Chapter 13: Oligopoly and Monopolistic Competition

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Objectives

- Market Structures: Review
- Cartels
- Cournot Oligopoly
- Stackelberg Oligopoly
- Bertrand Oligopoly
- Monopolistic Competition (time permitting)

Introduction

- Oligopoly is a market structure with so small number of firms that there is strategic interaction between the firms.
- Duopoly (two firms) is its simplest case
- Unlikely to have a general solution– depends on the number of firms and specific details of how firms interact

Classification of Oligopolies: I. collusive

- ***Cartel***: is an outcome when firms collude to maximize total profit
- The result is the same as monopoly with two plants where the firm optimal is at

$$MR = MC_1 = MC_2$$

- Example: Given market demand $P = 100 - 2Q$, $TC_1 = 4q_1$, and $TC_2 = 4q_2$

  where $Q = q_1 + q_2$, find the profit maximizing level of q_1, q_2, Q, p, π.

  Soln:

Classification of Oligopolies: II. non-collusive

a. Simultaneous moves

1. quantity setting — Cournot Model (identical product and differentiated product)
2. price setting — Bertrand (identical product and differentiated product)

b. Sequential moves (Stackelberg Model)

1. quantity leadership
2. price leadership

Cournot Model (Simultaneous Quantity Setting)

Given:

- Homogeneous good produced by Firm 1 and Firm 2
- q_i = Firm i's output
- Linear (inverse) demand:

$$p(Q) = 440 - 2Q = 440 - 2(q_1 + q_2) \quad \text{where } Q = q_1 + q_2$$

- Constant MC for each firm: $TC_i = 200q_i$

Cournot model

Game description:

- To maximize profit, each firm sets q_i given q_j
- so setting output is the *strategy*, and the *pay-off* is the profit earned, which is given by

$$\max_{q_i \geq 0} \pi_1(q_1, q_2) = (440 - 2(q_1 + q_2)) \cdot q_i - cq_i$$

- The F.O.C of this gives us $q_i = B(q_j)$ for $i = 1, 2$ which is called **Best response/reaction (BR) function** of a firm.

Cournot-Nash Equilibrium: Numerical Example

- ***Nash equilibrium***: A set of actions taken by the firms is a Nash equilibrium if, holding the actions of all other firms constant, no firm can obtain a higher profit by choosing a different action.

- ***Example***: Suppose in the cellphone service there are only two firms (Tmobile and Verizon) with each firm having cost of $TC = 200q_i$ and facing market demand of $P = 440 - 2Q$. Find the optimal q_1, q_2, Q, P and total profit under Nash equilibrium.

Soln:

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q1=q2 = 40;  Q=(q1+q2) =80

market price = 280

each firm's profit = 3200

total profit = 6400
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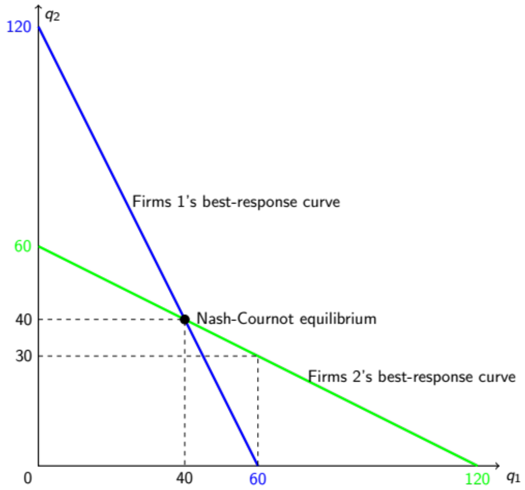
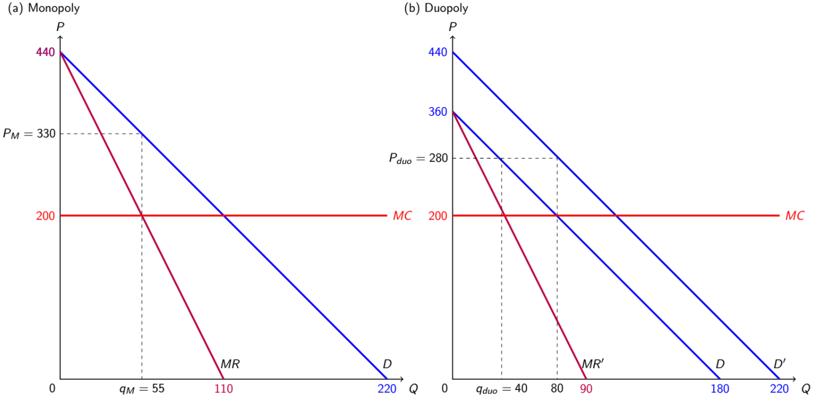
BR Functions and Cournot Eqm



Cournot and Monopoly Eqm



MR, Elasticity and Market Structure

- We can write a typical Cournot firm's profit-maximizing condition as:

$$\boxed{MR = P(1 - \frac{1}{n|\varepsilon|}) = MC}$$

  - for $n = 1$, $MR = P(1 - \frac{1}{|\varepsilon|}) = MC$, which is Monopoly maximization condition
  - for $n \to \infty$, $P = MC$, perfect competition optimal condition

