Bundling

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Introduction

• Sale of two or more products in fixed (or variable) combination
• Related to tie-in-sales (can buy 2 only if already bought 1)
• hardware-software, printer-ink, tv-channels, restaurant-menus, libraries-portfolio subscriptions
• Pure (only the bundle is sold) vs. mixed bundling (the individual components and the bundle are sold).
• Variations
  • premium: buy bundle at a higher price, e.g. open source software vs. commercial packages
  • cross-couponing: buy 1 and get a coupon to buy 2 at a lower price
Cases

- Jefferson Parish (tying: hospital and exclusive contract with anesthesiology practice)
- Tetra-Pak (packaging equipment and cartons)
- GE-Honeywell (avionics and airplanes)
- BSkyB (digital TV and channels)
- Microsoft (OS+browser+media player)

Recent DP on art.82
Tying, bundling may have exclusionary effects if

1. there is pre-existing dominance
2. the products tied or bundled are distinct
3. the practice is likely to have foreclosure effects
4. there is no efficiency or objective justification for the practice
Chicago View: “There is only one monopoly”

If monopoly price on 1 is $p$ and there is competition on 2 (price $c$). Bundle price $p'$ leads to a profit of $p' - c$: but then consumers who buy 2 are willing to pay $p' - c$ for 1: no need to bundle.

- No possibility of leveraging market power: only if 2 is competitive.
- Ignores heterogeneity of consumers
- Value of ‘incremental’ good may differ accross consumers

(Stigler 1963): goods 1, 2, agents $i, j$, valuations

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<td>2.5</td>
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<td>$j$</td>
<td>7</td>
<td>3</td>
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<td>individual pricing</td>
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A Guide to the Literature

Monopoly

- Stigler (1968): pure bundling (block booking of movies), price discrimination.
- Adams-Yellen (1976): introduce mixed bundling
- MacAfee-McMillan-Whinston (1989): conditions on distributions for which bundling is optimal for a monopoly
- Rochet-Chon (1998), Armstrong (1996): generalize previous results
- Whinston (1990), Nalebuff (2002): entry deterrence
Competition

- Spulber (1979): Hotelling
- Cournot (1838), Matutes-Regibeau (1992): (complementary) single product firms, incentives to bundle or to be compatible.
- Armstrong-Vickers (2006): one or two-stop shopping
Optimality of Bundling and Correlation of Values

- Adams-Yellen (1976): examples where bundling is optimal for a monopoly; suggest negative correlation in values leads to bundling.

  - monopoly
  - two goods with marginal costs $c_1, c_2$
  - consumers have valuations $(v_1, v_2)$ with distribution $F$.
  - Conditional distribution $G_i(v_i|v_j)$
  - Marginal distribution $H(v_i)$

- Pure bundling dominated (absent other considerations...) by mixed bundling: offer prices $p_1, p_2, P_B$ for individual purchases and bundle

- Issue of monitoring of purchases (can the monopoly prevent to buy goods 1 and 2 separately? If not, $p_B < p_1 + p_2$ is necessary.)
When is Bundling Optimal?

Idea

- Start from optimal individual prices (ignoring the possibility of bundling) $p_i^*$.
- Introduce bundle at price $p_B = p_1^* + p_2^*$, and increase price of 2 to $p_2^* + \epsilon$.
- Then Bundling becomes preferred by agents who purchased both goods initially.
- Check that profit is larger.

(Idea refined and simplified by Armstrong)
• Optimal individual prices, \( \max_{p_i}(p_i - c_i) \int_{p_i}^\infty dH_i(v_i) \): \( p_i \) solves

\[
1 - H_i(p_i) - (p_i - c_i)h_i(p_i) = 0
\]

• Consumer \( v \) prefers bundling if

\[
v_1 + v_2 - p_B \geq \max_i \{v_i - p_i\}
\]

• Starting from \( p_B = p_1 + p_2 \), consumer buys bundle only if \( v_1 \geq p_1 \) and \( v_2 \geq p_2 \).

• Effect of increasing \( p_2 \) to \( p_2 + \epsilon \)?
  1. Gains \( \epsilon \) on consumers who buy 2
  2. Lose some consumers who bought 2 before
  3. gains consumers who buy the bundle since \( p_B < p_1 + p_2 + \epsilon \):
     need \( p_2 - v_2 \geq 0 \) and \( p_1 - v_1 - \epsilon \geq 0 \)
\[ p_2 = p_1 - \epsilon \]
Buy Bundle

\[ p_2 + \epsilon \]

\[ p_2 \]

\[ p_1 - \epsilon \]

\[ p_1 \]
\[ p_2 + \epsilon \]

\[ p_1 - \epsilon \]

\[ p_1 \]

\[ p_2 \]

\[ (1) \]

\[ (2) \]

\[ (3) \]

