ORGANIZACIÓN INDUSTRIAL EMPÍRICA
IN7E0

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Outline

Introduction

- We started with the paper of Grennan (2013), who studied price discrimination and bargaining.
- Let us continue our journey with **Mergers When Prices Are Negotiated: Evidence from the hospital industry** by Gowrisankaran, Nevo and Town (AER 2015)

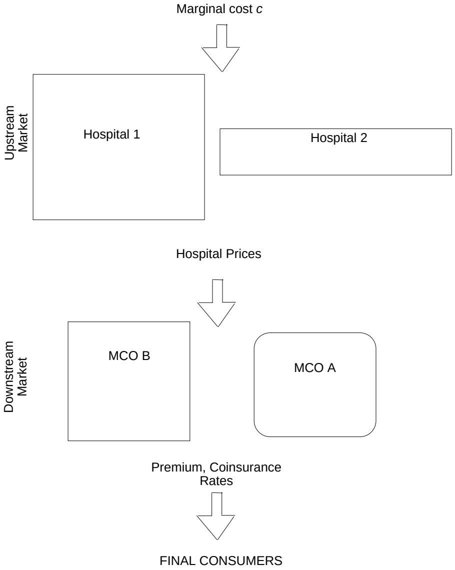
Gowrisankaran, Nevo and Town (AER 2015)

In this paper they estimate a model of competition in which prices are negotiated between managed care organizations (MCOs) and hospitals.

They use the estimates to investigate the extent to which hospital bargaining and patient coinsurance restrain prices and to analyze the impact of counterfactual hospital mergers and policy remedies.

They analyze the impact of hospital competition. Over the last 25 years, hospital markets have become significantly more concentrated due to mergers.

Is society better off? Various effects on consumers


Marginal cost c
Upstream Market
Hospital 1
Hospital 2
Hospital Prices
Downstream Market
MCO B
MCO A
Premium, Coinsurance Rates
FINAL CONSUMERS

Contribution

1. The approach can be used more generally to understand mergers in industries where prices are determined by negotiation between differentiated sellers and a small numbers of *gatekeeper* buyers who act as intermediaries for end consumers.
2. A standard way to model competition is with a Bertrand pricing game. In this industry, patient demand for hospitals is very inelastic because patients pay little out of pocket for hospital stays, and therefore Bertrand competition between hospitals implies negative marginal costs. (**Why?**)
3. In contrast, the estimated bargaining model generates more reasonable marginal costs and merger impacts.

Model

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

Each competing hospital negotiates with each insurer 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).

Two stage Game

1. **First Stage**: MCOs and hospital systems negotiate the base price that each hospital will be paid by each MCO for hospital care. They model the outcome of these negotiations using the Horn and Wolinsky (1988) model.

2. **Second Stage**: Each MCO enrollee receives a health draw. Enrollees who are ill decide where to seek treatment, choosing a hospital to maximize utility. Utility is a function of out-of-pocket expense, distance to the hospital, hospital-year indicators, the resource intensity of the illness interacted with hospital indicators, and a random hospital-enrollee-specific shock.

The out-of-pocket expense is the negotiated base price (determined in the 1st stage) multiplied by the coinsurance rate and the resource intensity of the illness.

Patient Hospital Choice

The paper estimates a discrete choice random utility model of how patients i enrolled in MCO m will choose hospital j to cure illness d.

$$u_{ijd} = \underbrace{\beta X_{ijd} - \alpha c_{id} w_d p_{m(i)j}}_{\delta_{ijd}} + e_{ij}$$

where X_{ijd} is a vector of hospital and patient characteristics, and w_d is a disease weight. Hence, the out-of-pocket expense to the patient is a function of the base price, disease weight, and coinsurance rate. A standard multinomial logit will be estimated.

Patients Surplus

The ex-ante expected utility to patient i, as a function of prices $\mathbf{p}_{m(i)}$ and the network $\mathcal{N}_{m(i)}$ of hospitals in the plan, is given by:

$$W_i(\mathcal{N}_{m(i)}, \mathbf{p}_{m(i)}) = \sum_{d=1}^{D} f_{id} \ln \left(\sum_{j \in 0, \mathcal{N}_{m(i)}} \exp(\delta_{ijd}) \right)$$

where f_{id} denote the probability that patient i at MCO m is stricken by illness d.

