Chapter 9 : PRICE DISCRIMINATION

nonuniform pricing

Incentive and conditions for price discrimination

Profit motive for price discrimination

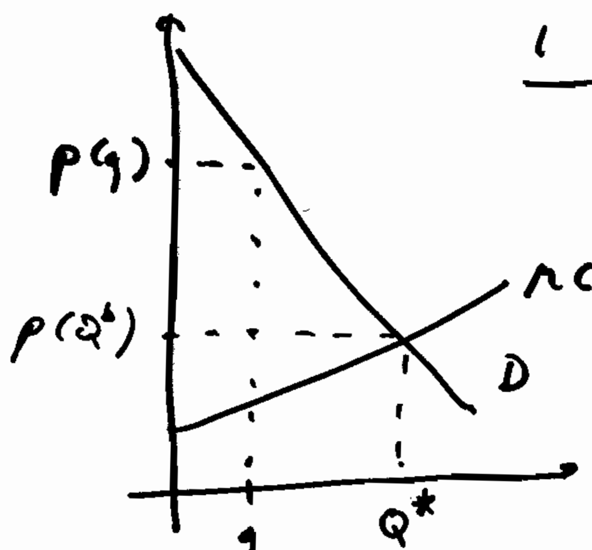
Resale impedes price discrimination

- less of a problem for services
  if high { transaction costs / arbitrage
- attempts to limit resale :
  ex : vertical integration

Types of discrimination :

Perfect price discrimination
(1st degree) Perfectly discriminating monopoly

1 consumer



$$\max_Q \underbrace{\left(\int_0^Q p(q)\,dq - C(Q) \right)}_{= \text{Total welfare}} \longrightarrow \begin{cases} \text{FOC}: p(Q^*) = MC(Q^*) \\ \text{efficient} \end{cases}$$

achievable through, e.g.:

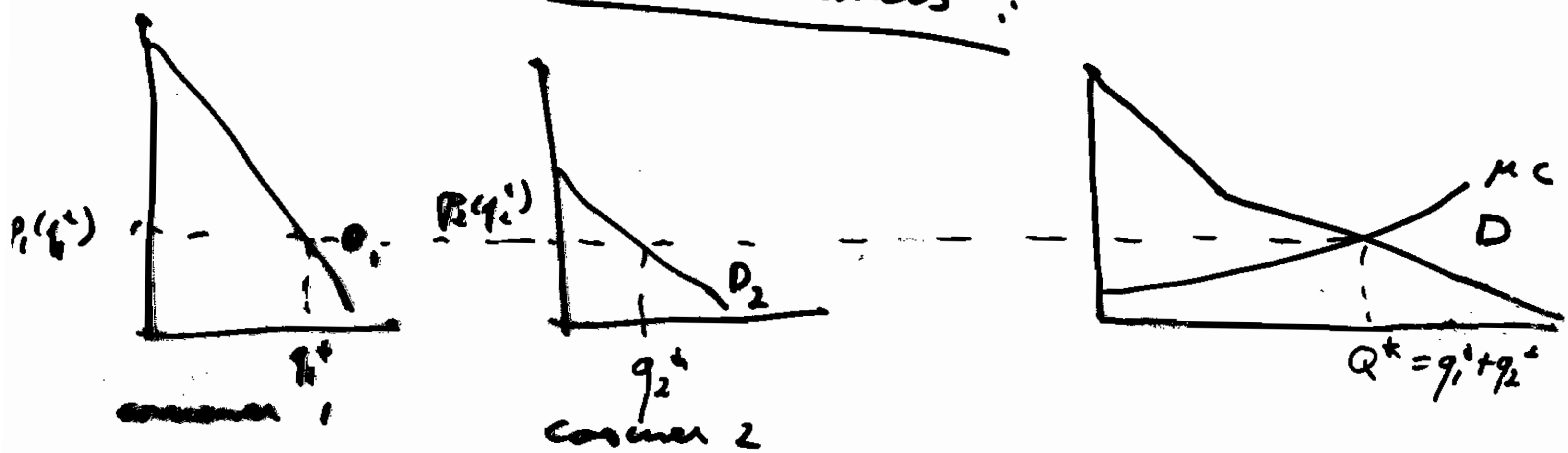
- Payment schedule : $T(q) = \int_0^q p(q)\,dq$

- Two-part tariff: $T(q) = A + p\,q$

$$A = \int^{Q^*} p(q)\,dq \;;\quad p = p^* = p(Q^*)$$

Example 4.2 (wage-employment guarantee)

Several consumers :



$$\max_{q_1, q_2} \left(\int_0^{q_1} p_1(q_1')\,dq_1' + \int_0^{q_2} p_2(q_2')\,dq_2' - C(q_1' + q_2') \right)$$

→ Efficiency

FOC : if $q_i^* > 0 \rightarrow p_i(q_i^*) = MC(Q^*)$

$\Rightarrow$ if $q_1^*, q_2^* > 0$: $p_1(q_1^*) = p_2(q_2^*) = MC(Q^*)$

achievable through, e.g.:

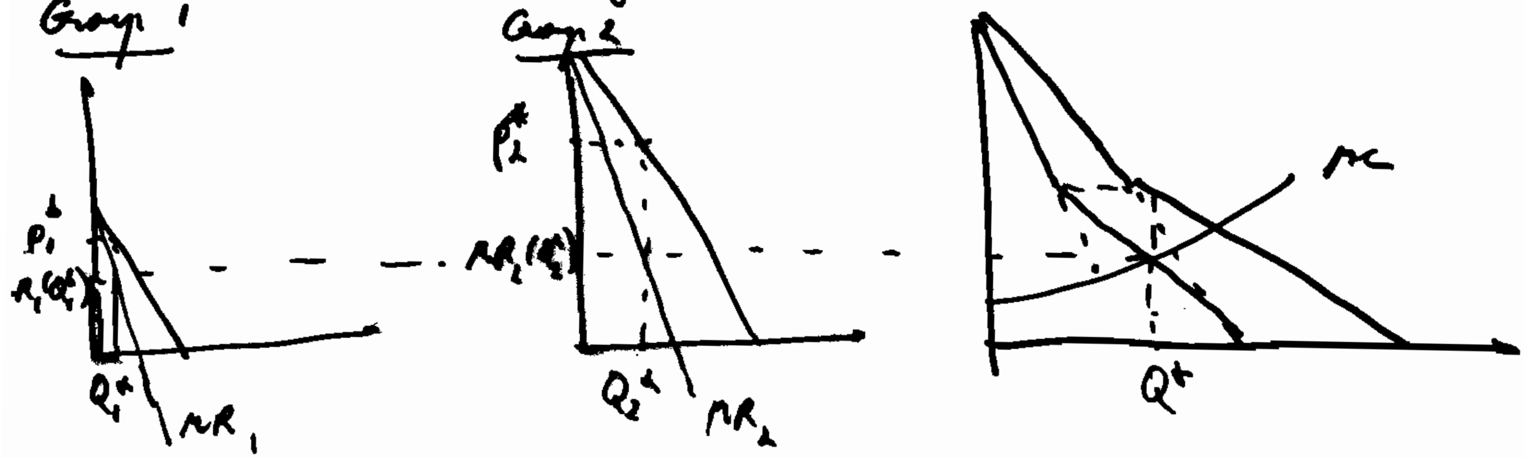
- Personalized payment schedule : $T_i(q_i) = \int_0^{q_i} p_i(q_i')\,dq_i'$

- ——————— Two-part tariff : $T_i(q_i) = A_i + p\,q_i$

$$\left(\begin{array}{l} A_i = \int_0^{q_i^*} p_i(q_i')\,dq_i' \\ p = MC(Q^*) \end{array} \right.$$

Different prices to different groups:

3rd degree price discrimination



$$\max_{Q_1, Q_2} \; p_1(Q_1)Q_1 + p_2(Q_2)Q_2 - C(Q_1+Q_2)$$

FOC: if $Q_i^* > 0 \rightarrow p_i(Q_i^*) + Q_i^* p_i'(Q_i^*) - MC(Q_1^* + Q_2^*) = 0$

$$\rightarrow \frac{p_i(Q_i^*) - MC(Q^*)}{p_i(Q_i^*)} = -\frac{1}{\varepsilon_i(Q_i^*)}$$

If $Q_1^*, Q_2^* > 0$: $\begin{cases} p_1 \cdot \left(1 + \frac{1}{\varepsilon_1}\right) = MC \\ p_2 \cdot \left(1 + \frac{1}{\varepsilon_2}\right) = MC \end{cases}$

$$\longrightarrow \frac{p_1}{p_2} = \frac{1 + 1/\varepsilon_2}{1 + 1/\varepsilon_1} = \frac{1 - 1/|\varepsilon_2|}{1 - 1/|\varepsilon_1|}$$

