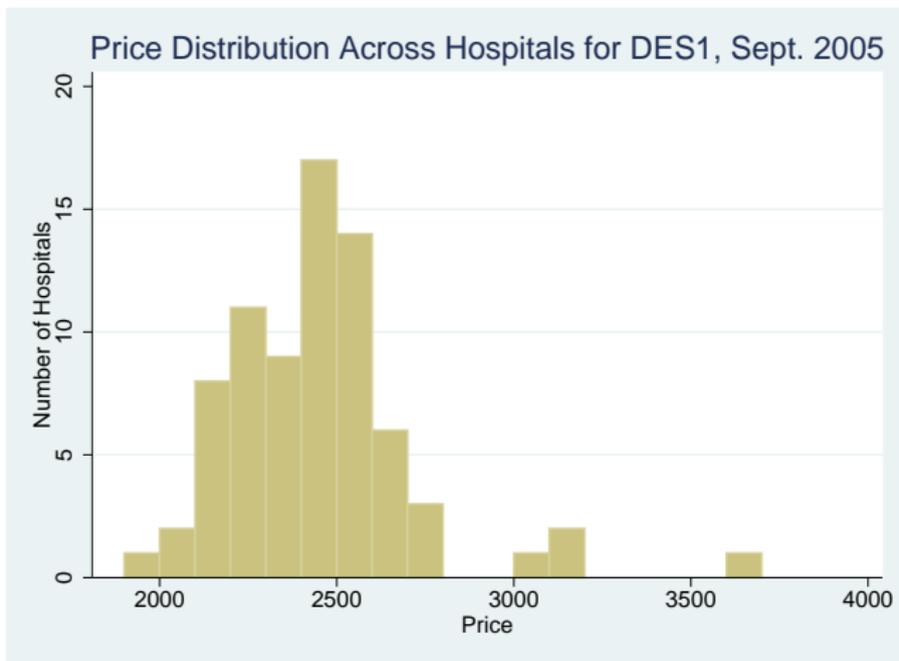# Price Discrimination and Bargaining:
Empirical Evidence from Medical Devices

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Hospitals Pay Different Prices (for the same stent)

Price Distribution Across Hospitals for DES1, Sept. 2005

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]

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RQ0: What explains this price variation?

- demand → 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:

Year	Month	Hospital	Product	Manufacturer	Quantity	Price
2004	January	001	BMS9	Mfr1	7	1050
⋮
2007	June	096	DES2	Mfr4	41	2500

Hospital Data:

Year	Month	Hospital	State	Public	Teaching	Diagnostic
2004	January	001	Arkansas	0	1	283
⋮

The Model

(STAGE 1) Pricing: bargaining and competition

$\mathbf{p}(\textcolor{red}{\mathbf{wtp}}, \textcolor{red}{\mathbf{c}}, \textcolor{red}{\mathbf{ba}})$ for all stents at each hospital for contract period

(STAGE 2) Demand: patients arrive; doctors choose

$\mathbf{q}(\mathbf{p}, \textcolor{red}{\mathbf{wtp}})$ for all stents at each hospital for each month

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(STAGE 2) Demand: patients arrive; doctors choose

