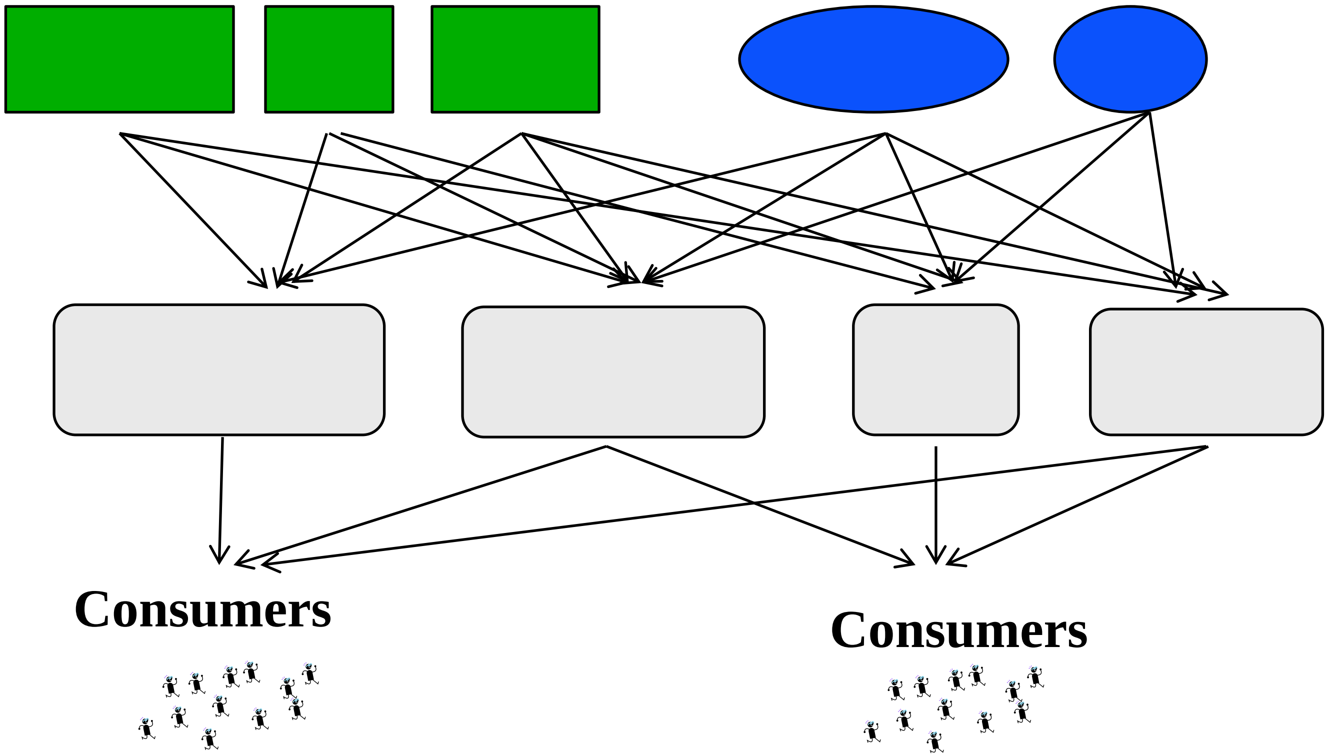
Vertical Market Structure 4

Health Care Applications, MFNs

IO Fall 2013

Pakes and Yurukoglu

Vertical Markets in IO



Main ingredients: Buyers and sellers with market power, externalities between different groups, contracting

Road Map

- Basic Theory
- Vertical Restraints and Contractual Terms
- Estimation of Vertical Bargaining Model

- Today: **Focus on Health Care**
- Grennan on Stents to Hospitals
- Brand, Gowrisankaran, Nevo, and Town on Hospital-Insurance
- Capps, Lazarev, and Me on Hospital-Insurance MFNs

Grennan (2013)