Ex-ante Expected Costs

Each MCO, acting on behalf of its contracted employers, seeks to maximize a weighted sum of the consumer surplus of its enrollees net of the payments to hospitals, taking $m(i)$ as fixed.
A hospital system that does not reach agreement with MCO m will not capture back any of m's patients through plan switches by those patients.
The MCO pays the part of the bill that is not paid by the patient, hence:

$$TC(\mathcal{N}_m, \mathbf{p}_m) = \sum_{i=1}^{I} \sum_{d=1}^{D} 1[m(i) = m](1 - c_{id}) f_{id} w_d \sum_{j \in 0, \mathcal{N}_m} p_{mj} s_{ijd}(\mathcal{N}_m, p_m)$$

Ex-ante Expected Surplus of the Downstream market

Define the value in dollars for the MCO and the employer it represents to be:

$$V_m(\mathcal{N}_m, \mathbf{p}_m) = \frac{\tau}{\alpha} \sum_{i=1}^{I} 1[m(i) = m] W_i(\mathcal{N}_m, \mathbf{p}_m) - TC_m(\mathcal{N}_m, \mathbf{p}_m)$$

where τ is the relative weight on employee welfare.
For any system s for which $\mathcal{J}_s \subseteq \mathcal{N}_m$, the net value that MCO m receives from including system s in its network is:

$$V_m(\mathcal{N}_m, \mathbf{p}_m) - V_m(\mathcal{N}_m \backslash \mathcal{J}_s, \mathbf{p}_m)$$

Notice the passive beliefs a la Horn-Wolinsky.

Ex-ante Expected Hospital Profits

Define the normalized quantity to hospital j in network $\mathcal{N}_m$:

$$q_{mj}(\mathcal{N}_m, \mathbf{p}_m) = \sum_{i=1}^{I} \sum_{d=1}^{D} 1[m(i) = m] f_{id} w_d s_{ijd}(\mathcal{N}_m, p_m)$$

Since prices and costs are per unit of w_d, the returns that hospital system s expects to earn from a given set of managed care contracts are:

$$\pi_s(\mathcal{M}_s, \{\mathbf{p}_m\}_{m \in \mathcal{M}_s}, \{\mathcal{N}_m\}_{m \in \mathcal{M}_s}) = \sum_{m \in \mathcal{M}_s} \underbrace{\sum_{j \in \mathcal{J}_s} q_{mj}(\mathcal{N}_m, \mathbf{p}_m)[p_{mj} - mc_{mj}]}_{\text{NV}}$$

where $\mathcal{M}_s$ is the set of MCOs that include system s in their network, and NV is the net value that system s receives from including MCO m in its network.

Nash Product

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

$$NB^{m,s}(p_{mj,j\in\mathcal{J}_s} \backslash \mathbf{p}_{m,-s}) = \left(\sum_{j\in\mathcal{J}_s} q_{mj}(\mathcal{N}_m, \mathbf{p}_m)[p_{mj} - mc_{mj}] \right)^{b_{s(m)}} \times \left(V_m(\mathcal{N}_m, \mathbf{p}_m) - V_m(\mathcal{N}_m \backslash \mathcal{J}_s, \mathbf{p}_m)\right)^{b_{m(s)}}$$

where the parameters $b_{s(m)}$ and $b_{m(s)} > 0$ represent the bargaining ability of system s and MCO m.

Equilibrium Conditions

The Nash bargaining solution is the vector of prices that maximizes the Nash product:

$$p_{mj}^{*} = \arg\max_{p_{mj}} NB^{m,s}(p_{mj}, \mathbf{p}_{m,-j}^{*} \backslash \mathbf{p}_{m,-s}^{*})$$

where $\mathbf{p}_{m,-j}^{*}$ is the equilibrium price vector for other hospitals in the same system as j

Equilibrium Conditions

The FOC of the Nash bargaining solution can be written as follows:

$$\mathbf{p} = \mathbf{mc} - (\Omega + \Lambda)^{-1}\mathbf{q}$$

where $\mathbf{p}, \mathbf{mc}$ and $\mathbf{p}$ are the standard price, mg costs and quantity vectors.
Matrix elements are $\Omega_{j,k} = \frac{\partial q_{mk}}{\partial p_{mj}}$ and

$$\Lambda_{j,k} = \frac{b_{m(s)}}{b_{s(m)}} \frac{\frac{\partial V_m}{\partial p_{mj}}}{(V_m(\mathcal{N}_m, \mathbf{p}_m) - V_m(\mathcal{N}_m \backslash \mathcal{J}_s, \mathbf{p}_m))} q_{mk}$$

