ORGANIZACIÓN INDUSTRIAL EMPÍRICA IN7E0

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Outline

1. Introduction
2. Grennan (AER 2013)
    - Demand Model
    - Bargaining Model
    - Results
3. Conclusions

Introduction

- We covered the theoretical literature including the Nash bargaining model, the Rubinstein's model and the Horn and Wolinsky model.
- We start to take bargaining models to the data.
- The easiest way to learn how to estimate these models will be some recent examples
- We start with the paper of Grennan (AER 2013), who studied price discrimination and bargaining.

Grennan (2013): *Price discrimination and bargaining: empirical evidence from medical devices.*

The prices of coronary stents vary a lot across heterogenous hospital, allowing for a price discrimination from the suppliers.

Under uniform prices: Are hospitals better off? Is the society better off?

The paper seeks to construct the counterfactual of a uniform price through a single hospital, but what bargaining skills will have this new entity?

Heterogeneity of bargaining skills leaves the question open regarding if consumers are better off in a scenario of uniform prices.

Finding: The consumers are better of if and only if the bargaining skills of the single entity is at the top percentiles of estimated bargaining power parameters.

Coronary Stent Price Variation across Hospitals

Table 1—Price Variation across Hospitals

Stent	Mean ($)	SD ($)	SD/Mean	Min ($)	Max ($)	N
BMS4	1,006	175	0.17	775	1,500	25
BMS5	926	191	0.21	700	1,600	23
BMS6	952	156	0.16	775	1,475	26
BMS7	1,035	174	0.17	775	1,600	39
BMS8	1,063	338	0.32	800	1,950	11
BMS9	1,088	224	0.21	800	1,800	47
DES1	2,508	317	0.13	2,100	3,280	54
DES2	2,530	206	0.08	2,150	3,195	54

Notes: The table reports summary statistics for the distribution of price ($US) across hospitals for each stent. The sample is restricted to September 2005 (middle of the sample in time) to isolate cross-sectional variation. There are $N = 54$ hospitals sampled, and BMS1–3 have exited the market.

Coronary Stent Market share Variation across Hospitals

TABLE 2—MARKET SHARE VARIATION ACROSS HOSPITALS

Stent	Mean (%)	SD (%)	SD/Mean	Min (%)	Max (%)	N
BMS4	5	3	0.7	1	14	25
BMS5	3	2	0.6	1	7	23
BMS6	6	6	1.0	1	25	26
BMS7	4	5	1.1	1	25	39
BMS8	4	4	1.1	1	14	11
BMS9	8	8	1.0	1	32	47
DES1	43	30	0.7	1	88	54
DES2	41	30	0.7	2	93	54

Notes: The table reports summary statistics for the distribution of market share (percent of all stents used) across hospitals. (Average shares do not add up to 100 percent because not all stents are used by all hospitals, as documented in the last column of the table.) The table is restricted to September 2005 (middle of the sample in time) to isolate cross-sectional variation. There are $N = 54$ hospitals sampled in this month, and BMS1–3 have exited the market.

Model

In this bargaining between many hospitals and many suppliers the prices are set in a model of bargaining.

Each competing hospital negotiates with each manufacturer separately and simultaneously.

The outcomes of these bilateral negotiations must be consistent with one another, forming a Nash equilibrium in the sense that no party wants to renegotiate.

Thus, prices are determined as a Nash equilibrium of bilateral Nash bargaining problems introduced by Horn and Wolinsky (1988).

Timing of the Game

The two stages of the game are as follows:

1. **Pricing**: Device manufacturers and hospitals contract on prices, taking expected future quantities into account.
2. **Demand**: Given prices and choice sets, doctors decide on stent purchases as patients arrive at the hospital.

As usual, the model is solved using backward induction.

Demand for Coronary Stents.

The paper estimates a discrete choice random utility model of how doctors choose which stent j to use for each patient i in hospital h at time t.

$$\max_{j \in \mathcal{J}_{ht}} u_{ijht} = \max_{j \in \mathcal{J}_{ht}} \theta_{jh} - \theta^P p_{jht} + X_{jt}\theta^x + \rho\xi_{jht-1} + \xi_{jht} + \varepsilon_{ijht}$$

where the random term ε_{jht} assumes the existence of two nests (BMS and DES), adopting a two-level nested logit correlation pattern.

The random term also includes a random mean shifter that allows for a bimodal distribution that reflects the brand loyalty of some doctors. This utility function can be thought of as a reduced form for how a doctor incorporates his own preferences, patient welfare, and hospital profitability into the treatment decisions.