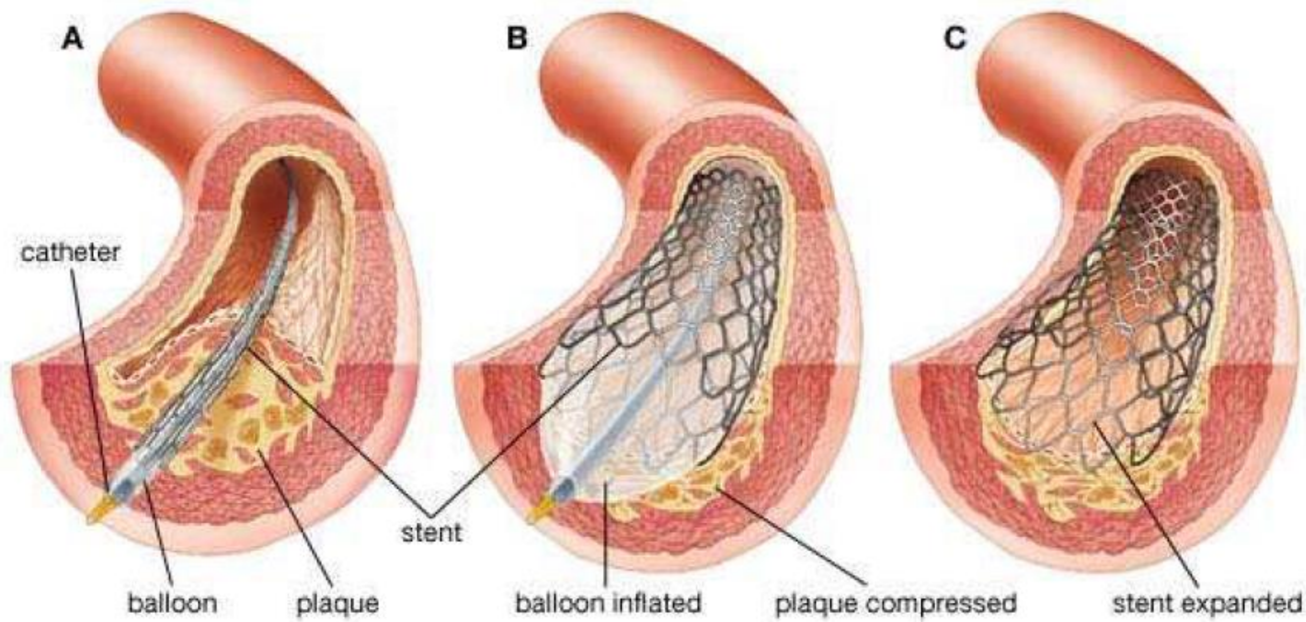
- We discussed Grennan’s paper when we talked about banning wholesale price discrimination.

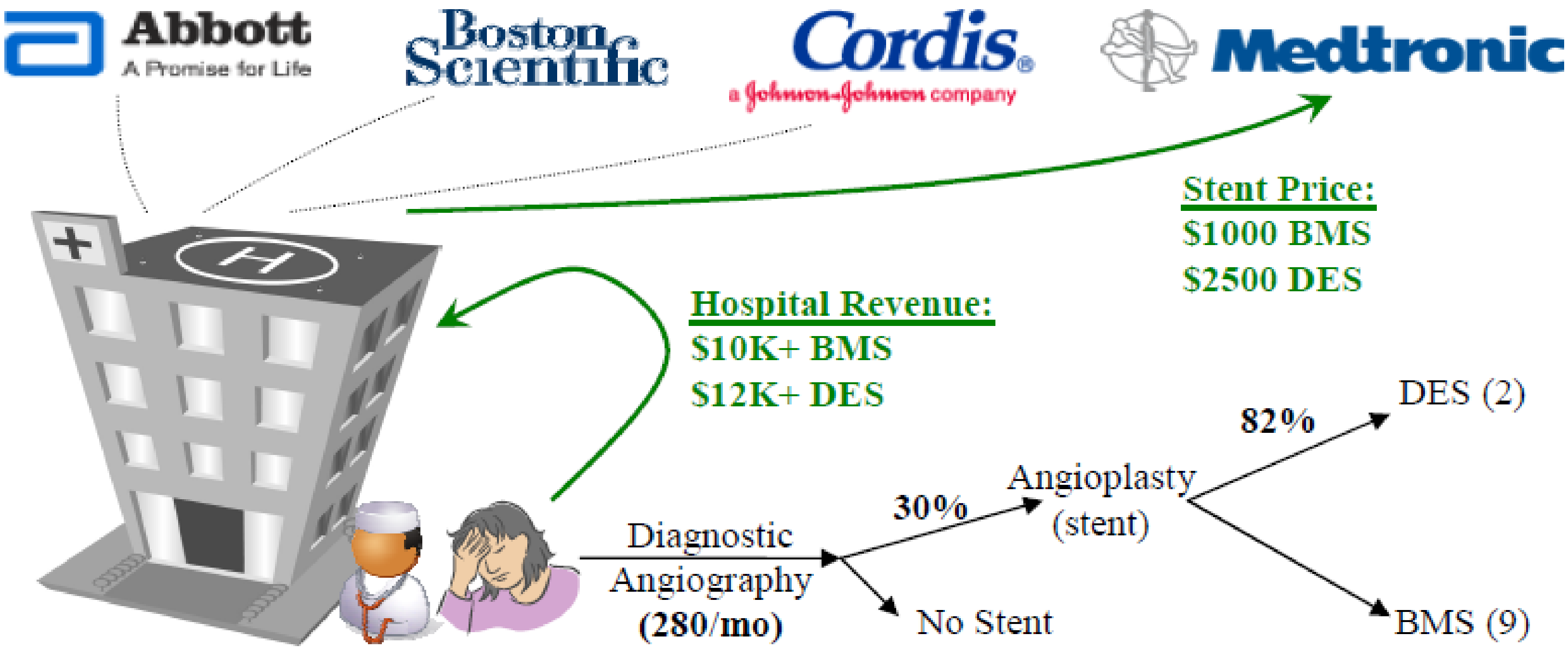
- I focused on the results (average prices rise), but the underlying model is a bargaining model.

