

# IOSSA Rev Part III. Sources of market power

## Chapter 5. Product differentiation



Slides

*Industrial Organization: Markets and Strategies*

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## Case. Competition in the banking deposit market

- There exists market power
  - Positive intermediation margins
  - Lerner index: US, 23% / Japan, 20% / EU, 15%
- Where does it come from?

### 1) Consequence of firms' conduct

- Pricing strategy to deter entry (see Part IV)
- Product differentiation

### 2) Consumer inertia due to (i) lack of information or (ii) switching costs.

- It's time-consuming to compare deposit rates of competing banks
- or moving accounts from one bank to another takes time (and possibly money)

## Chapter 5. Learning objectives

- Understand that product differentiation involves two conflicting forces: it relaxes price competition, but it may reduce the demand that the firm faces.
- Be able to distinguish between horizontal and vertical product differentiation.

# Views on product differentiation

- Product differentiation depends on consumers' preferences.
- Two cases:
  - **Horizontal product differentiation**
    - Each product would be preferred by some consumers.
  - **Vertical product differentiation**
    - Everybody would prefer one over the other product.
  - **More formally (naïve definition):** if, at equal prices,
    - consumers do not agree on which product is the preferred one → products are *horizontally* differentiated;
    - all consumers prefer one over the other product → products are *vertically* differentiated.

## Hotelling model

- Now, **firms choose location and price.**
- 2 stage model
  1. Location choice (long term decision)
  2. Price choice (short term decision)
- Recall (in Chapter 3) the price stage with extreme locations (i.e., 0 and 1).
- We repeat the analysis for any pair of locations  
→ 2 scenarios:
  - **Linear** transportation costs (complicated)
  - **Quadratic** transportation costs (easier!)

## Quadratic Hotelling model

- Only difference: transport costs increase with the square of distance

$$v_i(x) = r - \tau(x - l_i)^2 - p_i$$

- Indifferent consumer

$$r - \tau(\hat{x} - l_1)^2 - p_1 = r - \tau(l_2 - \hat{x})^2 - p_2 \Leftrightarrow \hat{x} = \frac{l_1 + l_2}{2} - \frac{p_1 - p_2}{2\tau(l_2 - l_1)}$$

- Backward induction: Consider Price stage (stage II)

$$\max_{p_1} (p_1 - c)\hat{x}(p_1, p_2) \text{ and } \max_{p_2} (p_2 - c)[1 - \hat{x}(p_1, p_2)]$$

$$\rightarrow \begin{aligned} p_1^* &= c + \frac{\tau}{3}(l_2 - l_1)(2 + l_1 + l_2) \\ p_2^* &= c + \frac{\tau}{3}(l_2 - l_1)(4 - l_1 - l_2) \end{aligned} \quad (\text{unique price equilibrium})$$

## Quadratic Hotelling model (cont'd)

- Location stage (Stage I)

$$\begin{aligned} \hat{\pi}_1 &= \frac{1}{18} \tau (l_2 - l_1) (2 + l_1 + l_2)^2 & \rightarrow & \quad \partial \hat{\pi}_1 / \partial l_1 < 0 \text{ for all } l_1 \in [0, l_2) \\ \hat{\pi}_2 &= \frac{1}{18} \tau (l_2 - l_1) (4 - l_1 - l_2)^2 & \rightarrow & \quad \partial \hat{\pi}_2 / \partial l_2 > 0 \text{ for all } l_2 \in (l_1, 1] \end{aligned}$$

- Subgame perfect equilibrium: firms locate at the extreme points → “maximum differentiation”
- 2 forces at play
  - **Competition effect** → differentiate to enjoy market power  
→ drives competitors apart
  - **Market size effect** → meet consumers preferences  
→ brings competitors together
  - *Balance* depends on distribution of consumers, shape of transportation costs function and feasible product range

## Quadratic Hotelling model (cont'd)

- **Lesson:** With endogenous product differentiation, the degree of differentiation is determined by balancing
  - the competition effect (drives firm to  $\uparrow$  differentiation)
  - the market size effect (drives firm to  $\downarrow$  differentiation).

