Crawford, Lee, Whinston, Yurukoglou

C.Conlon

Fall 2022

Grad IO

Overview

- This paper asks how vertical integration changes the incentives for downstream firms to raise the price of upstream inputs to its downstream rivals.
- The vertically integrated firm may raise rivals costs or it may fully foreclose its rival from acquiring the input.
- Vertical integration may be good for efficiency reasons, but bad if foreclosure effects are large.
- This approach builds on a literature using Nash Bargaining solutions to determine how to allocate surplus among upstream and downstream firms.

Crawford, Lee, Whinston, Yurukoglou (ECMA 2018)

- Household i in market m and period t subscribes to MVPD $f \in \mathcal{F}_{mt}$.
- Spends time w_{ifct} watching channel c or non TV activities $c = 0$ choice is the vector $\mathbf{w}_{ift}$.

$$\max_{\mathbf{w}_{ift}} v_{ift}(\mathbf{w}_{ift}) = \sum_{c \in \mathcal{B}_{fmt} \cup \{0\}} \frac{\gamma_{ict}}{1-\nu_c} (w_{ift})^{1-\nu_c}$$

$$\text{s.t. : } w_{ifct} \geq 0 \quad \forall c \quad \text{ and } \sum_{c \in \mathcal{B}_{fmt} \cup \{0\}} w_{ifct} \leq T$$

- γ_{ict}: marginal value for first unit of watching TV channel
  - γ_{ict} with probability ρ_c^0 takes on $\gamma_{ict} \sim Exp(\rho_c^1)$ and zero otherwise.
- $\nu_c \in \{\nu^S, \nu^{NS}\}$: decay parameter (allow for different decay for sports and non-sports channels).
- Paper is about the value of Regional Sports Networks (RSNs). Probably high (γ, ν).
- Law and Order re-runs Probably low (γ, ν).

MVPD Demand

We can now calculate demand for MVPD service:

$$u_{ift} = \beta^{v} v^{*}_{ift} + \beta^{x} x_{ft} + \beta^{sat}_{if} + \alpha p_{ft} + \xi_{ft} + \epsilon_{ift}$$

- v^{*}_{jft} is viewership utility from bundle of channels on previous slide.
- p_{ft} is monthly (tax inclusive) price.
- x_{ft} firm-state and year dummies
- $\beta^{sat}_{i} \sim Exp(\rho^{sat}_{f})$ for satellite providers.
- Demand is logit with random coefficients for (β, γ).
- Marketsize is # of TV households.

Supply/ Bargaining

1. MVPDs and content providers negotiate over a per subscriber fee τ_{fct} paid by distributor f to channel c: vector form τ_t.
2. Simultaneously: each distributor chooses prices and channel composition of its bundle in all markets where it operates.
3. $\{\mathbf{p}_{mt}, \mathcal{B}_{mt}, \tau_t, \mu\}$ are jointly optimal w.r.t one another.

MVPD Payoffs

$$\Pi^M_{ft}(\mathcal{B}_{mt}, p_{mt}, \tau_t, \mu) = D_{fmt} \times (p^{pre-tax}_{fmt} - mc_{fmt}) +$$
$$\mu \times \left(\sum_{g \in \mathcal{F}_{mt}} \sum_{c \in \mathcal{B}_{gmt}} O_{fct} \times D_{gmt} \times (\tau_{gmt} + a_{ct}) \right)$$

- D_{fmt} is consumer demand from previous slide
- τ is per subscriber fee and a_{ct} is advertising revenue (to MVPD).
- $O_{fct} \in [0, 1]$ measures the share of c that is owned by f at time t.
  - SNY (Mets) is owned 8% by Comcast and 27% by TWC.
- μ is internalization parameter. A fully rational firm $\mu = 1$ cares about profits of input providers that they own. $\mu = 0$ firm ignores the fact that as TWC pays SNY more they pocket 27% of proceeds.
- mc_{fmt} includes the sum of all τ's in the bundle plus MC of overall service.
- Maximize sum of profits over all markets m. In empirical model τ_{ft} does not depend on m.