Insights

$\frac{\partial V_m}{\partial p_{mj}}$ can be decomposed in two main effects:

1. The standard effect: higher prices reduce patients'expected utility.
2. The other term accounts for the effect of consumer choices on payments from MCOs to hospitals. As the price of hospital j rises, consumers will switch to cheaper hospitals. This term can be either positive or negative, depending on whether hospital j is cheaper or more expensive than the share-weighted price of other hospitals

In this model, as long as coinsurance rates are strictly between zero and one, MCOs use prices to steer patients towards cheaper hospitals, and this will influence equilibrium pricing.

Example of the Second Effect

Consider a hospital system with two hospitals, one low cost and one high cost, that are otherwise equal. The MCO/hospital system pair will maximize joint surplus by having a higher relative price on the high-cost hospital, as this will steer patients to the low-cost hospital.

At coinsurance rates near one, i.e., no insurance, this effect disappears, because patients bear most of the cost and hence the MCO has no incentive to steer to low-cost hospitals beyond patients' preferences. Interestingly, at coinsurance rates near zero (full insurance) this effect also disappears: since the patient bears no expense, price does not impact hospital choice.

Thus, MCO bargaining increases the effective price sensitivity, and hence lowers prices relative to differentiated products hospital Bertrand pricing.

Data

Data from Northern Virginia to simulate the effects of a merger that was proposed in this area. Two sources: administrative claims data provided by four large MCOs serving Northern Virginia (payor data) and inpatient discharge data from Virginia Health Information. Data are supplemented with information on hospital characteristics.

A longstanding challenge in the analysis of hospital markets is the difficulty of acquiring actual transaction-level prices for each hospital-payor pair in the market. The administrative claims data are at the transactions level and contain most of the information that the MCO uses to process the appropriate payment to a hospital for a given patient encounter.

Using the claims data, they construct base prices, p_{mjt} , for each hospital-payor-year triple.

Demand Results

Patient choice model estimated by maximum likelihood using the discharge data plus price and coinsurance info.

Table 3—: Multinomial logit demand estimates

Variable	Coefficient	Standard error
Base price × weight × coinsurance	−0.0008**	(0.0001)
Travel time	−0.1150**	(0.0026)
Travel time squared	−0.0002**	(0.0000)
Closest	0.2845**	(0.0114)
Travel time × beds / 100	−0.0118**	(0.0008)
Travel time × age / 100	−0.0441**	(0.0023)
Travel time × FP	0.0157**	(0.0011)
Travel time × teach	0.0280**	(0.0010)
Travel time × residents/beds	0.0006**	(0.0000)
Travel time × income / 1000	0.0002**	(0.0000)
Travel time × male	−0.0151**	(0.0007)
Travel time × age 60+	−0.0017	(0.0013)
Travel time × weight / 1000	11.4723**	(0.4125)
Cardiac major diagnostic class × cath lab	0.2036**	(0.0409)
Obstetric major diagnostic class × NICU	0.6187**	(0.0170)
Nerv, circ, musc major diagnostic classes × MRI	−0.1409**	(0.0460)

Note: ** denotes significance at 1% level. Specification also includes hospital-year interactions and hospital dummies interacted with disease weight. Pseudo R^2=0.445, N=1,710,801.

Demand Elasticities

Table 4—: Mean estimated 2006 demand elasticities for selected hospitals

Hospital	(1) PW	(2) Fairfax	(3) Reston	(4) Loudoun	(5) Fauquier
1. Prince William	−0.125	0.052	0.012	0.004	0.012
2. Inova Fairfax	0.011	−0.141	0.018	0.006	0.004
3. HCA Reston	0.008	0.055	−0.149	0.022	0.002
4. Inova Loudoun	0.004	0.032	0.037	−0.098	0.001
5. Fauquier	0.026	0.041	0.006	0.002	−0.153
6. Outside option	0.025	0.090	0.022	0.023	0.050

Note: Elasticity is $\frac{\partial s_j}{\partial p_k}\frac{p_k}{s_j}$ where j denotes row and k denotes column)

Demand Summary

The parameter on out-of-pocket price is negative and significant indicating that, in fact, inpatient prices do play a role in admissions decisions.

