thousand per patient)</i> | | | | |
| Constant | 5.51 | 14.90 | 6.08 | −1.41 |
| Simulated 95 percent C.I. | (−1.93, 16.6) | (1.03, 19.3) | (−2.70, 13.2) | (3.29) |
| Conservative 95 percent C.I. | (−24.0, 21.5) | (−22.7, 27.9) | (−12.8, 31.4) | |
| Star hospital | 6.77 | | 4.69 | 7.73 |
| Simulated 95 percent C.I. | (3.27, 15.8) | | (0.78, 16.4) | (1.41) |
| Conservative 95 percent C.I. | (6.40, 27.0) | | (4.68, 33.3) | |
| Cost per admission | −0.80 | −1.47 | −0.74 | −0.39 |
| Simulated 95 percent C.I. | (−1.96, −0.32) | (−2.02, −0.41) | (−1.77, −0.31) | (0.19) |
| Conservative 95 percent C.I. | (−3.40, 0.16) | (−3.55, −0.32) | (−3.09, 0.04) | |
| Capacity constrained | | 6.92 | | |
| Simulated 95 percent C.I. | | (3.64, 15.7) | | |
| Conservative 95 percent C.I. | | (5.36, 24.4) | | |

Notes: $N = 441$ insurance plans (the 516 in the full dataset less 9 plans in Baltimore, MD; 13 Kaiser plans; 42 with unobserved premiums; and 8 selective plans that I regard as outliers). Figures in parentheses represent 95 percent confidence intervals (C.I.). Plan premium adjustments are incorporated as described in Section IIID. Coefficients represent the predicted profits to the hospital. “Drop same system hosp” is an indicator for hospitals for which a same-system hospital has been excluded. Star hospitals have above ninetieth percentile market share when all plans contract with all hospitals; capacity-constrained hospitals are full under the same thought experiment. “Number of enrollees” is the model’s prediction of the plan’s number of enrollees given its premium and network choice. The logit results report standard errors calculated using the usual maximum likelihood estimation methodology.

TABLE 8—ADDING PLAN AND MARKET CHARACTERISTICS

| Hospital characteristics | Beds per population | Number of patients | Local plan | Plan: good screening |
|---|---------------------|--------------------|----------------|----------------------|
| <i>Per patient component (unit = \$ thousand per patient)</i> | | | | |
| Constant | 8.48 | 6.26 | 5.60 | 7.33 |
| Simulated 95 percent C.I. | (−3.95, 31.9) | (−3.64, 15.9) | (−2.43, 15.5) | (−1.18, 13.6) |
| Conservative 95 percent C.I. | (−8.05, 58.4) | (−6.86, 20.9) | (−5.78, 21.5) | (−8.16, 21.8) |
| Star hospital | 8.48 | 6.93 | 6.36 | 8.56 |
| Simulated 95 percent C.I. | (1.97, 16.1) | (2.40, 14.9) | (2.12, 12.6) | (2.69, 11.7) |
| Conservative 95 percent C.I. | (7.36, 35.2) | (5.69, 19.7) | (5.59, 18.9) | (7.67, 23.1) |
| Cost per admission | −0.76 | −0.76 | −0.74 | −0.93 |
| Simulated 95 percent C.I. | (−2.56, −0.02) | (−1.69, 0.02) | (−1.85, −0.23) | (−1.65, −0.24) |
| Conservative 95 percent C.I. | (−4.36, 0.52) | (−2.70, −0.16) | (−2.96, −0.24) | (−3.0, −0.27) |
| Market beds per population | −1.19 | | | |
| Simulated 95 percent C.I. | (−5.14, 1.70) | | | |
| Conservative 95 percent C.I. | (−15.3, −1.17) | | | |
| Number of patients | | −0.54 | | |
| Simulated 95 percent C.I. | | (−4.66, 11.0) | | |
| Conservative 95 percent C.I. | | (−3.31, 16.2) | | |
| Local plan | | | 1.21 | |
| Simulated 95 percent C.I. | | | (−0.37, 11.4) | |
| Conservative 95 percent C.I. | | | (−7.06, 15.2) | |
| Breast cancer screen | | | | 135.7 |
| Simulated 95 percent C.I. | | | | (−79.9, 251) |
| Conservative 95 percent C.I. | | | | (−104, 439) |