FOCs/Optimality

For Prices:

$$\Pi^M_{ft}(\mathcal{B}_{mt}, p_{mt}, \tau_t, \mu) = \frac{s_{fmt}}{1 + tax_{fmt}} \times (p^{pre-tax}_{fmt} - mc_{fmt}) \frac{\partial s_{fmt}}{\partial p_{fmt}} +$$

$$\mu \times \left(\sum_{g \in \mathcal{F}_{mt}} \sum_{c \in \mathcal{B}_{gmt}} O_{fct} \times \frac{\partial s_{gmt}}{\partial p_{fmt}} \times (\tau_{gmt} + a_{ct}) \right) = 0$$

For Carriage:

$$\mathcal{B}_{fmt} = \arg \max_{\mathcal{B}_f \subseteq A_{ft}} \Pi^M_{fmt}(\{\mathcal{B}_f, \mathcal{B}_{-f,mt}\}, p_{mt}, \tau_t, \mu)$$

- In each market you can carry a channel or not, choose among channels you have an agreement with τ:
  - If you carry you pay τ per subscriber but get a in ad revenue.
  - If you don't carry you might lose some subscribers.

Channel Payoffs / Bargaining

$$\Pi^C_{cmt}(\mathcal{B}_{mt}, \boldsymbol{p}_{mt}, \boldsymbol{\tau}_t; \mu) = \sum_{g \in \mathcal{F}_{mt}: c \in \mathcal{B}_{gmt}} D_{gmt} \times \left(\tau_{gct} + a_{ct}\right) \ldots \tag{7}$$
$$+ \mu \sum_{g \in \mathcal{F}_{mt}} D_{gmt} \times \left(O^C_{gct} \times (p^{\text{pre-tax}}_{gmt} - mc_{gmt}) + \sum_{d \in \mathcal{B}_{gmt} \setminus c} O^{CC}_{cdt} \times (\tau_{gdt} + a_{gdt})\right).$$

However, if f and c are not integrated, c's profits in m are:

$$\Pi^C_{cmt}(\mathcal{B}_{mt}, \boldsymbol{p}_{mt}, \boldsymbol{\tau}_t; \mu, \lambda_R) = \sum_{g \in \mathcal{F}_{mt}: c \in \mathcal{B}_{gmt}} D_{gmt} \times \left(\tau_{gct} + a_{ct}\right) \ldots \tag{8}$$
$$+ \mu \sum_{g \in \mathcal{F}_{mt}} D_{gmt} \times \left(\lambda_R \times O^C_{gct} \times (p^{\text{pre-tax}}_{gmt} - mc_{gmt}) + \sum_{d \in \mathcal{B}_{gmt} \setminus c} O^{CC}_{cdt} \times (\tau_{gdt} + a_{gdt})\right).$$

- Same as before μ is internalization of integrated profits
- New parameter λ_R is about raising rivals costs.
- Still get ad revenues but are different for channel and mvpd a_{ct}.

Channel Payoffs / Bargaining

$$\Pi^C_{cmt} = \pi_{cmt} + \mu \times (\pi_{fmt} + \pi_{dmt})$$

(a) Internal Bargaining.

$$\Pi^C_{cmt} = \pi_{cmt} + \mu \times ((\lambda_R \times \pi_{gmt}) + \pi_{dmt})$$

(b) Bargaining with Rival MVPD.

Figure 2: Examples of Π^C_{cmt} when c bargains with MVPD f.

Bargaining

Bargaining. We assume that, given channel c is carried on some of MVPD f's systems, the affiliate fee τ_{fct} between distributor f and channel c maximizes their respective bilateral Nash products *given the expected negotiated affiliate fees of all other pairs and the expected prices and bundles for all distributors.* In other words, affiliate fees $\boldsymbol{\tau}_t$ satisfy:

$$\tau_{fct}(\boldsymbol{\tau}_{-fc,t}, \mathcal{B}_t, \boldsymbol{p}_t) = \arg\max_{\tau_{fct}} \underbrace{\left[\sum_{m \in \mathcal{M}_{fct}} [\Delta_{fc}\Pi^M_{fmt}(\mathcal{B}_{mt}, \boldsymbol{p}_{mt}, \{\tau_{fct}, \boldsymbol{\tau}_{-fc,t}\}; \mu)] \right]}_{GFT^M_{fct}(\tau_{fct},\cdot)}^{\zeta_{fct}} \tag{9}$$

$$\times \underbrace{\left[\sum_{m \in \mathcal{M}_{fct}} [\Delta_{fc}\Pi^C_{cmt}(\mathcal{B}_{mt}, \boldsymbol{p}_{mt}, \{\tau_{fct}, \boldsymbol{\tau}_{-fc,t}\}; \mu, \lambda_R)] \right]}_{GFT^C_{fct}(\tau_{fct},\cdot)}^{1-\zeta_{fct}} \quad \forall f, c \in \mathcal{A}_{ft} \ ,$$

where $\mathcal{M}_{fct} \equiv \{m : c \in \mathcal{B}_{fmt}\}$ denotes the set of markets in which c is carried on f's bundle, $\zeta_{fct} \in [0, 1]$ represents a firm-channel-time specific Nash bargaining parameter, and:

$$[\Delta_{fc}\Pi^M_{fmt}(\mathcal{B}_{mt}, \cdot)] \equiv \left(\Pi^M_{fmt}(\mathcal{B}_{mt}, \cdot) - \Pi^M_{fmt}(\mathcal{B}_{mt} \setminus fc, \cdot) \right) ,$$

$$[\Delta_{fc}\Pi^C_{cmt}(\mathcal{B}_{mt}, \cdot)] \equiv \left(\Pi^C_{cmt}(\mathcal{B}_{mt}, \cdot) - \Pi^C_{cmt}(\mathcal{B}_{mt} \setminus fc, \cdot) \right) ,$$

Bargaining Example

Ignore any vertical integration and think about just the bargaining:

$$\sum_{m\in\mathcal{M}_{fct}} D_{fmt}\tau_{fct} = (1-\zeta_{fct}) \underbrace{\sum_{m\in\mathcal{M}_{fct}} \Big([\Delta_{fc}D_{fmt}](p_{fmt}^{\text{pre-tax}} - mc_{fmt\setminus fc})\Big)}_{GFT^{M}_{fct}(0,\cdot)} \tag{12}$$

$$- (\zeta_{fct}) \underbrace{\sum_{m\in\mathcal{M}_{fct}} \Big(D_{fmt}a_{ct} + \sum_{g\neq f: c\in\mathcal{B}_{gmt}} [\Delta_{fc}D_{gmt}]\big(\tau_{gct} + a_{ct}\big)\Big)}_{GFT^{C}_{fct}(0,\cdot)},$$

where $[\Delta_{fc}D_{gmt}] \equiv D_{gmt}(\mathcal{B}_{mt},\cdot) - D_{gmt}(\mathcal{B}_{mt}\setminus fc,\cdot)$ denotes the change in firm g's demand in market m and time t if channel c was removed from firm f's bundle, and $mc_{fmt\setminus fc} \equiv \sum_{d\in\mathcal{B}_{fmt}\setminus c} \tau_{fdt} + \kappa_{fmt}$.

- Combined gains from trade from both M and C
- Last term is "opportunity cost".
- Estimate two values for $\zeta \in \{\zeta^I, \zeta^E\}$.

Nash in Nash Mechanics

- Bargaining happens simultaneous with carriage and pricing
- What this means is that if τ_{fct} changes then there is no change in p_{fmt}.
  - Criticism is that this limits (but does not eliminate) mechanism for double marginalization (by restricting what happens off the equilibrium path).
  - Sometimes criticized as "schizophrenic": division negotiating τ doesn't talk to local managers deciding $p_{fmt}, \mathcal{B}_{fmt}$.
- This is common in the literature: Grennan on Medical Devices, Ho or Ho and Lee on Hospitals-Insurers, Gowrisankaran, Nevo and Town on Hospitals-Insurers.
- Collard-Wexler, Gowrisankaran and Lee (2017) attempt to micro-found the Nash-in-Nash solution.

Double Marginalization

Assume single channel c fully owned by downstream firm m:

- Given τ firm f sets the cable bundle price $p = \phi(mc_f + (1-\mu)\tau)$.

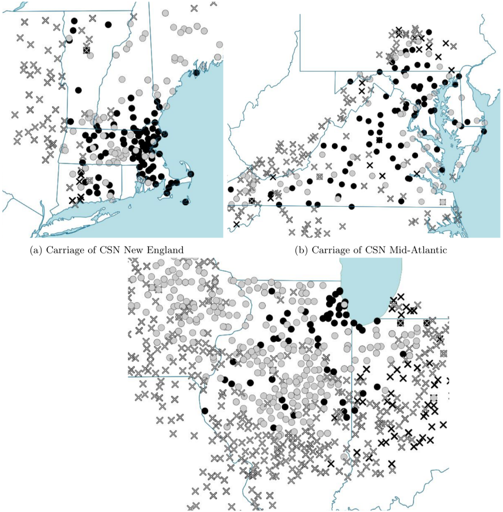
$$\begin{aligned} GFT_c^C(0,\cdot) &= 0 + \mu \times (p - mc_f)D(p) \\ GFT_f^M(0,\cdot) &= \mu \times (p - mc_f)D(p) + \mu \times 0 \end{aligned}$$

- The negotiated affiliate fee is then:

$$(1-\mu) \times D(p) = (1-\zeta)(p - mc_f)D(p) - \zeta\mu \times (p - mc_f)D(p)$$

- Holding p fixed an increase in μ lowers $91-\mu)\tau$ (effective affiliate fee).
- eq price satisfies $p = \phi(mc_f + [(1-\zeta) - \zeta\mu](p - mc_f))$.
- Increasing μ lowers p.

