ig picture Oligopoly: Quantity Oligopoly: Price Comparison

# Industrial Organization, Week 3 Oligopoly

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Big picture Oligopoly: Quantity Oligopoly: Price Comparisor

## 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 competitionm,  $q_i(q_{-i})$
- 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



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# Demand in quantity competition

$$P(Q) = P(q_1, q_2, q_3, ..., q_n)$$
  
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.
- $\blacktriangleright$  n is number of firms. We will be using i and j to talk about two different firms

# Demand in quantity competition

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

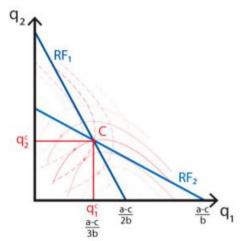
$$= (a - bQ)q_i - C(q_i)$$

$$= aq - b(q_i + q_j)q - cq_i$$

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

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

# Quantity Reaction Graph



# Herfindahl Index: A measure of market power

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

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

This can be re-written in two equivalent ways.

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

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

$$\frac{1}{\eta} \sum_{i=1}^{n} a_i^2 \tag{8}$$

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#### 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 ↔ 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 principles mathematiques de la theorie des richesses", Journal de Savants



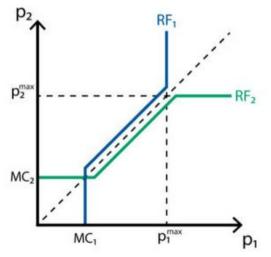
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## Demand in price competition

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

- ▶ 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  $\epsilon$  switching cost  $a_i < 0.5$

# Price Reaction Graph



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## 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 → price competition
- ► Low capacity → 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