Bundling Revisited: Substitute Products and Inter-Firm Discounts

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Bundling revisited

- Standard bundling model assumes
  - valuations are additive
  - bundle discounts only offered for products supplied by same firm
- Assumptions are related:
  - with additive valuations, little motive to base price on whether customer buys from other firm
- This paper relaxes these assumptions
  - analyzes motive to introduce bundle discounts when products are partial substitutes
  - both by integrated firm and by separate sellers
  - investigates "partial tariff coordination" by sellers

Overview

- Incentive to bundle exists when demand for bundle is elastic compared to stand-alone items
- Separate sellers often wish to offer discount if customer buys rival product
- more substitutability makes
  - integrated firm set *higher* linear price
  - separate sellers set *lower* linear price
- Bundle discounts make substitute products more like complements
  - induce integrated firm to lower its price
  - induce separate sellers to raise their price
  - can act as collusive device by separate sellers

Related literature

- Long (1984):
  - clever analysis of integrated firm's incentive to bundle
  - uses standard demand theory rather than detailed analysis of 2-D joint distributions of additive valuations
  - works nicely with non-additive valuations
- Schmalensee (1982), Lewbel (1985):
  - analyze (with numerical examples) incentive of single-product monopoly to bundle with competitive product
  - incentive there if negative correlation or partial substitutes
- Gans & King (2006): Four-product example, where sellers of two products form "alliance" and agree in advance to set bundle discount
- Lucarelli *et al.* (2010): Differential pricing of drugs depending on "stand alone" or "cocktail'

Integrated firm (Long, 1984)

- Integrated firm sells two symmetric products
  - consumers have unit demand for each product (might want both)
  - $X_1(p)$ is number of consumers who want a single item given linear price p
  - $X_2(p)$ is number of consumers who want both items given linear price p
- Firm has incentive to offer discount for buying two items when

$$-\frac{X_1'}{X_1} < -\frac{X_2'}{X_2}$$

- With additive valuations (v_i is valuation for product $i = 1, 2$ on its own, $v_{12} = v_1 + v_2$), condition becomes

$$\Pr\{v_2 \geq p \mid v_1 \geq p\} \text{ is decreasing in } p \qquad (\clubsuit)$$

Separate sellers I

- Firm i is sole supplier of product i, sets linear price p_i
  - $q_i(p_1, p_2)$ is number of consumers who buy only product i
  - $q_{12}(p_1, p_2)$ is number of consumers who buy both items
- Firm i has incentive to offer a lower price to those customers who also buy rival product when

$$-\frac{1}{q_i}\frac{\partial q_i}{\partial p_i} < -\frac{1}{q_{12}}\frac{\partial q_{12}}{\partial p_i}$$

- With additive valuations, need negative correlation in valuations:

$$\Pr\{v_2 \geq p \mid v_1\} \text{ is decreasing in } v_1$$

- With substitutes (e.g., value of bundle is $v_{12} = v_1 + v_2 - z$) incentive is common

Separate sellers II

- However, if fraction of consumers have additive preferences and fraction only want one item:
  - a seller wants (if feasible) to charge a *premium* if consumer also buys other product
  - so seller's incentives depend sensitively on details of product substitution
- Implementation:
  - when just one firm wants to offer discount, could ask customer for "proof of purchase" from other seller
  - when both firms offer discount, need "pricing platform" of some kind (e.g., sellers display their prices contingent on consumer's other purchases, consumer decides on bundle, and pays each seller their contingent price)
- Suppliers of partially substitutable products to a retailer might ask for *lower* payment if retailer also buys rival product
  - in contrast to usual market share discounts, etc.

Integrated firm with substitute products I

- Integrated firm sells two symmetric products
  - consumer has value v_i for product i on its own and value $v_{12} \leq v_1 + v_2$ for the bundle
- Define
  - $v_{[1]} = \max\{v_1, v_2\}$ is value for first item
  - $v_{[2]} = v_{12} - v_{[1]} \leq v_{[1]}$ is incremental value for second item
- Firm has incentive to offer a bundle discount whenever

$$\Pr\{v_{[2]} \geq p \mid v_{[1]} \geq p\} \text{ is decreasing in } p \qquad (\spadesuit)$$

- If $v_{12} = v_1 + v_2 - z$, then ($\spadesuit$) holds whenever ($\clubsuit$) holds (plus regularity condition)
- If fraction of consumers have additive preferences and fraction only want one item, then ($\spadesuit$) holds iff ($\clubsuit$) holds

Integrated firm with substitute products II

- E.g., $c = 0$, (v_1, v_2) uniform on $[0,1]^2$ and v_{12} uniform on $[\max\{v_1, v_2\}, v_1 + v_2]$
  - most profitable linear price is $p \approx 0.54$
  - most profitable bundling tariff is stand-alone price $p \approx 0.52$ and bundle discount $\delta \approx 0.15$
- *All* prices fall when bundling used (in contrast to additive case)
- Intuition:
  - when products are more substitutable, the integrated firm raises its linear price
  - firm usually has incentive to introduce bundle discount
  - this makes products less like substitutes
  - induces firm to lower its regular price

Partial coordination between sellers I

- Analysis so far: no coordination at all between sellers, or complete coordination (the "integrated firm" case)
- Danger of complete coordination is that benefits of competition are lost (but efficiency gains from bundling may be gained)
- What about allowing firms to coordinate on bundle discount δ, which they fund equally, and then choose their stand-alone prices independently?
  - so firm i gets revenue p_i when it sells stand-alone item, and revenue $p_i - \frac{1}{2}\delta$ when its product is sold in a bundle
- With additive valuations:
  - scheme boosts profit whenever (♣) holds
  - also (at least if δ small) boosts total welfare if valuations independently distributed

Partial coordination between sellers II

- But with substitute products:
  - choosing δ means products less substitutable
  - competition is relaxed
  - can be means to collude
- Example: Two museums in a city
  - zero marginal cost
  - consumers value visiting any single museum at V_1
  - incremental value of visiting second museum is $V_2 < V_1$
  - with linear price, equilibrium price is $p = V_2$, consumer surplus is $V_1 - V_2$
  - with joint pricing scheme with bundle discount δ, each museum independently charges $p = V_2 + \delta$
  - full collusion achieved by choosing $\delta = V_1 - V_2$