Lecture 11: Vertical control

EC 105. Industrial Organization.

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Outline
Introduction

Vertical integration and vertical restraints

- Up to now, consider only firm who produces as well as sells final product
- Most industries characterized by *upstream* vs. *downstream* firms.
- Question: focus on problems in vertical setup, and upstream firm’s incentives to either **vertically integrate** or approach the integrated outcome using **vertical restraints**.
- Upstream: produce product. Downstream: retailer/distributor who sells the product
  1. Double marginalization
  2. Free-riding
- Upstream: produce inputs. Downstream: produce and sell final product
  1. Input substitution
  2. Price discrimination
  3. Contracts
- Don’t focus on cost aspects (Stigler)
Double marginalization 1

- Monopolist upstream manufacturer; marginal cost $c$, chooses wholesale price $p_w$
- Monopolist downstream retailer; marginal cost is $p_w$, chooses retail price $p_r$
- Graph
- Integrated firm: choose $p_r$ so that $MR(q) = c \rightarrow q_i$
- Nonintegrated outcome: solve backwards

1. Retailer: sets $p_r$ so that $MR(q) = p_w$. $MR(q)$ is the demand curve faced by manufacturer: **Monopoly retailer restricts output.**

2. Manufacturer maximizes using retailer’s demand curve: lower quantity, higher price relative to integrated firm.

- Total profits lower in non-integrated scenario.
• Integrated monopolist: \((Q_i, P_i)\)

• Nonintegrated: monopolist retailer sets retail price where \(P_w = MR\). Thereby, wholesaler faces demand curve of MR.

• Wholesaler optimally sets \(P_w^*\) so that \(c = MR^*_2\) (so “double marginalization”): outcome is \((P_w^*, P_r^*, Q_w^*)\)

• Total profits lower in non-integrated scenario.
Example: $Q = 10 - p; \ c=2$

Integrated firm: $q_i = 4, \ p_i = 6, \ \pi_i = 16$

Non-integrated scenario (solve backwards):

- **Retailer:**
  1. Given $p_w$, $\max_{p_r} (p_r - p_w)(10 - p_r)$
  2. FOC: $10 - p_r - (p_r - p_w) = 0 \rightarrow p_r = \frac{10 + p_w}{2}$
  3. Demand, as a function of $p_w$: $Q(p_w) = 10 - \frac{10 + p_w}{2} = 5 - \frac{p_w}{2}$. This is demand curve faced by manufacturer (and coincides with MR curve of retailer)

- **Manufacturer**
  1. $\max_{p_w} (p_w - 2)(5 - \frac{p_w}{2})$
  2. FOC: $5 - \frac{p_w + p_w - 2}{2} = 0 \rightarrow p_w = 6$

  - $p_w = 6 \rightarrow p_r = 8, \ q_n = 2$. Lower output, higher price.
  - $\pi_w = 4, \ \pi_r = 8$. Lower total profits.
  - Lower total profits is incentive to integrate. What else can mftr. do?
Main problem is that monopoly retailer sets $p_r > p_w$. How can this be overcome?

- **Resale price maintenance (RPM)**
  - Price ceiling: $p_r = p_w$. Illegal?
  - Quantity forcing: force retailer to buy $q = q_i$ units (sales quotas)
  - General: increase competition at retail level. With PC retail market, $p_r = p_w$ and problem disappears.

Alternatively, set $p_w = c$ and let retailer set $p_r$ so that $MR(q) = c = p_w$. Then recoup integrated profits $\pi_i$ by **franchise fee**. Only works if franchise market is competitive.
Free-riding in retail sector 1: “downstream moral hazard”

- DM arises since retail sector is not competitive. Now consider problems which arise if retail sector is competitive.
- Assume monopolist mftr. and retail sector with two firms competing in Bertrand fashion.
- Demand function $Q(p, s)$, depending on price $p$ and retail services (advertising) $s$.
- Problem: Assume demand goes up if either firm advertises. One firm has no incentive to advertise if other firm does: **free-riding**.
- Examples: in-store appearances, online perfume discounters
- Solve the game backwards:
  - Bertrand competition: zero profits no matter what. Neither firm advertises $\rightarrow$ low demand.
  - Mftr. faces lower demand and lower profits.
Free-riding in retail sector 2

- Main problem: under Bertrand competition, retail profits don't depend on whether or not there is advertising. Correct problem by tying retailer profits to their advertising activities: general principle of the residual claimant.

  1. **Exclusive territories**: grant retailers monopoly in selling manufacturer’s product. Now retailer’s profits increase if it advertises, but run into DM problem. Explain make-specific new car dealerships?

  2. Limit number of distributors (same idea)

  3. Resale price maintenance: set \( p > p_w \). Again, this ties retailers’ profits to whether or not they advertise.

- Free-riding at manufacturer level: If there is upstream competition, one mftr’s efforts to (say) improve product image can benefit all manufacturers → **exclusive dealing**: forbid retailer from selling a competing manufacturer’s product.