- Notation:
  - Patients (i)
  - Hospitals (h)
  - Stents (j)

Coronary Stents

- Coronary Artery Disease is the leading cause of death in the U.S.
- Angioplasty recovery 1 week vs. CABG 1-2 months
- 3M stents/yr $\longrightarrow$ \$30B/yr in procedures; \$5B/yr in stents





Contracts:

- price/unit for 1yr
- mfr distributes on consignment

Stent choice:

- differentiated products
- depends on doctor/patient

Grennan (2013)

- Demand: Mixture of Nested Logits

$$\max_{j \in \mathcal{J}_{ht}} \quad u_{ijht} = \delta_{jht} + \varepsilon_{ijht},$$

$$\delta_{jht} = \theta_{jh} - \theta^p p_{jht} + X_{jt}\theta^x + \xi_{jht},$$

$$\varepsilon_{ijht} = \epsilon_{ijht}^{stent} + (1 - \sigma_{stent})\epsilon_{ijht}^{des} + (1 - \sigma_{stent})(1 - \sigma_{des})\epsilon_{ijht} + \lambda_{ijht},$$

Grennan (2013)

- Supply Side
- Key issues:
- Marginal costs of stent production non-zero (different from cable)
- Hospitals don’t compete
- Multiproduct manufacturers

Grennan (2013)

Nash Equilibrium of bilateral Nash Bargaining problems

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

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

- 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)

$$\max_{p_{jht}} \quad [q_{jht}(\vec{p}_{ht})(p_{jht} - c_{jht})]^{b_{jt}(h)} [\pi_{ht}(\vec{p}_{ht}) - d_{jht}]^{b_{ht}(j)} \qquad \forall j \in \mathcal{J}_{ht},$$

Assumes single-product manufacturers, not sure why (they aren’t, and not hard to incorporate)

Grennan (2013)

- Estimation

- Skip demand side, fairly standard.

- Some arguments about variation in bargaining parameters creating price variation

Grennan (2013)

- Estimation Supply Side

$$c_{jht} = \gamma_j = \gamma_{bms} 1_{\{j=bms\}} + \gamma_{des} 1_{\{j=des\}},$$

- Specified so that all BMS and all DES stents have the same marginal cost of production.

so that cost is determined entirely by whether the stent is a BMS or DES. Ideally, marginal costs would be stent-specific, but the data in this study is not able to identify a more flexible specification. This issue, and the robustness of the paper's results to cost estimates, are discussed at length in the results. I further assume that there are no unobservable determinants of costs. This assumption seems reasonable in this context because marginal costs of production and distribution are thought to be quite low and to vary little (if at all) for a given product across hospitals and time. Also, it allows me to estimate the full distribution of relative bargaining abilities, which I am specifically interested in for this study.

