Industrial Organization, Week 3
Oligopoly

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Agenda

1. Big picture
2. Oligopoly: Quantity
3. Oligopoly: Price

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

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.
- n is number of firms. We will be using i and j to talk about two different firms

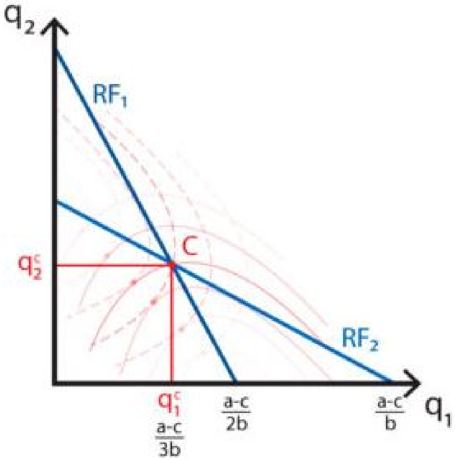
Demand in quantity competition

$$max_q \pi(Q) = aq - b(q_i + q_j)q - cq_i \tag{1}$$

$$= [a - b(q_i + q_j) - c]q_i \tag{2}$$

$$\rightarrow q_i = \frac{a - bq_j - c}{2b} = \frac{a - c}{2b} - \frac{q_j}{2} \tag{3}$$

Quantity Reaction Graph



Herfindahl Index: A measure of market power

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

$$\sum_{i=1}^{n} \pi = \sum_{i=1}^{n} (p - c) q_i \tag{4}$$

This can be re-written in two equivalent ways.

$$(p - \sum_{i=1}^{n}) q = \frac{pq}{\eta} \sum_{i=1}^{n} a_i^2 \tag{5}$$

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

$$\frac{1}{\eta} \sum_{i=1}^{n} a_i^2 \tag{6}$$

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

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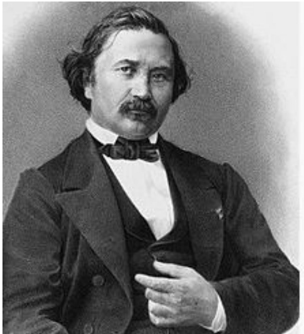
Joseph Bertrand

- 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

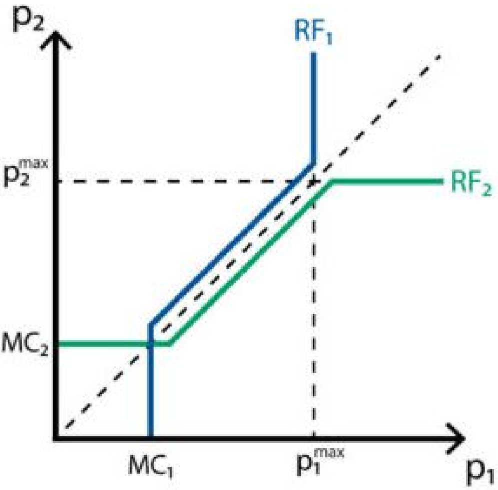


Demand in price competition

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

- Note 1: If you have a lower price, you get all of the demand
- Note 2: If consumers prefer the "new" , then, second firm to match competitor, $a_i > 0.5$, 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

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