Estimating the Demand for Coronary Stents.

The non-standard demand is more complicated due the lag of ξ_t. The author uses the usual IV approach

$$E(Z^D \xi) = 0$$

with lagged prices as instruments.

In this context the hospital profits (aggregated with utility of patients and doctors) are:

$$\pi_{ht} = \sum_{j \in \mathcal{J}_{ht}} \int_{A_j ht} \frac{u_{ijht}}{\theta^P} d\varepsilon$$

Nash Product in Grennan (2013)

Each bilateral price of device j and hospital h maximizes the Nash product of manufacturer profits and hospital surplus, **taking the other prices as given**, solving

$$\max_{p_{jh}} [q_{jh}(\mathbf{p})(p_{jh} - c_{jh})]^{\lambda_j(h)} [\pi_h(\mathbf{p}_h) - d_{jh}]^{\lambda_h(j)}, \quad \forall j \in \underbrace{\mathcal{J}_h}_{\text{set of Suppliers of } h}$$

where the parameters $\lambda_j(h) > 0$ and $\lambda_h(j) > 0$ represent the bargaining ability of the manufacturer and hospital vis-a-vis each other, respectively.

Conditional on competition, the amount of value captured depends on bargaining via $\lambda_j(h)/(\lambda_j(h) + \lambda_h(j)) \in (0, 1)$.

Alternative for Disagreement Payoffs

$$\max_{p_{jh}}[q_{jh}(\mathbf{p})(p_{jh}-c_{jh})]^{\lambda_j(h)}[\pi_h(\mathbf{p}_h)-d_{jh}]^{\lambda_h(j)}, \quad \forall j \in \underbrace{\mathcal{J}_h}_{\text{set of Suppliers of } h}$$

d_{jh} is the hospital's disagreement payoff when no contract with j is signed.

The manufacturer's disagreement payoff is equal to marginal cost by the assumptions that the hospital is a monopsonist, the manufacturer is not capacity constrained, and each hospital is small enough that any returns to scale in manufacturing are not affected by inclusion or exclusion from a single hospital.

Insights 1: Particular Cases

$$\max_{p_{jh}}[q_{jh}(\mathbf{p})(p_{jh}-c_{jh})]^{\lambda_j(h)}[\pi_h(\mathbf{p}_h)-d_{jh}]^{\lambda_h(j)}$$

When the hospital has zero bargaining ability ($\lambda_h(j)=0, \forall j$), manufacturers set prices in a Bertrand-Nash price equilibrium; and when a manufacturer has zero bargaining ability ($\lambda_j(h)=0$), that manufacturer prices at marginal cost.

Insights 2: Disagreement Payoffs

Different assumptions on the threat points, d_{jh} , correspond with different notions of bargaining.

Horn and Wolinsky (1988) and Crawford and Yurukoglu (2012), letting $d_{jh} = \pi_h(\mathbf{p}_h; \mathcal{J}_h \backslash \{j\})$, where the parties assume that other contracts would not be renegotiated if they did not reach agreement. **(Passive Beliefs)**

Another (harder) alternative would be: $d_{jh} = \pi_h(\widehat{\mathbf{p}}_h; \mathcal{J}_h \backslash \{j\})$, where $\widehat{\mathbf{p}}_h$ is the prices that would be negotiated if j were not in the market, corresponds to the case studied by Stole and Zwiebel (1995). In that case, contracts can be freely renegotiated in the event of a breakdown, and h and j never rejoin negotiations once they have broken down.

First Order Conditions in Grennan (2013)

Solving the FOC for each bilateral negotiation, we have:

$$
\begin{aligned}
p_{jht} &= c_{jht} + \frac{\lambda_{jt}(h)}{\lambda_{jt}(h) + \lambda_{ht}(j)} \left(1 + \frac{\partial q_{jht}}{\partial p_{jht}} \frac{(p_{jht} - c_{jht})}{q_{jht}}\right) \left(\frac{\pi_{ht} - d_{jht}}{q_{jht}}\right) \\
&+ \frac{\lambda_{jt}(h)}{\lambda_{jt}(h) + \lambda_{ht}(j)} \left[p_{jht} - c_{jht}\right]
\end{aligned}
$$

Notice that $\frac{\partial q_{jht}}{\partial p_{jht}} \frac{(p_{jht} - c_{jht})}{q_{jht}} \in [-1, 0]$. Hence more elastic hospital demands (closer to minus one) will negotiate lower prices. Inelastic demands (closer to zero) will imply negotiating larger prices.

