Lecture 11: Vertical control

EC 105. Industrial Organization.

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Outline

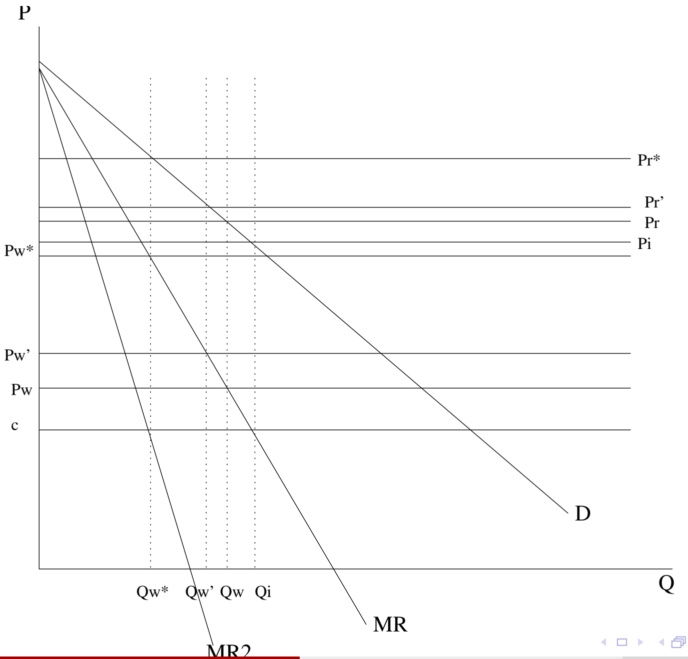
1. Introduction
2. Double marginalization
3. Downstream moral hazard
4. Input substitution
5. Contracts: exclusive dealing

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 $MR(q) = c \longrightarrow q_i$
- 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.


P
Pr*
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Qw
Qi
MR
MR2

- 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.

Double marginalization 2

Example: $Q = 10 - p$; c=2
Integrated firm: q_i=4, p_i=6, π_i=16
Non-integrated scenario (solve backwards):

- Retailer:
  1. Given p_w, $\max_{p_r}\ (p_r - p_w)(10 - p_r)$
  2. FOC: $10 - p_r - (p_r - p_w) = 0 \longrightarrow p_r = \frac{10+p_w}{2}$.
  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: $5 - \frac{p_w + p_w - 2}{2} = 0 \longrightarrow p_w = 6$
- $p_w = 6 \longrightarrow p_r$=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?

Double marginalization 3

- 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 π_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 $\longrightarrow$ 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 *price floor* $\underline{p} > p_w$. 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 $\longrightarrow$ **exclusive dealing**: forbid retailer from selling a competing manufacturer's product.
- Empirical evidence: perfumes

Input substitution 1

- 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.

Input substitution 2

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:

$$C(e, w, Q) = \min_{E,L} eE + wL \text{ s.t. } Q = E^{1/2}L^{1/2} \tag{1}$$

    given input prices e, w, and output level Q.
  - Substituting in the constraint:

$$C(e, w, Q) = \min_{E} eE + w\left(\frac{wQ^2}{E}\right) \tag{2}$$

  - 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.
  - $C(e, w, Q) = 2Q(we)^{1/2}$. Marginal cost $= \frac{\partial C}{\partial Q} =$

$$MC(e, w, Q) = 2(we)^{1/2}. \tag{3}$$

Input Substitution 4

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 $p = MC \Leftrightarrow p = 10 - q = 2(we)^{1/2} \Longrightarrow q = 10 - 2(we)^{1/2}$
- Given this q, demand for E is:

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

- US: $\max_e (e-1) * E = (e-1) * \left[10\left(\frac{1}{e}\right)^{1/2} - 2\right]$
- 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, $\left(\frac{w}{e}\right) << \frac{w}{m} = 1$, 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 $\Longleftrightarrow$ 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 ($\mathcal{I}$) and entrant ($\mathcal{E}$) upstream seller; one downstream retailer/buyer ($\mathcal{B}$)
$\mathcal{B}$ demands one unit of product, derives utility 1 from it.
$\mathcal{I}$ produces at cost $1/2$, sells at price P.
$\mathcal{E}$ has cost c_e, unknown to $\mathcal{B}$ or $\mathcal{I}$; it is uniformly distributed between $[0, 1]$. If enter, sells at price $\tilde{P}$.
Two stage game:

1. $\mathcal{I}$ and $\mathcal{B}$ negotiate a contract. $\mathcal{E}$ decides whether or not to enter.
2. Production and trade:
    - Contract must be obeyed.
    - Bertrand competition between $\mathcal{I}$ and $\mathcal{E}$.

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

With a contract 1

Consider a contract b/t $\mathcal{B}$ and $\mathcal{I}$ which specifies

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

What is optimal (P, P_0)?

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

$$\max_{P,P_0} \phi' * P_0 + (1-\phi') * (P - 1/2) \\ \text{subject to } 1 - P \geq 1/4. \tag{4}$$

- 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 π^d=?, K=?, π^m=?
- What if two competing incumbent sellers?
- What if $\mathcal{E}$'s cost known? Then Chicago result holds: contract will never be desired by *both* $\mathcal{I}$ and $\mathcal{B}$.
- What if $\mathcal{B}$ is risk averse (ie., dislikes variation in payoffs)?
  - Under contract: guaranteed surplus of 1/4, no matter if $\mathcal{E}$ enters or not
  - Without contract, gets 1/2 if $\mathcal{E}$ enters, but 0 if $\mathcal{E}$ stays out.
  - Prefers contract since it is less risky: if extremely risk-averse, exclusive contract could even survive renegotiation (ie., if incumbent can set P very close to 1).

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..)