Product Differentiation II
Industrial Organization

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Pop Quiz

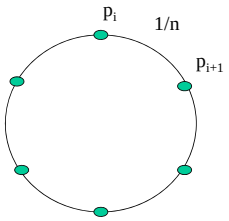
- What does Hotelling assume about the number of firms in his location model?
- Does the Hotelling spatial location model tell us whether or not there is too much product differentiation?
- Does location in spatial location models necessarily mean physical location in a geographic sense?

Outline

- Salop's Circular City
- Vertical Differentiation
- RTE cereals
- Empirically modelling product differentiation
  - The 1955 Automobile Price War

Salop's Circular City

- Uniform distribution of customers
- Product space is homogeneous
  - No location is *apriori* better than another
- No barriers to entry (equilibrium profit=0)



- Consumers buy 1 unit of a good
- Have transportation costs t (linear)
- Each firm only locates in one location
- Fixed cost of entry f, and marginal cost c
- Firm's profit if enters:

$$(p_i\text{-}c)D_i\text{-}f$$

1. Potential entrants choose whether or not to enter (do not choose location)
2. Firms compete in prices given location

(Purpose of Salop's model is to look at extent of entry rather than product choice)

Indifference Condition:

$$p_i + tx = p + t(1/n - x)$$

Demand:

$$D_i(p_i, p) = 2x = (p + t/n - p_i)/t$$

$$\max_{p_i}\left[(p_i - c)\left(\frac{p + t/n - p_i}{t}\right) - f\right]$$

$$p = c + t/n$$

Zero profit condition:

$$(\text{p-c})\frac{1}{\text{n}} - f = \frac{t}{n^2} - f = 0$$

$$n = \sqrt{t/f} \quad \text{p=c+}\sqrt{\text{tf}}$$

Notes

- We want to solve for 2x in the circular case because the firm has two indifferent consumers: each on each side of its location. In other words, the firm captures all consumers in a 2x segment of the circle.

Welfare

- A planner would want to minimize sum of transport and fixed costs:

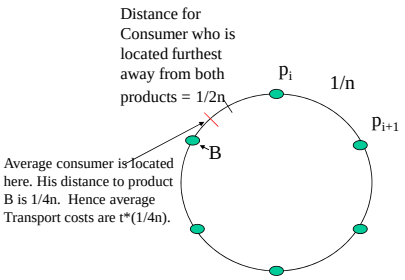
$$\min_n(nf + \frac{t}{4n})$$

$$n^* = \frac{1}{2}\sqrt{t/f}$$

Market generates too many firms

Salop's Circular City

Why the average consumer's transportation cost is t/4n:



Horizontal vs. Vertical Differentiation

- Horizontal Differentiation: No quality differences, but differences in preferences
- Vertical Differentiation: Everyone agrees there are quality differences; different people purchase different qualities because of different incomes

A Vertical Differentiation Model (Tirole, p. 296-297)

- Starts by analyzing price competition given a quality choice
- Looks at ex-ante choice of qualities

$U = \theta s - p$ if consumers consume one unit of quality S

U=0, otherwise

θ is a taste for quality that is uniformly distributed across the population, $\underline{\theta} > 0$ and $\overline{\theta} = \underline{\theta} + 1$

Need two assumptions

1) that the amount of consumer heterogeneity is sufficient

2) that each consumer buys one of the two brands

Marginal cost is the same for both brands

A consumer is indifferent between brands if and only if

$\theta s_1 - p_1 = \theta s_2 - p_2$

As in Hotelling, demand functions for each of the two brands are

$$D_1(p_1, p_2) = \frac{p_2 - p_1}{s_2 - s_1} - \underline{\theta}$$

and $$D_2(p_2, p_1) = \overline{\theta} - \frac{p_2 - p_1}{s_2 - s_1}$$

If each firm maximizes profits with respect to its own price, get Nash equilibrium prices

