

Industrial Organization, Week 3

Oligopoly

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Agenda

- 1 Big picture
- 2 Oligopoly: Quantity
- 3 Oligopoly: Price
- 4 Comparison

Demand in price competition

- ▶ A monopolist sets the monopoly price and quantity, regardless controlling prices or quantities
- ▶ Oligopoly means a few firms, implicitly there is some cost to enter the industry
- ▶ Nash equilibrium in industrial organization implies a reaction function
- ▶ Reaction function: Reacting to the other players reaction.
- ▶ Example: Quantity competition, $q_i(q_{-i})$
- ▶ Ultimately the question is about demand elasticity.

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Antoine-Augustin Cournot

- ▶ French Mathematician, Born in 1801, Sorbonne
- ▶ Book: 'Recherches sur les principes mathématiques de la théorie des richesses', 1838



Demand in quantity competition

$$P(Q) = P(q_1, q_2, q_3, \dots, q_n)$$

Example: $P(Q) = 100 - Q$

- ▶ Note 1: An asymmetric equilibrium is often(not always) not an option because there exists a deviation
- ▶ Suppose firm 1 is producing 10 and firm 2 is producing 100. Firm 2 has a higher incentive than firm 1 to decrease it's quantity because it will increase revenue on 99 units.
- ▶ n is number of firms. We will be using i and j to talk about two different firms

Demand in quantity competition

$$\max_q \pi(Q) = P(Q)q_i - C(q_i) \quad (1)$$

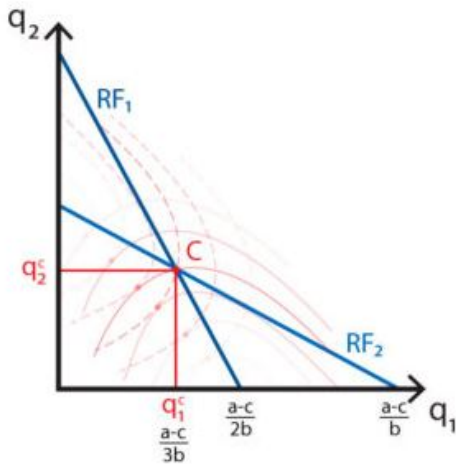
$$= (a - bQ)q_i - C(q_i) \quad (2)$$

$$= aq_i - b(q_i + q_j)q_i - cq_i \quad (3)$$

$$= [a - b(q_i + q_j) - c]q_i \quad (4)$$

$$\rightarrow q_i = \frac{a - bq_j - c}{2b} = \frac{a - c}{2b} - \frac{q_j}{2} \quad (5)$$

Quantity Reaction Graph



Herfindahl Index: A measure of market power

If we have linear costs, we can re-write industry profits as

$$\sum_{i=1}^n \pi = \sum_{i=1}^n (p - c)q_i \quad (6)$$

This can be re-written in two equivalent ways.

$$(p - \sum_{i=1}^n)q = \frac{pq}{\eta} \sum_{i=1}^n a_i^2 \quad (7)$$

We simply divide the the total industry profits by the revenue to measure market power

$$\frac{1}{\eta} \sum_{i=1}^n a_i^2 \quad (8)$$

Lessons from Cournot

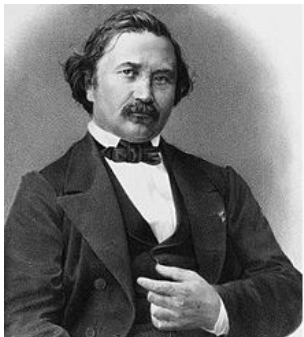
- ▶ Lesson 1: Profits increase when a firm becomes *relatively* more efficient
- ▶ Lesson 2: Converges to perfect competition as number of firms increases
- ▶ Lesson 3: Markup higher \leftrightarrow higher market share
- ▶ Lesson 4: Less elastic demand means higher markup/profits/market share

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Joseph Bertrand

- ▶ French Mathematician, Born in 1822, Ecole Polytechnique
- ▶ Bertrand, J. (1883) "Book review of *théorie mathématique de la richesse sociale* and of *recherches sur les principes mathématiques de la théorie des richesses*", *Journal de Savants*

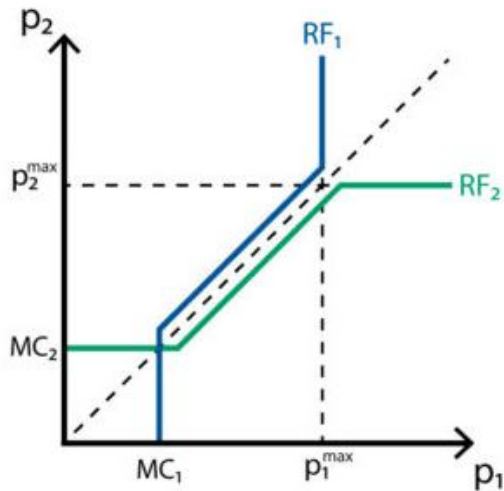


Demand in price competition

$$Q(p) = \begin{cases} Q(p_i) & \text{if } p_i < p_j \\ a_i Q(p_i) & \text{if } p_i = p_j \\ 0 & \text{if } p_i > p_j \end{cases}$$

- ▶ Note 1: If you have a lower price, you get all of the demand
- ▶ Note 2: a_i has to be between 0 and 1 to indicate that the market is split.
- ▶ Note 3: If consumers prefer the "new" , and firm i enters second then, $a_i > 0.5$, if they have ϵ switching cost $a_i < 0.5$

Price Reaction Graph



Notes on Bertrand Competition

- ▶ Lesson 1: Prices equal to marginal cost
- ▶ Lesson 2: Perfect competition is possible with only two firms
- ▶ Extensions 1: If they do not know each others costs, then weakly expected positive profits
- ▶ Extensions 2: If the products are not homogenous, some market power
- ▶ Extensions 3: If not symmetric, either monopoly price or competitors cost

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Comparison

- ▶ If product is homogenous. Quantity has higher prices, lower quantities and higher profits
- ▶ If we have a price setting but firms chooses capacity first(at linear cost), results identical
- ▶ High capacity \rightarrow price competition
- ▶ Low capacity \rightarrow quantity competition
- ▶ Alternative framing: what is easier to adjust, prices or quantities?
- ▶ Extension: Even if products are heterogenous, price always gives lower prices and higher quantity