Vertical Relations: Double Marginalization, Price Negotiation and Integration

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Introduction: Vertical Contracting

- **Goal:** Solve an externality problem between downstream and upstream firms
  - *Agency problem:* Unmeasurable service quality
  - *Pricing:* Double marginalization
  - *Upstream competition:* Exclusion of rival suppliers
  - *Under-investment:* Incomplete contracting
- **Double marginalization:** Retailer does not internalize the loss in revenue from setting prices above cost.
- **Legal restrictions:**
  - *Resale-price maintenance* (RPM) is illegal in the U.S.
  - *Wholesale price discrimination* is illegal only if judged anticompetitive (almost never prosecuted)
  - *Tie-in* and *exclusive territories* are judge by a rule of reason (technically illegal)
  - *Vertical mergers* are rarely prosecuted by the federal agencies

Double Marginalization: Basic Model

- **Linear pricing contract:** Manufacturer sets wholesale price w
  - Downstream firm (with market-power):

$$\max_p \quad (p-w)D(p) \leftrightarrow D(p) + D'(p)(p-w) = 0$$

  - Upstream firm (monopolist):

$$\max_w \quad (w-c)D(p(w)) \leftrightarrow D(p(w)) + D'(p(w))(w-c)p'(w) = 0$$

  - **Key result:** As long as $w > c$, $p^* > p^{VI}$ and $q^* < q^{VI}$. Why?
    - ★ Downstream firm fails to internalize the profit loss to the manufacturer associated with selling fewer units than q^{VI}.
- **Remedies:**
  - Two-part tariff contract (i.e. franchising)

$$w = c \text{ and } F = (p^{VI} - c)q^{VI}$$

  - Resale-price maintenance
  - Minimum quantity contracts
  - Vertical integration

Testing for Double Marginalization

Source: Villas-Boas (2007)

- **Data:** The market for Yogurt in a Midwestern city
  - *Source:* IRI
  - *Market-structure:* 5 Manufacturers $\times$ 3 Retailers $=$ 43 products
  - *Sample:* Product characteristics and sales over 104 weeks
- Mixed-logit demand (omitting time dimension):

$$\begin{aligned} u_{ij} &= x_j\beta_i - \alpha_i p_j + \xi_j + \epsilon_{ij}, \\ \begin{pmatrix} \beta_i \\ \alpha_i \end{pmatrix} &= \begin{pmatrix} \bar{\beta} \\ \bar{\alpha} \end{pmatrix} + D_i\Gamma + \nu_i\Sigma \end{aligned}$$

  where $j \in \{0, 1, \ldots, N\}$, N is the number of brands $\times$ stores, and D_i is a vector of demographic characteristics (age and income), and $\nu_i \sim N(0, 1)$.
- The demand parameters are estimated as in Nevo (2001).
  - *Instruments:* Aggregate cost-shocks $\times$ product FEs (pretty weak...)

Vertical Pricing

- **Assumption:** Manufacturers are allowed to charge different wholesale prices for each retailer/product combination (i.e. w_j)
- **Notation:** (again omitting the time dimension)
  - Ω^r: Ownership matrix at the retail level
  - Ω^w: Manufacturer ownership matrix (i.e. brands)
  - Δ^r: Retail demand own and cross price derivative (i.e. $\Delta^r_{jk} = \partial s_k / \partial p_j$)
  - Δ^w: Wholesale demand own and cross derivative (i.e. $\Delta^w_{jk} = \partial s_k / \partial w_j$)
  - Λ: Retail equilibrium pass-through matrix (i.e. $\Lambda_{kj} = dp_k / dw_j$)
- **Identity:** Manufacturer perceived demand slope depends on the retailers' anticipated pricing decision

$$\Delta^w_{jk} = \partial s_k / \partial w_j = \sum_{l=1}^{N} \frac{\partial s_k}{\partial p_l} \frac{dp_l}{dw_j}, \text{ or } \Delta^w = \Lambda^T \Delta^r$$

- **Timing:** Manufacturers set wholesale prices, and retailers determine retail prices knowing the entire vector of wholesale price

Vertical Contract 1: Linear Pricing

- Retail supply relation:

$$(p_j): \quad s_j + \sum_k \Omega^r_{jk} \frac{\partial s_k}{\partial p_j}(p_k - w_k - c^r_j) = 0 \leftrightarrow p_j = c^r_j + w_j + \left(\Omega^r \cdot \Delta^r\right)^{-1}_{j,\cdot} s$$

- Wholesale supply relation:

$$(w_j): \quad s_j + \sum_k \Omega^w_{jk} \frac{\partial s_k}{\partial w_j}(w_k - c^w_k) = 0, \text{ where } \frac{\partial s_k}{\partial w_j} = \sum_{l=1}^{N} \frac{\partial s_k}{\partial p_l} \frac{dp_l}{dw_j}$$

$$\leftrightarrow w_j = c^w_j + \left[\Omega^w \cdot \left(\Lambda^T \Delta^r\right)\right]^{-1}_{j,\cdot} s$$

- Equilibrium pass-through (differentiating retailers' FOC):

$$(w_f): \sum_{l=1}^{N} \underbrace{\left[\frac{\partial s_j}{\partial p_l} + \sum_k \Omega^r_{jk} \frac{\partial^2 s_k}{\partial p_j \partial p_l}(p_k - w_k) + \Omega^r_{jk} \frac{\partial s_l}{\partial p_j}\right]}_{g(j,l)} \frac{dp_l}{dw_f} - \underbrace{\Omega^r_{jf} \frac{\partial s_f}{\partial p_j}}_{h(j,f)} = 0$$

$$\leftrightarrow \Lambda = G^{-1} H$$

Vertical Pricing (continued)

- **Model 2:** Non-linear pricing
  - Manufacturer sets $w_j = c_j^w$ and charges a fixed-fee fee F_j (does not affect prices):

$$(p_j): \quad s_j + \sum_k \Omega^r_{jk} \frac{\partial s_k}{\partial p_j}(p_k - c_j^w - c_j^r) = 0 \leftrightarrow p_j = c_j^r + c_j^w + (\Omega^r \cdot \Delta^r)^{-1}_{j,\cdot} s$$

  - Alternatively, retailer set $p_j = w_j + c^r$ and manufacturer transfers payment to retailer:

$$(w_j): \quad s_j + \sum_k \Omega^w_{jk} \frac{\partial s_k}{\partial w_j}(w_k - c_k^w) = 0$$

$$\leftrightarrow s_j + \sum_k \Omega^w_{jk} \frac{\partial s_k}{\partial p_j}(p_k - c_k^r - c_k^w) = 0$$

  - **Note:** This last FOC, is equivalent to the one used in BLP and Nevo.