Buy Bundle
Competition Policy

Monopoly

Competition

Other

\[ v_1 \]

\[ v_2 \]

\[ p_2 + \epsilon \]

\[ p_2 \]

\[ p_1 - \epsilon \]

\[ p_1 \]

\[ \text{Buy Bundle} \]

\[ \text{gains } \epsilon \]

\[ \text{gains } p_1 \]

\[ \text{loses } p_2 \]
• If $v_1, v_2$ are i.i.d., then $(1) + (2) \approx 0$ for small $\epsilon$.
• Hence, total effect is positive (since (3) is first-order): with i.i.d. valuations, bundling is optimal.
• Generally, the condition for $\epsilon > 0$ to yield a net gain is

$$
\int_0^{p_1} \left[ (1 - G_2(p_2|x)) - g_2(p_2|x)(p_2 - c_2) \right] h_1(x) \, dx + \\
(p_1 - c_1) \left[ 1 - G_2(p_2|p_1) \right] h_1(p_1) > 0
$$

• With i.i.d., boils down to

$$
H_1(P_1)[(1 - H_2(p_2)) - h_2(p_2)(p_2 - c_2)] + (p_1 - c_1)(1 - H_2(p_2))h_1(p_1) > 0
$$
Leverage and Exclusion

- Remember Chicago view: not possible to leverage monopoly power into a competitive market. But what if the other market is not competitive (e.g., oligopolistic)?
- Entry deterrence because shifting to entrant offering only on product is more costly when the incumbent offers a bundle (foregoes the other good!)
- Leveraging most effective when valuations are *positively correlated*: opposite situation of when bundling for PD is likely to be optimal (negative correlation of values)
- Intuition: if positive correlation, an entrant offering only one product is at a disadvantage.
Nalebuff, QJE 2004

- Incumbent produces 1 and 2 at zero cost
- Entrant can enter either 1 or 2, entry cost $E$
- Consumers have valuations $v \in [0, 1]^2$, i.i.d., uniformly distributed
- Independent monopoly prices

$$\max_p p \int_p^1 dv \Rightarrow p = 1/2, \text{ total profit } = 1/2$$

- At these prices, an entrant can get the whole market by pricing just below 1/2: hence an entrant gets half the total profit of the monopoly if it enters. As long as $E \leq 1/4$, there is entry.
- What if the incumbent sells only a bundle at price $p_B = 1$?
Pure Bundling Effect

- Now, an entrant (say in 2) has to set a price low enough that consumers get a positive surplus and *are compensated* from foregoing the consumption of 1 (since 1 is only offered in a bundle)
- By setting a price $y$ for 2, the entrant can attract all consumers $v$ for which $v_2 \geq y$ and $v_2 - y \geq v_1 + v_2 - 1$
- Hence demand facing the entrant is $(1 - y)^2$, and his entry price maximizes $y(1 - y)^2$ leading to $y = 1/3$ and a profit of $4/27$, which is strictly less than the profit of $1/4$ he fetches when the incumbent does not use a bundle.
- ‘Pure bundling effect’: using pure bundle makes entry more difficult because of the higher opportunity cost of consumers to shift to the entrant.
Bundle Discount Effect

• But things are even better for the incumbent because by offering the bundle at a discount w.r.t. independent prices, it also increases his profit

• Indeed, if the bundle price is $x \leq 1$, the demand facing a monopoly incumbent is

$$\int_0^x \left( \int_{x-v_1}^1 dv_2 \right) dv_1 + (1 - x) = 1 - x^2 / 2$$

leading to a monopoly price of $x = \sqrt{2/3}$

• Since the bundle price is lower, the entrant will make even less profits at any price: by optimizing on ‘bundling profits’ the incumbent makes entry more difficult!
• Incentives to decrease $x$ even more. Indeed, incumbent foregoes some monopoly profits in exchange for entry deterrence: the first effect is second order, the second effect is first order.

• Positive correlation helps: suppose for instance that $v_A = v_B$, then with a bundle price of 1, an entrant in the 2 market pricing at $y$ attracts consumers $v_2 \geq y$ and $v_1 \leq 1 - y$. If $y \geq 1/2$, there is no demand, if $y = 1/2$, there is a measure zero of agents, if $y \leq 1/2$, the demand is limited to the segment $[(y, y), (1 - y, 1 - y)]$, that is a measure $1 - 2y$.

• Compare this with the case of perfect negative correlation: with a price of $y$, the entrant gets the segment $[(0, 1), (1 - y, y)]$, that is a measure $1 - y$.