The author distinguishes the adjustments to nontransferable utility $\left(1 + \frac{\partial q_{jht}}{\partial p_{jht}} \frac{(p_{jht} - c_{jht})}{q_{jht}}\right)$ and the added value of device j, $\left(\frac{\pi_{ht} - d_{jht}}{q_{jht}}\right) + p_{jht} - c_{jht}$.

Modeling costs and bargaining parameters

The paper assumes product specific constant marginal costs

$$c_{jht} = \gamma_j$$

And replaces the bargaining parameters by a residual:

$$\frac{\lambda_{jt}(h)}{\lambda_{ht}(j)} = \underbrace{\beta_{jh}}_{=1} \nu_{jht} = \nu_{jht}$$

where β_{jh} measures the average relative ability of stent j to hospital h, capturing firm-specific features (such as size). ν_{jht} is the econometric unobservable shock to the negotiation which we will see that capture most of the action in negotiations.

Estimating Costs and Bargaining abilities

From the FOC we can find:

$$\log\left(\frac{p_{jht}-\gamma_j}{\left(1+\frac{\partial q_{jht}}{\partial p_{jht}}\frac{(p_{jht}-\gamma_j)}{q_{jht}}\right)\left(\frac{\pi_{ht}-d_{jht}}{q_{jht}}\right)}\right)=\log(\nu_{jht})$$

The author distinguishes the adjustments to nontransferable utility and the added value of device j.

The standard GMM approach will require instruments that ensure $E(Z^S\log(\nu))=0$.

Identification and Instruments in the Demand Side

The GMM problem search over the parameters that meet the demand moment conditions:

$$E(Z^D \xi) = 0$$

The author argues that demand does not anticipate future changes in bargaining abilities (timing assumption).

If new prices are negotiated at the beginning of the month, and the demand shocks ξ are known afterwards. Thus, lagged prices are correlated with new prices but not with new demand shocks.

Therefore, Z^D includes i) lagged own price, ii) lagged average price of other stents at the same hospital.

Identification and Instruments in the Supply Side

GMM problem of supply moment conditions $E(Z^S \log(\nu)) = 0$.

The author argues that bargainers do not anticipate future changes in bargaining abilities. If shocks ν to bargaining abilities are not anticipated by players, then lagged added values (which are computed using demand parameters only) are valid instruments. Only cost parameters γ are estimated in the supply side.

Therefore, $Z^S = (1(BMS)av_{jht-1}, 1(DES)av_{jht-1})$, where one month lagged first derivatives of the added value are

$$av_{jht} = \left(\frac{p_{jht-1}}{\left(1+\frac{\partial q_{jht-1}}{\partial p_{jht-1}}\right)\frac{p_{jht-1}}{q_{jht-1}}} \right).$$

Counterfactual Mergers

Using FOC to compute equilibrium prices in counterfactual mergers we have:

$$p_{jht} = \bar{c}_{jht} + \frac{\lambda_{jt}(\mathcal{H})}{\lambda_{jt}(\mathcal{H}) + \lambda_{\mathcal{H}t}(j)} \left(1 + \overline{\frac{\partial q_{jht}}{\partial p_{jht}} \frac{(p_{jht} - c_{jht})}{q_{jht}}}\right) \left(\frac{\pi_{ht} - d_{jht}}{q_{jht}}\right) + \frac{\lambda_{jt}(\mathcal{H})}{\lambda_{jt}(\mathcal{H}) + \lambda_{\mathcal{H}t}(j)} [p_{jht} - c_{jht}]$$

where $\frac{\lambda_{jt}(\mathcal{H})}{\lambda_{jt}(\mathcal{H})+\lambda_{\mathcal{H}t}(j)}$ captures the bargaining effect and $\overline{\frac{\partial q_{jht}}{\partial p_{jht}} \frac{(p_{jht}-c_{jht})}{q_{jht}}}$ captures the demand/competitive effect.

Bargaining effect

What is going to be the bargaining ability of new single entity (or representant) $\mathcal{H}$?

Best case scenario is going to be the maximum of the mergers's abilities?

If it is the average, Is it good enough to decrease negotiated prices?

We need an empirical assessment of this argument.

Demand/Competitive effect: Asymmetry in Own Price Elasticities

If demand across hospitals is asymmetric in the sense that some hospitals prefer one stent while other hospitals prefer another (and thus different stents want to set high prices in different hospitals), then a move to uniform pricing will tend to soften competition as stent suppliers retreat to their more captive markets. Creating a pure horizontally differentiated market.