## Vertical product differentiation

- All consumers agree that one product is preferable to another, i.e., has a higher *quality*
- Consumers
  - Quality is described by  $s_i \in [\underline{s}, \bar{s}] \subset \mathbb{R}_+$
  - Preference parameter for quality:  $\theta \in [\underline{\theta}, \bar{\theta}] \subset \mathbb{R}_+$ 
    - larger  $\theta \rightarrow$  consumer more sensitive to quality changes
  - Each consumer chooses 1 unit of 1 of the products
  - Uniform distribution on  $[\underline{\theta}, \bar{\theta}]$ , mass  $M = \bar{\theta} - \underline{\theta}$
  - Utility for consumer  $\theta$  from one unit of product  $i$

$$r + \theta s_i - p_i$$

## Vertical product differentiation (cont'd)

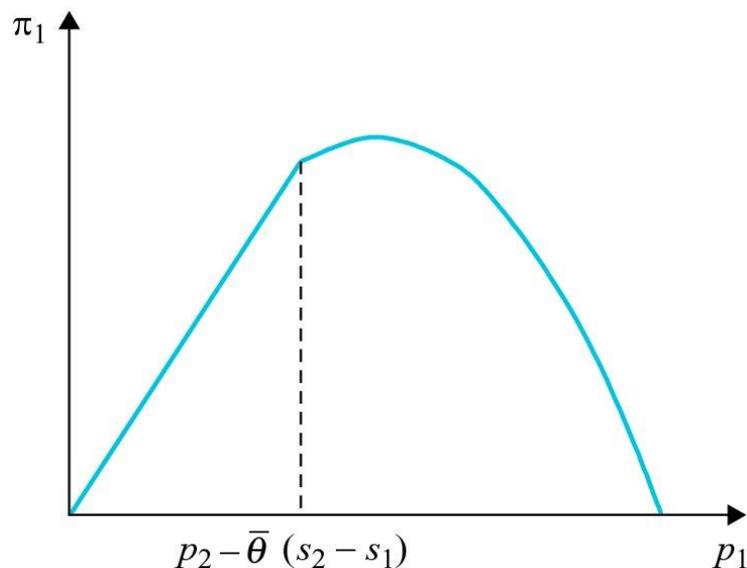
- Firms
  - Duopolists play game:
    1. Choose quality:  $s_1, s_2$
    2. Choose price:  $p_1, p_2$
  - Constant marginal cost,  $c = 0$
- Price stage
  - Suppose  $s_1 < s_2$
  - Indifferent consumer is determined by the ratio of price and quality differences:

$$r - p_1 + \hat{\theta}s_1 = r - p_2 + \hat{\theta}s_2 \Leftrightarrow \hat{\theta} = \frac{p_2 - p_1}{s_2 - s_1} \text{ for } \hat{\theta} \in [\underline{\theta}, \bar{\theta}]$$

## Vertical product differentiation (cont'd)

- Price stage (cont'd)

$$\pi_1(p_1, p_2; s_1, s_2) = \begin{cases} 0 & \text{if } p_1 > p_2 - \underline{\theta}(s_2 - s_1), \\ p_1 \left( \frac{p_2 - p_1}{s_2 - s_1} - \underline{\theta} \right) & \text{if } \underline{\theta}(s_2 - s_1) \leq p_2 - p_1 \leq \bar{\theta}(s_2 - s_1), \\ p_1(\bar{\theta} - \underline{\theta}) & \text{if } p_1 < p_2 - \bar{\theta}(s_2 - s_1). \end{cases}$$



Solving the system of F.O.C.:

$$p_1^* = \frac{1}{3}(\bar{\theta} - 2\underline{\theta})(s_2 - s_1)$$

$$p_2^* = \frac{1}{3}(2\bar{\theta} - \underline{\theta})(s_2 - s_1)$$

(parameter restriction:  $\bar{\theta} > 2\underline{\theta}$ )

→ Even the price of the low-quality firm increases with the quality difference!

## Vertical product differentiation (cont'd)

- Quality stage
  - Substitute for second-stage equilibrium prices in profit function:
 
$$\tilde{\pi}_1(s_1, s_2) = \frac{1}{9} (\bar{\theta} - 2\underline{\theta})^2 (s_2 - s_1)$$

$$\tilde{\pi}_2(s_1, s_2) = \frac{1}{9} (2\bar{\theta} - \underline{\theta})^2 (s_2 - s_1)$$
  - Both profits  $\uparrow$  in the quality difference  $\rightarrow$  equilibrium quality choices:
    - Simultaneous:  $(s_1, s_2) = (\underline{s}, \bar{s})$  or  $(\bar{s}, \underline{s})$
    - Sequential: 1<sup>st</sup> (2<sup>nd</sup>) chooses highest (lowest) quality

- **Lesson:** In markets in which products can be vertically differentiated, firms offer different qualities in equilibrium so as to relax price competition.

## Review questions

- In which industries is product differentiation important? Provide two examples.
- What makes firms locate close to each other in the product space? And what does it make them to differentiate themselves from their competitors?
- When is vertical product differentiation present in an industry? Discuss demand and cost characteristics.