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Product differentiation

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Topic 7. Product differentiation: patterns of price setting

1. Introduction
2. Horizontal *versus* vertical product differentiation
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5. Conclussions

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1. Introduction

- **Aim**: To study an oligopoly model relaxing the homogeneous product assumption, to analyse the effect of product differentiation on price competition intensity and product choice.

- Main implication of the homogeneous product assumption in an oligopoly model of price competition (*à la Bertrand*)
  - Bertrand paradox → Price competition between two firms is a sufficient condition to restores the competitive situation $p = c$

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2. Horizontal and vertical product differentiation

- **Horizontal product differentiation**: two products are differentiated horizontally if, when they are offered at the same price consumers **do not agree** on which is the preferred product.

  Example:
- **Vertical product differentiation**: two products are differentiated vertically if, when they are offered at the same price consumers **agree** on which is the preferred product.
  - Example:

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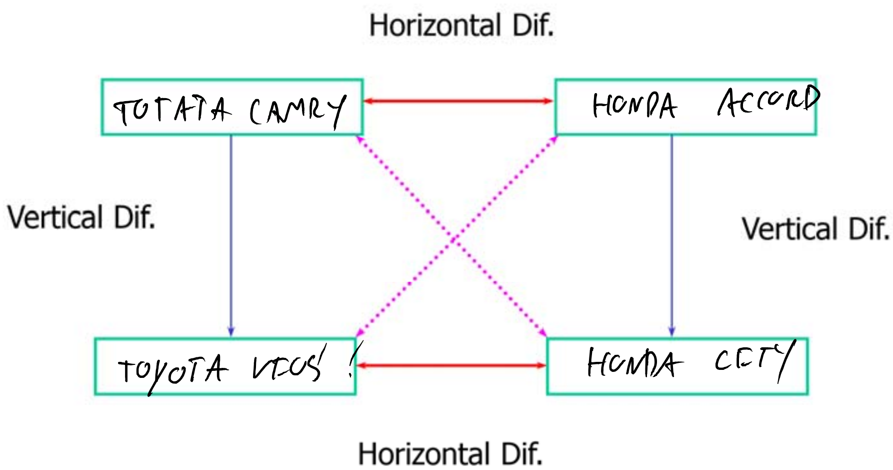
Example



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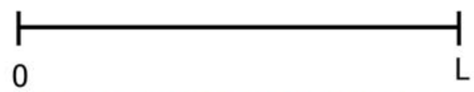
HOTELLING (1929)

3. Linear city model with linear transport costs : assumptions

- Consumers are uniformly distributed with unit density along a segment of L length



- Two firms (firms 1 and 2) are located along the segment
- The two firms sell a product that is identical except for the location of the firm.
- The two firms have constant and identical marginal cost $c \rightarrow c_1 = c_2 = c$
- Each consumer buys a single unit of the product.

$\rightarrow$ Alternative interpretation of the segment as a product characteristic

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3Linear city model with linear transport costs : two-stage game

Stage 1: the two firms choose simultaneously their location (long-run decision)

Stage 2: the two firms choose simultaneously their prices (short-run decision)

We impose maximum product differentiation and so we focus on the determination of the *Nash equilibrium in prices* (Stage 2).

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3. Linear city model with linear transport costs : consumers' utility function

- The utility that a consumer *i* located in X obtains from the purchase of of the good of firm *j* is given by:

$$U_{ij} = r - p_j - t x_{ij}$$

r: reservation price

p_j: price of the product of firm *j*

x_{ij}.: distance (along the segment) between the location of consumer *i* and the location of firm *j*

t: transport cost per unit of distance (or alternatively intensity of the preference for a given product)

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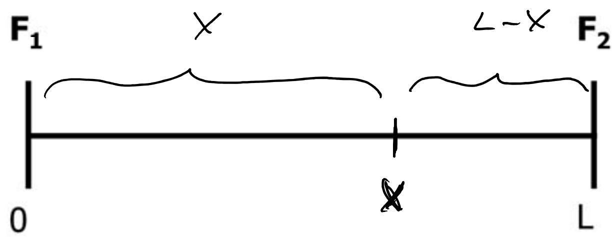
3 Linear city model with linear transport costs : transport costs

- With linear transport costs per unit of distance :



  - Transport cost if the product is bought at firm 1 = $t \cdot x$
  - Transport cost if the product is bought at firm 2 = $t \cdot (L-x)$

- Total cost of the product = price + transport costs
  - Total cost if the product is bought at firm 1 = $P_1 + t \cdot x$
  - Total cost if the product is bought at firm 2= $P_2 + t \cdot (L-x)$

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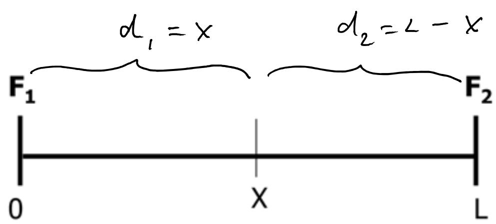
3 Linear city model with linear transport costs : demands determination

$$U_{x,1} = U_{x,2}$$



$$r - p_1 - t \cdot x = r - p_2 - t(L - x)$$

$$p_1 + tx = p + t(L - x)$$

so $d_1 = x = \frac{p_2 - p_1}{2t} + \frac{L}{2}$ → DEMAND FUNCTION FOR FIRM 1

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$d_2 = L - x = \frac{p_1 - p_2}{2t} + \frac{L}{2}$ → DEMAND FUNCTION FOR FIRM 2