Vertical Pricing (continued)

- **Alternative models:** Partial collusion and linear pricing
  - Downstream collusion: $\Omega^r = \mathcal{O}$
  - Upstream collusion: $\Omega^w = \mathcal{O}$
  - Monopoly pricing and vertical integration
  - Etc.
- **Conclusion:** Even if we do not observe w_{jt}, alternative vertical pricing models imply different supply relations equations

$$p_{jt} = x_{jt}\gamma + \tilde{\lambda}_w \left[\tilde{\Omega}^w_t \cdot \left(\Lambda^T_t \Delta^r_t\right)\right]^{-1}_{j,\cdot} s_t + \tilde{\lambda}_r \left[\tilde{\Omega}^r_t \cdot \Delta^r_t\right]^{-1}_{j,\cdot} s_t + \omega_{jt}$$

  where $x_{jt}\gamma + \omega_{jt} = c^w_{jt} + c^r_{jt}$, and $\tilde{\Theta} = \left\{\tilde{\lambda}_w, \tilde{\lambda}_r, \tilde{\Omega}^r, \tilde{\Omega}^w\right\}$ represent alternative vertical conduct assumptions.
- **Identification:** This supply relation corresponds to a non-linear IV problem. To identify $\tilde{\Theta}$, we need valid/relevant instruments.
  - Missing from the paper...
  - What would be a good IV?

Results: Estimated marginal cost

Sample statistics of recovered costs and informal testing

	Recovered retail and wholesale costs				
	Mean	S.D.	Min	Max	Percentage <0
Model 1: Simple linear pricing	0·2730	0·1552	−0·1532	0·5364	1·35
Model 2: Hybrid model	0·2757	0·1681	−0·1541	0·5364	1·45
Model 3.1: Zero wholesale margin	0·3796	0·0907	0·1201	0·6298	0
Model 3.2: Zero retail margin	0·3815	0·0895	0·1302	0·6279	0
Model 4: Wholesale collusion	0·1352	0·1114	−0·4590	0·4409	13·12
Model 5: Retail collusion	0·1530	0·1329	−0·4895	0·5053	12·6
Model 6: Monopolist	0·2953	0·0951	−0·0089	0·5628	0·08

Notes: Recovered costs = p − epcm where p is retail price and epcm are the estimated margins. Last column has the percentage of cases with recovered estimated costs being negative.

Results: Non-Nested Hypothesis Tests

p-Values for pairwise non-nested comparisons

	Alternative models						
H_0 model	1	2	3·1	3·2	4	5	6
1: Simple linear pricing	–	0·50	0·00	0·50	0·24	0·00	0·50
2: Hybrid	0·00	–	0·50	0·50	0·12	0·00	0·50
3.1: Zero wholesale margin	0·41	0·29	–	0·05	0·50	0·39	0·07
3.2: Zero retail margin	0·39	0·40	0·05	–	0·50	0·39	0·17
4: Wholesale collusion	0·49	0·48	0·50	0·50	–	0·48	0·50
5: Retail collusion	0·00	0·00	0·50	0·50	0·22	–	0·50
6: Monopolist	0·34	0·35	0·17	0·31	0·48	0·34	–

- **Takeaway:** The data is consistent with models *without* double marginalization
- **Cause for concerns:** The moment conditions are not able to distinguish between the Monopoly and Bertrand-Nash models...

Bundling and Input Price Negotiations

Reference: Crawford and Yurukoglu (2012)

- An important policy question in media market is wether or not we should allow firms to bundle products
  - Case study: A la carte *vs* bundling in the distribution of TV channels.
- **Example:** Indirect price discrimination between two types of consumers
  - Distribution of willingness-to-pay:

	Fraction	HBO	ESPN	Bundle
Type A	1/2	10	3	13
Type B	1/2	4	11	15
Average		7	7	14

  - Monopoly prices (assume $mc = 0$):
    - ★ HBO: $p^M = 10$ (why?)
    - ★ ESPN: $p^M = 11$ (why?)
    - ★ Bundle: $p^M = 13$ (why?)
  - **General rule:** When tastes are not too positively correlated, a monopolist would prefer to offer only a bundle.

What if upstream firms have positive bargaining power?

- The previous example assumes that the downstream monopolist can make a take-it-or-leave-it offer to HBO and ESPN (and $MC = 0$).
- Timing:
  1. Distributor simultaneously negotiate with HBO and ESPN over cost
  2. Distributor sets prices and decide to bundle or not
  3. Demand and profits are realized
- In the two-types example, bargaining is purely about how to split the surplus (i.e. p^m is independent of w_j)
- "Nash-in-Nash" multi-lateral bargaining over the bundle (Horn and Wollinsky (1988)):
  - Nash bargaining fixing w_{-j}

$$\max_{w_j} \left((p^m - w_j - w_{-j}) \times D\right)^{\beta} \left(D \times (w_j - 0)\right)^{1-\beta}$$