$\mathbf{q}$(**p**, **wtp**) for all stents at each hospital for each month

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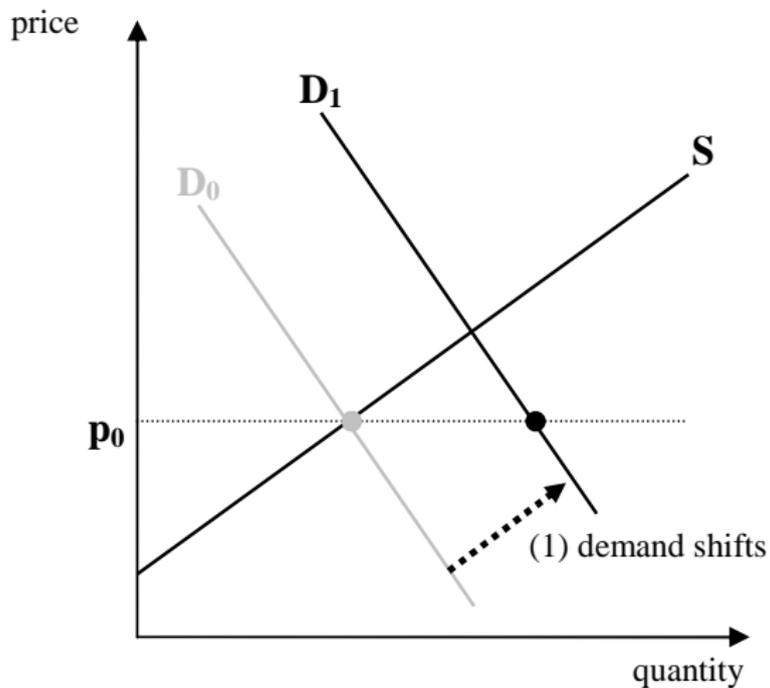- random coefficients discrete choice model
  [McFadden 1978; Berry, Levinsohn, & Pakes 1995; Nevo 2001]
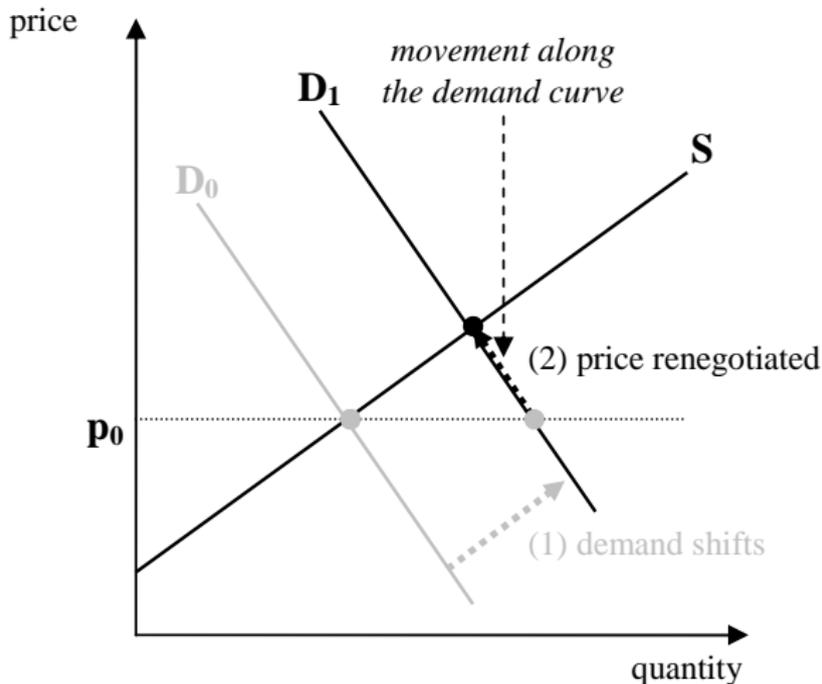- bargaining introduces new sources of identification

Demand Identification with Negotiated Prices
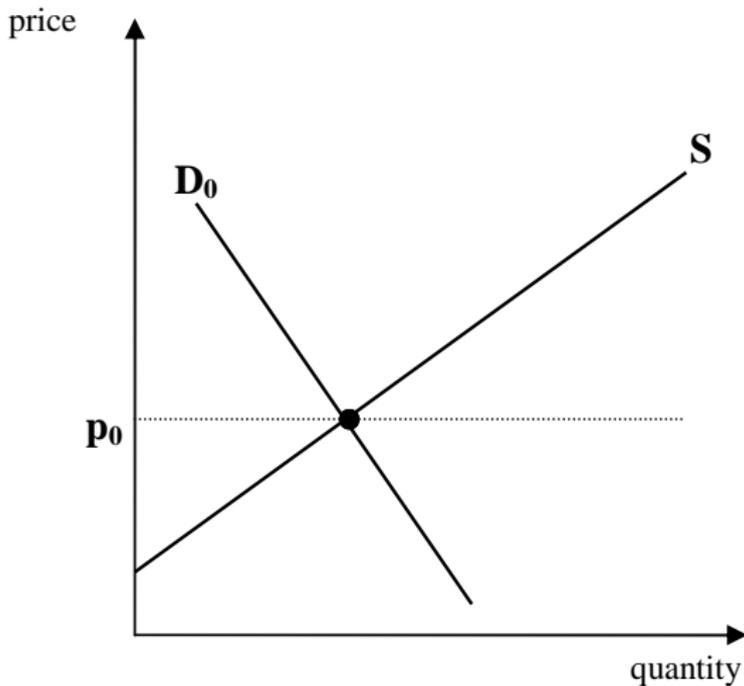
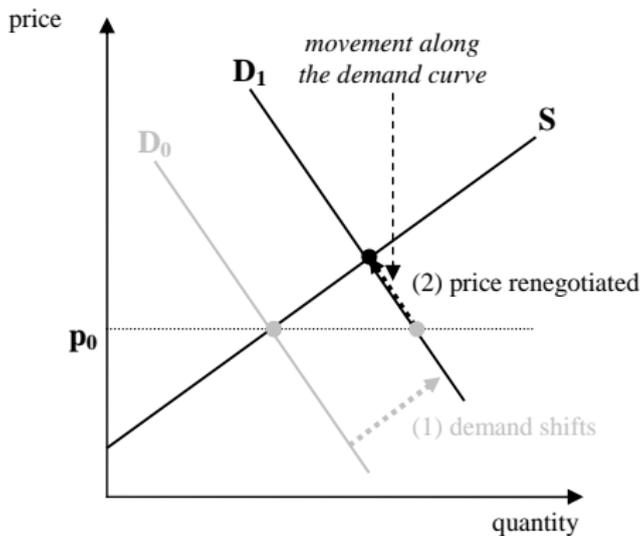# Demand Identification with Negotiated Prices