Grennan (2013)

$$\frac{b_{jt}(h)}{b_{ht}(j)} = \beta_{jh}\nu_{jht}$$

- The content in this equation is that hospital-manufacturer **bargaining parameters are stable over time.**
- ν is going to be assumed as a mean one error term.

Grennan (2013)

- Choose β_{jh} to make first order condition from Nash bargaining problem hold (with error term mean one).

- Different from cable paper. There I solved each bargaining game for every candidate set of parameters.

- This (first order condition) is probably faster as it doesn't spend time solving the whole bargaining game for "far-away" candidate parameters.

Grennan (2013)

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

$$\ln\left(g(X^s_{jht};\gamma)\right) \quad = \quad \ln(\beta_{jh}) + \ln(\nu_{jht})$$

$$\text{where } g(X^s_{jht};\gamma) := \frac{p_{jht}-\gamma_j}{\left(1+\frac{\partial q_{jht}}{\partial p_{jht}}\frac{p_{jht}-\gamma_j}{q_{jht}}\right)\frac{\pi_{ht}-d_{jht}}{q_{jht}}}$$

Grennan (2013)

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

- p_{jht} is the data the analyst can work with.
- Can different combinations of cost and bargaining parameter generate p?
- I think in general yes- at least there exists p's for which this is true.
- γ_j a little misleading given parametrization.
- Also doesn't depend on t
- Reasonable that it doesn't depend on h (though one could argue about transportation costs, and could depend on buyer in other contexts like services).

Grennan (2013)

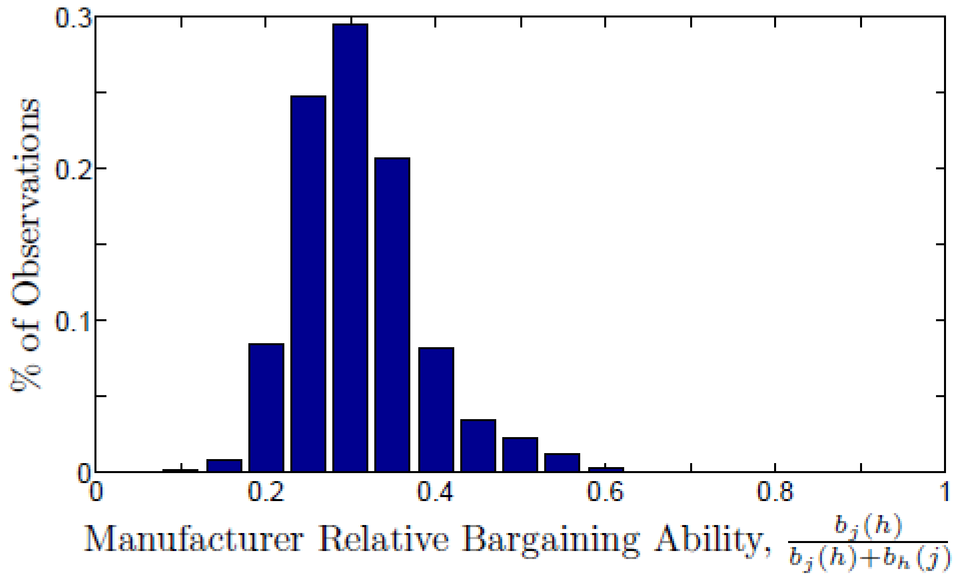
Table 6: Cost estimates and comparison. The first column reports marginal cost estimates for the bargaining model used in this paper. Column two reports industry expert estimates for per-unit costs. The ranges reflect different experts' assumptions about what should enter "cost". Column three reports marginal cost estimates (mean and std. dev. across stent-hospital-months) implied by the model if manufacturers were assumed to set prices.

	bargaining model estimates	industry expert estimates	assuming Bertrand, $b_h = 0$	
			mean	std. dev.
γ_{bms}, BMS cost ($)	34	100-400	-2211	547
	(79)		(471)	(75)
γ_{des}, DES cost ($)	1103	400-1600	-2481	1325
	(286)		(660)	(174)

Showing that TIOLI by manufacturers would imply too low estimated costs

This is a joint test on the demand instruments and TIOLI assumption.