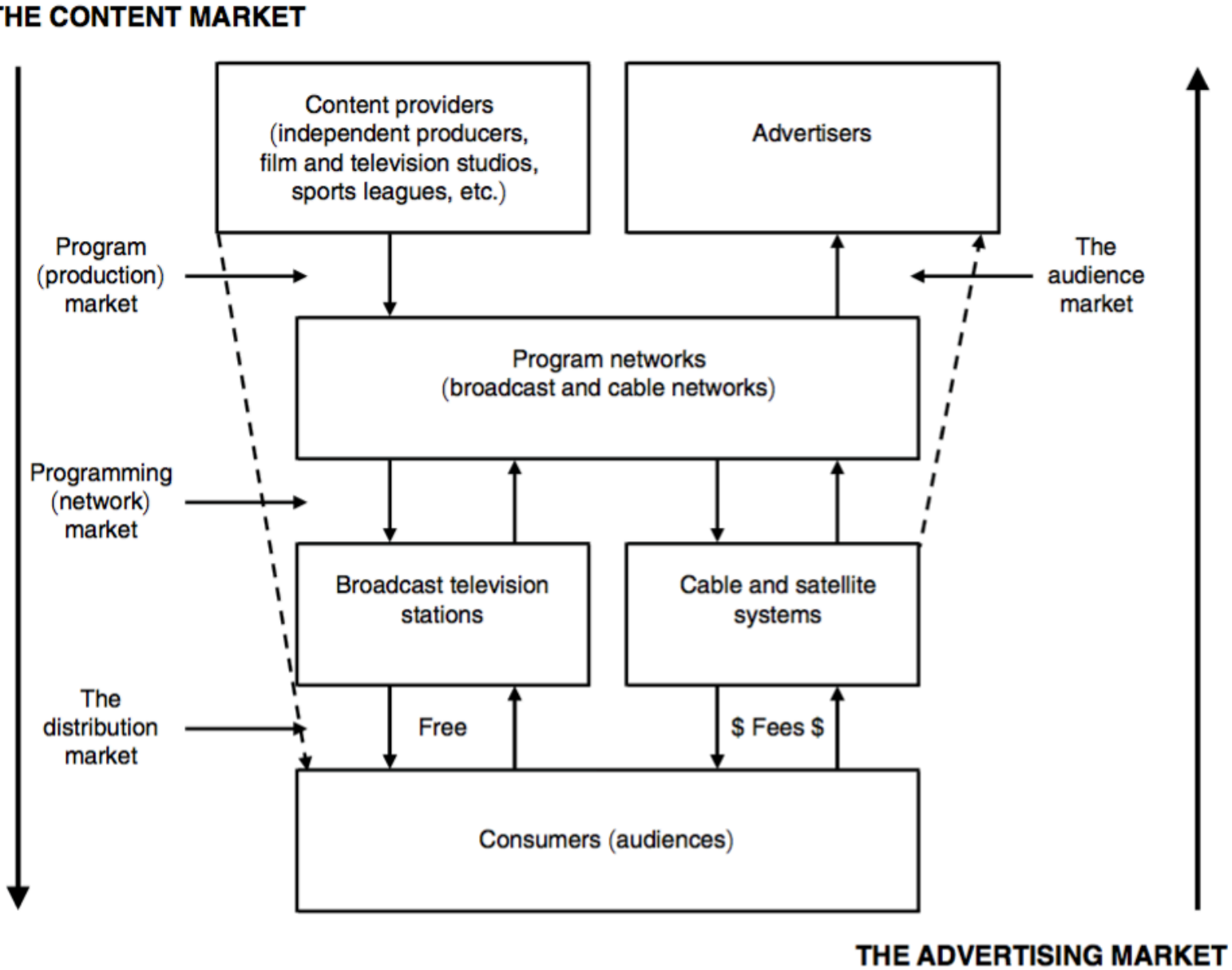
$$\leftrightarrow w_j = (1-\beta)p^m - (1-\beta)w_{-j}$$

  - Simultaneous Nash equilibrium (symmetric): $w_j = w_{-j} = p^m \frac{(1-\beta)}{2+\beta}$

What if upstream firms have positive bargaining power?

- In this example, if upstream firms have sufficient bargaining power (i.e. low β), bundling is no longer the most profitable option.
- The results crucially depend on: (i) heterogeneity and correlation in taste, and (ii) profitability the partial versus full coverage (i.e. outside option).

The TV Industry Supply Chain



Bundling and Input Prices in TV Markets

- Market structure:
  - Cable distributors typically offer multiple tiers bundles
  - Content providers control multiple TV channels (e.g. Disney, Time Warner, etc)
  - Input prices vary across distributors (f) and channels (c): τ_{fc}
- Structure of the problem:
  - Stage 1: Estimation of the distribution of WTP for channels
  - Stage 2: Optimal bundle composition and bundling cost
  - Stage 3: Estimation of bargaining parameter
- Main data-sets:
  - **Factbook:** Local cable market-level data on the composition of bundles, prices, market shares, ownership.
  - **Economics of basic cable networks:** Channel-level data on cost and revenue (τ's).
  - **Viewership:** Channel ratings per DMA/period + household survey on hours spent per channel

Estimation of the distribution of WTP for channels

- Indirect utility for bundle j:

$$\begin{aligned} u_{ijm} &= \underbrace{\sum_{c \in C_j} \gamma_{ic} \log(1 + t^*_{ijc})}_{v^*_{ijm}} + x_{jm}\gamma + \alpha_i p_{jm} + \xi_{jm} + \epsilon_{ijm} \\ &= \delta_{jm} + \mu_{ijm} + \epsilon_{ijm} \end{aligned}$$

- Time allocation:

$$t^*_i = \arg\max_{\{t_{ic}\}} \sum_{c \in C_j} \gamma_{ic} \log(1 + t_{ic}), \quad s.t. \sum_c t_{ic} < T$$

- Parametrization of channel tastes:

$$\gamma_{ic} = \begin{cases} 0 & \text{With probability: } \rho_c(z_i) \\ z_i\beta + \nu_{ic} & \text{With probability: } 1 - \rho_c(z_i) \end{cases}$$

where $\nu_i = (\nu_{i1}, \ldots, \nu_{iC}) \sim Exp(V, \Sigma)$.