Identification



(a) Carriage of CSN New England

(b) Carriage of CSN Mid-Atlantic

(c) Carriage of CSN Chicago

Figure 4: Carriage by Comcast and non-integrated cable MVPDs of three Comcast-integrated RSNs across cable systems in 2007. Dots represent carriage by a system, X's represent no carriage.

Table 2: Estimates of Key Parameters

	Parameter	Description	Estimate	SE
Viewership	ν^{NS}	Viewership Decay, Non-sports	0.59	0.00
Parameters	ν^{S}	Viewership Decay, Sports	0.95	-
$\boldsymbol{\theta}_1$	γ^{b}	Fraction of Teams Blacked-out	-0.58	0.31
	γ^{d} (10^3mi)	Distance	-0.93	0.27
Bundle Choice	α	Bundle Price	-1.00	0.44
Parameters	β^{v}	Bundle Viewership Utility	0.14	0.07
$\boldsymbol{\theta}_2$	$\rho^{sat}_{DirecTV}(10^2)$	DirecTV Exponential Parameter	0.42	0.23
	$\rho^{sat}_{Dish}(10^2)$	Dish Exponential Parameter	0.49	0.27
Pricing, Bargaining,	σ^2_{ω}	Variance of Carriage Shocks	0.00	0.00
Carriage and	ζ^{E}	Bargaining, External	0.28	0.03
Foreclosure Parameters	ζ^{I}	Bargaining, Internal	0.37	0.06
$\boldsymbol{\theta}_3, \underline{\lambda}_R$	μ	Internalization	0.79	0.09
	$\mu \times \underline{\lambda}_R^{Phil}$	Internalization & Rival Foreclosure, Philadelphia	1.11	0.14
	$\mu \times \underline{\lambda}_R^{SD}$	Internalization & Rival Foreclosure, San Diego	0.94	0.11

Notes: Selected key parameters from the first and second step estimation of the full model, where parameter ν^S is estimated separately via a grid search (see Appendix C.3). Additional viewership parameters contained in $\boldsymbol{\theta}_1$ are reported in Appendix Table A.4; state-firm and year fixed effects in $\boldsymbol{\theta}_2$ are not reported. Asymptotic GMM standard errors are computed using numerical derivatives and 1500 bootstrap draws of markets and simulated households to estimate the variance-covariance matrix of the moments.

- Most markets have program access rules (PAR)s assume $\lambda_R = 0$.
- Estimate lower bound on λ_R because SAN and PHL have exclusion.

Results and Counterfactuals

- Advantages of VI
  - Lower negotiated price τ to cable company
  - Lower prices to consumers
  - More carriage by integrated firm
- Disadvantages
  - Higher prices to competitor (often satellite) τ
  - Higher prices to competitor's customers p
  - Foreclosure or failure fo reach agreement.
- Three scenarios
  - No VI ($\mu = 0$).
  - VI with PARs $\lambda_R = 0$
  - VI without PARs μ, λ_R both nonzero.