- Similarly, the modified Lerner index for Cournot firms can be given by

$$\frac{P - MC}{P} = \frac{1}{n|\varepsilon|}$$

  - for n=1, we have the monopoly case: $\frac{P-MC}{P} = \frac{1}{|\varepsilon|}$

Cournot with different marginal costs: Numerical Example

Given Market demand

$$p = 440 - Q \quad \text{and } TC_1 = 100q_1 \quad \text{and } TC_2 = 200q_2$$

where $Q = q_1 + q_2$

Find optimal q_1, q_2, Q, p and total profit

Answer:

Stackelberg Leadership (Sequential Quantity Setting)

A. Game description

- Identical product (cannot charge different prices)
- Firm 1 (leader) first chooses q_1, which Firm 2 (follower) observes and then chooses q_2
- Unlike the Cournot model's simultaneous quantity setting, here we have sequential quantity setting
- Since Firm 1 is the leader, it uses ***BR2*** function to maximize its profit

Stackelberg Leadership (Sequential Quantity Setting)

B. ***Sub-game perfect equilibrium***

- Backward induction: Solve first the profit maximization problem of Firm 2 and then calculate the residual demand that Firm 1 faces, which it will use to maximize its profit

Numerical Example: Suppose the market demand is $P = 440 - 2Q \Rightarrow Q = 220 - 0.5P$, $TC_1 = 200q_1$ and $TC_2 = 200q_2$

1. From previous problem, we know that the BR function of firm 2 to be:

$$q_2 = r(q_1) = 60 - \frac{1}{2}q_1$$

Numerical Example: Cont'd

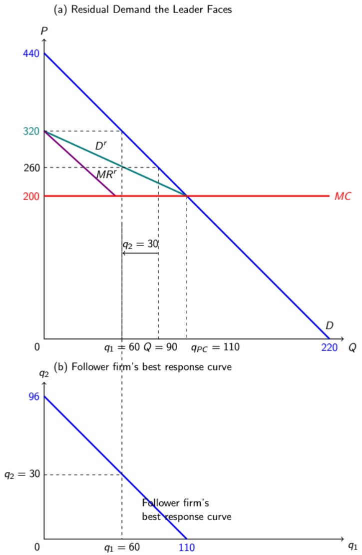
2. Then Firm 1's (the leader's) residual demand is: $q_1 = Q(P) - q_2 = (220 - 0.5P) - (60 - .5q_1) \Rightarrow P = 320 - 1q_1$

- Then firm 1's problem is to solve:

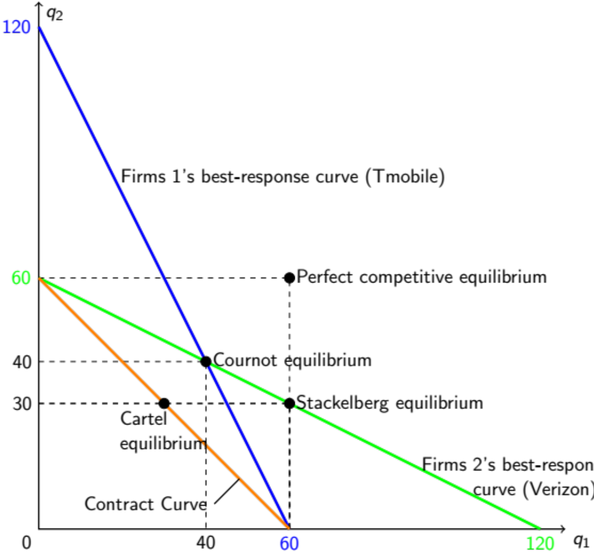
$$\max_{q_1 \geq 0} \pi = P \cdot q_1 - TC_1 = (320 - 1q_1)q_1 - 200q_1$$

which gives $q_1^* = 60, q_2^* = 30, Q^* = 90, P^* = 260$

Stackelberg Quantity Leadership Eqm.: Graphically



Comparison Competitive, Stackelberg, Cournot, and Collusive Equilibria



Bertrand Oligopoly Model (Simultaneous price setting)

- Here firms compete by setting lower prices
- **Nash-Bertrand equilibrium** exists if there are a set of prices such that no firm can obtain a higher profit by choosing a different price if the other firms continue to charge these prices.
- Bertrand equilibrium depends on whether firms are producing identical or differentiated products.

Bertrand Model with Identical Products

- Consider again two firms producing identical product and marginal cost
- As long as $P > MC$, each firm has the incentive to lower price a little bit to capture the entire market
- The only consistent (equilibrium) beliefs are $P_1 = P_2 = MC$

SUMMARY

- Oligopoly and monopolistic competition do not have all of the desirable welfare properties of perfect competition.
- There is a deadweight loss caused by the markup of price over marginal cost.
- Although, the number of firms (and thus varieties) can be good thing, it can be too large or too small.
- Thus, there is no clear way for policymakers to improve the market outcome.