Equilibrium Product Lines: Competing Head-to-Head May Be Less Competitive

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Introduction

- *Product line competition*
- "Filling in the gaps" vs. "Head-to-head" strategies
  - To reduce competition and so raise prices
  - Covering niche market (consumer heterogeneity)
  - Consumers may prefer to concentrate their purchases with a single supplier (shopping cost)

- *Do competing firms choose "fill in the gaps" between competitors' products, or do they compete "head-to-head" by making product choices that match their competitors' products?*

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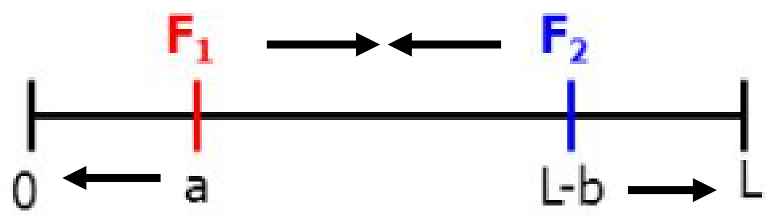
Literature review

- Single product competition (Linear city model)
  - Both firms concentrate at “the center” (head-to-head; Hotelling, 1929)
  - Spread to each end (Filling-the-gap; D’Aspremont et al., 1979)
  - Affected by the consumer disutility
  - Limited to a single product competition

Head-to-head:

Filling-the-gap:



- Extended the Salop’s circular city model

Major findings

- Industry profits may be *higher* in competing head-to-head than in doing filling-in-gap.
  - Counter-intuitive against Bertrand competition.
  - Affected by heterogeneous consumers' search cost for each firm
  - Distribution is given as $f(y, z)$: y and z are the fixed costs to purchase from the firms, respectively.

- When firms compete head-to-head, there exists deadweight losses and welfare losses
  - High prices
  - Reduced product variety

Model (Filling-in-gap)

- Demand model
  - Three options: Buy from A, do from B, or do from both.
  - Three types of cost: Purchasing cost (price), substitution cost (transportation cost), and shopping cost.

- Each firm decides "competition strategy" and each products' price
  - Firm A's product located at $\frac{i}{n}$, and Firm B's at $\left(i - \frac{1}{2}\right)/n$ for $i = 1, \ldots, n$
  - $\max \pi_i = q_i p_i$: q_i and p_i are sales and price.

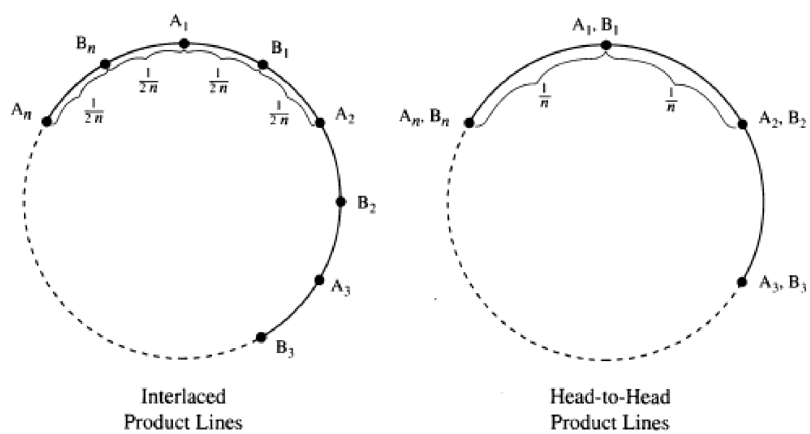


FIGURE 1. THE PRODUCT SPACE

Filling-in-gap: Demand

- **Inelastic demand (selection based on minimum cost):**
  - Only at A, if $\alpha + y < \min\{\beta + z, \gamma + y + z\}$ ①
  - Only at B, if $\beta + z < \min\{\alpha + y, \gamma + y + z\}$
  - From both suppliers, otherwise. ③
  - E.g., $q_A = \underbrace{\int_{\alpha-\gamma}^{\infty} \int_0^{z+\beta-\alpha} f(y,z)dy\,dz}_{①} + 2n\hat{x} \underbrace{\int_0^{\alpha-\gamma} \int_0^{\beta-\gamma} f(y,z)dy\,dz}_{\text{Some of ③}}$