Estimation of the distribution of WTP for channels

- Aggregate demand takes the standard mixed-logit form:

$$\sigma_{jm}(\delta_m, F_m; \theta) = \int \frac{\exp(\delta_{jm} + \mu_{ijm}(z_i, \nu_i)}{1 + \sum_k \exp(\delta_{km} + \mu_{ikm}(z_i, \nu_i)} d\Phi(\nu_i; V, \Sigma) dF_m(z_i)$$

- The parameters of the model are estimated by matching viewership and market shares data
  - Shares of consumers with positive viewership for channel c (given z_i)
  - Average time spent watching channel c (given z_i)
  - Covariance between ratings of channel c and z_i
  - Conditional market shares of cable and satellite (given z_i)
  - etc.
- This is similar to Bayer, Ferreira, and McMillan (2007). The key difference is that we use *usage intensity* measure from surveys to identify the distribution of tastes (rather than observed choices).

Estimation of Channel Input Costs

- **Challenges:**
  - The data only contains information on **average** channel input costs across distributors: $\bar{\tau}_c = E(\tau_{fc})$.
  - Since channels are only sold through **bundles**, the price that distributer f charges for each bundle does not reveal the cost of individual channels (only the marginal cost of the bundle)
- **Solution:** Parametrize input cost function as,

$$\tau_{fc} = (\eta_1 + \eta_2 \bar{\tau}_c) \exp(\phi_1 \text{Nb. Subscribers}_f + \phi_2 \text{Ownership Share}_{fc})$$

- **Equilibrium restriction:** Bundle prices

$$\frac{\partial \Pi_{fm}(b_m, p_m, \tau)}{\partial p_{jm}} = \sum_{j \in B_{fm}} \left(p_{jm} - \sum_{c \in C_{jm}} \tau_{fc} \right) \frac{\partial \sigma_{jm}(p_m)}{\partial p_{km}} + \sigma_{km}(p_m) = 0$$

$$MC_{jm}(p_m) = \sum_{c \in C_j} \tau_{fc} = -(\Delta \times \Omega)^{-1}_{j,\cdot} \sigma_m$$

Estimation of Channel Input Costs (continued)

- **Equilibrium restriction:** Bundle composition
  - Value of offering bundle b_{fm} in market m:

$$V_{fm}(b_{fm}, b_{-fm}, \tau) = \Pi_{fm}\left((b_{fm}, b_{-fm}), (p_{fm}, p_{-fm}), \tau\right) + \text{Error}_{b,fm}$$

  - If bundles and prices are chosen simultaneously, Nash-eqlb. implies:

$$V_{fm}(b_{fm}, b_{-fm}, \tau) > V_{fm}(b'_{fm}, b_{-fm}, \tau) \leftrightarrow$$

$$\underbrace{\Pi_{fm}\left((b_{fm}, b_{-fm}), (p_{fm}, p_{-fm}), \tau\right) - \Pi_{fm}\left((b'_{fm}, b_{-fm}), (p'_{fm}, p_{-fm}), \tau\right)}_{=\Delta\Pi_{fm}(b,b')} > \text{Error}_{bb',fm}$$

  - **Assumption:** Mean zero error expressed in deviation

$$E(\text{Error}_{bb',fm} + \text{Error}_{b'b,fm'}) = 0$$

  - This implies the following moment inequality (see Pakes et al. (2006)):

$$E(\Delta\Pi_{fm}(b, b', \tau) + \Delta\Pi_{fm'}(b', b, \tau)) \geq 0, \text{ if } \tau_{fc} = \tau^0_{fc}, \forall(f, c).$$

Estimation of Channel Input Costs (continued)

- In practice the input cost parameters, (η, ϕ), are estimated by combining four moment conditions:

$$\frac{1}{C}\sum_{c} E_f(\tau_{fc}(\eta,\phi) - \bar{\tau}_c) \approx 0$$

$$\frac{1}{M}\frac{1}{J}\sum_{j,m} \text{Nb. Subscribers}_{fm}\left(MC_{jm}(p_m) - \sum_{c\in C_{jm}} \tau_{fc}(\eta,\phi)\right) \approx 0$$

$$\frac{1}{M}\frac{1}{J}\sum_{j,m} \text{Ownership Share}_{fm}\left(MC_{jm}(p_m) - \sum_{c\in C_{jm}} \tau_{fc}(\eta,\phi)\right) \approx 0$$

$$\frac{1}{M}\frac{1}{F}\sum_{j,m} \min\left\{0, \frac{1}{J}\sum_{j}\left(\Delta\Pi_{fm}(b,b';\eta,\phi) + \Delta\Pi_{fm'}(b',b;\eta,\phi)\right)\right\} \approx 0$$

- This gives us estimated input costs: $\hat{\tau}_{fc} = \tau_{fc}\left(\hat{\eta}, \hat{\phi}\right)$.

Estimation of the Bargaining Parameter(s)

- **Question:** Are the estimated input costs consistent with buyer or seller bargaining power?
- Consider a distributer, f, present in only one market, negotiating with a conglomerate, k, of channels (e.g. ABC/Disney)
- Holding fixed the input cost negotiated with other distributers/conglomerates, the vector τ_{fk} is a solution to the following Nash-Bargaining problem:

$$\max_{\tau_{fk}} \quad (\Pi_f(\tau_{fk}, \tau_{f,-k}) - \Pi_f(\infty, \tau_{f,-k}))^{\xi_{fk}} \\ (\Pi_k(\tau_{fk}, \tau_{-f,k}) - \Pi_k(\infty, \tau_{-f,k}))^{1-\xi_{fk}}$$

- **Threat points:** $\Pi_f(\infty, \tau_{f,-k})$ is the profit of distributer f without the channels offered by k, and $\Pi_k(\infty, \tau_{-f,k})$ is the conglomerate's profits if cannot distribute its channels to firm f.