Notes: Results from including plan and market characteristics in per patient profits. $N = 441$ insurance plans. “Beds per population” is the number of hospital beds in the market per 1,000 population. “Number of patients” is the number of the plan’s enrollees admitted to the hospital. “Local plan” is an indicator for all plans other than the ten large national chains in the data. “Breast cancer screen” is the difference between the plan’s breast cancer screening rate and the average in the market.

TABLE 9—ALTERNATIVE SPECIFICATIONS

| Hospital characteristics | No prem adjustments | Allow plans to adjust | Allow hosps to adjust | NFP plan obj. finance | Public hosp obj. finance |
|---|------------------------|--------------------------|--------------------------|--------------------------|-----------------------------|
| <i>Fixed component (unit = \$ million per month)</i> | | | | | |
| Hospital in system | 0.20 | 0.07 | 0.17 | 0.17 | 0.12 |
| Simulated 95 percent C.I. | (0.05, 0.41) | (0.02, 0.32) | (0.04, 0.35) | (0.04, 0.33) | (0.04, 0.30) |
| Conservative 95 percent C.I. | (0.20, 1.03) | (0.07, 0.62) | (0.17, 0.75) | (0.14, 0.82) | (0.12, 0.64) |
| Drop same system hospital | 0.09 | 0.04 | 0.08 | 0.08 | 0.07 |
| Simulated 95 percent C.I. | (0.01, 0.18) | (0.01, 0.15) | (0.01, 0.15) | (0.01, 0.15) | (0.02, 0.13) |
| Conservative 95 percent C.I. | (0.04, 0.41) | (0.01, 0.26) | (0.05, 0.32) | (0.02, 0.31) | (0.04, 0.27) |
| <i>Per patient component (unit = \$ thousand per patient)</i> | | | | | |
| Constant | 9.65 | 9.26 | 8.15 | 5.58 | 9.23 |
| Simulated 95 percent C.I. | (−1.73, 16.7) | (−0.69, 14.5) | (1.41, 18.0) | (−4.17, 17.1) | (−3.62, 16.4) |
| Conservative 95 percent C.I. | (−20.6, 15.3) | (−14.2, 17.0) | (−14.3, 19.1) | (−22.0, 22.7) | (−21.4, 23.0) |
| Star hospital | 2.76 | 2.21 | 2.28 | 6.64 | 4.14 |
| Simulated 95 percent C.I. | (1.37, 13.1) | (1.17, 10.4) | (1.39, 13.3) | (0.95, 12.7) | (2.83, 11.8) |
| Conservative 95 percent C.I. | (2.68, 23.1) | (2.19, 15.6) | (2.19, 20.6) | (6.34, 24.3) | (4.04, 20.7) |
| Cost per admission | −0.99 | −0.90 | −0.85 | −0.84 | −0.85 |
| Simulated 95 percent C.I. | (−1.94, −0.42) | (−1.65, −0.26) | (−1.87, −0.48) | (−1.7, −0.23) | (−1.56, −0.17) |
| Conservative 95 percent C.I. | (−2.74, −0.07) | (−2.28, 0.04) | (−2.5, −0.18) | (−3.1, −0.05) | (−2.59, 0.07) |
| NFP plan × enrollees | | | | 0.31 | |
| Simulated 95 percent C.I. | | | | (−2.24, 3.15) | |
| Conservative 95 percent C.I. | | | | (−3.23, 6.13) | |
| Public hospital × patients | | | | | 12.38 |
| Simulated 95 percent C.I. | | | | | (−19.4, 542) |
| Conservative 95 percent C.I. | | | | | (−30.7, 523) |

Notes: Results with alternative specifications. $N = 441$ insurance plans. Figures in parentheses represent 95 percent confidence intervals (C.I.). Column 1 gives the results when plans do not adjust premiums in response to network changes. Columns 2 and 3 allow plans and hospitals, respectively, to respond by changing networks after a deviation by their negotiating partners. Plans are not permitted to adjust premiums in these scenarios, so the results should be compared to column 1. See Sections VA and VD for details. Columns 4 and 5 allow not-for-profit plans and public hospitals to maximize a weighted sum of profits and the number of enrollees/number of patients treated, respectively.