Figure 4: Distribution of bargaining ability of manufacturers relative to hospitals, $\frac{b_{jt}(h)}{b_{jt}(h)+b_{ht}(j)}$. Over all 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.



	mean	std. dev.	std. dev. / mean	min	max	N
$\frac{b_{jt}(h)}{b_{jt}(h)+b_{ht}(j)}$	0.33	0.07	0.22	0.08	0.71	10,098
	(0.04)	(0.01)	(0.02)	(0.02)	(0.07)	

Standard errors, clustered by hospital, in parentheses.

Grennan (2013)

- Some open questions about bargaining parameter estimates:

- How much of dispersion is from error term vs specific to hospital-manufacturer pair (or hospital or manufacturer)
- Any relationship with characteristics of hospital or manufacturer?

Brand, Gowrisankaran, Nevo, Town (2013)

- Application is to hospital-insurer bargaining in Northern Virginia.

- Research question is how does bargaining affect merger analysis in this industry?

- Estimate preferences for hospitals, costs, and bargaining parameters.

- Simulate a merger and report predicted welfare effects.

Brand, Gowrisankaran, Nevo, Town (2013)

- **Features of Paper:**
- Big industry
- Great data on some dimensions
- Natural place to apply a bargaining model

- **Issues:**
- Separating costs and bargaining parameters rears its head again.
- No competition between insurance companies.

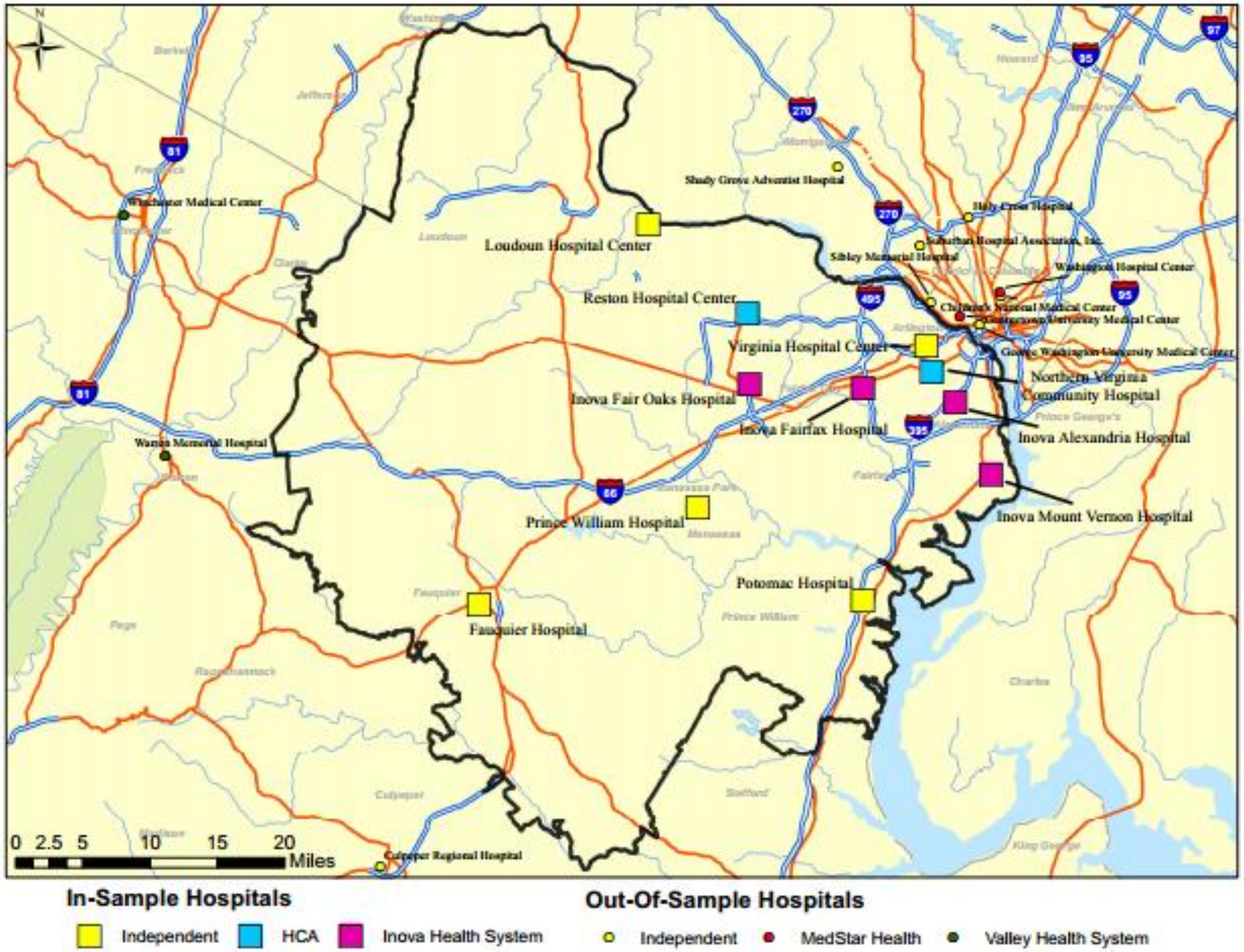
Brand, Gowrisankaran, Nevo, Town (2013)