Demand Identification with Negotiated Prices

Demand Identification with Negotiated Prices

Instruments for negotiated prices:

- p_{jht-1} by "sticky price" mechanism
- $\bar{p}_{k\neq jht-1}$ 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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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]

$$\max_{p_j} \quad \underbrace{[\pi_j(p)]^{b_j(h)}}_{\text{mfr profits}} \quad \underbrace{[\pi_h(p) - d_{jh}]^{b_h(j)}}_{\text{h profits with mfr - h profits w/out mfr}} \qquad \forall j \in \mathcal{J}_h$$

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- 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

$$\underbrace{p_{jh} - c_{jh}}_{\text{margin}} = \underbrace{\frac{b_j(h)}{b_j(h) + b_h(j)}}_{\text{bargaining abilities}} \underbrace{\left\{ \overbrace{\left(1 + \frac{\partial q_{jh}}{\partial p_{jh}} \frac{p_{jh} - c_{jh}}{q_{jh}} \right)}^{\text{adjust for } q \text{ dependent on } p} \overbrace{\frac{\pi_h - d_{jh}}{q_{jh}} + p_{jh} - c_{jh}}^{\text{``Added Value'' of } j} \right\}}_{\text{surplus up for negotiation}}$$

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Empirical specification:

$$p_{jht} = \underbrace{\gamma_j}_{\text{cost}} + \underbrace{\frac{\beta_j}{\beta_h} \nu_{jht}}_{\text{bargaining abilities}} \underbrace{\widetilde{AV}_{jht}}_{\text{demand estimates}}$$

Parameter Estimates: Sources of Price Variation

	Price Data		Cost Est.	Barg. Ratio Est.		Added Value Est.	
	mean (\$)	s.d. (\$)	mean (\$)	mean	s.d.	mean (\$)	s.d. (\$)
BMS4	1006	175	34	0.33	0.07	2980	254
			(79)	(0.04)	(0.004)	(327)	(25)
BMS5	926	191	34	0.32	0.07	2807	155
			(79)	(0.10)	(0.006)	(313)	(13)
BMS6	952	156	34	0.31	0.05	2993	291
			(79)	(0.06)	(0.004)	(321)	(28)
BMS7	1035	174	34	0.35	0.07	2899	248
			(79)	(0.02)	(0.004)	(314)	(21)
BMS8	1063	338	34	0.36	0.10	2809	222
			(79)	(0.04)	(0.01)	(310)	(18)
BMS9	1088	224	34	0.34	0.08	3171	403
			(79)	(0.01)	(0.005)	(341)	(31)
DES1	2508	317	1103	0.35	0.08	4298	463
			(286)	(0.02)	(0.004)	(389)	(26)
DES2	2530	206	1103	0.36	0.06	4317	472
			(286)	(0.02)	(0.002)	(390)	(30)

September 2005 only. BMS1-3 have exited the market. Standard errors clustered at hospital level.

What Determines Bargaining Abilities?

