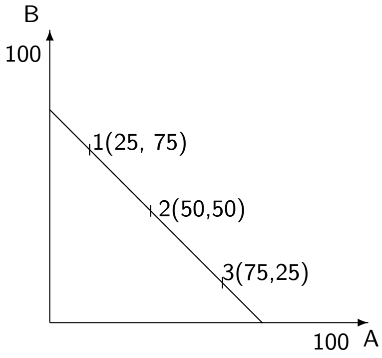
# Reasons for Bundling:

1. Price discrimination.
2. Leverage Theory: Extending the monopoly power of a monopolist from one market to the other.

# McAfee, McMillan and Whinston (1989)

- Provide conditions under which bundling is a profitable strategy in discriminating consumers.
- Some preliminaries:

  The rationale: To exploit the difference of consumers' willingness to pay.



- By charging a bundled price of \$100, the firm can exploit all consumer surplus of all consumers.
- Question: Under what condition is bundling always better than unbundling?

# Model

- One monopolist, two goods (1 & 2). Good i is produced with constant MC, $c_i$.
- A consumer buys good i if its price $P_i$, is lower than the utility it brings, $V_i$.
- Distribution of consumers' tastes: $F(V_1, V_2)$; $f(V_1, V_2)$: its density. $g_i(V_1|V_2)$: conditional density. $G_i()$ and $H_i()$ are corresponding distribution functions.

- pure bundling: The firm offers bundled good only.
- mixed bundling: The consumers are allowed to buy both bundled good and separately.
- mixed bundling dominates pure bundling.

  This is because for any pure bundling with price $P_B$, we can always create a mixed bundling with $(P_B, P_1 = P_B - C_2, P_2 = P_B - C_1)$, which makes at least equal profit.

- Proposition 1:

  Let $(P_1^*, P_2^*)$ be the optimal non-bundling prices. Mixed bundling dominates unbundled sales if

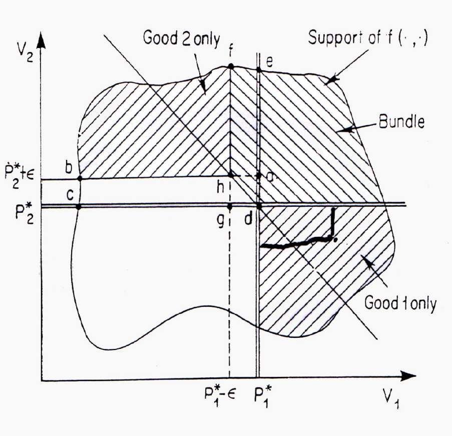
$$\int_0^{P_1^*} \{[1 - G_2(P_2^*|s)] - g_2(P_2^*|s)(P_2^* - c_2)\} h_1(s) ds$$
$$+ (P_1^* - c_1)[1 - G_2(P_2^*|P_1^*)] h_1(P_1^*) > 0. \tag{1}$$

- $P_1^* + P_2^* = V_1 + V_2$

  Create a bundle with price $P_1^* + P_2^*$

  Raise price of good 2 to be $P_2^* + \varepsilon$

  Keep price of good 1 unchanged.



- Corollary 1.

  If $V_1$ and $V_2$ are independently distributed, then bundling dominates unbundled sales.

- *Proof of Corollary 1.*

  For the case of independently distributed reservation values, condition (1) reduces to (note that $h_i(P) = g_i(P|s)$ for all $(P, s)$ and $i = 1, 2$):

$$H_1(P_1^*)\{[1 - H_2(P_2^*)] - h_2(P_2^*)(P_2^* - c_2)\} \\ + (P_1^* - c_1)h_1(P_1^*)[1 - H_2(P_2^*)] > 0. \tag{2}$$

  But, if $P_2^*$ is the optimal unbundled price for good 2, then the first term in (2) is equal to zero, so that (2) reduces to

$$(P_1^* - c_1)h_1(P_1^*)[1 - H_2(P_2^*)] > 0. \tag{3}$$

Now, by the assumptions of no atoms and existence of a positive measure of valuations above cost, $(P_1^* - c_1)[1 - H_2(P_2^*)] > 0$. Also, under our continuity assumption it must be that $h_1(P_1^*) > 0$ (again, from the non-bundling first-order condition). Thus, condition (3) holds, and a local gain from bundling is possible.

# Chen (1997)

- Considers the incentive to bundle for two firms which are duopolists in one market, and there is perfect competition in the other.
  - Two firms: A, B
  - Two goods: X, Y
  - $MC$ for X is c, and $c_Y$ for Y
  - A continuum of consumers with mass 1.
  - Consumers are identical, whose valuation for X is r.
  - Demands for X and Y are independent. Only one X is needed.
  - Valuation for Y is v, which is stochastic with density $g(v)$.

  $G(v)$ is corresponding distribution function.

$$v \in [\underline{v}, \overline{v}], \ \underline{v} < c_Y < \overline{v}.$$

# Two-stage game

- 1st stage: Firms decide whether to

  (i) sell X only; or

  (ii) sell X & Y as bundle (XY); or

  (iii) sell both X and XY at the same time.

- 2nd stage: The firm decides the prices for its products. Thus the 2nd stage is a Bertrand competition.

  There are 4 possible subgame in 2nd stage:

  (X, X), (X, XY), (XY, X), and (XY, XY). First exclude the possibility of mixed bundling. (i.e., (iii) above). This will be justified.