Welfare effects of price discrimination

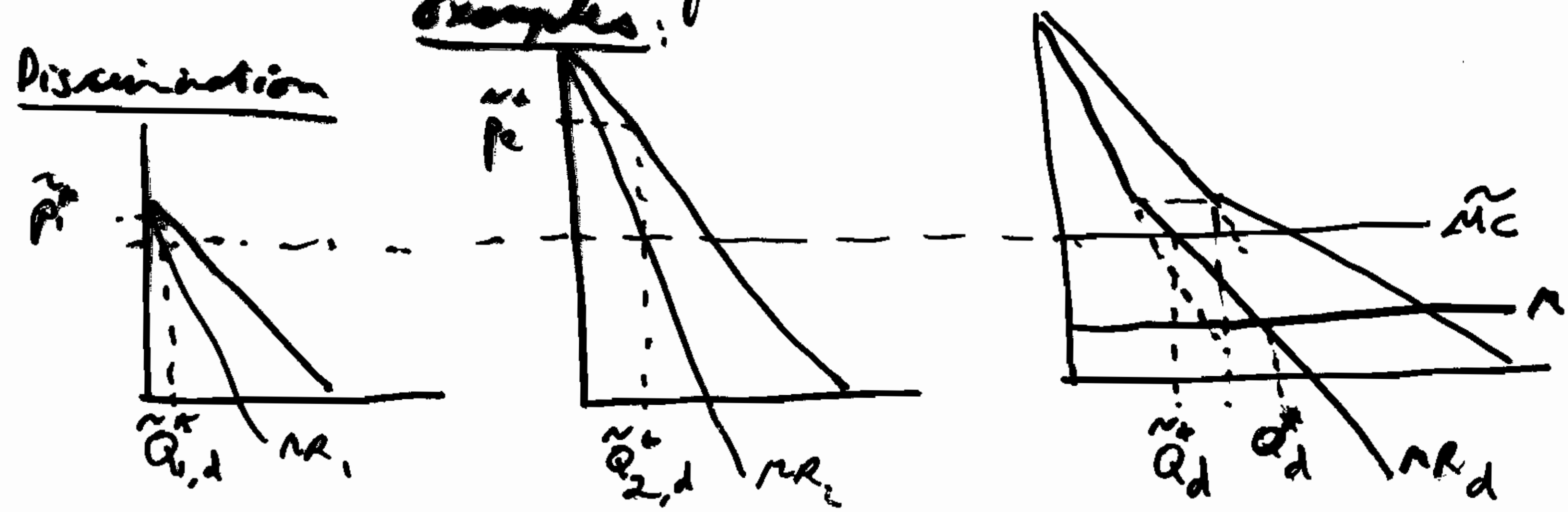
Total Welfare

3rd degree price discriminating monopolist W_d

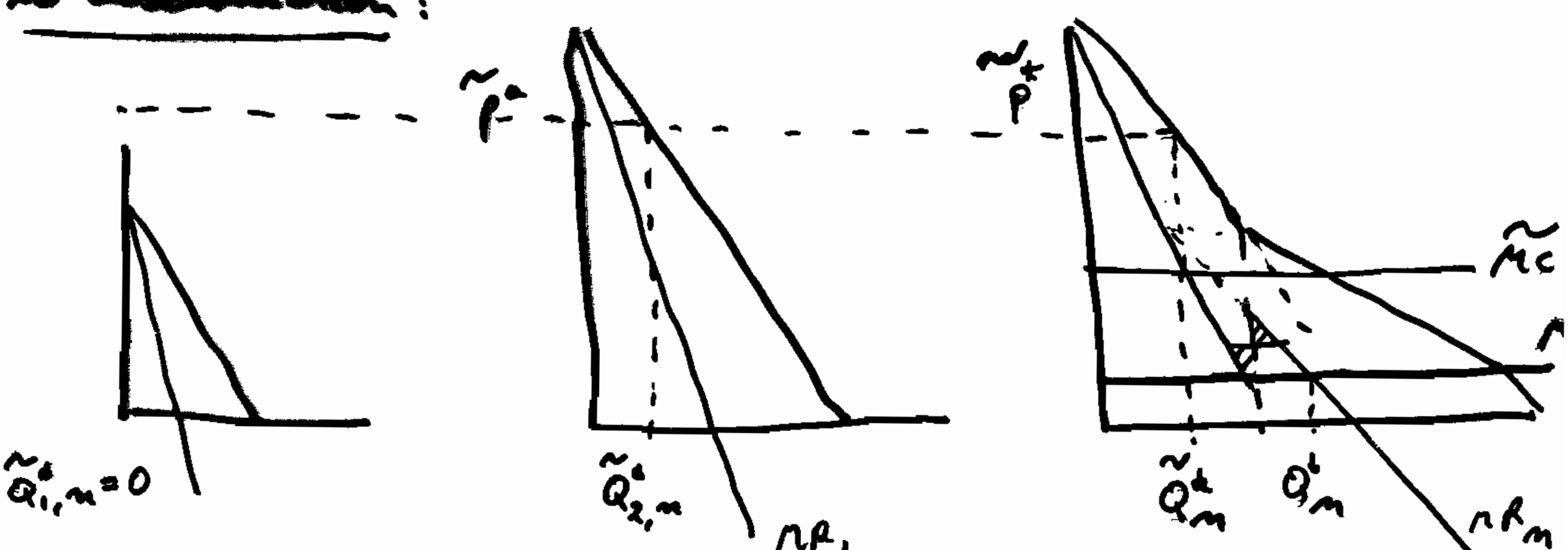
vs nondiscriminating —— W_m

Examples:

Discrimination



no discrimination:



If MC : $Q_d^* = Q_m^*$; $W_d < W_{nd}$

If $\tilde{MC}$: $\tilde{Q}_d^* > \tilde{Q}_m^*$; $\tilde{W}_d > \tilde{W}_{nd}$

if $\left(\begin{array}{l} p_1, \dots, p_m \downarrow \\ c \text{ convex } (mc \uparrow) \end{array} \right.$:

$$Q_d \le Q_{nd} \Rightarrow W_d \le W_{nd}$$

$$w^d = w(q_1^d, \dots, q_m^d) = \left(\sum_{i=1}^{m} \int^{q_i^d} p_i(q)\,dq \right) - c\left(\sum_{i=1}^{m} q_i^d \right)$$ concave function

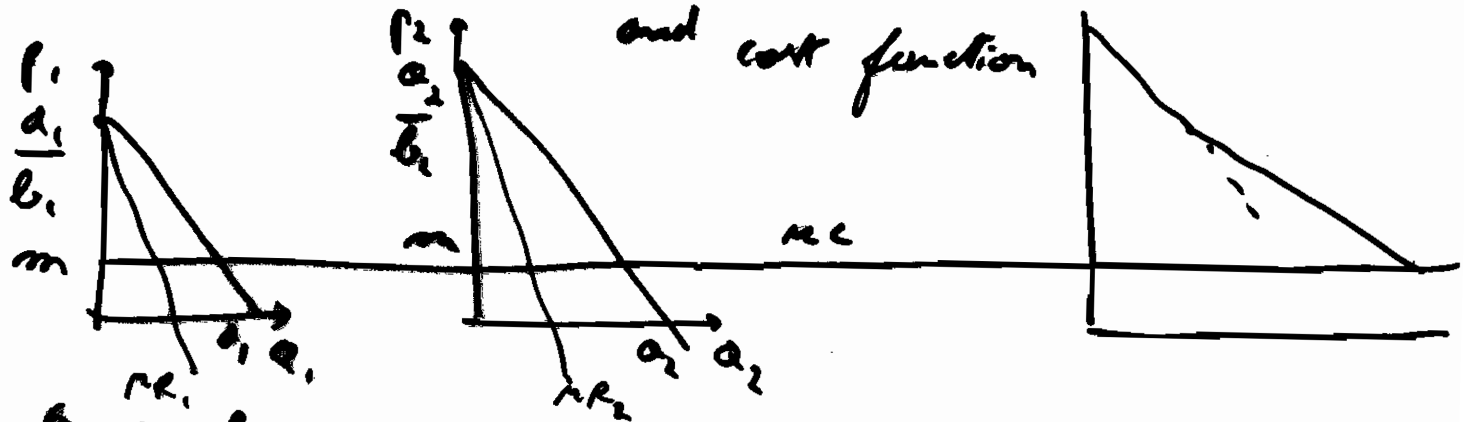
$$\le w(q_1^{nd}, \dots, q_m^{nd}) + \sum_{i=1}^{m} \frac{\partial w}{\partial q_i}(q_1^{nd}, \dots, q_m^{nd}) \cdot (q_i^d - q_i^{nd})$$

$$= w^{nd} + \sum_{i=1}^{m} \Big(\underbrace{p_i(q_i^{nd})}_{p^{nd}} - mc(Q^{nd}) \Big) (q_i^d - q_i^{nd})$$

$$= w^{nd} + \underbrace{\left(p^{nd} - mc(Q^{nd}) \right)}_{\ge 0} \underbrace{\left(Q^d - Q^{nd} \right)}_{\le 0}$$

$$\Rightarrow w^d \le w^{nd}$$

Exercise: Linear demand curves and cost function



$Q_1 = a_1 - b_1 p_1$ $\qquad$ $Q_2 = a_2 - b_2 p_2$ $\qquad$ $Q(p) = a_1 + a_2 - (b_1 + b_2) p$

if $p < \min\left(\frac{a_1}{b_1}, \frac{a_2}{b_2}\right)$

$MC \equiv m < \frac{a_1}{b_1}, \frac{a_2}{b_2}$

3rd degree p.d.:

$$Q^*_{1,d} = \frac{a_1 - b_1 m}{2} = \frac{a_1}{2} - \frac{b_1}{2} m$$

$$Q^*_{2,d} = \frac{a_2 - b_2 m}{2} = \frac{a_2}{2} - \frac{b_2}{2} m$$

$$\longrightarrow Q^*_d = Q^*_{1,d} + Q^*_{2,d} = \frac{a_1 + a_2}{2} - \frac{b_1 + b_2}{2} m$$