However, in contrast to travel time, patients are relatively insensitive to the gross price paid from the MCO to the hospital, largely because of the low coinsurance rates that they face.

Price elasticity estimates are substantially less than 1, which cannot be rationalized in a Bertrand model.

Structural Estimation

The econometric error is:

$$\varepsilon(\mathbf{b},\gamma,\tau) = -\gamma v + \mathbf{mc}(\mathbf{b},\tau) = -\gamma v + \mathbf{p} + (\Omega + \Lambda(b,\tau))^{-1}\mathbf{q}$$

GNT estimate the remaining parameters with a GMM estimator based on the moment condition that $\mathbb{E}[\varepsilon_{\mathbf{mj}}(\mathbf{b},\gamma,\tau) \mid Z_{mj}] = 0$, where Z_{mj} is a vector of (assumed) exogenous variables.

Instruments

From the model, price is endogenous in the first-stage bargaining model because it is chosen as part of a bargaining process where the marginal cost shock is $\varepsilon_{\mathbf{mj}}$ observed.

Thus IV list: cost fixed effects, indicators for the entities covered by each bargaining, predicted willingness-to-pay for the hospital, predicted willingness-to-pay for the system, predicted willingness-to-pay per enrollee for each MCO, and predicted total hospital quantity, where these values are predicted using the overall mean price.

They assume that these four exogenous variables do not correlate with ε but do correlate with price, implying that they will be helpful in identifying the effect of price.

Structural Estimates

Table 5—: Bargaining parameter estimates

	Specification 1		Specification 2	
Parameter	Estimate	S.E.	Estimate	S.E.
MCO welfare weight (τ)	2.79	(2.87)	6.69	(5.53)
MCO 1 bargaining weight	0.5	–	0.52	(0.09)
MCOs 2 & 3 bargaining weight	0.5	–	1.00**	(7.77×10^{-10})
MCO 4 bargaining weight	0.5	–	0.76**	(0.09)
Hospital cost parameters				
Prince William Hospital	8,635**	(3,009)	5,971**	(1,236)
Inova Alexandria	10,412*	(4,415)	6,487**	(1,905)
Inova Fairfax	10,786**	(3,765)	6,133**	(1,211)
Inova Fair Oaks	11,192**	(3,239)	6,970**	(2,352)
Inova Loudoun	12,014**	(3,188)	8,167**	(1,145)
Inova Mount Vernon	10,294*	(5,170)	4,658	(3,412)
Fauquier Hospital	14,553**	(3,390)	9,041**	(1,905)
No. VA Community Hosp.	10,086**	(2,413)	5,754**	(2,162)
Potomac Hospital	11,459**	(2,703)	7,653**	(902)
Reston Hospital Center	8,249**	(3,064)	5,756**	(1,607)
Virginia Hospital Center	7,993**	(2,139)	5,303**	(1,226)
Patients from MCO 2	−9,043**	(2,831)	–	–
Patients from MCO 3	−8,910**	(3,128)	–	–
Patients from MCO 4	-4,476	(2,707)	–	–
Year 2004	1,130	(1,303)	1,414	(1,410)
Year 2005	1,808	(1,481)	1,737	(1,264)
Year 2006	1,908	(1,259)	2,459*	(1,077)

Note: ** denotes significance at 1% level and * at 5% level. Significance tests for bargaining parameters test the null of whether the parameter is different than 0.5. We report bootstrapped standard errors with data resampled at the payor/year/system level. "Patients from MCO 1" and "Year 2003" are both excluded indicators.

Insights of the Bargaining Estimates

Their estimation can explain the large cross-MCO price differences in three ways:

1. as differences in hospital costs across MCOs
2. as differences in the bargaining weights across MCOs
3. as differences in WTP across MCOs.

Specification 1 focuses on the first explanation, while the Specification 2 focuses on the second. The third alternative could occur if, for example, the geographic or illness severity distribution of enrollees varies across MCOs. Both specifications allow for the third alternative but find that the cost or bargaining weight explanations (respectively) fit the data better.