- Empirical evidence: perfumes
Now consider the case where upstream firm produces an input that is used by downstream firms in producing final good.

Main ideas: Monopoly pricing for one of the inputs shifts downstream demand for input away from it.

Can lead to socially inefficient use of an input.

By integrating with DS industry, monopolist increases demand for its input (and perhaps profits).

Occurs no matter if downstream industry is competitive or not.
Example (diagram):

- Market demand for final good: \( p = 10 - q \)
- Two inputs:
  1. Competitive labor market, wage \( w = 1 \)
  2. Energy \( E \) produced by an upstream monopolist. Monopolist produces with marginal cost \( m = 1 \) and sells it at price \( e \).
- Final good produced from a production function \( q = E^{1/2} L^{1/2} \).
- Competitive downstream industry: final good is sold at \( p = MC(q) \).
- Analyze 3 things (C/P pp. 551-552):
  1. Calculate \( MC(q) \) function for DS industry
  2. Integrated outcome
  3. Non-integrated outcome
Input substitution 3

- Calculating DS marginal costs
- First solve for DS firm cost function $C(w, e, Q)$: given input prices $w$ and $e$, what is minimal cost required to produce output $Q$?
  - DS firms combine $E$ and $L$ to produce a given level of output $Q$ at the lowest possible cost:
    \[
    C(e, w, Q) = \min_{E,L} eE + wL \text{ s.t. } Q = E^{1/2}L^{1/2}
    \]  
  given input prices $e$, $w$, and output level $Q$.
- Substituting in the constraint:
  \[
  C(e, w, Q) = \min_{E} eE + w \left( \frac{wQ^2}{E} \right)
  \]  
- FOC: $E = Q \left( \frac{w}{e} \right)^{1/2}$, and $L = Q \left( \frac{e}{w} \right)^{1/2}$. Substitute back into cost function.
- $C(e, w, Q) = 2Q(w e)^{1/2}$. Marginal cost $= \frac{\partial C}{\partial Q} =$
  \[
  MC(e, w, Q) = 2(we)^{1/2}.
  \]
Integrated firm: Monopoly also controls DS industry

- In integrated firm, set $e = m = 1$, so that $MC = 2$.
- $\max_p (p - 2)q = (p - 2)(10 - p)$.
- $p_i = 6$, $q_i = 4$. $E_i = L_i = 4$.
- $\pi_i = (6 - 2) * 4 = 16$. 
Input substitution 5

Non-integrated scenario

- DS: Chooses quantity $q$ so that $p = MC \iff p = 10 - q = 2(we)^{1/2} \implies q = 10 - 2(we)^{1/2}$
- Given this $q$, demand for $E$ is:

$$E = 10 \left(\frac{1}{e}\right)^{1/2} - 2$$

- US: $\max_e (e - 1) \ast E = (e - 1) \ast \left[10 \left(\frac{1}{e}\right)^{1/2} - 2\right]$
- FOC (complicated!): $5e - 2e^{3/2} + 5 = 0$
- $e_u = 7.9265$. $MC = 5.6308 = p_u$. $q_u = 4.3692$.
- At these input prices, $(\frac{w}{e}) << \frac{w}{m} = 1$, so use much more labor (much less energy) than optimal.
- $\pi_u^{US} = 10.75$, $\pi_u^{DS} = 0$ (DS is competitive). Lower profits for US firm.
- Story holds only if two input are substitutes.
Long-term contracts

- In vertical structure, can observe contracts between US and DS firms
- Can they be anti-competitive?
- Consider common type of contract: *Exclusive dealing*. Upstream seller dictates that it is sole source for downstream retailer.

**Chicago school answer: No**

- Reduced competition means higher wholesale price $\iff$ lower profits for retailer
- Since signing ED contract is voluntary, retailer would never voluntarily enter into a relationship with lower profits.

Consider these issues in one model: Aghion/Bolton model
Setup

Graph: Incumbent (\(I\)) and entrant (\(E\)) upstream seller; one downstream retailer/buyer (\(B\))

- \(B\) demands one unit of product, derives utility 1 from it.
- \(I\) produces at cost 1/2, sells at price \(P\).
- \(E\) has cost \(c_e\), unknown to \(B\) or \(I\); it is uniformly distributed between [0, 1]. If enter, sells at price \(\tilde{P}\).

Two stage game:
1. \(I\) and \(B\) negotiate a contract. \(E\) decides whether or not to enter.
2. Production and trade:
   - Contract must be obeyed.
   - Bertrand competition between \(I\) and \(E\).
In the absence of contract 1

Graph:

- Bertrand competition if $\mathcal{E}$ enters: market price is $\max \{ c_e, 1/2 \}$
  - If $c_e < 1/2$, $\mathcal{E}$ sells, at $\tilde{P} = 1/2$.
  - If $c_e > 1/2$, $\mathcal{I}$ sells, at $P = c_e$.

- $\mathcal{E}$ enters only when profit > 0: only when $c_e < 1/2$. Cost threshold $c^*$ is $1/2$. This is with probability $\phi = 1/2$. This is efficient: $\mathcal{E}$ enters only when technology is superior to $\mathcal{I}$.