- Agents

- Consumers/patients i
- Hospitals j
- MCO (health insurance) m

- Consumers are attached to an MCO, no matter what.
- From the MCO, they have a set of hospitals to choose from, if need be.

Figure 1: Hospitals in Northern Virginia



Brand, Gowrisankaran, Nevo, Town (2013)

- Consumers are hit by disease shocks d with probability f_{id}

- Choose which hospital according to:

$$u_{mijd} = \beta x_{mijd} - \alpha c_{mid} w_d p_{mj} + e_{mij}.$$

Co-insurance rate

Hospital-insurer negotiated “base price”

Disease intensity weight

Brand, Gowrisankaran, Nevo, Town (2013)

- MCO – Hospital bargaining Nash product

$$NB^{m,s}(p_{mj_{j\in J_s}}|\vec{p_{m,-s}}) = \Big(\sum_{j\in J_s} q_{mj}(N_m,\vec{p_m})[p_{mj} - mc_{mj}]\Big)^{b_{s(m)}}$$

$$\Big(V_m(N_m,\vec{p_m}) - V_m(N_m\setminus J_s,\vec{p_m})\Big)^{b_{m(s)}}$$

$$W_m(N_m,\vec{p_m}) = \frac{1}{\alpha}\sum_{i=1}^{I_m}\sum_{d=1}^{D} f_{mid}\ln\left(\sum_{j\in 0,N_m}\exp(\delta_{mijd})\right)$$

$$TC_m(N_m,\vec{p_m}) = \sum_{i=1}^{I_m}\sum_{d=1}^{D}(1-c_{mid})\sum_{j\in 0,N_m} p_{mj} f_{mid} w_d s_{mijd}(N_m,\vec{p_m})$$

$$V_m(N_m,\vec{p_m}) = \tau W_m(N_m,\vec{p_m}) - TC_m(N_m,\vec{p_m})$$

Brand, Gowrisankaran, Nevo, Town (2013)

- Explanation of what they are doing:

- Insurance company payoffs are assumed to be some parameter "τ" times consumer welfare of the insurers enrollees.

- Has unfortunate implications: for example if star hospital dropped from the insurer:

1. No patients switch (they are just unhappy)
2. No other insurer picks up enrollees
3. Hospitals loses access to all enrollees of m

Brand, Gowrisankaran, Nevo, Town (2013)

- A more satisfying formulation would be that insurers set premiums and networks to compete for consumers
- Similar to Comcast sets prices and channels in competition with DirecTV
- They don’t have data on premiums.
- Would involve estimating a demand system for insurance together with hospital demand.
- Definitely do-able, probably data constraint.
- Unfortunate that in paper they try to justify their formulation as being superior.

Brand, Gowrisankaran, Nevo, Town (2013)

- Data:

- Insurance claims data from FTC merger proceeding
- Diagnosis, patient's location, hospital choice
- Exact transfers between hospitals and insurers by patient.
    - Collapse to hospital-insurance base price, then scale by disease weight.