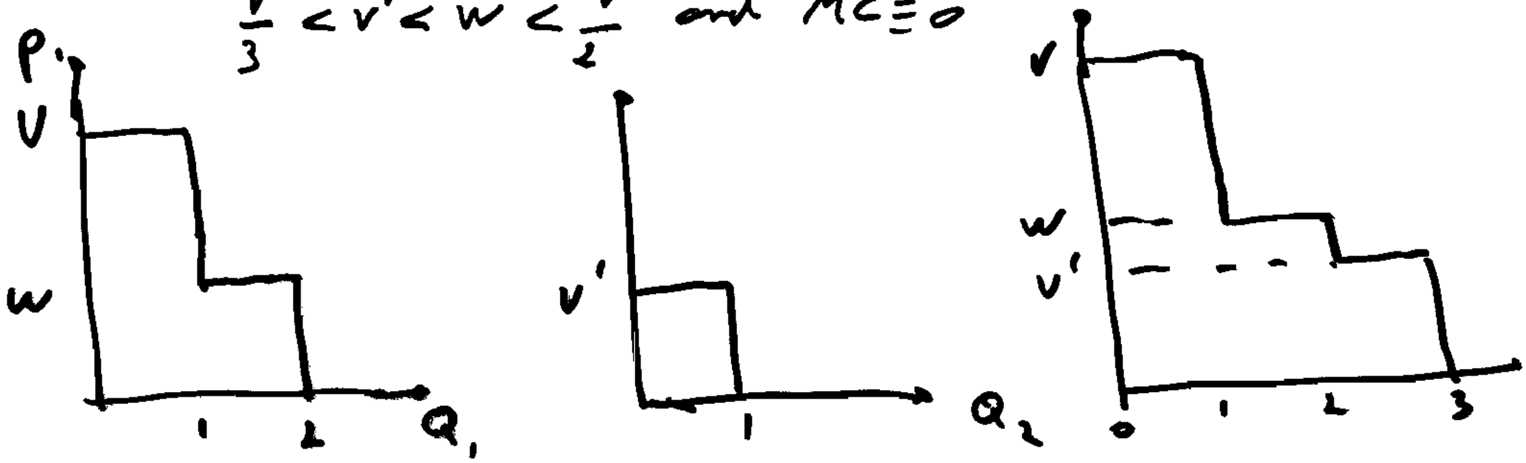
no discrimination: If monopoly serves both markets:

$$Q^*_m = \frac{a_1 + a_2 - (b_1 + b_2) m}{2}$$

$$\Longrightarrow Q^*_d = Q^*_m$$

Example where $Q_d^1 < Q_m^1$

$\frac{V}{3} < V' < W < \frac{V}{2}$ and $MC \equiv 0$



Discrimination : Since $V > 2W$: $Q_{1,d} = 1$; $Q_{2,d} = 1$

$Q_d = 2$

no discrimination : Since $3V' > V > 2W$: $Q_m = 3$

Chap 10: Advanced Topics in Pricing

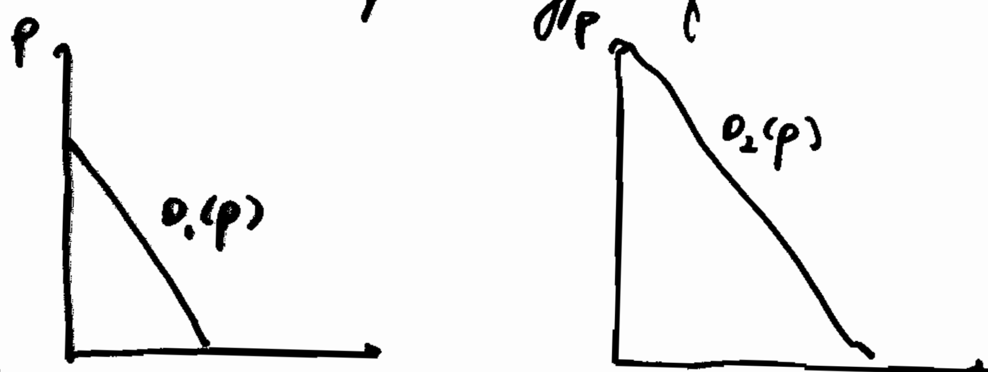
Nonlinear pricing

(2^{nd}-degree price discrimination
(screening

Assume : • no "commodity arbitrage"
• "personal arbitrage"

Single 2-part tariff : $T(q) = A + p \cdot q$

For example 2 types of consumers

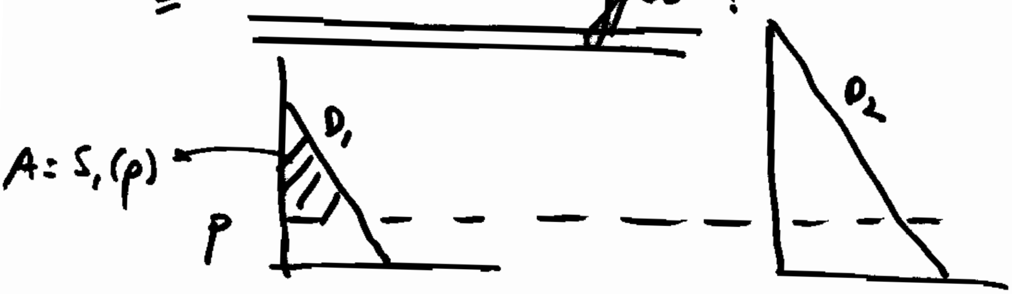


$C(Q) = c \cdot Q$

$\boxed{\lambda}$ $\boxed{1-\lambda}$ with $0 < \lambda < 1$

Options:

1. Sell to both types :

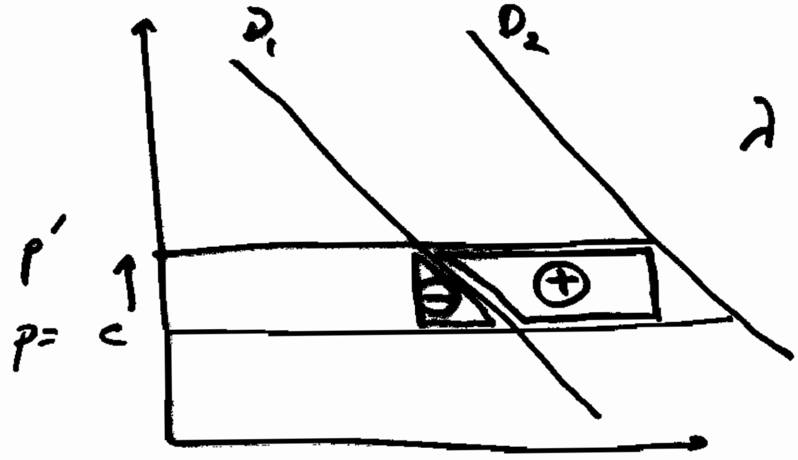


$$p^* \in \arg\max_p S_1(p) + (\lambda D_1(p) + (1-\lambda) D_2(p))(p - c)$$

$$A^* = S_1(p^*)$$

$\underline{p^* > c}$:

In fact:



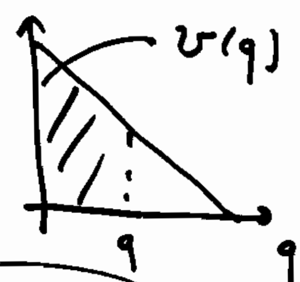
$\lambda |\ominus| < (1-\lambda)|\oplus|$

Also: $\underline{p^* < P_{\text{uniform}}}$
(requirements) ✓ tie-in sale of complementary products

Example of application:

Consumption: MC

1 Basic good : c_0
with
q units complementary good : c



Consumer utility : $v(q)$ – Payment

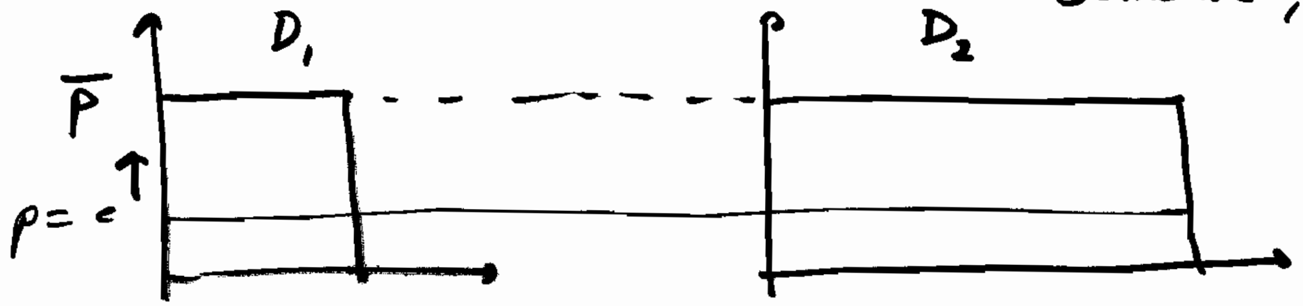
no tie-in :

M → Basic good → Consumers

Competitive Industry → complement $p = c$ → Consumers

$p_0 = S_1(c)$

example: (connected to "Requirements Tie-in with Interrelated Demands", pp 333-335)

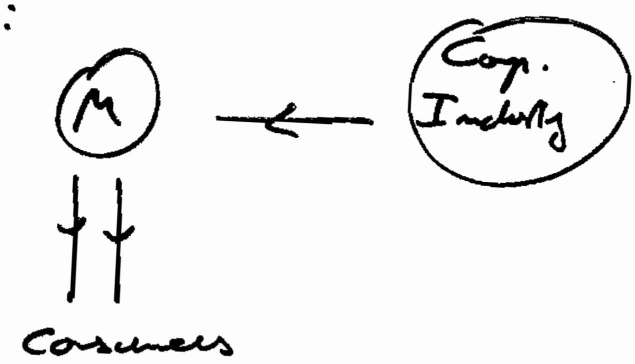


If $p=c \rightarrow A = S_1(c)$: Surplus is left to Type 2

If instead $p=\bar{p}$: $A = S_1(\bar{p}) = 0$

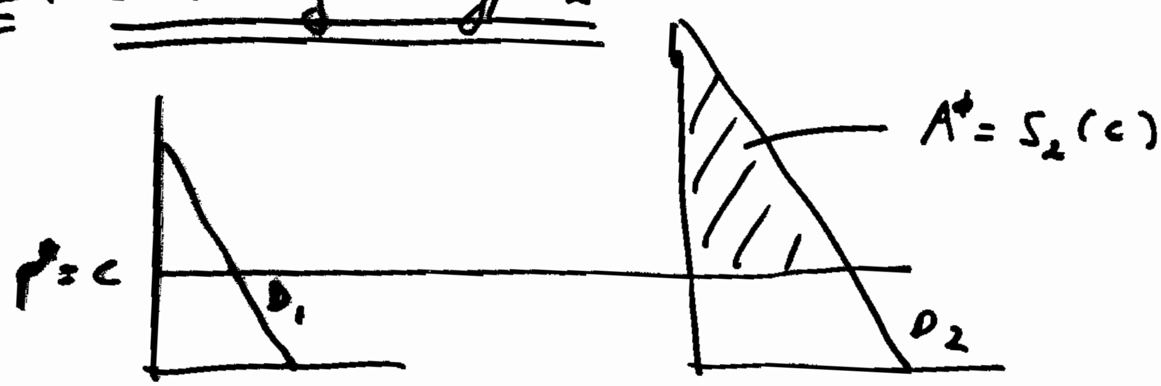
as good as 1st-degree p.d.

Tie-in :



$$\left[\begin{array}{l} p_0 = S_1(p^*) < S_1(c) \\ p = p^* > c \end{array}\right.$$

2. Sell only to type 2



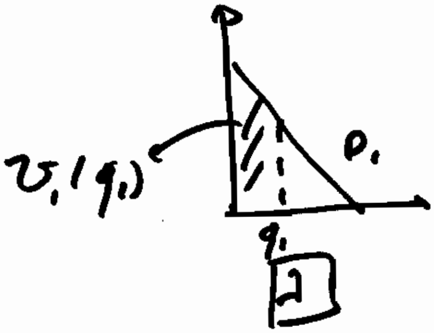
$p^* < p_{uniform}$

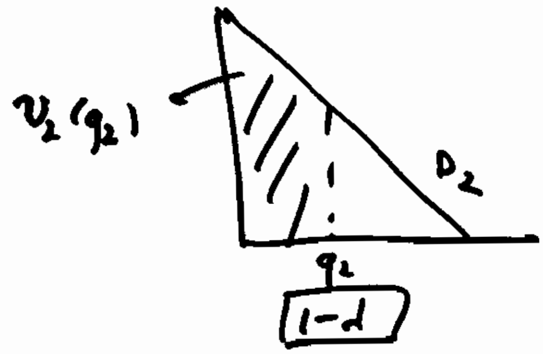
3 Optimal 2-part tariff :

Compare profits from 1. and 2.

Two 2-part tariff

Optimal fully nonlinear tariff





$$v_2(q_2) = \int_0^{q_2} p_2(q_2')\,dq_2'$$

$$v_1(q_1) = \int_0^{q_1} p_1(q_1')\,dq_1'$$

$D_2 > D_1$

Utility: $v_1(q_1) - T_1$ $\qquad$ $v_2(q_2) - T_2$

Revenues: $\lambda T_1 \quad + \quad (1-\lambda) T_2$

Costs: $\lambda c q_1 \quad + \quad (1-\lambda) c q_2$

"revelation principle": Any payment schedule is "outcome-equivalent" to a $\{(q_1, T_1), (q_2, T_2)\}$ s.t.

$$\left[\begin{array}{l}
(IC_1)\ v_1(q_1) - T_1 \geq v_1(q_2) - T_2 \iff T_2 - T_1 \geq v_1(q_2) - v_1(q_1) \\
(IC_2)\ v_2(q_2) - T_2 \geq v_2(q_1) - T_1 \iff T_2 - T_1 \leq v_2(q_2) - v_2(q_1) \\
(IR_1)\ v_1(q_1) - T_1 \geq 0 \\
(IR_2)\ v_2(q_2) - T_2 \geq 0
\end{array}\right.$$

$\geq v_1(q_1) - T_1$

Problem of the monopoly:

$$\max_{q_1, T_1, q_2, T_2} \{ \lambda T_1 + (1-\lambda) T_2 - \lambda c q_1 - (1-\lambda) c q_2 \}$$

subject to

$(IC_1), (IC_2)$

$(IR_1), ((IR_2))$

Because (IR_2) is "redundant", we drop it

$(IC_1) \iff T_2 - T_1 \geq \int_{q_1}^{q_2} p_1(q)\,dq$

$(IC_2) \iff T_2 - T_1 \leq \int_{q_1}^{q_2} p_2(q)\,dq$

$\Rightarrow q_1 \leq q_2$

$\boxed{(IR_1) \text{ binding}}$ (otherwise: $T_1, T_2 \uparrow$ with $T_2 - T_1$ fixed)

$\boxed{(IC_2) \text{ binding}}$ (otherwise: $T_2 \downarrow$)

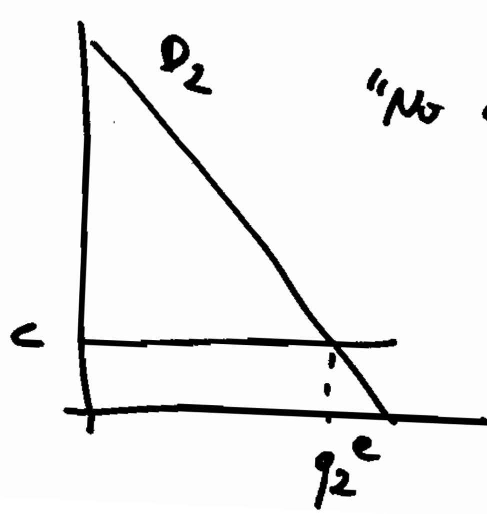
$\left.\begin{array}{l} (IC_2) \text{ binding} \\ \boxed{q_2 \geq q_1} \end{array}\right\} \Rightarrow (IC_1)$

$\Rightarrow$ Problem reduces to

$$\max_{\substack{q_1, q_2 \\ \text{s.t. } q_2 \geq q_1}} \left\{ \lambda v_1(q_1) + (1-\lambda)\left[v_2(q_2) - \left(v_2(q_1) - v_1(q_1)\right)\right] - c\lambda q_1 - c(1-\lambda) q_2 \right\}$$

<u>F.O.C.</u>: $\frac{\partial}{\partial q_2} = 0 \Rightarrow v_2'(q_2^*) = c$ or $p_2(q_2^*) = c$