Demand Results

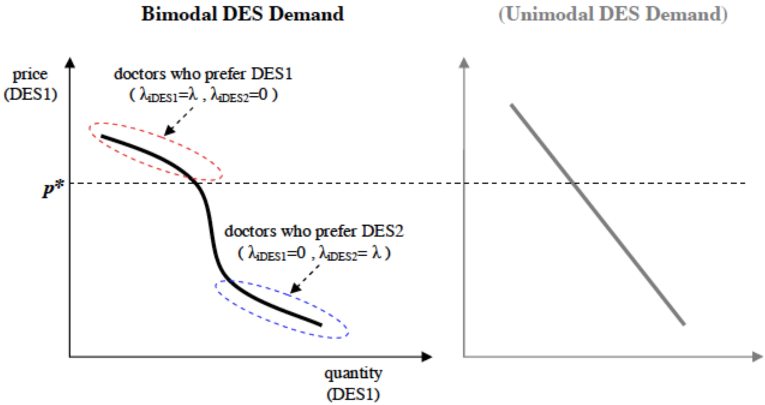


Figure C1. : Bimodal versus unimodal demand for DES

Note: The random mean, λ_{ijht}, allows the distribution of doctor/patient tastes to be *bimodal*. A bimodal distribution implies a demand curve with multiple groups of consumers, each with similar willingness-to-pay, whereas a unimodal distribution does not; and these two situations have very different implications for pricing—in particular near a price such as p^* in the figure.

Demand Summary

There is a large price insensitivity in some portions of the demand. Some doctors (and hospitals) will prefer some stents regardless of the price.

These hospitals have a insensitive demand that would show in the bargaining optimality condition ($\frac{\partial q_{jht}}{\partial p_{jht}} \frac{(p_{jht} - c_{jht})}{q_{jht}} \in [-1, 0]$) closer to zero.

Cost Estimates

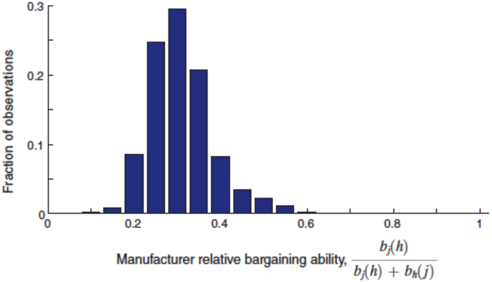
Table 6—Cost Estimates and Comparison

	Bargaining model	Industry experts	Bertrand, $b_h = 0$	
			Mean	SD
BMS cost, γ_{bms} ($)	34	100–400	−2,211	547
	(79)		(471)	(75)
DES cost, γ_{des} ($)	1,103	400–1,600	−2,481	1,325
	(286)		(660)	(174)

Notes: The first column reports marginal cost estimates for the bargaining model used in this paper. Column two reports a range of industry expert estimates for per-unit costs. Column three reports marginal cost estimates (mean and standard deviation across stent-hospital-months) implied by the model if manufacturers were assumed to set prices. $N = 10,098$. Standard errors clustered by hospital, $N_H = 96$.

For the cheapest device the estimates are poor. For the expensive one, they are quite OK.

Distribution of Bargaining Power



	Mean	SD	SD/Mean	Min.	Max.	N
$\frac{b_{jt}(h)}{b_{jt}(h) + b_{ht}(j)}$	0.33 (0.04)	0.07 (0.01)	0.22 (0.02)	0.08 (0.02)	0.71 (0.07)	10,098

Figure 4. Distribution of Manufacturer Relative Bargaining Abilities, $\frac{b_{jt}(h)}{b_{jt}(h) + b_{ht}(j)}$

Notes: Overall product-hospital-time observations. The measure takes the value 0 in the case where the hospital gets all the surplus (conditional on disagreement points) and the manufacturer prices at cost; and it takes the value 1 in the case where the manufacturer gets all the surplus, pricing at the highest price consistent with competition. Standard errors in parentheses, clustered by hospital.