Brand, Gowrisankaran, Nevo, Town (2013)

Table 1: Hospital characteristics

Hospital	Beds	Mean price $	FP	Mean NICU	Cath lab
Prince William Hospital	170	10,273	0	1	0
Alexandria Hospital	318	9,754	0	1	1
Fair Oaks Hospital	182	9,793	0	0.5	1
Fairfax Hospital	833	11,881	0	1	1
Loudoun Hospital	155	11,560	0	0	1
Mount Vernon Hospital	237	12,110	0	0	1
Fauquier Hospital	86	13,269	0	0	0
N. VA Community Hosp.	164	9,545	1	0	1
Potomac Hospital	153	11,420	0	1	1
Reston Hospital Center	187	9,972	1	1	1
Virginia Hospital Center	334	9,545	0	0.5	1

Note: we report (unweighted) mean prices across year and payor. "FP" is an indicator for for-profit status, "Mean NICU" for the presence of a neonatal intensive care unit, and "Cath lab" for the presence of a cardiac catheterization lab that provides diagnostic and interventional cardiology services.

Brand, Gowrisankaran, Nevo, Town (2013)

Table 2: Patient sample

Hospital	Mean age	Share white	Mean DRG weight	Mean travel time	Mean coins. rate	Discharges Total	Discharges Share
Prince William Hospital	36.1	0.73	0.82	13.06	0.032	9,681	0.066
Alexandria Hospital	39.3	0.62	0.92	12.78	0.025	15,622	0.107
Fair Oaks Hospital	37.7	0.54	0.94	17.75	0.023	17,073	0.117
Fairfax Hospital	35.8	0.58	1.20	18.97	0.023	46,428	0.319
Loudoun Hospital	37.2	0.74	0.81	15.54	0.023	10,441	0.072
Mount Vernon Hospital	50.3	0.66	1.38	16.18	0.022	3,749	0.026
Fauquier Hospital	40.5	0.90	0.92	15.29	0.033	3,111	0.021
N. VA Comm. Hosp.	47.2	0.48	1.43	16.02	0.016	531	0.004
Potomac Hospital	37.5	0.60	0.93	9.62	0.024	8,737	0.060
Reston Hospital Center	36.8	0.69	0.90	15.35	0.021	16,007	0.110
Virginia Hospital Center	40.8	0.59	0.98	15.88	0.017	12,246	0.084
Outside option	39.3	0.82	1.39	0.00	0.029	2,113	0.014
All Inova	37.5	0.59	1.09	17.37	0.024	85,540	0.641
All others	38.1	0.68	0.92	13.74	0.023	60,199	0.359

Brand, Gowrisankaran, Nevo, Town (2013)

- Demand Estimates

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 MDC × cath lab	0.2036**	(0.0409)
Obstetric MDC × NICU	0.6187**	(0.0170)
Nerv, circ, musc MDC × MRI	−0.1409**	(0.0460)
N	1,710,801	
Pseudo R^2	0.445	

Note: ** denotes significance at 1% level. Specification also includes hospital-year interactions and hospital dummies interacted with disease weight.

Consumers are price insensitive because co-insurance rates are small.

Estimates imply increasing travel time by 1 minute to all hospitals reduces CS by $167, probably a little high.

Brand, Gowrisankaran, Nevo, Town (2013)

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)

Elasticites are in ranges such that this can not be analyzed as a standard product market. Something has to give.

Bargaining model can rationalize these estimates.

Brand, Gowrisankaran, Nevo, Town (2013)

Table 5: Estimates from bargaining model

	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)
Cost parameters				
Inova Fairfax	10,786**	(3,765)	6,133**	(1,211)
Inova Fair Oaks	11,192**	(3,239)	6,970**	(2,352)
Inova Alexandria	10,412*	(4,415)	6,487**	(1,905)
Inova Mount Vernon	10,294*	(5,170)	4,658	(3,412)
Inova Loudoun	12,014**	(3,188)	8,167**	(1,145)
Prince William Hospital	8,635**	(3,009)	5,971**	(1,236)
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)
MCO 2 Cost	−9,043**	(2,831)	–	–
MCO 3 Cost	−8,910**	(3,128)	–	–
MCO 4 Cost	-4,476	(2,707)	–	–
Year 2004	1,123	(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.

Brand, Gowrisankaran, Nevo, Town (2013)

- Estimates become a little difficult to sort out at this point.