Estimation of the Bargaining Parameter(s)

- Since we have estimated all the τ_{fc}'s, the disagreement payoffs (or threat points) can be calculated from the data.
- If the τ_{fc}'s are generated in equilibrium they must satisfy the following FOC:

$$\frac{\xi_{fk}}{\Pi_f - \Pi_f^{-k}} \frac{\partial \Pi_f}{\partial \tau_{fc}} = \frac{1 - \xi_{fk}}{\Pi_k - \Pi_k^{-f}} \frac{\partial \Pi_k}{\partial \tau_{fc}}, \quad \forall c \in C_k$$

- The bargaining weight parameters can therefore be estimated by finding the value of ξ_{fk} that minimizes the sum of square residual between $\hat{\tau}_{fc}$ and $\tau_{fc}(\xi)$.
  - **Note:** Alternatively, there should be a way of inverting the above FOC to recover an estimate of ξ_{fk}. See Grennan (2013).
- In practice, the paper "solves" each bargaining game independently (holding fixed τ_{-f}), and finds the $\hat{\xi}_{fk}$ that fits the data best.
  - This implies solving a simplified version of the downstream game for alternative values of τ_{fc}'s.
  - What about bundle composition?

Estimation of the Bargaining Parameter(s)

- **Questions:**
  - The bargaining parameters are the "residuals" that rationalize the estimated τ_{fc}'s, given the functional form assumption for $\tau_{fc}(\eta, \phi)$ and the assumption of firms' threat points.
  - What do we know about the dispersion of τ_{fc} in practice? What about firms' threat points (i.e. leverage)? What if negotiation was sequential?
  - This is an important area of research.

Estimated distribution of channel WTPs

Channel	Mean WTP	SD WTP	Share positive	Mean WTP family HH	Mean WTP black HH	Highest correlated channel
ABC Family Channel	1.59	2.24	0.49	1.68	1.80	TV Land
AMC	1.40	1.59	0.51	1.15	1.83	MSNBC
Animal Planet	2.05	3.02	0.58	2.08	1.81	National Geographic Channel
Arts & Entertainment	2.10	2.63	0.58	1.90	2.23	History Channel
BET Networks	1.27	2.74	0.34	1.34	4.54	MTV2
Bravo	0.65	0.67	0.61	0.63	0.76	ESPN
Cartoon Network	2.06	4.01	0.49	2.27	2.54	Nickelodeon
CNBC	2.02	2.97	0.55	1.84	2.01	CNN
CNN	5.38	5.91	0.68	4.94	8.30	Fox News Channel
Comedy Central	1.51	2.39	0.61	1.52	1.34	MTV
Country Music TV	0.89	1.56	0.57	0.89	0.79	Food Network
Court TV	1.76	3.11	0.50	1.79	2.23	Arts & Entertainment
Discovery Channel	2.70	2.99	0.65	2.55	2.67	Animal Planet
Disney Channel	1.43	2.51	0.65	1.52	1.72	Nickelodeon
E! Entertainment Television	1.15	1.69	0.62	1.16	1.10	VH1
ESPN	3.08	4.46	0.64	2.86	3.63	ESPN 2
ESPN 2	1.80	3.12	0.62	1.75	2.02	ESPN
Food Network	2.06	3.25	0.71	2.08	2.18	TV Guide Channel
Fox News Channel	4.07	5.89	0.60	4.10	4.69	CNN
Fox Sports Net	1.63	2.82	0.55	1.58	1.55	ESPN 2
FX	1.45	2.59	0.51	1.47	1.41	USA Network
GSN	0.74	2.97	0.08	0.83	1.51	ESPN 2
Golf Channel	0.52	1.86	0.12	0.38	0.68	CNN
Hallmark Channel	1.43	3.96	0.16	1.47	2.09	Country Music TV
HGTV	2.60	4.67	0.42	2.59	3.02	Food Network
History Channel	2.70	4.06	0.40	2.53	3.09	Arts & Entertainment
Lifetime	2.25	3.73	0.31	2.46	5.57	AMC
MSNBC	1.69	3.23	0.29	1.38	2.61	AMC
MTV	1.22	2.28	0.59	1.25	1.36	VH1
MTV2	0.71	1.23	0.52	0.79	0.63	VH1
National Geographic Channel	1.03	1.60	0.69	1.04	0.92	Animal Planet
Nickelodeon	1.31	2.55	0.50	1.45	1.35	Disney Channel
Oxygen	0.41	0.44	0.60	0.49	0.64	Disney Channel
Syfy	1.74	2.97	0.54	1.74	1.82	USA Network
SoapNet	0.49	1.04	0.42	0.52	0.58	TBS Superstation
Speed Channel	0.33	0.41	0.56	0.41	0.19	Versus
Spike TV	1.18	2.00	0.57	1.18	1.07	The Weather Channel
TBS Superstation	2.05	2.85	0.69	1.98	2.23	TNT
The Weather Channel	1.71	1.83	0.70	1.59	1.66	Spike TV
TLC	1.82	2.81	0.61	1.84	1.57	Discovery Channel
TNT	2.36	3.10	0.72	2.31	2.54	USA Network
Toon Disney	0.44	1.69	0.13	0.57	0.90	Cartoon Network
Travel Channel	0.76	2.27	0.15	0.80	0.74	Nickelodeon
TV Guide Channel	0.50	0.75	0.57	0.54	0.60	Food Network
TV Land	2.06	3.40	0.59	2.11	2.45	ABC Family Channel
USA Network	2.12	3.19	0.51	2.19	2.62	TNT
Versus	0.23	0.31	0.49	0.28	0.21	Speed Channel
VH1	0.74	1.28	0.56	0.75	0.90	MTV2
WE: Women's Entertainment	0.45	0.69	0.50	0.49	0.53	National Geographic Channel

Estimated input cost function

$\tau_{fc} = (\eta_1 + \eta_2 \bar{\tau}_c) \exp(\phi_1 \text{Nb. Subscribers}_f + \phi_2 \text{Ownership Share}_{fc})$

	All moments		No bundling moments	
Parameter	Estimate	Standard error	Estimate	Standard error
Constant	0.16	0.00	0.20	0.00
Kagan scale	0.91	0.00	0.93	0.00
MSO size	−0.08	0.00	−0.10	0.00
Vertical integration dummy	−0.14	0.01	−0.16	0.01

Notes: This table reports the impact of various factors on our estimated input costs. Kagan scale refers to the input cost for that channel as estimated by Kagan World Media (2008). Distributor (MSO) size is measured in tens of millions of households. Vertical integration is the share of the channel owned by that distributor (between 0 and 1).

