Price Discrimination and Bargaining:
Empirical Evidence from Medical Devices

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November 3, 2011
Hospitals Pay Different Prices (for the same stent)

Inter-Quartile Range = $310/stent → $300,000/year/hospital
Research Questions

**RQ:** What happens under more uniform pricing?

- Do hospital mergers, GPOs, transparency ↓ prices?
- It’s not clear . . .

[Dranove & Lindrooth 2003; Burns & Lee 2008; Kyle & Ridley 2007]
Research Questions

**RQ:** What happens under more uniform pricing?
- Do hospital mergers, GPOs, transparency $\downarrow$ prices?
- It’s not clear . . .
  [Dranove & Lindrooth 2003; Burns & Lee 2008; Kyle & Ridley 2007]

**RQ0:** What explains this price variation?
- demand $\rightarrow$ price discrimination with oligopoly
  [Holmes 1989; Corts 1998; Hastings 2008; Villas-Boas 2009]
- allowing for bargaining
  [Dranove et al 2008; Dafny 2010; Crawford & Yurukoglu 2011]
Panel Data Over Hospitals and Time

Unbalanced panel: all stents, 96 U.S. hospitals, Jan. ‘04 - Jun. ‘07 (10,098 stent-hospital-months) [Millenium Research Group Marketrack survey]

Product Data:

<table>
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<tr>
<th>Year</th>
<th>Month</th>
<th>Hospital</th>
<th>Product</th>
<th>Manufacturer</th>
<th>Quantity</th>
<th>Price</th>
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Hospital Data:

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The Model

(STAGE 1) Pricing: bargaining and competition

\[ p(w_{tp}, c, ba) \] for all stents at each hospital for contract period

(STAGE 2) Demand: patients arrive; doctors choose

\[ q(p, w_{tp}) \] for all stents at each hospital for each month
# The Model

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\[ p(w_{\text{tp}}, c, ba) \] for all stents at each hospital for contract period

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\[ q(p, w_{\text{tp}}) \] for all stents at each hospital for each month

- hetero across hospitals; across patients/doctors within hospital
- random coefficients discrete choice model
  
  [McFadden 1978; Berry, Levinsohn, & Pakes 1995; Nevo 2001]
- bargaining introduces new sources of identification
Demand Identification with Negotiated Prices

![Graph showing demand (D) and supply (S) curves, with equilibrium price (p₀) and quantity (Q₀).]
Demand Identification with Negotiated Prices

![Diagram showing demand shifts]

- **Price**: $p_0$
- **Quantity**: $D_0$, $D_1$

(1) demand shifts
Demand Identification with Negotiated Prices

(1) demand shifts
(2) price renegotiated

movement along the demand curve

S

D0

D1

p0

(1) demand shifts
(2) price renegotiated
Demand Identification with Negotiated Prices

Instruments for negotiated prices:

- $p_{jht-1}$ by “sticky price” mechanism
- $\tilde{p}_{k\neq jht-1}$ proxy for bargaining ability; other stent demand shifts
Pricing Model: Bargaining and Competition

Incorporate cost/demand/competition (range) and bargaining ability.
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Incorporate cost/demand/competition (range) and bargaining ability.

Nash Equilibrium of bilateral Nash Bargaining problems

[THEORY: Cremer & Riordan 1987; Horn & Wolinsky 1988; de Fontenay & Gans 2007]

[EMPIRICS: Crawford & Yurukoglu 2011; Dranove, Satterthwaite, & Sfekas 2011]

\[
\max_{p_j} \left[ \pi_j(p) \right]^{b_j(h)} \left[ \pi_h(p) - d_{jh} \right]^{b_h(j)} \quad \forall j \in J_h
\]

mfr profits  h profits with mfr - h profits w/out mfr
Pricing Model: Bargaining and Competition

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\[
\max_{p_j} \left[ \pi_j(p) \right]^{b_j(h)} - \left[ \pi_h(p) - d_{jh} \right]^{b_h(j)} \quad \forall j \in J_h
\]

- \(d_{jh}\): hospital \(h\) disagreement point—not contracting with stent \(j\)
- \(b_j(h)\): stent \(j\) bargaining ability (vs. hospital \(h\))
- \(b_h(j)\): hospital \(h\) bargaining ability (vs. stent \(j\))
Pricing Equation from Model

\[
p_{jh} - c_{jh} = \frac{b_j(h)}{b_j(h) + b_h(j)} \left\{ \left( 1 + \frac{\partial q_{jh}}{\partial p_{jh}} \frac{p_{jh} - c_{jh}}{q_{jh}} \right) \frac{\pi_h - d_{jh}}{q_{jh}} + p_{jh} - c_{jh} \right\}
\]