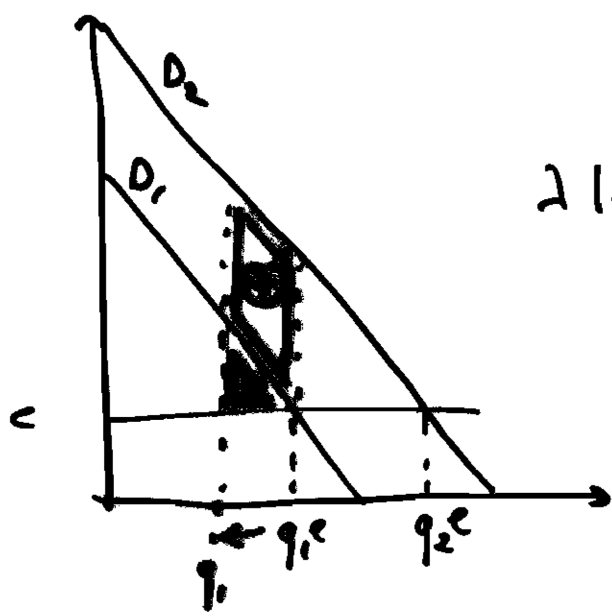
$\Rightarrow q_2^* = q_2^e$



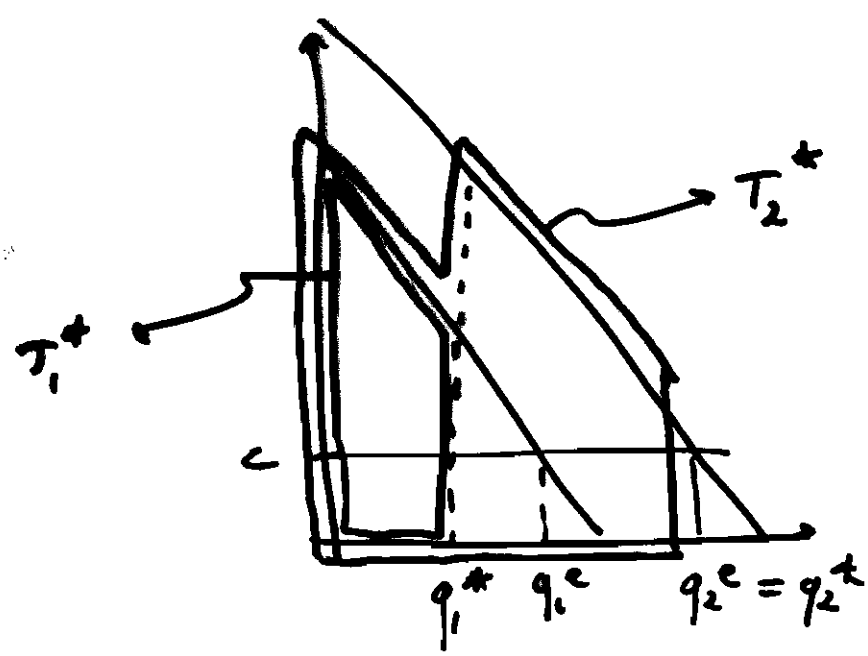
"No distortion at the top"

$$\frac{\partial}{\partial q_1} = 0 \Rightarrow \lambda\,(v_1'(q_1^*) - c) = (1-\lambda)\underbrace{(v_2'(q_1^*) - v_1'(q_1^*))}_{\substack{\parallel \\ (p_2(q_1^*) - p_1(q_1^*)) > 0}}$$

$$\Rightarrow v_1'(q_1^*) = p_1(q_1^*) > c \Rightarrow q_1^* < q_1^e < q_2^e = q_2^*$$



$\lambda\,|\ominus| < (1-\lambda)\,|\oplus|$



<u>Examples</u>

Tie-in Sales

General justifications for tie-in sales

Efficiency; evade regulations; secret price discounts; assure quality.

Tie-in Sales as a method of price discrimination

(bundling
(package tie-in sale

requirements tie-in sale

Package ~~tie~~-in sales of independent products

Package tie-in with both products monopolized

bundling may reduce variation in willingness to pay

$\Rightarrow$ less surplus left to consumers

Example

Mixed bundling with both products monopolized

- individual pricing
- pure bundling
- mixed bundling

Example

Assume $p_b \leq p_h + p_p$

<u>individual pricing</u>:

consumer (r_h, r_p) buys h iff $r_h \geqslant p_h$

p $\quad r_p \geqslant p_p$

<u>pure bundling</u>:

________________ bundle iff

$$r_h + r_p \geqslant p_b$$

<u>mixed bundling</u>:

________________ only h iff

$$r_h \geqslant p_h$$

$$p_b - p_h \geqslant r_p \iff \cancel{r_h} - p_h \geqslant \cancel{r_h} + r_p - p_b$$

________________ only p iff

$$r_p \geqslant p_p$$

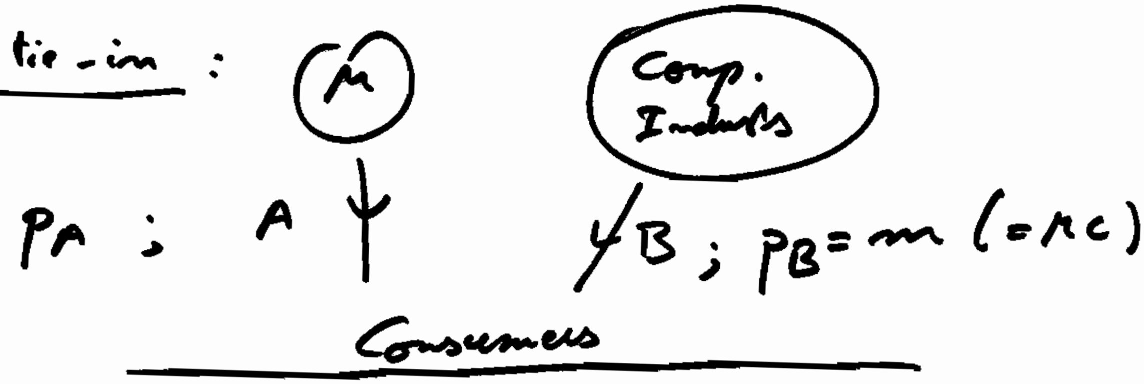
$$p_b - p_p \geqslant r_h \iff \cancel{r_p} - p_p \geqslant r_h + \cancel{r_p} - p_b$$

________________ bundle iff

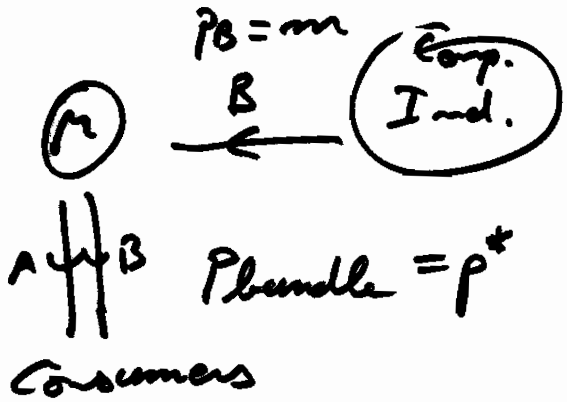
$$\left[\begin{array}{l} r_h + r_p \geqslant p_b \\ p_b - p_h \leq r_p \\ p_b - p_p \leq r_h \end{array}\right.$$

Package tie-ins with only one product monopolized

no tie-in :



tie-in :



[No tie-in with $p_A = p^* - m$ dominates
tie-in with $p_{bundle} = p^*$.

Interrelated Demands

(Package Tie-ins with interrelated demands)

Requirements Tie-ins with interrelated demands.

Quality choice

Other methods of nonlinear pricing

minimum quantities and quantity discounts,
selection of price schedules,
premium for priority.

Chapter 11: Strategic Behavior

(noncooperative) strategic behavior:

[______ in order to affect

actions by rivals

Whether strategic behavior can be successful depends on

(- advantage
- commitment (threats / promises must be credible)

Predatory pricing:

Dominant firm: ↓ price → (preys / rivals exit or are bought) → ↑ price

More generally: (signals / investments) → rivals less aggressive

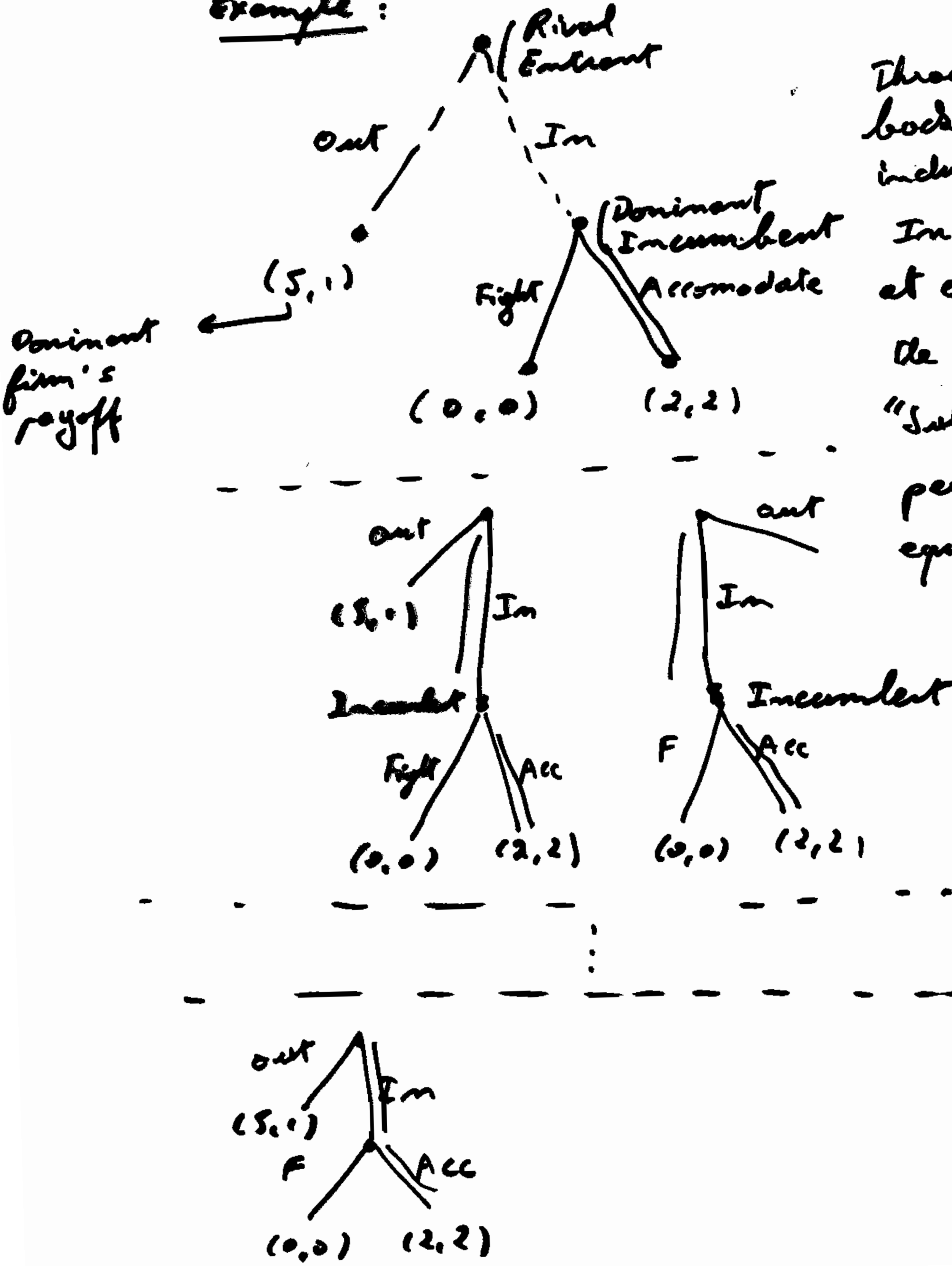
Examples of counter-measures by preys:

- merging
- long-term contracts with customers
- exit and reenter
  (↓ output during predation, ↑ output after

Problem for predator: commitment to predation

Example:

Finite # of periods



Through backwards induction: In, Accomodate at every Period is the only "Sub-game" perfect equilibrium. ("chain Store paradox")

Possible reasons commitment can be credible:

- ability to sustain bigger losses (less severe financial constraint)
- better information about
  - own cost / "type"
  - demand
- building reputation (across time, markets)

Limit pricing

Incumbent firm: ↓ price (↑ output) to deter entry

more generally: signals / investments to alter behavior of potential entrants

Example of model of limit pricing:

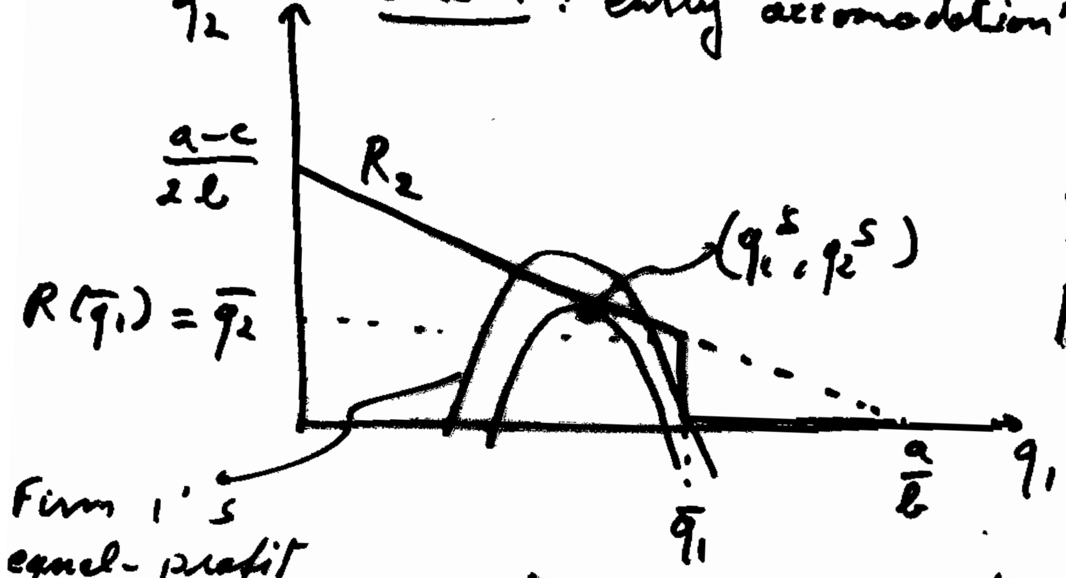
Stackelberg model where:

- incumbent is leader (1st mover)
- entrant with fixed entry cost is follower

$p(Q) = a - bQ$

$C_2(q) = \begin{cases} f + cq & \text{if } q > 0 \\ = 0 & \text{if } q = 0 \end{cases}$

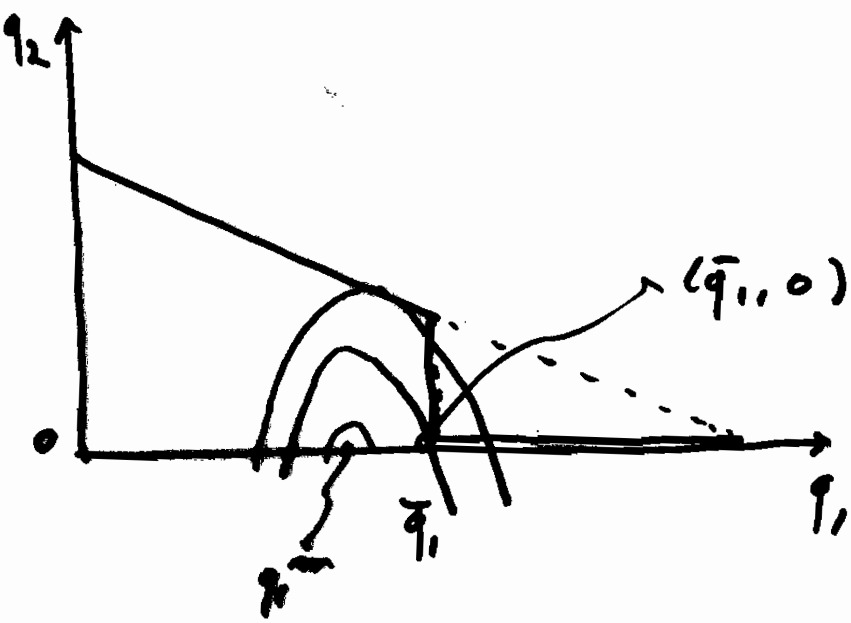
Case 1: "entry accomodation"



$\bar{q}_1$ s.t.

