Product Differentiation I

Industrial Organization

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Outline

- Monopolistic Competition (Chamberlin)
- Location Models
  - Spatial Approach (Hotelling)
  - Characteristics Approach (Lancaster)

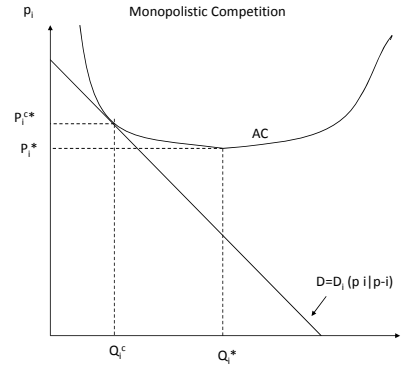
Product Space

- Two goods are almost never perfect substitutes
- Products intereract with other products in the economy
- How to describe differentiation?

Monopolistic Competition (Chamberlin 1933)

- A representative consumer model
  - Typical consumer views all brands as equally good substitutes; brands are treated symmetrically, each consumer consumes a little bit of each product
- Model can be applied to differentiated or undifferentiated products
- Difference with oligopoly:
  - In oligopoly model, number of firms is determined outside the model
  - In Chamberlin's model, firms freely enter as long as it is profitable for them to do so

- So, *Entry Condition* determines number of firms in the model
  - Firms enter until profit=0, so n is endogenously determined
- Model requires that firms face a downward-sloping demand curve
  - Downward sloping demand can be generated by product differentiation
  - Can also be generated by high fixed costs that limit the number of firms that enter the industry; firms face a downward sloping residual demand curve



Is it true that there are too many firms?

- Introduction of different goods can be justified even if production does not exhaust economies of scale
- So, for too many firms, must have homogeneous goods
  - Here is one homogeneous as presented by CP
    - This is a diversion from our product differentiation discussion
    - Focus is on zero profit condition

Example with homogeneous products

$$\pi = pq - C(q) = 0$$
$$C(q) = pq$$
$$\frac{C(q)}{q} = p$$
$$AC = p$$
$$Demand:$$
$$Q = 1000 - 1000p$$
$$Cost:$$
$$C(q) = 0.28q + F$$
$$p = .28 + \frac{F}{q}$$

- To determine Q (and thus equilibrium number of firms), first determine the Cournot equilibrium output for each possible number of firms, then examine the equilibria and pick the one in which firms make zero profits
- Equilibrium number of firms increases as fixed costs decrease
- Conventional wisdom: Leads to too many firms

2 firm example

$$q_1 + q_2 = 1000 - 1000p$$
$$p = \frac{1000 - q_1 - q_2}{1000}$$
$$C(q) = 0.28q + F$$
$$Firm1: R - C = pq_1 - C(q)$$
$$(\frac{1000 - q_1 - q_2}{1000})q_1 - .28q_1 - F$$
$$FOC: \frac{1000 - q_1 - q_2}{1000} + q_1(\frac{-1}{1000}) - .28 = 0$$
$$\text{Reaction Functions:}$$
$$1000 - 2q_1 - q_2 - 280 = 0$$
$$q_1 = \frac{1000 - q_2 - 280}{2}, q_2 = \frac{1000 - q_1 - 280}{2}$$

- Solving simultaneously,
- $q_1=q_2=240$
- Plugging into the demand function,
- p=52
- Then can find firm profit for various levels of fixed costs. The monopolistically competitive equilibrium is where firm profit =0. This point will vary as fixed costs vary.

Table 7.2, P. 210, CP

- CP works out with different levels of fixed costs and different numbers of firms.

			F=$6.40		F=$1.60
	Price	Firm	Average	Firm	Firm
# of Firms	(cents)	Output	costs	Profit	Profit
1	64	360	29.8	132.2	128
2	52	240	30.7	51.2	56
3	46	180	41.6	26	30.8
4	42.4	144	32.4	25.34	19.14
5	40	120	33.3	8	12.8
6	38.3	102.9	34.2	4.18	8.98
7	37	90	35.1	1.7	6.5
8	36	80	36	0	4.8
9	35.2	72	36.9	-1.22	3.58
10	34.5	65.5	37.8		2.68
11	34	60	38.7		2
12	33.5	55.4	39.6		1.47
13	33.1	51.4	40.4		1.04
14	32.8	48	41.3		0.7
15	32.5	45	42.2		0.42
16	32.2	42.4	43.1		0.19
17	32	40	44		0
18	31.8	37.9	44.9		-0.16

Back to Product Differentiation

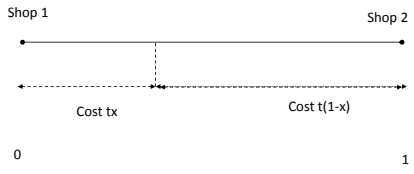
- In general, with product differentiation and monopolistic competition, there can be two effects, working in opposite directions

Product Diversity: Too many products? Assume each firm produces one product each. The number of products may be too few or too many depending on which of the following effects dominates:

1. The non-appropriability of consumer surplus effect: not all consumer surplus is captured by the entrant, unless it can perfectly price discriminate. This is a positive externality which can cause socially too few products/firms to enter.
2. The business stealing effect: not all profit captured by the firm is created by the firm. Some is taken from other existing firms. This is a negative externality leading to socially too many firms.