- Is this a good model of vertical integration?

Estimated bargaining parameters for large conglomerates

Conglomerate	Big cable	Small cable	DirecTV	Dish Network
ABC Disney	0.28	0.25	0.18	0.17
Viacom	0.49	0.48	0.54	0.53
NBC Universal	0.50	0.49	0.52	0.51
Comcast (Content Division)	0.69	0.68	0.67	0.66
Scripps	0.55	0.55	0.58	0.58
News Corporation	0.42	0.39	0.34	0.32
Rainbow Media	0.70	0.69	0.68	0.67
Discovery Networks	0.62	0.61	0.63	0.63
Time Warner	0.40	0.38	0.38	0.37
Hallmark	0.69	0.69	0.71	0.71
Lifetime	0.43	0.43	0.43	0.43
Oxygen	0.73	0.72	0.71	0.70
Weather Channel	0.69	0.69	0.69	0.69
TV Guide	0.77	0.77	0.76	0.76

Counter-Factual Simulation Results: ALC vs Bundling

	Bundling	ALC no reneg	Percent change	ALC with reneg	Percent change
Nonwelfare outcomes					
Cable & sat penetration	0.880	0.998	13.3	0.993	12.8
Total affiliate fees	$18.22	$18.22	0.0	$36.98	103.0
Mean consumer expn	$27.63	$21.07	−23.8	$28.24	2.2
Number channels received	42.8	22.0	−48.5	19.3	−54.9
Number channels watched	22.2	22.0	−0.5	19.3	−12.8
Welfare outcomes					
Channel profits					
Total license fee rev	$16.03	$7.95	-50.4	$15.44	−3.7
Total advertising rev	$13.38	$14.71	10.0	$14.73	10.1
Total channel revenue	$29.41	$22.67	−22.9	$30.16	2.6
Distributor profits	$11.59	$13.11	13.1	$12.81	10.4
Total industry profits	$41.00	$35.78	−12.7	$42.97	4.8
Mean consumers surplus	$45.82	$54.59	19.2	$45.91	0.2
Total surplus	$86.82	$90.37	4.1	$88.88	2.4

Notes: This table reports the results of our baseline counterfactual simulations of full à la carte (ALC) pricing policies on prices and welfare. The economic environment consists of one large and one small cable market (served by one large and one small cable operator) and two "national" satellite providers, each offering access to their platform and approximately 50 cable channels. In the bundling equilibria reported in column one, each firm competes by pricing a single bundle of channels. In both ALC equilibria, each firm competes by setting a fixed fee and then separate prices for each offered channel. Columns two and three report results for ALC *without* allowing input-market renegotiation (i.e., with input costs at their values in the bundling equilibrium); columns four and five allow renegotiation. In the renegotiation equilibrium, we impose that downstream prices equal the renegotiated input costs. See footnote 39 in the text for details. Average outcomes (e.g., Total Affilate Fees, Number of Channels) are weighted across distributors according to their estimated market shares. Dollar values are 2000 dollars per US television household per month.

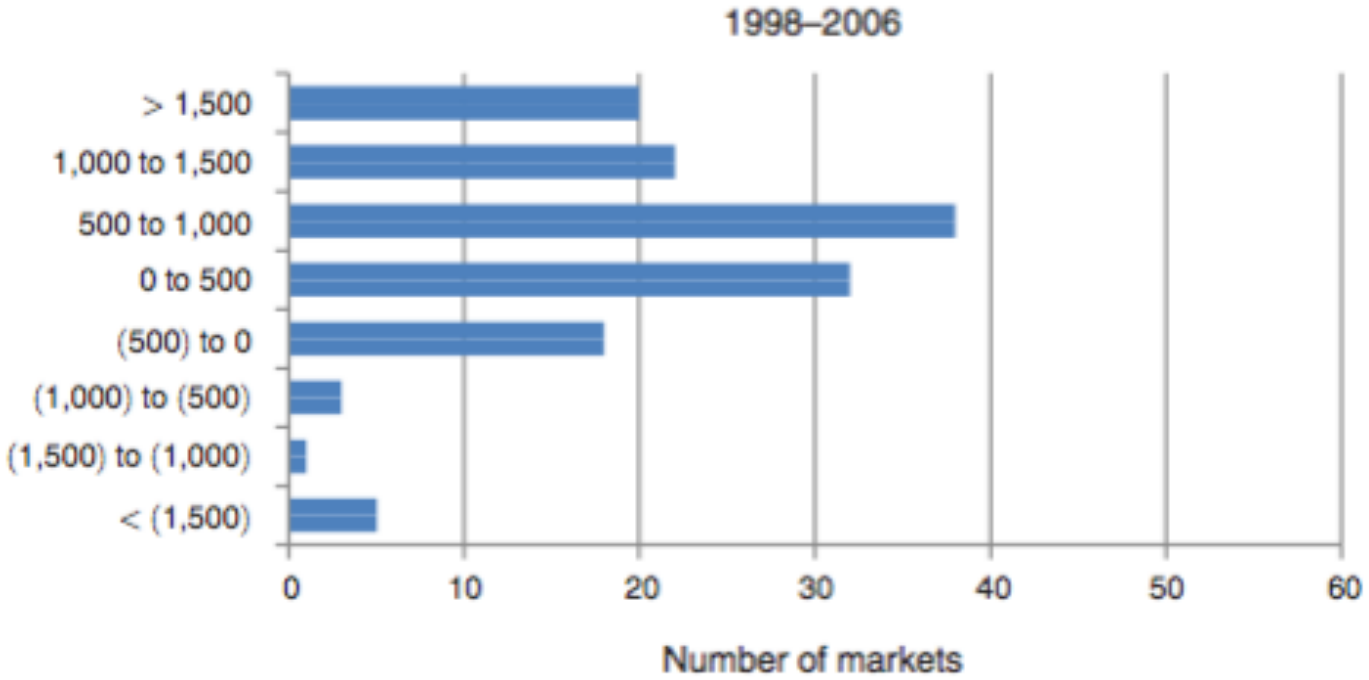
What is the effect of upstream mergers?