$p_1 = c + \frac{\bar{\theta} - 2\underline{\theta}}{3}(s_2 - s_1)$ and

$p_2 = c + \frac{2\bar{\theta} - \underline{\theta}}{3}(s_2 - s_1)$

$\pi_1(s_1, s_2) = (\bar{\theta} - 2\underline{\theta})^2 \Delta s / 9$

$\pi_2(s_1, s_2) = (2\bar{\theta} - \underline{\theta})^2 \Delta s / 9$

Conclusions

- High quality firm charges a higher price than low quality firm
- It also makes a higher profit
- Undifferentiated firms charge marginal cost and make no profit.
- If firms compete on quality and then on price and firms first make a quality choice, because undifferentiated firms make no profit, s_2 will differ from s_1.
- Firms will maximally differentiate
- What will happen if firms enter sequentially?

RTE cereals industry

- In 1972, the US government accused the 4 largest RTE manufacturers (Kellogg, General Mills, General Foods, and Quaker Oats) of
- 1) proliferating brands
- 2) differentiating similar products
- 3) intensive advertising.
- In 1978, Quaker Oats was dismissed from the case.

- The RTE cereals industry was highly concentrated throughout the post war period. The top 4 producers controlled 85% of the market, the top 6 controlled 95%.
- High profit margins
- The top 6 introduced 80 brands between 1950 and 1972.
- Until the early 70's, no new producers of RTE. In the early 70's, the fringe producers of natural cereal entered.
- MES of production at 3-5% of the total market, and absolute capital requirements not great; know-how not a barrier to entry
- Advertising-sales ratios generally in excess of 10%

Three questions

- How exactly was entry deterred?
- Could the pattern of deterrence described in the model have arisen without explicit agreements between the incumbents?
- What explains the failure of entry deterrence in the 1970's?

Conclusions

- No price competition, competition on advertising and packaging, brands positioned to avoid direct competition between rivals – outcome was not only highly profitable, but also effective entry deterrence. Brand proliferation by incumbents rather than entrants because: incumbents can guarantee absence of competitive response from their own 'neighbouring' brands, and probably from 'neighbouring' brands of incumbent rivals; and because entrant needs to enter with multiple brands in order to attain minimum economic scale
- All of this could have occurred without explicit agreements.
- Incumbent firms simply failed to anticipate the growth in consumer demand for natural cereals after 1970 – by 1974 had reached 10% of market share

Empirical Models of Product Differentiation

- Two ways to approach models of product differentiation empirically
  - 1) Assume products are basically close substitutes, take average price of products, proceed as one would in a homogenous goods industry.
    - Problems: May attribute market power to collusion, when in fact, it is product differentiation
    - May be interested in differences in elasticities and cross-price elasticities.
  - 2) Model the product differentiation
    - Can get quite complicated!

Complications of P.D. models

- Demand: As products become more distinct, quantity sold and prices become less tied to pricing, advertising, and other policies of firms
  - Can be addressed through cross-elasticities, but can have too many cross-elasticities
- Supply: As products become more distinct, firms will react less to competitive moves by rivals
  - Complexity of supply
- Much of the literature is very structured; economists may be trying to do too much with the data

Vertical Differentiation (Bresnahan JIE 1987)

- Motivation:
  - In 1955, American passenger automobile production was 45 percent greater than in the two surrounding years, while quality-adjusted prices were lower.
  - Paul Samuelson said "… would flunk any econometrics paper that claimed to provide and explanation of 1955 auto sales."

- Explained this by applying a model of vertical differentiation (similar in spirit to the vertical differentiation model we discussed) Quality of a particular car model depended on characteristics like size, power, and luxury.
- He tested whether 1955 could be explained by a competitive model, and whether surrounding years were better explained by collusive models.
- Price/quantity outcomes consistent with collusion in all years except 1955, when Bertrand-Nash equilibrium fits better.

Conclusions

- Started out by looking at 3 different types of horizontal differentiation
  - Representative Consumer Models
  - Spatial models
  - Characteristics Approach
- Vertical Differentiation
- Applications