3 Linear city model with linear transport costs : demand properties

- Price elasticity of demand

$$\eta = \frac{\partial d_1}{\partial p_1}\frac{p_1}{d_1} = -\frac{p_1}{p_2 - p_1 + Lt} < 0$$

- Price elasticity of demand and transport costs

$$\frac{\partial |\eta|}{\partial t} = -\frac{Lp_1}{(p_2 - p_1 + Lt)^2} < 0$$

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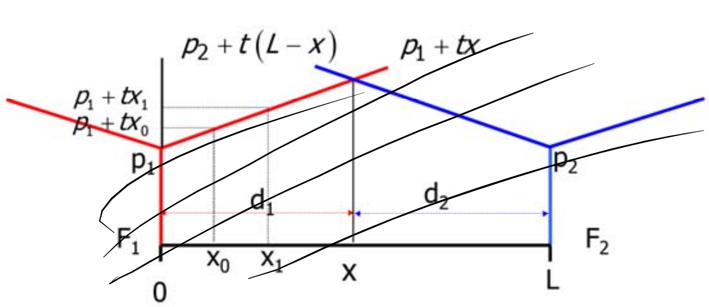
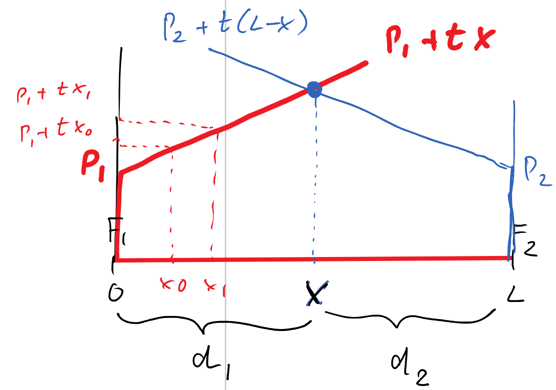
3 Linear city model with linear transport costs : demands determination

- Total cost of buying at 1 = Total cost of buying at 2

$$p_1 + tx = p_2 + t(L - x)$$





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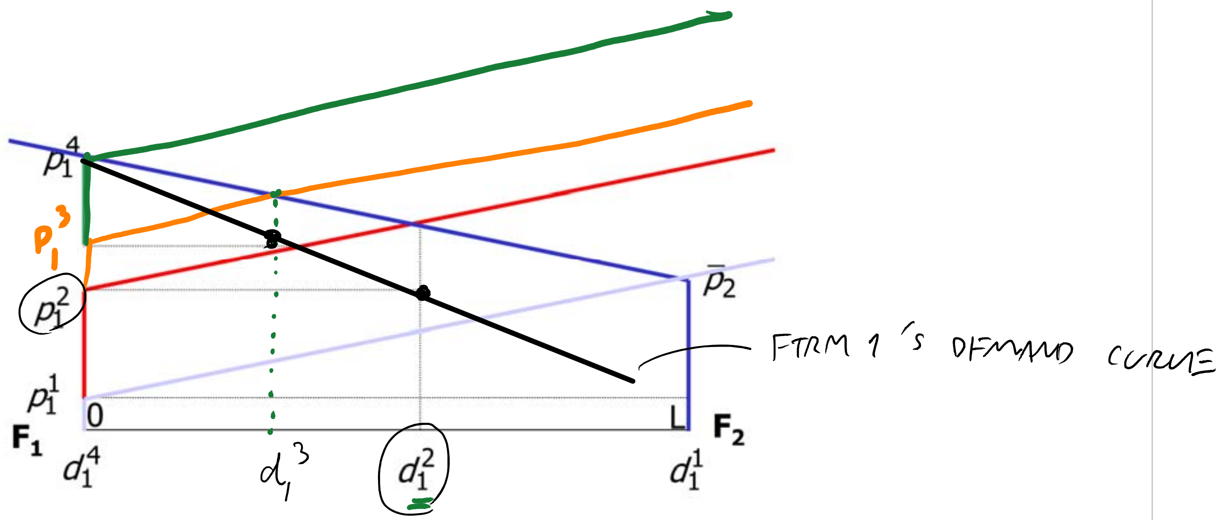
3 Linear city model with linear transport costs : firm 1 demand



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3 Linear city model with linear transport costs : Obtaining the Nash equilibrium in prices (I)

- Maximization problem of firm 1

$$\max_{p_1} \pi_1 = d_1(p_1 - c) = \left[\frac{p_2 - p_1}{2t} + \frac{L}{2}\right] \cdot (p_1 - c)$$

F.O.C: $$\frac{\partial \pi_1}{\partial p_1} = \frac{p_2 - 2p_1 + c}{2t} + \frac{L}{2} = 0$$

$$p_1^*(p_2) = \frac{p_2 + Lt + c}{2}$$: BR FUNCTION OF FIRM 1

- Maximization problem of firm 2

$$\max_{p_2} \pi_2 = d_2(p_2 - c) = \left[\frac{p_1 - p_2}{2t} + \frac{L}{2}\right] \cdot (p_2 - c)$$

FOC: $$\frac{\partial \pi_2}{\partial p_2} = \frac{p_1 - 2p_2 + c}{2t} + \frac{L}{2} = 0$$

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$$p_2^*(p_1) = \frac{p_1 + Lt + c}{2}$$: BR FUNCTION OF FIRM 2

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