Microeconomic Theory I

7. Market Power

Andrea Canidio

CEU

Fall 2014

Monopoly: when firms set their price

(which isn't what monopoly is about, but for some reason it is what's written in most textbooks)

Monopoly

- So far: firms maximize profits taking prices as given.
  - **each firm faces a completely inelastic demand function:** each firm thinks it can sell any amount at given prices.
  - but the aggregate demand is elastic.
  - the equilibrium price in every given market is found by equating aggregate supply and aggregate demand.
- **Monopoly**: a firm facing a demand equal to the aggregate demand.
- More in general: a firm has **market power** if it faces a downward-sloping demand.

Monopoly

An example:

1. $q = d(p)$ a demand function with
   - $\bar{p} > 0$, $d(\bar{p}) = 0$
   - $d'(p) < 0$ for $0 < p < \bar{p}$
2. $C(q)$ total costs

The monopolist's problem:

$$\pi(p) = \max_p \{pd(p) - C(d(p))\}$$

$$\text{FOC:} \quad \underbrace{d(p) + pd'(p)}_{MR_p} - \underbrace{C'(q)d'(p)}_{MC_p} = 0$$

$$(\text{or: } \pi(q) = \max_q \left\{qd^{-1}(q) - C(q)\right\}$$

$$MR_q = MC_q \;)$$

Monopoly

- Remember: for price takers, the objective function is

$$\pi(q) = pq - C(q)$$
$$\text{FOC: } p = MC$$

  - the intersection of MC and D

- Effect of monopoly power on welfare
  - Redistribution from consumer to producer
  - Reduction in aggregate welfare (DWL)

Monopoly

Exercise

$$d(p) = 30 - p \quad 0 \leq p \leq 30$$
$$C(q) = 120 \log(1 + q) \quad q \geq 0$$

1. Calculate monopolist's price and quantity.
2. Compare with competitive equilibrium (CE).

Price discrimination

- The monopolist faces a trade off: to increase demand, he needs to lower its price for everybody, even for people who would have bought also at higher price.
- Price discrimination: sometimes firms can charge different amounts to different consumers.

1. 1st degree
    - Charge each consumer their willingness to pay (WTP)
    - Maximizes social welfare
2. 2nd degree
    - Charge different prices for different quantities
3. 3rd degree
    - Market segmentation: set different prices in different markets having different demands.

Duopoly and Strategic Interaction

Duopoly

- Duopoly: two firms compete in the same market.
- Duopoly is an example of strategic interaction: the payoff of each firm depends not only on its own behavior, but also on the behavior of its opponent.
    - Strategic Interaction is studied in Game Theory.
- Strategic interaction between the two firms
- Two types of strategic interaction: Bertrand Duopoly and Cournot Duopoly.

Bertrand duopoly

- Bertrand duopoly = price competition.
    - Firms set their price and consumers buy from the cheapest.
- Example:
    1. Market demand:

$$q = d(p)$$
$$\exists \bar{p} > 0 \quad d(\bar{p}) = 0$$
$$d'(\bar{p}) < 0 \quad 0 < p < \bar{p}$$

    2. For both firms, $C(q) = cq$ (constant marginal cost)

Bertrand duopoly

- Key assumption:
  - If $p_1 \neq p_2$, consumers buy the cheapest good, if $p_1 = p_2$, they split $\frac{1}{2} : \frac{1}{2}$
  - each firm sets its price taking the price set by the other firm as given
  - an equilibrium is a situation where each firm set its price optimally given the other firm's price.
- Demand firm 1 and 2 are facing:

$$q_1(p_1, p_2) \begin{cases} 0 & \text{if } p_1 > p_2 \\ \frac{d(p_1)}{2} & \text{if } p_1 = p_2 \\ d(p_1) & \text{if } p_1 < p_2 \end{cases} \qquad q_2(p_1, p_2) \begin{cases} d(p_2) & \text{if } p_1 > p_2 \\ \frac{d(p_2)}{2} & \text{if } p_1 = p_2 \\ 0 & \text{if } p_1 < p_2 \end{cases}$$

$$\pi_1(p_1, p_2) = (p_1 - c)\, q_1(p_1, p_2)$$
$$\pi_2(p_1, p_2) = (p_2 - c)\, q_2(p_1, p_2)$$

Bertrand duopoly

Claim

There is the unique (Nash) equilibrium, with $p_1^* = p_2^* = c$.