- Substitution with the nearest product

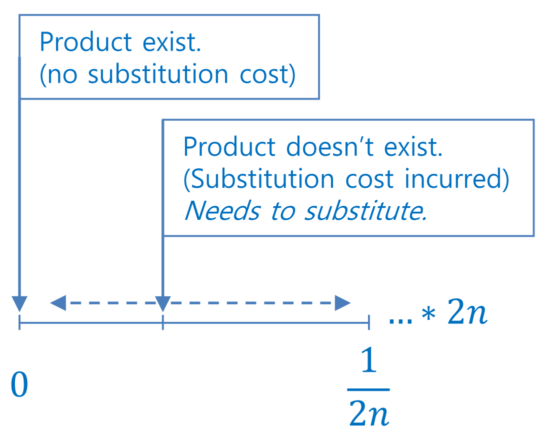
$$p_0 + g(x) < p_{\frac{1}{2n}} + g\left(\frac{1}{2n} - x\right).$$

  - Consumers wants every variant by one unit.
  - Purchasing costs plus substitution costs is:

$$\alpha = 2n \int_0^{1/2n} p_A + g(x)dx, \text{ only A}$$

$$\beta = 2n \int_0^{1/2n} p_B + g\left(\frac{1}{2n} - x\right)dx, \text{ only B}$$

$$\gamma = 2n \left(\int_0^{\hat{x}} p_A + g(x)dx + \int_{\hat{x}}^{1/2n} p_B + g\left(\frac{1}{2n} - x\right)dx \right), \text{ from both.}$$



Filling-in-gap: Equilibrium price

- First order condition provides:

$$p_i = \frac{q_i}{-\partial q_i/\partial p_i}, \forall i$$

  - $\partial q_i/\partial p_i$ is characterized as well.

- The unique symmetric price equilibrium:

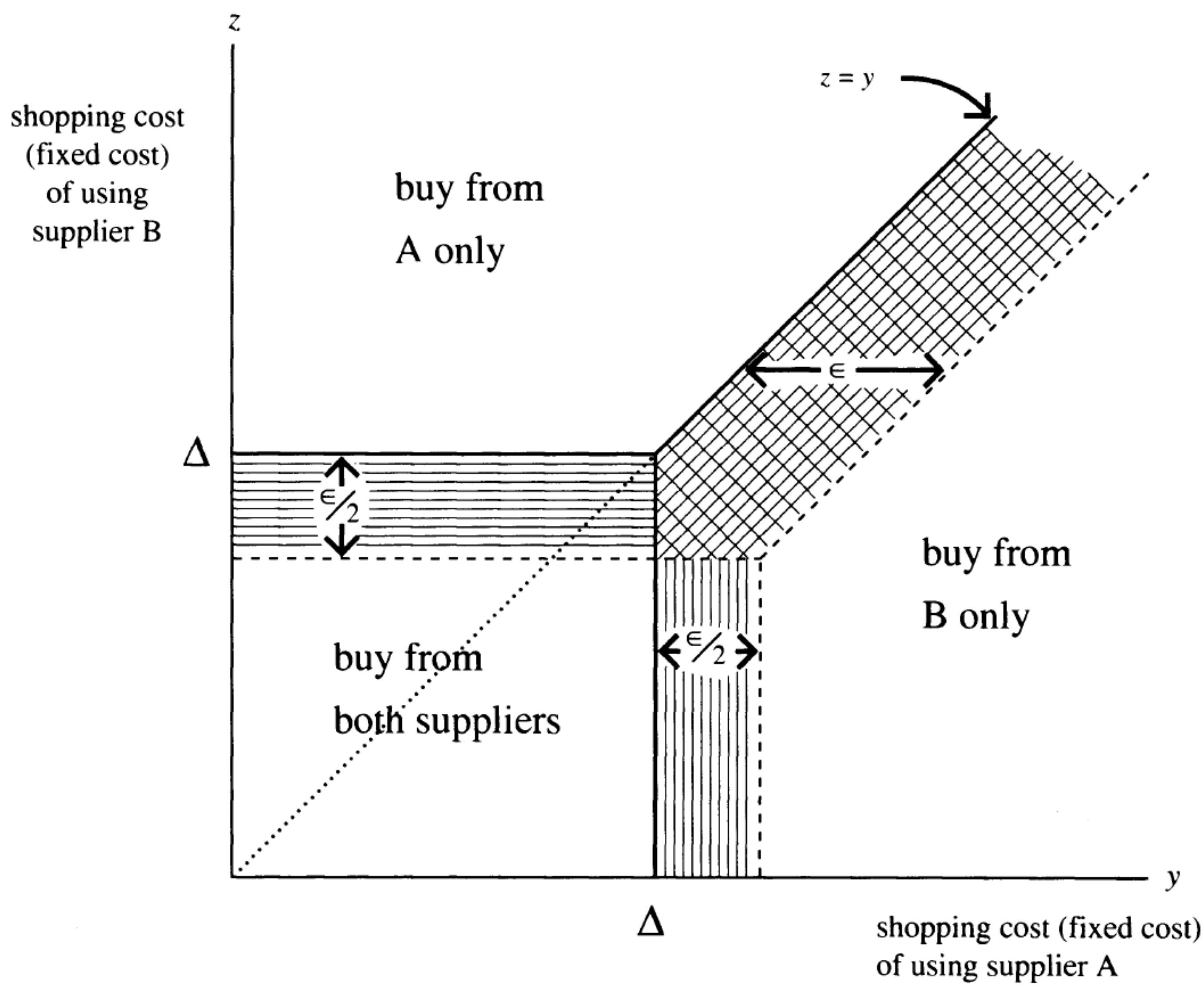
$$p_i^I = \frac{1/2}{\int_\Delta^\infty f(z,z)dz + \frac{1}{2}\int_0^\Delta f(z,\Delta) + nF(\Delta,\Delta)/g'\left(\frac{1}{4}n\right)}, \forall i$$