Reference: Gowrisankaran, Nevo, and Town (2015)

- So far we have studied mergers in markets in which buyers are **price-takers**
  - Workhorse model: Multi-product Bertrand-Nash equilibrium
- This framework is not appropriate to study mergers between **oligopolists**
  - If buyers have full bargaining power, upstream mergers will have zero effect on prices
  - If sellers have full bargaining power, downstream mergers will have zero effect of prices.
- Mergers in health-care markets:
  - The hospital industry is responsible for the largest number of horizontal merger litigation by federal agencies (first success in 2011!)
  - At the same time, private health insurance markets have become increasing concentrated (Dafny et al. (2012))

Fact 1: Insurance Concentration and Premiums

Reference: Dafny et al. (2012)



	Dep var = lagged HHI	Dep var = annual change in ln(premium)		
	First-stage estimates	Reduced-form estimates	IV estimates	OLS estimates
Sim Δ *HHI* × (year >= 2001)	0.475***	0.186***		
	(0.014)	(0.050)		
Lagged HHI			0.391***	0.015
			(0.130)	(0.018)

Fact 2: Dispersion of Discounts and Buyer Power

Reference: Sorensen (2003)

	Distribution by year:					
		Discount Quantiles				
Year	Number of Agreements	.10	.25	.50	.75	.90
1995	609	.018	.030	.037	.168	.352
1996	714	.025	.030	.100	.257	.379
1997	711	.030	.049	.159	.336	.459
1998	706	.030	.060	.164	.355	.477

	Distribution by payer type:					
			Weighted	Discount Quantiles		
Type	Number	Mean	Mean[a]	.10	.50	.90
Indemnity	30	.089	.152	.018	.034	.252
HMO	26	.283	.310	.068	.291	.478
PPO	40	.141	.157	.030	.100	.323
Employer	16	.122	.186	.020	.035	.357
TPA	38	.123	.094	.020	.073	.306
Overall	150	.167	.233	.025	.106	.406

[a]Weighted by total revenues upon which discount is based.

Model: Bargaining Between Hospitals and MCOs

- Market structure:
  - J hospitals and M managed-car organizations (MCOs).
  - MCOs offer their enrollees access to a network of hospitals: $\mathcal{N}_m$ (fixed).
- Objectives:
  - **MCO:** Maximize the weighted sum of consumer surplus of its enrollees net of payments to hospitals (p_{mj}).

$$V_m(\mathcal{N}_m, p_m) = E\left[\tau CS_i(\mathcal{N}_m, p_m) - \sum_{j \in \mathcal{N}_m} (1 - c_i) f_i p_{mj} \sigma_{ij} \middle| m(i) = m\right]$$

    where τ is welfare weight, CS_i is the surplus of consumer i (in \$), f_i is the probability being sick, and c_i is the copay % (fixed).
  - **Hospitals:** Maximize expected profits

$$\Pi_{sm}(\mathcal{N}_m, p_m) = \sum_{j \in \mathcal{J}_s} q_{mj}(\mathcal{N}_m, p_m)(p_{mj} - mc_{mj})$$

    where q_{mj} is the number of patients "send" from MCO m to hospital j, p_{mj} is the hospital cost charged to MCO m, and mc_{mj} is the marginal cost of serving patients from MCO m.

Model: Bargaining Between Hospitals and MCOs

- **Assumption:** Constant marginal cost

$$mc_{mj} = v_{mj}\gamma + \omega_{mj}$$

where v_{mj} is a vector of hospital and MCO characteristics, and ω_{mj} is an unobserved relation-specific cost shock.

- **Threat points:**
  - **MCO:** If negotiation fails, insurees do not have access to the hospital in network $\mathcal{N}_s$

$$V_m(\mathcal{N}_m \backslash \mathcal{J}_s, p_m) = E\left[\tau CS_i(\mathcal{N}_m \backslash \mathcal{J}_s, p_m) - \sum_{j \in \mathcal{N}_m \backslash \mathcal{J}_s} (1 - c_i) f_i p_{mj} \sigma_{ij} \middle| m(i) = m\right]$$

  - **Hospitals:** Because of the constant marginal cost assumption, the disagreement profits are *zero*

Model: Bargaining Between Hospitals and MCOs

- *Nash-in-Nash* bargaining:
  - Hold fixed the negotiated prices with other networks: $\{p_{mj}\}_{j \notin \mathcal{J}_s}$.
  - Input prices solve the following Nash-Bargaining problem:

$$\max_{p_{mj}: j \in \mathcal{J}_s} \left[V_m(\mathcal{N}_m, p_m) - V_m(\mathcal{N}_m \backslash \mathcal{J}_s, p_m)\right]^{b_{ms}} \left[\Pi_{sm}(\mathcal{N}_m, p_m)\right]^{1-b_{ms}}$$

  - Nash equilibrium conditions conditions:

$$\frac{-b_{ms}}{V_m(\mathcal{N}_m, p_m) - V_m(\mathcal{N}_m \backslash \mathcal{J}_s, p_m)} \frac{\partial V_m(\mathcal{N}_m, p_m)}{\partial p_{mj}} = \frac{(1 - b_{ms})}{\Pi_{sm}(\mathcal{N}_m, p_m)} \frac{\partial \Pi_{sm}(\mathcal{N}_m, p_m)}{\partial p_{mj}}$$

    for all $j \in \mathcal{N}_s$, s and m bilateral negotiation pairs.
- **Note:** If $b_{ms} = 0$, $\frac{\partial \Pi_{sm}(\mathcal{N}_m, p_m)}{\partial p_{ms}} = 0$ (i.e. Bertrand-Nash condition).