- Solution: (pure strategies only)
- Case one, (X, X):

  Both offer $P_X = c$ and make zero profit.
- Case two, (XY, XY):

  Both offer $P_{XY} = c + c_y$ and make zero profit.
- Case three, (XY, X) or (X, XY):

  (1) At any equilibrium, $P_X > c$, $P_{XY} > c + c_Y$. That is, both firms make positive profits.

  (2) In equilibrium, one firm offers X, and the other XY.

- Reason for (1):

  For a consumer with valuation v for Y, whether he will buy X or XY

  depends on the relative size of

  $v - P_X$: utility for buying Y, and

  $r + v - P_{XY}$: utility for buying XY.

- The # of buyers for X is thus

$$q_X(P_{XY}, P_X) = \begin{cases} G(P_{XY} - P_X); \text{ if } P_{XY} - P_X < c_Y, P_X \leq r \\ 1; \text{ if } P_{XY} - P_X \geq c_Y, P_X \leq r \\ 0; \text{ if } P_X > r. \end{cases}$$

- Demand for XY is thus $1 - q_X$, if $P_X \leq r$.
- Profit for firms selling X and XY are, respectively,

$$\pi_X = (P_X - c)q_X(P_X, P_{XY}),$$

$$\pi_{XY} = (P_{XY} - c - c_Y)q_{XY}(P_X, P_{XY}).$$

- Suppose $P_X^*$ and $P_{XY}^*$ are equilibrium prices. Then

  $\pi_X(P_X^*, P_{XY}^*) \geq \pi_X(c+\varepsilon, P_{XY}^*)$ (obviously, $P_X^* \geq c$ and $P_{XY} \geq c + c_Y$)

  $\geq \varepsilon G(P_{XY}^* - (c+\varepsilon)) \geq \varepsilon(c_Y - \varepsilon) > 0$

  if $\varepsilon$ is small enough.

  This implies $P_X^* > c$, $\pi_X^* > 0$.

- Given that $P_X^* > c$, we can set $\delta > 0$ small enough so that $c + c_Y + \delta < P_X^* + c_Y$ , and under that price the # of buyers for XY is at least $1 - G(c_Y) > 0$. That means it must be that $P_{XY}^* > c + c_Y$ and $\pi_{XY}^* > 0$. QED

- (2) follows immediately from (1).
- Note that this argument critically depends on the assumption of Bertrand competition.
- FOC:

$$P_X - c - \frac{G(P_{XY} - P_X)}{g(P_{XY} - P_X)} = 0,$$

$$P_{XY} - c - c_Y - \frac{1 - G(P_{XY} - P)}{g(P_{XY} - P_X)} = 0.$$

- A unique pair $(P_X^*, P_{XY}^*)$ solves FOC if

$$\frac{d\frac{g(v)}{G(v)}}{dv} \leq 0, \text{ and } \frac{d\frac{g(v)}{1-G(v)}}{dv} \geq 0.$$

- $P_X^* > P_{XY}^* - c_Y$: There is transfer of surplus form consumers to firms in the X market. However, dead-weight loss occurs when consumers with $v < c_Y$ buy the bundle XY.

- When bundling is allowed, producers of X are better off, and consumers worse off. Social welfare reduces.
- Even if the Y market is competitive, firms in X market can still benefit from bundling, because it provides a useful way to differentiate X and thus gain market power.
- Example: $g(v) = 1$, $0 \leq v \leq 1$, $c + 2/3 < \gamma$, $(3\sqrt{5} - 5)/2 \leq c_Y < 1$.
  Then $P_X^* = c + (1 + c_Y)/3$ and $P_{XY}^* = c + 2(1 + c_Y)/3$.
  $\Pi_x^* = [(1 + c_Y)/3]^2$ and $\Pi_{XY}^* = [(2 + c_Y)/3]^2$.
  Consumers with $(1 + c_Y)/3 < v < c_Y$ buy XY and consume Y. There is inefficiency.

- When mixed bundling is allowed: When both firms offer (X, XY), both earn zero profits. When one firm offers XY and the other (X, XY), the former makes zero profit and the latter $\Pi^*$, with $0 \geq \Pi^* < \Pi_X^*$.
- Mixed bundling is thus a weakly dominated strategy.
- Sharp contrast to McAfee et. al.

  Intuition: Product differentiation role is undermined if mixed bundling is offered.

- Firm selling X earns higher profit than firm selling XY.

  The game is somewhat like a battle- of-sex game, in that every firm would like the opponent to bundle in order to soften competition. But will itself bundle if it expects the other firm not to.

| | A | B |
|---|---|---|
| A | 3,3 | 2,1 |
| B | 1,2 | 3,3 |

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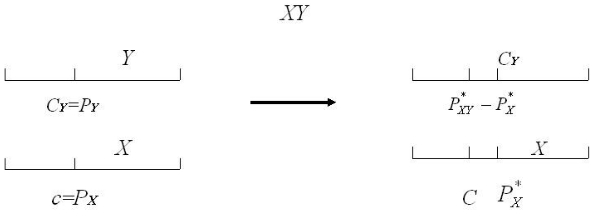


- Contrary to conventional wisdom, mixed bundling is dominated by pure bundling.

# Literature review

- Schmalensee: monopoly competitive bundling is useless.
- Chen: oligopoly+ competitive; bundling useful.
- Whinston: monopoly + oligopoly; bundling useful.

# Topics to pursue

(1) Oligopoly + oligopoly

prisoners' dilemma?

(2) Bundling goods are usually complements

e.g. Explorer + window

cable + program

printer + cartridge

phone + internet

(i) What are the effects when we make special assumptions on characteristic of commodities?

(ii) In particular

- Perfect complement
- One good requires the other to use, but not the other way round.