- If $\mathcal{E}$ doesn’t enter, $\mathcal{I}$ charges 1.
In the absence of contract 2

Sumup:

- Expected surplus of $B$: $\phi \times \frac{1}{2} + (1 - \phi) \times (1 - 1) = \frac{1}{4}$.
- Expected surplus of $I$: $\phi \times 0 + (1 - \phi) \times (1 - 1/2) = \frac{1}{4}$.
- $B$ and $I$ will write contract only when it leads to higher expected surplus for both $B$ and $I$. This is Chicago school argument.
- Question: Is there such a contract which would deter $E$’s entry (ie., lower cost threshold $c^* < 1/2$)?
With a contract 1

Consider a contract b/t B and I which specifies

1. \( P \): price at which B buys from I
2. \( P_0 \): penalty if B switches to E (liquidated damages)

What is optimal \((P, P_0)\)?

- What is B’s expected surplus from contract? \((1 - P)\) if buy from I; in order to generate sale, E must set \( \tilde{P} \) s.t. B gets surplus of at least \((1 - P)\). So: B’s expected surplus is \((1 - P)\).
- B get surplus of \(\frac{1}{4}\) without contract, so will only accept contract if surplus \(\geq \frac{1}{4} \iff (1 - P) \geq \frac{1}{4}\).
- When will E enter? If E enters, it will set \( \tilde{P} = P - P_0 \). In order to make positive profit \( c_e \leq \tilde{P} = P - P_0 \).
- E enters with probability \( \phi' = \max \{0, P - P_0\} \).
With a contract 2

- $\mathcal{I}$ proposes $P, P_0$ to maximize his expected surplus, subject to $\mathcal{B}$’s participation:

$$\max_{P, P_0} \phi' \cdot P_0 + (1 - \phi') \cdot (P - 1/2)$$

subject to $1 - P \geq 1/4$.  

(4)

- Set $P$ as high as possible: $P = 3/4$.

- Graph: optimal $P_0 = 1/2$, so that $\mathcal{I}$’s expected surplus $= 5/16 > 1/4$.

- $\mathcal{B}$’s expected surplus: $1/4$. as before.

- $\mathcal{E}$: only enter when $c_e \leq P - P_0 = 1/4$. Inefficient: when $c_e \in [1/4, 1/2]$, more efficient than $\mathcal{I}$, but (socially desirable) entry is deterred.
Would parties want to renegotiate the contract?

- Assume contract is renegotiated if both $\mathcal{I}$ and $\mathcal{B}$ agree to do so.

- If $\mathcal{E}$ enters and offers $\tilde{P} = 2/5$:
  - $\mathcal{B}$ offers to buy from $\mathcal{E}$, and pay $1/4$ to $\mathcal{I}$.
  - $\mathcal{I}$ accepts, since $1/4$ is same surplus he could get if $\mathcal{B}$ “punished” him by purchasing from him at $P = 3/4$.
  - $\mathcal{B}$ strictly better off, since $1 - 2/5 - 1/4 = 0.35$ is greater than $1/4$, his surplus under original contract.

- The exclusive dealing contract is not renegotiation-proof.

- Same argument for $\tilde{P}$ up to $1/2$:
  - No exclusive contracts are renegotiation-proof.
  - Once we take this into account, socially efficient outcome obtains, where $\mathcal{E}$ enters if her costs $c_e \leq 1/2 = c_i$. 


Remarks

- Contract deters entry by imposing switching costs upon buyer:
  much-observed practice: Loyalty-reward programs (Frequent-flyer miles, Buy 10/Get 1 free, etc.)

- Falls under category of raising rivals costs: recall that this is profitable if $\pi^m - K \geq \pi^d$. Here $\pi^d=?$, $K=?$, $\pi^m=?$

- What if two competing incumbent sellers?

- What if $E$’s cost known? Then Chicago result holds: contract will never be desired by both $I$ and $B$.

- What if $B$ is risk averse (i.e., dislikes variation in payoffs)?
  - Under contract: guaranteed surplus of 1/4, no matter if $E$ enters or not
  - Without contract, gets 1/2 if $E$ enters, but 0 if $E$ stays out.
  - Prefers contract since it is less risky: if extremely risk-averse, exclusive contract could even survive renegotiation (i.e., if incumbent can set $P$ very close to 1).
A “pure” incentive problem

- Consider a pure incentive problem where you and a partner are deciding how to divide up a pot of earnings.
- Who should make the proposal?
- (Assume no third parties. Prone to corruption, “rent-seeking”)
- “Decentralization” principle.
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Sum-Up

- Inefficiencies in vertical relationship
  1. double marginalization: DS monopoly contracts output too much
  2. Free-riding (DS moral hazard): DS competition provides too few retail services

- Reasons for vertical integration
  1. Input substitution: too little of monopoly input is used
  2. Contracts between upstream and downstream firms: can have anti-competitive effects (but somewhat fragile result..)