Counterfactuals

Table 4: Simulated Market Outcomes for Selected RSNs

		(i) No VI	(ii) VI PARs (vs. No VI)		(iii) VI No PARs (vs. No VI)	
		Level	$\%\Delta_{lvl}$	$\%\Delta_{WTP}$	$\%\Delta_{lvl}$	$\%\Delta_{WTP}$
CABLE INTEGRATED RSNs						
CSN PHIL	Cable Mkt Share	0.64	0.8%		1.8%	
Comcast		[0.62,0.65]	[0.2%,2.4%]		[0.6%,4.0%]	
Pop 4.25M	Sat Mkt Share	0.18	-0.5%		-10.4%	
Footprint 90%		[0.17,0.19]	[-3.3%,-0.2%]		[-14.8%,-0.5%]	
WTP $4.99	Cable Carriage	0.95	1.6%		0.4%	
		[0.62,0.97]	[0.0%,53.8%]		[-6.2%,52.9%]	
	Cable Prices	54.31	-0.5%		0.9%	
		[53.28,55.42]	[-1.5%,0.9%]		[-1.4%,1.8%]	
Foreclose: 85%	Aff Fees to Sat	2.26	3.6%		-	
		[1.00,2.64]	[-9.4%,7.0%]		-	
	Cable + RSN Surplus	30.19	0.2%	0.9%	1.1%	6.5%
		[14.57,32.67]	[0.0%,2.4%]	[0.3%,13.7%]	[0.4%,3.3%]	[3.0%,20.5%]
	Satellite Surplus	4.29	-0.9%	-0.8%	-2.1%	-1.8%
		[1.26,4.70]	[-3.4%,-0.4%]	[-2.4%,-0.5%]	[-4.8%,-1.1%]	[-4.5%,-0.9%]
	Consumer Welfare	31.21	0.6%	3.9%	-2.9%	-18.1%
		[16.82,34.81]	[0.2%,2.0%]	[1.4%,12.7%]	[-3.3%,1.5%]	[-21.8%,9.9%]
	Total Welfare	65.69	0.3%	4.0%	-1.0%	-13.4%
		[31.14,71.73]	[0.1%,1.9%]	[2.0%,25.2%]	[-1.1%,1.1%]	[-15.6%,14.7%]
MSG	Cable Mkt Share	0.63	3.3%		3.3%	
Cablevision		[0.62,0.67]	[0.3%,4.8%]		[0.2%,4.7%]	
Pop 11.7M	Sat Mkt Share	0.18	-4.3%		-4.3%	
Footprint 42%		[0.17,0.18]	[-7.1%,-0.4%]		[-8.1%,-0.4%]	
Pred WTP $2.32	Cable Carriage	0.68	10.5%		10.5%	
		[0.67,0.87]	[-2.5%,18.5%]		[-3.1%,18.5%]	
	Cable Prices	59.40	-2.4%		-2.4%	
		[56.80,60.81]	[-3.5%,0.0%]		[-3.5%,0.2%]	
Foreclose: 1%	Aff Fees to Sat	1.22	-3.3%		22.4%	
		[0.42,1.28]	[-5.9%,10.4%]		[17.1%,53.4%]	
	Cable + RSN Surplus	30.64	0.3%	4.4%	0.5%	6.8%
		[14.61,34.12]	[-0.1%,0.6%]	[-1.6%,7.4%]	[0.0%,1.3%]	[0.4%,14.6%]
	Satellite Surplus	4.16	-4.2%	-7.5%	-5.5%	-9.9%
		[1.24,4.48]	[-7.2%,-0.5%]	[-12.1%,-0.9%]	[-8.5%,-1.2%]	[-14.3%,-2.4%]
	Consumer Welfare	33.80	3.1%	44.6%	3.0%	44.3%
		[18.38,38.14]	[0.3%,4.3%]	[4.4%,66.3%]	[-0.4%,4.3%]	[-6.3%,66.0%]
	Total Welfare	68.60	1.4%	41.4%	1.4%	41.2%
		[32.06,76.01]	[0.1%,1.9%]	[3.4%,60.9%]	[0.1%,1.9%]	[2.5%,60.7%]
NON-INTEGRATED RSN						
NESN	Cable Mkt Share	0.61	7.6%		9.4%	
*Comcast		[0.59,0.65]	[1.6%,11.2%]		[2.7%,12.5%]	
Pop 5.20M	Sat Mkt Share	0.13	-7.8%		-22.3%	
Footprint 85%		[0.12,0.14]	[-12.6%,-1.8%]		[-26.5%,-7.2%]	
WTP $6.91	Cable Carriage	0.92	6.2%		3.6%	
		[0.68,0.98]	[0.0%,33.1%]		[-0.5%,38.1%]	
	Cable Prices	56.73	-4.7%		-3.9%	
		[54.24,57.88]	[-6.6%,-0.5%]		[-6.0%,0.6%]	
Foreclose: 96%	Aff Fees to Sat	3.32	3.1%		-	
		[1.23,3.79]	[-12.6%,16.9%]		-	
	Cable + RSN Surplus	28.38	0.9%	3.6%	2.0%	8.2%
		[13.68,31.36]	[0.1%,2.4%]	[0.9%,10.6%]	[0.7%,4.0%]	[5.4%,16.7%]
	Satellite Surplus	2.96	-8.3%	-3.5%	-10.9%	-4.7%
		[0.84,3.24]	[-13.2%,-1.8%]	[-5.5%,-1.3%]	[-13.9%,-3.0%]	[-6.3%,-1.7%]
	Consumer Welfare	28.36	6.4%	26.5%	3.3%	13.5%
		[15.54,31.97]	[1.4%,10.0%]	[8.2%,40.8%]	[-1.7%,7.1%]	[-9.0%,29.2%]
	Total Welfare	59.70	3.1%	26.5%	2.0%	17.0%

Conclusions

- VI is good but PARs are important.
- Can we get the good without the bad simply by price discriminating
  - ie: Charge a different price in Vermont than Boston for Celtics.