  where the saving substitution costs,

$$\Delta = 2n\int_0^{\frac{1}{4}n} g\left(x+\frac{1}{4n}\right) - g(x)dx,$$

  and n is the number of products.

Consumer behavior and price cutting ϵ of firm A



Head-to-head competition

- Analysis is similar to the filling-in-gap strategy.
  - firms locate products at i/n, for all $i = 1, \ldots, n$ (identical product lines)

- The symmetric equilibrium price is:

$$p_i^H = \frac{1}{2\int_0^\infty f(z,z)dz}, \forall i.$$

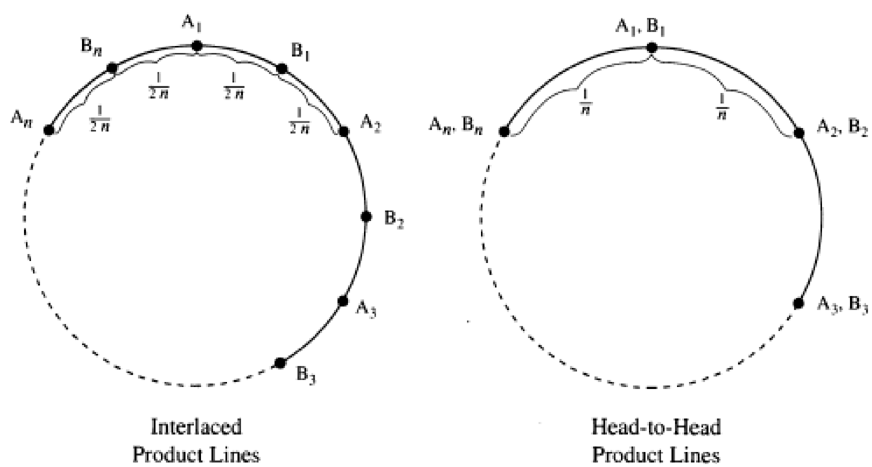


FIGURE 1. THE PRODUCT SPACE

Strategy comparison

- If $g(x) = tx$, $f(y,z) = 1/s^2$ (indep. to y and z) on $s \in [0, S]$,

$$p_i^I = \frac{s}{2}\left[\frac{1}{1 - 3t/64ns}\right] > p_i^H = \frac{s}{2}$$

  - Head-to-head competition is always more competitive.

- General $g(x)$ provides:
  - $p_i^I = \frac{s}{2}\frac{1}{1+\frac{\Delta}{2s}\left(\frac{2n\delta}{g'(1/4n)}-1\right)}, \forall i$, and $p_i^H = \frac{s}{2}, \forall i$.
  - *There exists the cases that Filling-the-gap can be more competitive. Firms may find head-to-head competition more profitable.*

- However, $SW_I - SW_H > 0$ (social welfare comparison)
  - Due to the inelastic demand, social welfare depends on the substitution and the shopping costs, not directly on the price.

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Conclusions

- The head-to-head competition may provide a higher profit than the filling-the-gap competition. (But, not always.)
  - The fewer consumers buying from more than one firm, the smaller the price-sensitive fraction of the market.
- When firms do compete head-to-head in order to reduce competition, there are, in general, both deadweight losses and welfare losses.
  - In case of the airlines, allowing collusions (departure time) may increase the social welfare (at least in theory).
- The result is robust in the following extensions:
  - Firms choose quantities rather than prices and in which industry demand is elastic.
  - Consumers prefer to consume an equal amount of every possible product