$p(\bar{q}_1 + R(\bar{q}_1)) = AC_2(R\bar{q}_1)$

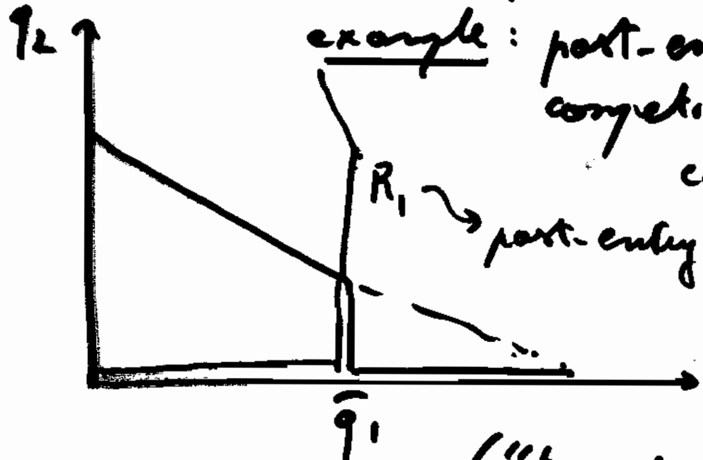
Case 2: "entry deterrence"



Blocked

Examples of ways to make commitment credible:

Initial investment in "inflexible" technology / capacity



example: post-entry Cournot competition

capacity $= \bar{q}_1$

R_1 → post-entry

("top-dog" strategy)
strategic substitutes

cost reducing investment (e.g. R&D)
learning by doing
:

example:

$p(Q) = 12 - Q$
$c_2(q) = 4q + 1$

entrant: Firm 2:

incumbent: Firm 1: $c_1(q) = 4q + 1$, at period 1 and at Period 2 if no R&D
$c_1(q) = 2q + 1$, at Period 2 if R&D

cost of R&D investment: 7.01

Post-entry Cournot competition

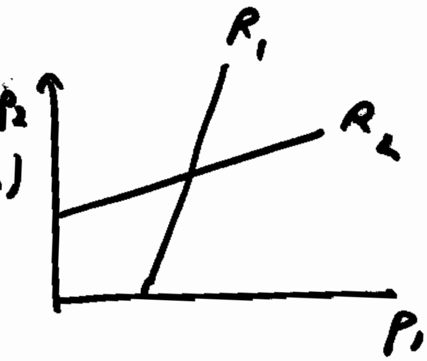
Period 1: Firm 1 chooses q_1; decides whether to invest in R&D

Period 2: Firm 2 decides to enter or not
If Firm 2 stays out: Firm 1 monopoly
enters: Cournot competition

Tying

Market B : (Differentiated goods B_1, B_2
(imperfect substitutes

If Firm 2 enters : • fixed cost of entry
• Bertrand competition
(strategic complements)

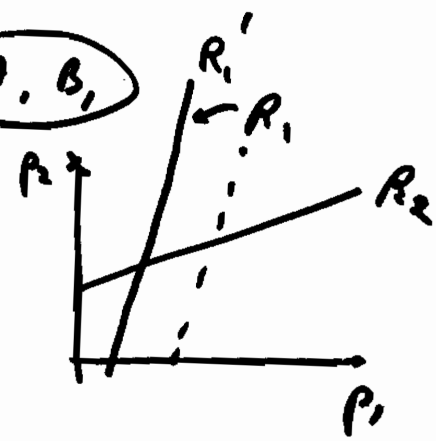


If Firm 2 stays out : Firm 1 monopoly

Market A : Firm 1 monopoly

Firm 1 can deter entry by tying (A, B_1)

Market B : post-entry



(top-dog strategy
strategic foreclosure)

Raising Rivals' Costs

Raising Rivals' Relative costs : Direct methods, interference through Government regulation, raise switching costs, raise input prices

Raising all firms' Costs

Example : $\pi_m = 100$; $\pi_{d1} = \pi_{d2} = \frac{\pi_d}{2} = \frac{80}{2} = 4$

Chapter 12: Vertical Integration and Vertical Restrictions

Some Reasons for and against vertical integration:

Integration to lower "transaction costs".

Specialized assets:

Idiosyncratic Investment
and asset specificity
⇒ "Bilateral Monopoly"
⇒ • inefficient volume of trade, when imperfect information
• —— Investment, due to "hold-up problem"

Types of specific assets:

Specific physical assets
Specific human capital
site-specific capital

Uncertainty

Transactions involving information

Extensive coordination

Integration to assure supply

→ **Theories of the firm**:

- Vertically integrated firm as a long-run relationship. (contractual view)

- Vertically integrated firm as a solution to incompleteness of contracts:
  → due to transaction costs

  [optimal allocation of "authority"
  → through
  - ownership
  - employer - employee relationship.

Integration to avoid government intervention.

Integration to increase monopoly profits:

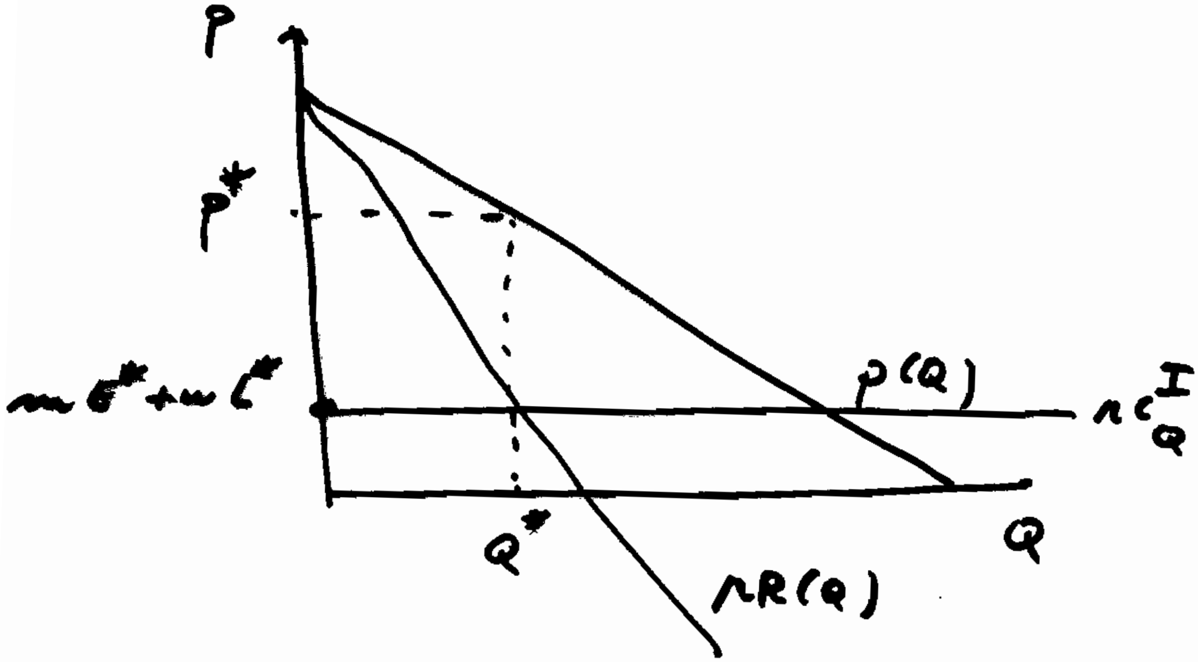
Examples:

No Integration: $\boxed{\text{Mon.};\ MC_E(E)=m}$ $\boxed{\text{Comp. Ind.};\ MC_L(L)=w}$

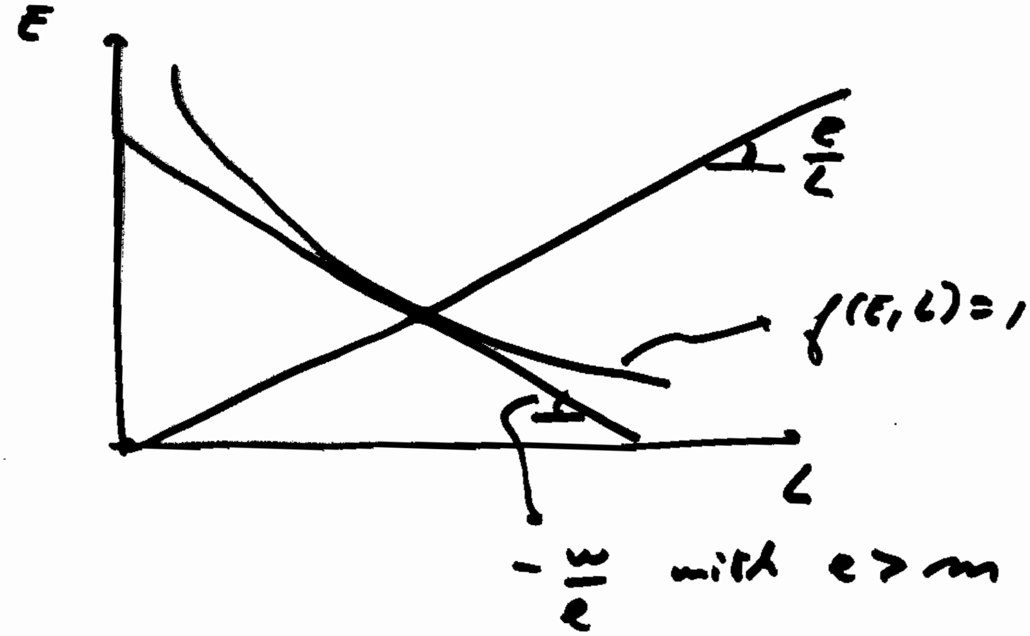
$E,\ e \searrow$ $\swarrow w,\ L$

f cstt returns to scale $\boxed{\text{Comp. Ind.};\ Q=f(E,L)}$

$\downarrow P,\ Q$

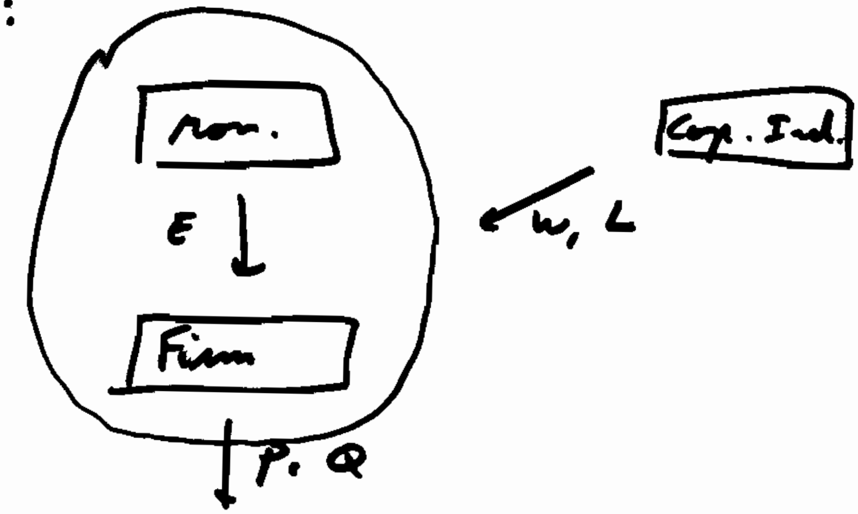


If no integration:



→ incentive for vertical integration

If integration:



Example 1: Fixed-proportion production function

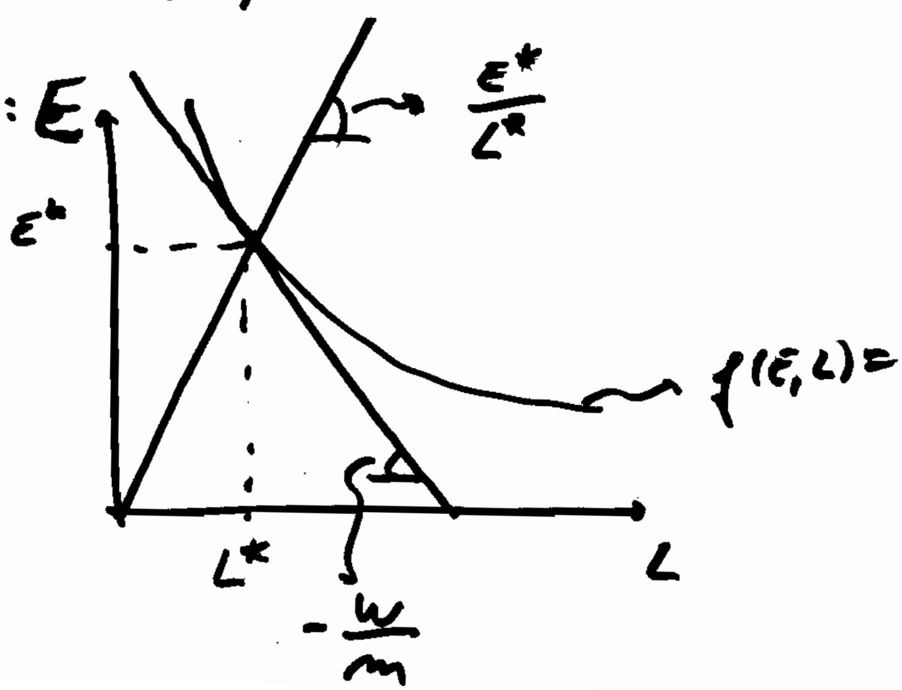
$$f(E, L) = \min(E, L)$$

→ no incentive for vertical integration

"a monopoly of bolts is as good as a monopoly of nuts and bolts"

Example 2: Variable-proportions production function.

If integration:

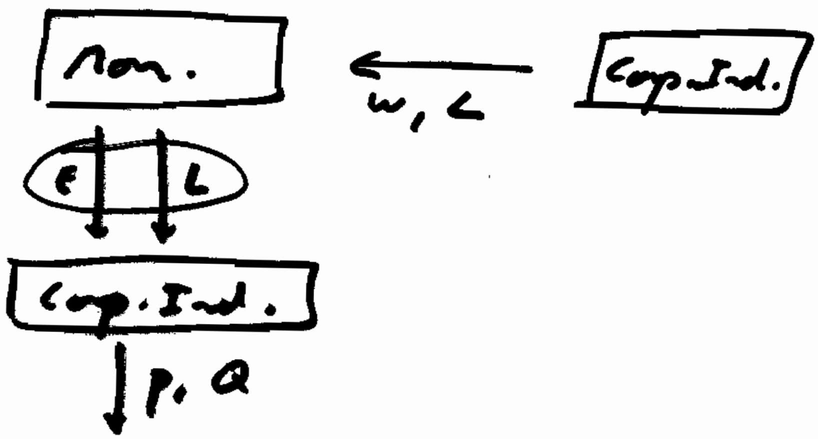


[In order to maximize joint profits:

$$MC_Q^I(Q) = mE^* + wL^*$$

<u>Remark</u> : outcome equivalent to vertical integration can be attained through vertical restrictions.

For example :
package tie-in sale



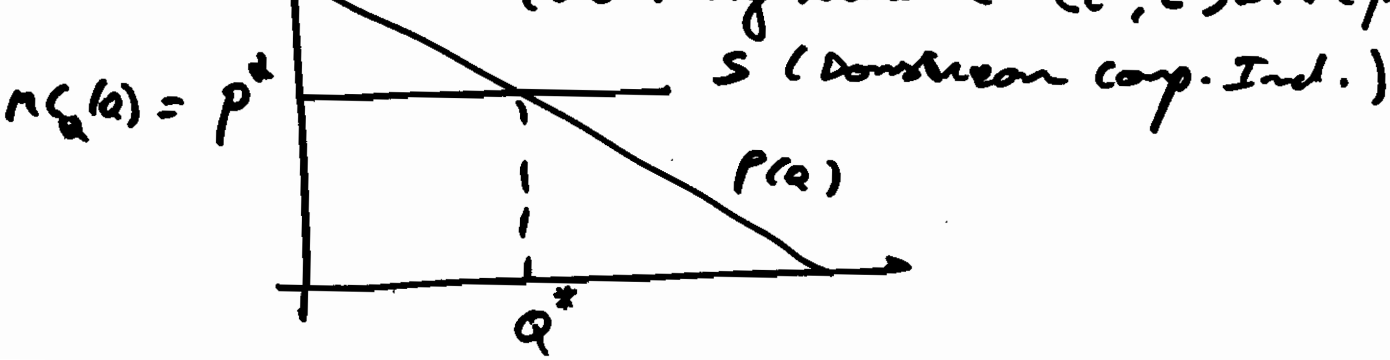
<u>1 package bundle</u> : $\left\{ \begin{array}{l} 1 \text{ unit of } L \\ \frac{E^*}{L^*} \text{ unit of } E \end{array} \right.$ <u>price of Bundle</u> : p_B

$$\Rightarrow MC_Q(Q) = L^* \cdot p_B$$

choose p_B s.t. $MC_Q(Q) = p^*$

$$\Rightarrow p_B = \frac{p^*}{L^*}$$

(or 1 "big" bundle (E^*, L^*) at the price p^*)



Price Discrimination

Integration to eliminate market power

The Life Cycle of a Firm

Vertical Restrictions

Vertical restrictions used to solve problems in Distribution : principal-agent problem

Double monopoly markup :

$\boxed{\text{Mon.}} \to \boxed{\text{Mon.}}$

→ incentive to integrate

outcome equivalent to integration through vertical restrictions:

Examples :

→ $p_2 = p^*$ and quantity forcing $q \geq q^*$

or

→ $p_2 = p^*$ and price ceiling. $p_1 \leq p^*$ (resale price maintenance)

or

→ 2-part tariff (Franchise)

$$\begin{cases} p_2 = m \\ F = \pi^* \end{cases}$$

Remark:

No Double mark-up if

$\boxed{\text{Mon.}} \to \boxed{\text{Comp. Ind.}}$

⇓

promote competition among distributors

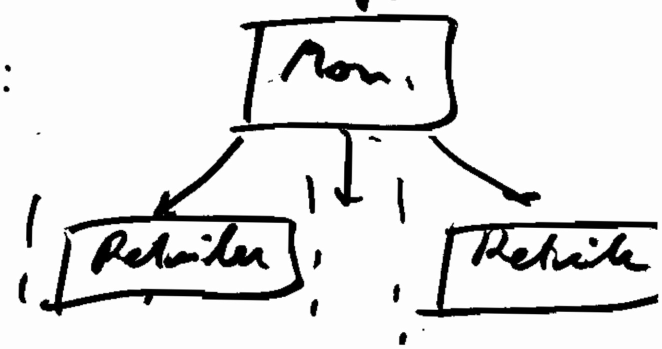
under-provision of services / quality by distributors

Free Riding among Distributors

when : services offered by retailers
advertising
pre-sale information
certification ; reputation of product

Possible Vertical Restrictions :

exclusive territories :



limit # of distributors : $n \le \bar{n}$

resale price maintenance : $p \geq \underline{p}$

monitor quality

Externalities due to lack of coordination among distributors

Free Riding by Manufacturers : exclusive dealing

The Effects of Vertical Restrictions

Franchising

Empirical Evidence