- Drawbacks of model: each consumer consumes all goods; cross elasticity of demand same for all "inside" goods: no "near neighbour" effects; particularly inappropriate for neighbourly products.
- Strength of model: Suitable for situations where consumer prefers variety, analytically convenient.

Horizontal Differentiation (Hotelling 1929)



Let s be the surplus enjoyed by each consumer

Utility of consumer located at x:

$s - p_1 - tx$

$s - p_2 - t(1-x)$

Deriving the demand function:

Case 1:

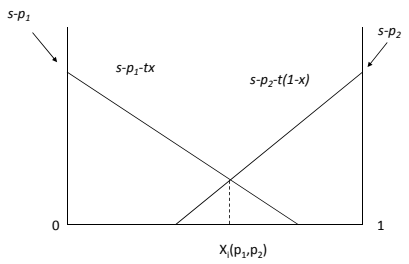
$|p_2 - p_1| < t$, differences in prices are not "too high"

There exists an indifferent consumer

$p_1 + tx_i = p_2 + t(1-x_i) \Rightarrow x_i = (p_2 - p_1 + t)/2t$

Demands are $D_1(p_1, p_2) = Nx_i$

$D_2(p_1, p_2) = N[1-x_i]$



Case 2: $|p_2 - p_1| > t$

If $p_2 - p_1 > t$ then shop 2 has no demand

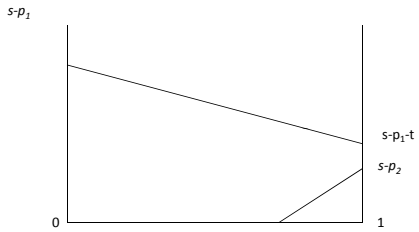
Shop 1 has demand $D(p_1, p_2) = N$ if $p_1 \le s - t$

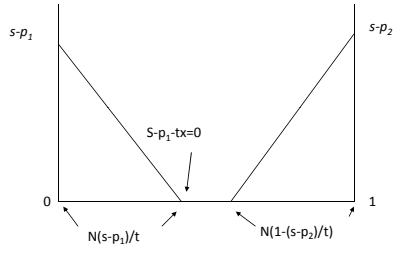
Shop 1 has demand $D(p_1, p_2) = N(s - p_1)/t$ if if $p_1 > s - t$

Case 3: Each shop has local monopoly power (and the market is not covered

Shop 1 has demand $N(s - p_1)/t$ if if $p_1 > s - t$

Shop 2 has demand $N(1-\frac{s - p_2}{t})$ if $p_2 > s - t$





How to price? (with quadratic transportation costs)

There exists an indifferent consumer

$p_1 + tx_i^2 = p_2 + t(1 - x_i)^2 \Rightarrow x_i = (p_2 - p_1 + t)/2t$

Firm2:

$D_2(p_1, p_2) = N[1 - x] = N[\frac{p_1 - p_2 + t}{2t}]$

$\pi^1(p_1, p_2) = N[(p_1 - c)(p_2 - p_1 + t)/2t]$

$FOC: p_2 + c + t - 2p_1 = 0$

Using symmmetry,

competitive prices and profits (per customer) are

$p_1 = p_2 = c + t$

and

$\pi_1 = \pi_2 = t/2$

Where to locate?

- Demand effect: This pushes firms to the centre to capture demand. Reasoning: Suppose firms begin by being located at each end of the city. Firm 2 can increase its share by moving toward the centre. Both firms end up at centre: zero differentiation.
- Strategic effect: This pushes firms towards the edges to soften price competition. Reasoning: Suppose both firms begin by being located in the centre. The firms are undifferentiated, and a price cut will capture all demand, so prices fall to marginal cost. If firm 2 moves to the right, a price cut will no longer capture all demand.

- With quadratic costs, firms will locate at ends. However, the socially optimal level of differentiation (to minimize transportation costs) is at ¼ or ¾. In the quadratic case, the strategic effect outweighs the demand effect and there is little price competition. However, depends on functional form, and there are other cases that demand effect may outweigh strategic effect.

The Characteristics Approach to Nutrition

- Food 1: 2 units of protein, 1 unit of vitamins
- Food 2: 1 unit of protein, 2 units of vitamins
- Food 3: 1 unit of protein, 1 unit of vitamins
  - A consumer is indifferent between 1 unit of foods 1 and 2 and 3 units of food 3

Characteristics Approach

- Goods are a bundle of "characteristics"
- Individuals are not interested in goods for their own sake, but for the characteristics they possess
- Individuals have preferences for collections of characteristics
- Preferences for goods derive from preferences for characteristics

Examples

- Good examples
  - Vitamins
  - Computers
- Bad examples
  - Fragrances
  - Status goods

Summary

- We have looked at
  - Chamberlain's model of monopolistic competition – a Representative Consumer Model
  - Hotelling's spatial approach
  - Lancaster's product characteristics approach