Proof.

1. Show $p_1 = p_2 = c$ is an equilibrium.
   - At $p_1 = p_2 = c$, $\pi = 0$
   - Decision of firm 1 at $p_2 = c$:
     - No incentive to increase p_1: for $p_1 > p_2 = c$, $\pi_1 = 0$ still
     - No incentive to decrease p_1: for $p_1 < p_2 = c$, $\pi_1 < 0$
   - The same is true for firm 2 (symmetry)
   - Neither firm 1 nor firm 2 has any incentive to deviate from $p_1 = p_2 = c$
   - Each firm is optimally responding to the other firm's price$\Rightarrow$ it is an equilibrium

Bertrand duopoly

2. Show that $p_1 = p_2 = c$ is the unique equilibrium.

(a) Suppose that there is an equilibrium with $p_1 < c$ or $p_2 < c$
- Either 1 or 2 can deviate to $p = c$ and increase π.
- There cannot be an equilibrium with $p_1 < c$ or $p_2 < c$

(b) Suppose there is an equilibrium with $c = p_1 < p_2$ (or $c = p_2 < p_1$)
- 1 can make $\pi_1 > 0$ by increasing p_1 a little bit to $c < p_1 < p_2$
- There cannot be an equilibrium with $c = p_1 < p_2$ (or $c = p_2 < p_1$)

(c) Suppose there is an equilibrium with $c < p_1 \leq p_2$ (or $c < p_2 \leq p_1$)
- 2 can increase π_2 by decreasing p_2 a little bit, to $c < p_2 < p_1$
- There cannot be an equilibrium with $c < p_1 \leq p_2$ (or $c < p_2 \leq p_1$)

□

Cournot duopoly

- Cournot duopoly = competition on quantity.
- Firms set their quantity and market forces determine the price
- Example:

$$C_1(q_1) = C_2(q_2) = 0$$

$$d(p) = \begin{cases} a - bp & \text{for } 0 \leq p \leq \frac{a}{b} \\ 0 & \text{otherwise} \end{cases}$$

$$q_1 + q_2 = d(p)$$

Cournot duopoly

$$p(q_1, q_2) = \begin{cases} \frac{1}{b}(a - q_1 - q_2) & \text{for } q_1 + q_2 \leq a \\ 0 & \text{for } q_1 + q_2 > a \end{cases}$$

$$\pi_1 = \max_{q_1} \left\{ \frac{1}{b}(a - q_1 - q_2) q_1 \right\}$$

$$\pi_2 = \max_{q_2} \left\{ \frac{1}{b}(a - q_1 - q_2) q_2 \right\}$$

Cournot duopoly

- Let's find $q_1^*(q_2)$ and $q_2^*(q_1)$: optimal quantity produced by one firm as a function of the quantity produced by the other firm.
- FOC1:

$$\frac{1}{b}(a - 2q_1 - q_2) = 0$$

$$q_1(q_2) = \begin{cases} \frac{a-q_2}{2} & \text{for } a > q_2 \\ 0 & \text{otherwise} \end{cases}$$

- FOC2:

$$\frac{1}{b}(a - q_1 - 2q_2) = 0$$

$$q_2(q_1) = \begin{cases} \frac{a-q_1}{2} & \text{for } a > q_1 \\ 0 & \text{otherwise} \end{cases}$$

Cournot duopoly

- Equilibrium: take $q_1(q_2(q_1))$

$$q_1^* = \frac{a - \frac{a-q_1}{2}}{2}$$
$$q_1^* = \frac{a}{3}$$

$$q_2^* = \frac{a - \frac{a}{3}}{2} = \frac{a}{3} \text{ (symmetry)}$$

$$p(q_1^*, q_2^*) = \frac{1}{b}\left(\frac{a}{3}\right) > 0$$