- **Margin**: \( b_j(h) \)
- **Bargaining Abilities**: \( b_j(h) + b_h(j) \)
- **Adjust for \( q \) dependent on \( p \)**
- **“Added Value” of \( j \)**
- **Surplus up for negotiation**
Pricing Equation from Model

\[ p_{jh} - c_{jh} = \frac{b_j(h)}{b_j(h) + b_h(j)} \left\{ \left( 1 + \frac{\partial q_{jh}}{\partial p_{jh}} \frac{p_{jh} - c_{jh}}{q_{jh}} \right) \frac{\pi_h - d_{jh}}{q_{jh}} + p_{jh} - c_{jh} \right\} \]

- **Margin (\( b_j(h) / (b_j(h) + b_h(j)) \))**
- **Bargaining Abilities**
- **Adjust for \( q \) dependent on \( p \)**
- **“Added Value” of \( j \)**
- **Surplus up for negotiation**
Pricing Equation from Model

\[ p_{jh} - c_{jh} = \frac{b_j(h)}{b_j(h) + b_h(j)} \]

margin

adjust for \( q \) dependent on \( p \)

"Added Value" of \( j \)

bargaining abilities

\[ \left( 1 + \frac{\partial q_{jh}}{\partial p_{jh}} \frac{p_{jh} - c_{jh}}{q_{jh}} \right) \]

surplus up for negotiation

\[ \frac{\pi_h - d_{jh}}{q_{jh}} + p_{jh} - c_{jh} \]
Pricing Equation from Model

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Empirical specification:

\[ p_{jht} = \gamma_j \underbrace{\nu_{jht}}_{\text{demand estimates}} + \frac{\beta_j}{\beta_h} \underbrace{\text{AV}_{jht}}_{\text{bargaining abilities}} \]
## Parameter Estimates: Sources of Price Variation

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<td>(286)</td>
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<td>(0.004)</td>
<td>(389)</td>
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<td>(286)</td>
<td>(0.02)</td>
<td>(0.002)</td>
<td>(390)</td>
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September 2005 only. BMS1-3 have exited the market. Standard errors clustered at hospital level.
What Determines Bargaining Abilities?

Regress $\ln\left( \frac{\beta_j}{\beta_h} \nu_{jht} \right)$ on firm dummy variables:

- $R^2 = 0.41$
- estimates of $\beta_j$ and $\beta_h$, for all $j$ and $h$
Uniform Pricing: What Would Happen?

\[
\max_{p_j} \left[ \pi_{jh}(p) \right]^{b_j} \left[ \pi_h(p) - d_{jh}(p) \right]^{b_{\mathcal{H}}} , \quad \forall j
\]

- **demand aggregated over hospitals**
  
  [Holmes 1989; Corts 1998; Hastings 2008; Villas-Boas 2009]

- \( b_{\mathcal{H}} \) allows for collective bargaining
Why GPOs May Not Benefit Hospitals

Change in Hospital Surplus, %

- Competitive Effect: competition less intense with no discrimination
- Bargaining Effect: outcome depends on bargaining ability of hospital group

%Δ in $\pi_H(b_H)$ with no discrimination

Bargaining Ability of Hospital Group (relative to mean), $b_H/\bar{b}_h$
Mergers and Demand (A)symmetry

<table>
<thead>
<tr>
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<th>Merge with $b_{H} = b_{h}$</th>
<th>Merge with $b_{H} = \max(b_{h})$</th>
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<tbody>
<tr>
<td>Intercept (asym)</td>
<td>-8.9 (1.0)</td>
<td>0.4 (1.2)</td>
</tr>
<tr>
<td>Slope (sym ↑)</td>
<td>7.5 (3.0)</td>
<td>20.0 (3.5)</td>
</tr>
<tr>
<td>$R^2$</td>
<td>0.06</td>
<td>0.24</td>
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<tr>
<td>% $\pi_H$ ↑</td>
<td>1</td>
<td>92</td>
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Takeaways

GPOs, Hospital Mergers, and Stent Prices:

- Competition more intense with non-uniform prices
- Bargaining ability of “merged” group important
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Further Research:

- Determinants of bargaining ability?
- Entry and the “cost” of medical technology in the longer-run?