- The problems are that

1. the insurance competition is mis-specified, probably severely, and
2. Not clear how to separately estimate bargaining parameters and hospital costs
3. Insurers have the same bargaining weight with everyone

Brand, Gowrisankaran, Nevo, Town (2013)

- Choose specification 1 saying it is more “reasonable”
- Run some merger counterfactuals
- My take-away from paper:
- Decent effort at applying bargaining model to an industry where they should be applied
- Important policy implications if done correctly
- Falls short, for me

MFN's

- One feature of cable contracts is the existence of an MFN: most favored nation clause
- Stipulates that one party to transaction will not grant better terms to a third party than it does to the other party in the transaction
- For example, MTV price won't be lower to DirecTV than Comcast is Comcast has MFN.

MFN’s

- DoJ opened an investigation into use by BCBS of Michigan of using these terms with hospitals.
- Hospital would certify that no insurer would get a better price than BCBS of Michigan.

- Models aren’t fully flushed out, but:
- Competition dampening effect: If a new insurer comes along, hospital faces an increased cost to offering a low price. It would then reduce prices to BCBS as well.
- Efficiency effect: Allows for deals that wouldn’t happen to happen (because of asymmetric information bargaining).

MFN's

- Insurance is highly concentrated.
- Not unusual for top insurer to have market share about 80% in a metropolitan area or state.

- Ongoing work..

- Early empirical result
- Issues on how to model

MFN’s

- Early empirical result:

- MFN ban associated with lower hospital prices.
- 16 states have banned MFNs in insurer-hospital MFNs.

- Data are from Medicare hospital cost reports.
- Construct hospital “price” as hospital non-Medicare, non-Medicaid revenues minus discounts divided by number of non-Medicare, non-Medicaid patients (following Dafny).

MFN's

year	N	mean	p50
1996	5378	12722.78	5446.428
1997	5356	14596.43	5571.856
1998	5331	13660.9	5624.888
1999	5252	15376.29	5745.704
2000	5259	17077.89	6082.83
2001	5276	20348.43	6740.096
2002	5268	26611.53	7547.568
2003	5328	27002.31	8231.147
2004	5365	28522.57	8791.935
2005	5388	30149.93	9583.346
2006	5388	28258.96	10150.88
2007	5380	26345.03	10571.59
2008	5400	27216.32	11010.23
2009	5374	27415.3	11378.27
2010	4681	27847.6	11925.13
2011	5275	29708.1	12194.87
2012	2812	24933.23	11976.92
Total	87511	23338.26	8292.402

MFN's

$$log(p_{ht}) = \alpha_h + \gamma_t + \beta MFNBan_{ht} + \epsilon_{ht}$$

$$log(p_{ht}) = \alpha_h + \gamma_t + \kappa_s t + \beta MFNBan_{ht} + \epsilon_{ht}$$

- MFN Ban varies at state-year level.
- Standard errors clustered by (state-year and hospital)

MFN's

	log(price)	log(price)	log(price)	log(price)
MFN Ban	-0.036 **	-0.050 ***	-0.051 ***	-0.056 ***
	(0.0152)	*(0.0138)*	*(0.0152)*	*(0.0157)*
log(Medicaid Discharges)	.	.	-0.065***	-0.068***
Hospital FE	Y	Y	Y	Y
Year FE	Y	Y	Y	Y
State Time Trend	N	Y	N	Y
N	83696	83696	78578	78578
R^2	0.157	0.179	0.198	0.2175
SE Clustered by State-Year and Hospital				

MFN's

- Modeling

- Can maybe build into Horn and Wolinsky model.

$$\max_{\tau_{mn}, z_{mn}} (\Pi_n(\tau_{mn}, z_{mn}, \tau_{-mn}, z_{-mn}) - \Pi_n(\emptyset, \tau_{-mn}, z_{-mn}))^{b_{mn}}$$
$$(\Pi_m(\tau_{mn}, z_{mn}, \tau_{-mn}, z_{-mn}) - \Pi_m(\emptyset, \tau_{-mn}, z_{-mn}))^{(1-b_{mn})}$$

- Does an equilibrium exist?
- Doesn't capture "more deals" efficiency

Conclusions

- Vertical market structure applications in health care
- Lots of room for improvement

- Evolution of networks over time (Lee and Fong have a computational model, no data, about this).
- Using equilibrium network to understand factors in negotiations (Ho 2009)
- Effects of contracts on investment and entry
- ACO’s and foreclosure