Benefits of Uniform Prices

TABLE 7—EFFECTS OF CHANGING TO UNIFORM PRICING

		Percent change with uniform prices		
	Current regime	$b_{\mathcal{H}} = 0$	$b_{\mathcal{H}} = \bar{\beta}_h$	$b_{\mathcal{H}} = \max(\beta_h)$
Manufacturer profits ($M/hospital/year)	1.24	81 (27)	8 (1)	−15 (3)
Hospital surplus ($M/hospital/year)	4.32 (0.58)	−48 (2)	−1.4 (0.3)	7.2 (0.5)
Total surplus ($M/hospital/year)	5.56 (0.75)	−19 (1)	0.7 (0.1)	2.2 (0.2)
Total stentings (stents/hospital/year)	977	−43 (2)	−1.1 (0.3)	5.9 (0.4)
Mean BMS price ($/stent)	1,016	207 (35)	1.7 (0.4)	−25 (1.6)
Mean DES price ($/stent)	2,509	114 (14)	1.7 (0.7)	−14 (0.9)

Notes: Standard errors in parentheses, clustered by hospital. Equilibrium outcomes under the current negotiated price regime compared to those under uniform pricing (e.g., GPO of all hospitals in sample) for September 2005. Column 2 sets $b_{\mathcal{H}}$ to zero, the case where hospitals do not bargain collectively and manufacturers set prices. Column 3 sets bargaining ability of the group of hospitals, $b_{\mathcal{H}}$, to the mean of individual hospitals, $\overline{\beta_h}$, in order to isolate the change to competition. Column 4 sets $b_{\mathcal{H}}$ to the maximum estimated bargaining ability of any individual hospital.

Average Bargaining ability is not enough to compensate decrease in competition.

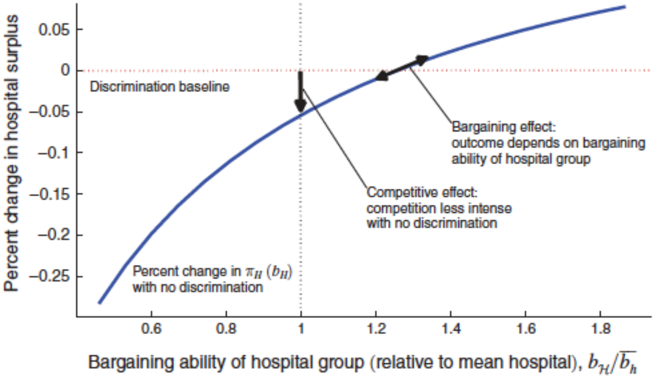
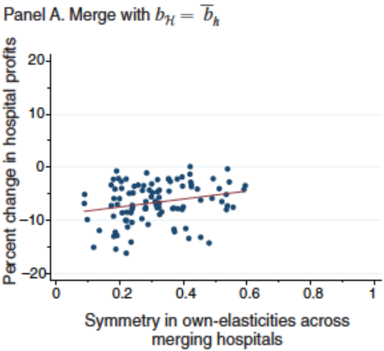


Figure 5. Competitive and Bargaining Effects

Notes: The vertical axis is the percent change in hospital profits, and the horizontal axis is the bargaining ability of the hospital group as a ratio of the mean hospital bargaining ability. The upward-sloping curve shows the relationship between the predicted hospital profits under uniform pricing and hospital bargaining ability.

Counterfactual Mergers: Role of Symmetry in own price elasticities.



Robustness Check Cost Estimations

Table C5—: Robustness to Various Cost Assumptions

	$c_{bms} = 0$ $c_{des} = 0$	Paper $c_{bms} = 34$ $c_{des} = 1103$	$c_{bms} = 240$ $c_{des} = 1540$
Mean bargaining split, $\frac{b_j(h)}{b_j(h)+b_h(j)}$, $(0, 1)$	0.43	0.33	0.25
Std. dev. bargaining split, $\frac{b_j(h)}{b_j(h)+b_h(j)}$, $(0, 1)$	0.15	0.07	0.07
Mfr profits, ($M/hospital/year)	2.18	1.24	0.84
Hospital surplus, ($M/hospital/year)	4.32	4.32	4.32
Mean DES price, ($/unit)	2509	2509	2509
Mfr profit change for $b_{\mathcal{H}} = \underline{\beta}_h$, (percent)	5.5	8.0	10.7
Hospital surplus change for $b_{\mathcal{H}} = \bar{\beta}_h$, (percent)	-3.1	-1.4	-1.2
Mean DES price change for $b_{\mathcal{H}} = \bar{\beta}_h$, (percent)	5.2	1.7	0.7

The author presents bound for the effects, given that the cost estimates are not very precise.

Conclusions

- Grennan explores important questions regarding price discrimination in the presence of bargaining.
- Opposite forces makes the conclusion an empirical question.
- The sources of heterogeneity in bargaining abilities and their variation over time and over pairs is still an open question.