Inferring Marginal Cost From Input Prices

- **Recall:** $\frac{\partial \Pi_{sm}(\mathcal{N}_m, p_m)}{\partial p_{mj}} = q_{mj} + \sum_{k \in \mathcal{N}_s} \frac{\partial q_{mk}}{\partial p_{mj}} (p_{mk} - mc_{mk})$
- Rearranging the NB FOC:

$$\underbrace{\frac{-b_{ms}}{V_m(\mathcal{N}_m, p_m) - V_m(\mathcal{N}_m \setminus \mathcal{J}_s, p_m)} \frac{\partial V_m(\mathcal{N}_m, p_m)}{\partial p_{mj}}}_{= -b_{ms} \frac{A}{B}} = \frac{(1 - b_{ms})}{\Pi_{sm}(\mathcal{N}_m, p_m)} \frac{\partial \Pi_{sm}(\mathcal{N}_m, p_m)}{\partial p_{mj}}$$

$$\leftrightarrow q + \Omega(p - mc) = -\Delta(p - mc) \leftrightarrow p - mc = -(\Omega + \Delta)^{-1} q$$

where q is $|\mathcal{N}_s| \times 1$ vector, $\Omega_{j,k} = \partial q_{mk} / \partial p_{mj}$, and $\Delta_{j,k} = (b_{ms}/(1 - b_{ms}))(A/B) q_{mk}$.

- Therefore, conditional on b_{ms}, the marginal cost of pair (m, s) can be inferred from observed input prices and quantities.
- This is different from Crawford and Yurukoglu (2012): Marginal cost of channels were assumed to be zero, and the bargaining weights were the model "residuals".

How the bargaining leverage of both parties affect prices?

- **Buyer leverage:** $\frac{A}{B} = \frac{\frac{\partial V_{ms}}{\partial p_{mj}}}{V_{ms} - V_{ms}^{-}}$
  - The bargaining leverage of the MCOs is determined by their ability of "steering" patients away from high-cost hospital, due to the co-pay (numerator)
  - The effect of loosing hospital network $\mathcal{N}_s$ on consumer welfare (denominator)
  - If consumers are not sensitive to prices (and/or $\tau = 0$), hospitals will be able to charge higher costs (everything else being equal)
- **Seller leverage:** $\frac{\partial \Pi_{sm}/\partial p_{mj}}{\Pi_{sm}}$
  - Because hospitals have constant MC, size does not directly affect their leverage.
  - Hospitals with larger networks have more leverage:
    - ★ Standard business stealing effect: $\partial \Pi_{sm}/\partial p_{mj}$
    - ★ Lowers the leverage of MCOs: Large welfare loss $V_{ms} - V_{ms}^{-}$
- **Upstream mergers:** Standard business-stealing internalization + Relative bargaining leverage change.

Estimation: Demand and Consumer Surplus

- Hospital choice: Consumer with hospital netowork $\mathcal{N}_{m(i)}$
  - Conditional of a realized illness $d \in \{1, \ldots, D\}$:

$$\max_{j \in \mathcal{N}_{m(i)}} x_{ijd}\beta - \alpha c_{id} w_d p_{m(i),j} + \epsilon_{ijd}$$

    where c_{id} is co-payment, and w_d is a disease weight.
  - The base price, p_{mj}, is the outcome of the negotiation between the MCO and hospital network.
- Aggregate demand from MCO m:

$$q_{md} = \sum_i 1(m(i) = m) \sum_d f_{id} \frac{\exp(x_{ijd}\beta - \alpha c_{id} w_d p_{m(i),j})}{\sum_{k \in \mathcal{N}_{m(i)}} \exp(x_{ikd}\beta - \alpha c_{id} w_d p_{m(i),k})}$$

- Expected utility:

$$W_i(\mathcal{N}_m, p_m) = \sum_d f_{id} \ln \left(\sum_{k \in \mathcal{N}_{m(i)}} \exp(x_{ikd}\beta - \alpha c_{id} w_d p_{m(i),k}) \right)$$

From this, we can compute consumers' WTP for hospital network $\mathcal{J}_s$:

$$WTP_{ims} = W_i(\mathcal{N}_m, p_m) - W_i(\mathcal{N}_m \backslash \mathcal{J}_s, p_m)$$

Estimation: Demand and Consumer Surplus

- **Data source:**
  - **Payor data:** Administrative claims data for four MCOs in Virgnia
  - **Discharge data:** Virginia health information
- **Price:** $c_m p_{mj}$
  - Regression of the disease weighted amount paid to hospital j separately for each MCO and year:

$$\text{TP}_{ijt}/w_d = \mu_j + z_i\gamma + e_{ijt}$$

  - Base price = Average predicted payment
  - Similar regression is used to calculate expected co-insurance rate (%)
- Additional control variables:
  - Hosptial/Year FE
  - Distance between individuals and hospitals
- **Estimation:** MLE of observed hospital choices conditional on illness
  - Identification: Exogenous variation in prices due to negotiated prices and coinsurance (across payors)

Demand Elasticity

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)

Estimation: Marginal Cost and Bargaining Power

- The bargaining model implies the following pricing equation:

$$p_{ms} = mc_{ms} - (\Omega_{ms} + \Delta_{ms})^{-1} q_{ms}$$

where q is $|\mathcal{N}_s| \times 1$ vector, $\Omega_{j,k} = \partial q_{mk}/\partial p_{mj}$, and $\Delta_{j,k} = (b_{ms}/(1 - b_{ms}))(A/B)q_{mk}$.

- This leads to a non-linear IV regression (just like BLP):

$$p_{mj} = v_{mj}\gamma + g(q_{ms}, p_{ms}; b, \tau) + \omega_{mj}$$

where v_{mj} includes MCO, year and hospital FEs.

- **Identification:**
  - Conditional of hospital and MCO FEs, the IVs must shift the relative leverage within hospital networks or within MCOs.
  - Z_{mj}: Predicted WTP and quantity evaluated at the average prices.

Marginal Cost and Bargaining Power 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.

Merger Simulation

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.

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