TABLE 10—ROBUSTNESS TO CHOICE OF HOSPITAL CHARACTERISTICS

| Hospital characteristics | Main specification | Star and cap con | Imaging services | Cap con last year |
|---|--------------------|------------------|------------------|-------------------|
| <i>Fixed component (unit = \$ million per month)</i> | | | | |
| Hospital in system | 0.18 | 0.12 | 0.33 | 0.39 |
| Simulated 95 percent C.I. | (0.05, 0.37) | (0.04, 0.35) | (0.04, 0.54) | (0.06, 0.62) |
| Conservative 95 percent C.I. | (0.18, 0.91) | (0.12, 0.64) | (0.28, 1.13) | (0.31, 1.4) |
| Drop same system hospital | 0.09 | 0.06 | 0.15 | 0.17 |
| Simulated 95 percent C.I. | (0.01, 0.16) | (0.01, 0.15) | (0.03, 0.24) | (0.03, 0.25) |
| Conservative 95 percent C.I. | (0.04, 0.35) | (0.02, 0.24) | (0.10, 0.48) | (0.12, 0.57) |
| <i>Per patient component (unit = \$ thousand per patient)</i> | | | | |
| Constant | 5.51 | 9.09 | 3.14 | 1.37 |
| Simulated 95 percent C.I. | (−1.93, 16.6) | (−5.36, 15.8) | (−9.77, 17.0) | (−13.6, 17.1) |
| Conservative 95 percent C.I. | (−24.0, 21.5) | (−17.4, 17.2) | (−25.6, 19.3) | (−53.4, 18.8) |
| Star hospital | 6.77 | 3.48 | | |
| Simulated 95 percent C.I. | (3.27, 15.8) | (−0.72, 14.0) | | |
| Conservative 95 percent C.I. | (6.40, 27.0) | (0.35, 27.0) | | |
| Cost per admission | −0.80 | −1.10 | −0.38 | −0.35 |
| Simulated 95 percent C.I. | (−1.96, −0.32) | (−1.89, −0.28) | (−1.56, 0.27) | (−1.63, 0.70) |
| Conservative 95 percent C.I. | (−3.40, 0.16) | (−2.76, −0.16) | (−2.23, 0.97) | (−2.41, 2.10) |
| Capacity constrained | | 4.23 | | |
| Simulated 95 percent C.I. | | (−6.21, 12.6) | | |
| Conservative 95 percent C.I. | | (−12.9, 16.7) | | |
| Imaging services | | | 2.85 | |
| Simulated 95 percent C.I. | | | (−2.51, 7.90) | |
| Conservative 95 percent C.I. | | | (−4.30, 14.4) | |
| Last year cap con | | | | 1.72 |
| Simulated 95 percent C.I. | | | | (−3.20, 8.07) |
| Conservative 95 percent C.I. | | | | (−7.09, 21.4) |

Notes: Results of robustness tests. $N = 441$ insurance plans. The first test includes both star and capacity-constrained hospitals. The second replaces the star variable with an indicator for the 22 percent of hospitals that offer positron emission tomography. The third replaces predicted capacity constraints with an indicator for capacity constraints in the previous year.

- ▶ Hospitals bear about 80% of their own costs. Why?
- ▶ Providers have incentive to merge.
- ▶ Becoming capacity constrained looks attractive.
- ▶ Choice/access is valuable to consumers even for seldom chosen “star” hospitals that are far away.