$\mathbf{p} = \mathbf{mc} - (\Omega + \Lambda)^{-1}\mathbf{q}$

Since Ω is the matrix of actual price sensitivities, GNT define the effective price sensitivity to be $\Omega + \Lambda$.

Table 6—: Lerner indices and actual and effective price elasticities

System name	Lerner index	Actual own price elasticity	Effective own price elasticity	Own price elasticity without insurance
Prince William Hospital	0.52	0.13	1.94	5.16
Inova Health System	0.39	0.07	2.55	3.10
Fauquier Hospital	0.22	0.17	4.56	6.11
HCA (Reston Hospital)	0.35	0.15	2.87	7.34
Potomac Hospital	0.37	0.15	2.74	6.77
Virginia Hospital Center	0.58	0.13	1.74	6.43

Note: reported elasticities and Lerner indices use quantity weights.

Counterfactuals Mergers

Table 7—: Impact of counterfactual industry structures

Counterfactual	System	%Δ Price	%Δ Quantity	%Δ Profits
1. Inova/PWH merger	Inova & PWH	3.1	−0.5	9.3
	Rival hospitals	3.6	1.2	12.0
	Change at Inova+PW relative to PW base	30.5	−4.9	91.5
2. Inova/PWH merger with separate bargaining	Inova & PWH	3.3	−0.5	8.8
	Rival hospitals	3.5	1.2	11.2
3. Loudoun demerger	Inova & Loudoun	−1.8	0.1	−4.7
	Rival hospitals	−1.6	−0.2	−4.7
	Change at Inova relative to Loudoun base	−14.7	0.8	−38.5
4. Breaking up Inova	All hospitals	−6.8	0.05	−18.9

Note: price changes are calculated using quantity weights. The price changes relative to PWH or Loudoun base reflect the total system revenue change divided by the base revenue of this hospital.

Counterfactual Analysis

Counterfactual 1 finds that the Inova/PWH merger leads to a significant increase in prices and profits for the new Inova system. The net quantity-weighted price increase is approximately 3.1% and the net increase in profits is 9.3%. Considering the relative size of PWH to the Inova system, a 3.1% price increase across the joint systems from this transaction is quite substantial, amounting to 30.5% of base PWH revenues. Patient volume at the merged system goes down slightly, by 0.5%, reflecting both low coinsurance rates (and hence that patient demand is inelastic) and the equilibrium price increase by rival hospitals. Not reported in the table, managed care surplus, which is weighted consumer surplus net of payments to hospitals, drops by approximately 27% from this merger.

Firewall Policies

They examine the implications of Firewall policies (separating bargaining) by simulating a world where Inova acquires PWH and the PWH negotiator bargains with a firewall from the other Inova hospitals.

Hence, GNT simulate this counterfactual by assuming that the disagreement values for PWH negotiations reflect the case where only PWH is excluded from the network, and analogously for the 'legacy-Inova' disagreement values.

Empirically, separate negotiations do not appear to solve the problem of bargaining leverage by hospitals.

More Exercises

Counterfactual 3 examines the impact of Inova divesting Loudoun Hospital, which it acquired in 2005 without antitrust opposition.
A divesture of Loudoun Hospital leads to a net reduction in price of 1.8% for the Inova system a reduction in profits of 4.7%, and an increase in managed care surplus of 13.5%.
The price decrease translates into an approximate 14.7% price decrease relative to Loudoun's discharge share of the Inova system. The smaller price impact is consistent with the FTC challenging Inova's proposed Prince William acquisition but not its Loudoun acquisition.
Finally, Counterfactual 4 simulates the impact of breaking up the entire Inova system into separately-owned hospitals. This breakup leads to a 7% market-wide decline in prices and a 54.8% increase in consumer surplus. This result is consistent with the evidence that points to the creation of large hospital systems during the 1990s as an important driver of higher hospital prices

Conclusions

- GNT explore important questions regarding mergers in sensitive sectors whenever we have **gatekeeper** buyers in the bargaining stage.
- The proposed merger between Inova hospital system and Prince William Hospital, which the FTC challenged, would have significantly raised prices.
- It leaves open questions regarding of counterfactual bargaining weights and the nature of competition between MCOs.