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

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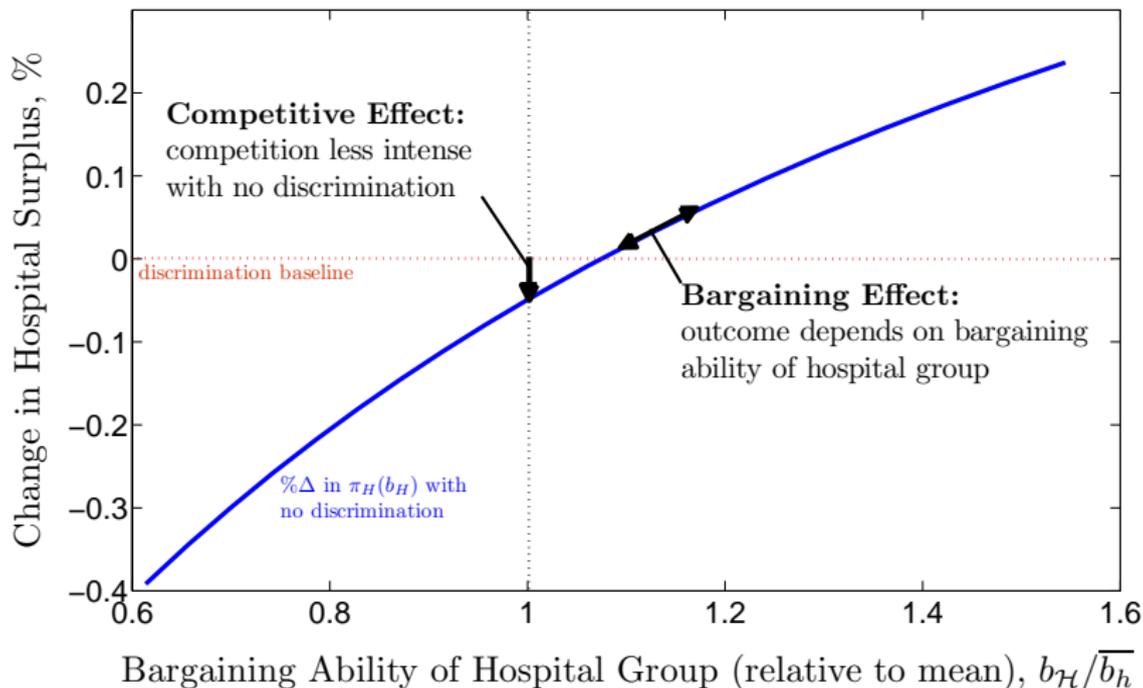
Uniform Pricing: What Would Happen?

$$\max_{p_j} \quad \underbrace{\left[\sum_h \pi_{jh}(p) \right]^{b_j}}_{\text{mfr } j \text{ \textbf{total} profits}} \underbrace{\left[\sum_h \pi_h(p) - d_{jh}(p) \right]^{b_{\mathcal{H}}}}_{\textbf{all } h \text{ profits}} \quad , \forall j$$

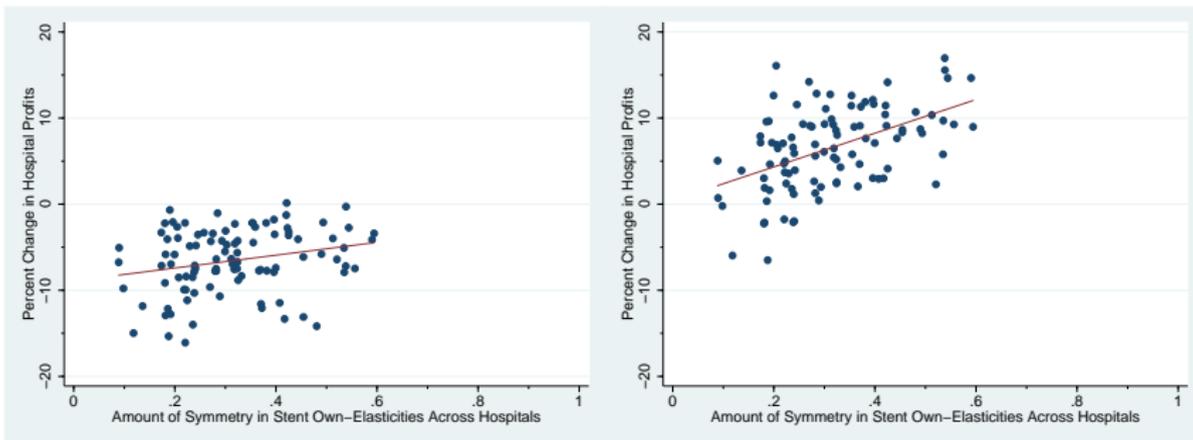- demand aggregated over hospitals

  [Holmes 1989; Corts 1998; Hastings 2008; Villas-Boas 2009]

- $b_{\mathcal{H}}$ allows for collective bargaining

Why GPOs May Not Benefit Hospitals

Mergers and Demand (A)symmetry

	Merge with $b_{\mathcal{H}} = \bar{b}_h$	Merge with $b_{\mathcal{H}} = \max(b_h)$
Intercept (asym)	-8.9	0.4
	(1.0)	(1.2)
Slope (sym $\uparrow$)	7.5	20.0
	(3.0)	(3.5)
R^2	0.06	0.24
% $\pi_H \uparrow$	1	92

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?