• What if entrant can enter in both markets at the same time? Need to consider competition between multiproduct firms.
Competition

- Welfare consequences under uniform and nonlinear pricing quite different, as when consumers do one stop shopping versus multi-stop shopping
One-Stop Shopping

- Two firms at 0 and 1 on Hotelling line
- Consumers are horizontally \((x)\) and vertically differentiated \((\theta)\): \(x \sim U[0, 1]\), transportation cost \(t\), and \(\theta \sim F\); \(x, \theta\) i.i.d.
- Consumer: \(u(\theta, q) - pq\)
- Firms: schedule \(T(q)\)
- Given \(T(q)\), consumer gets utility

\[
v(\theta, T) = \max_q u(\theta, q) - T(q)
\]

and firm A’s market share is

\[
s(v_A, v_B) = \frac{1}{2} + \frac{u_A - u_B}{2t}
\]
Efficient pricing

As long as consumers always buy the products, the unique symmetric equilibrium is attained when \( T(q) = t + \sum_i c_i q_i \)

Proof

1. Show that marginal cost pricing is profit maximizing in two-part tariffs
2. It follows that all equilibria are of the form \( T(q) = \pi + cq \)
3. Show that \( T(q) = t + cq \) is an equilibrium
4. Show that \( T'(q) = \pi + cq \) cannot be a symmetric equilibrium
Show 1: mc Pricing is Optimal In Two-Part Tariffs

- W.l.o.g., consider a one product world
- If $T(q) = f + pq$, the indirect utility is $v(p) = \max_q u(q) - pq$
- Optimal quantities are $q(p)$ and $v'(p) = -q(p)$, or

$$v(p) = v(c) - \int_c^p q(x) dx$$

- Let $\pi = f + pq(p)$ the profit; consider the schedule $T'(q) = f' + cq$, such that $v(c) - f' = v(p) - f$. Then the firm makes more profit $\pi' > \pi$:

$$\pi' = f'$$

$$= v(c) - v(p) + f$$

$$= \int_c^p q(x) dx + f$$

$$> pq(p) + f$$
Show 2: Equilibria are $T(q) = \pi + cq$

- Consider an equilibrium where utility from consumption of $A$ and $B$ are $v_A - f_A$ and $v_B - f_B$.
- As long as these utility levels are the same, the market shares of the firms are the same.
- From step 1, there exists $f'$ such that by deviating to $T(q) = f' + cq$, firm $A$ gives the same utility level to consumers but makes higher profits.
Show 3-4: \( T(q) = t + cq \) is the unique symmetric equilibrium

**Step 3**

- Suppose \( A \) deviates to \( T(q) = f + cq \)
- Profit is
  
  \[
  f \left( \frac{1}{2} + \frac{t - f}{2t} \right)
  \]
  
  and is maximum for \( f = t \)

**Step 4**

- Suppose another equilibrium \( T(q) = f + cq \) with \( f \neq t \) and industry profit \( \pi = f/2 \)
- Suppose \( A \) deviates to \( T'(q) = f' + cq \)
- Profit of \( A \) is
  
  \[
  f' \left( \frac{1}{2} + \frac{f - f'}{2t} \right)
  \]
  
  maximum at \( f' = \frac{f + t}{2} \neq f \)
Welfare with One-Stop Shopping

- Total surplus and profits are higher with two-part tariffs than uniform prices
- Consumer surplus may be lower (e.g., if demand functions are linear in prices) with two-part tariffs.
Two-Stop Shopping (MR 1992, AV 2006)

- Now, consumers can ‘mix and match’
- Consider two products for each firm
- Hotelling for both 1 and 2: consumer $x = (x_1, x_2)$, density $f$ on $[0, 1]^2$
- Shopping cost $z$: $z = \infty$ is like one-stop shopping, $z = 0$ means that there is no cost of mixing brands, $z$ small wrt $t$
- For given prices $p_1, p_2$ the bundle is offered at discount $\delta$
Graphical Representation

- Buy from $A$: $p_1^A + p_2^A - \delta^A + t(x_1 + x_2)$
- Buy $A_1, B_2$: $p_1^A + p_2^B + t(x_1 + 1 - x_2) - z$
- Buy from $B$: $p_1^B + p_2^B - \delta^B + t(2 - x_1 - x_2)$
- Buy $A_2, B_1$: $p_1^B + p_2^A + t(x_2 + 1 - x_1) - z$

Role of Bundling

- ‘Excessive loyalty’: the discount makes one-stop shopping more likely.
- ‘Excessive marginal prices’: usual Hotelling problem, amplified the lower is the discount offered in the bundle.
In a Symmetric Equilibrium ($z = 0$)

\[
\frac{1}{2} - \frac{\delta}{2t} \quad \frac{1}{2} + \frac{\delta}{2t} \\
A_1, B_2 \\
A_2, B_1
\]
• If $A$ increases prices by $\epsilon$ and discount by $2\epsilon$: no change for one stop shoppers but two stop shoppers buy from $B$ more often

\[
\frac{1}{2} + \frac{\delta}{2t}
\]
• If $A$ decrease the price of $p_1$: 

\[
\frac{1}{2} - \frac{\delta}{2t}
\]

\[
\frac{1}{2} + \frac{\delta}{2t}
\]
Find Equilibrium

- Integrate along the red lines
- In equilibrium, profits, surplus and consumer surplus are larger with bundling than no bundling if the hazard rates have a large enough variation. For instance holds for uniform distribution.
Other

- Information goods (Bakos-Brynjolfsson 1999, 2000): LLN, bundling decreases heterogeneity; benefit to bundle increasing in its size.

Empirical Work

- G. Crawford: Cable TV (+4% profits, -3.3% CS)
- P. Leslie: Broadway theaters (cf Estelle)