# Lecture 10. Pricing with Market Power, Monopolistic Competition, and Oligopoly

BTM210, KAIST

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# Topics Covered in This Lecture

Pricing with Market Power

Monopolistic Competition

Oligopoly

Pricing with Market Power

Monopolistic Competition

Oligopoly

# How Do Firms with Market Power Typically Behave?

- Firm's Objective
  - Capturing consumer surplus as much as possible
- How to
  - Adjust prices
  - Use various forms of price discrimination
- Example
  - Intertemporal price discrimination
  - Peak-load pricing
  - Two-part tariff

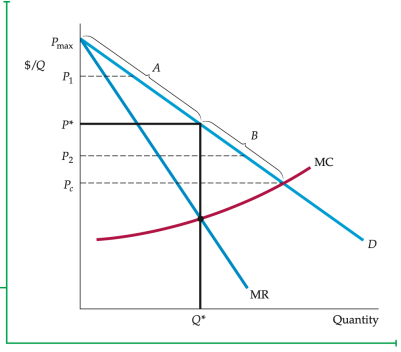
$$\max_{Q_i, P_i} \Pi = \sum_{i \in I} P_i Q_i - C(Q)$$

# Capturing Consumer Surplus w/ Price Discrimination

- Pricing strategies are means of capturing consumer surplus and transferring it to the producer.
  - A firm could capture the consumer surplus (or at least part of it) from its customers in region A, and also sell profitably to some of its potential customers in region B.

**FIGURE 11.1**
**CAPTURING CONSUMER SURPLUS**

If a firm can charge only one price for all its customers, that price will be $P^*$ and the quantity produced will be $Q^*$. Ideally, the firm would like to charge a higher price to consumers willing to pay more than $P^*$, thereby capturing some of the consumer surplus under region $A$ of the demand curve. The firm would also like to sell to consumers willing to pay prices lower than $P^*$, but only if doing so does not entail lowering the price to other consumers. In that way, the firm could also capture some of the surplus under region $B$ of the demand curve.




Source: *Microeconomics, 9th ed.* (Pindyck and Rubinfeld, 2018), Figure 11.1

# Three Forms of Price Discrimination

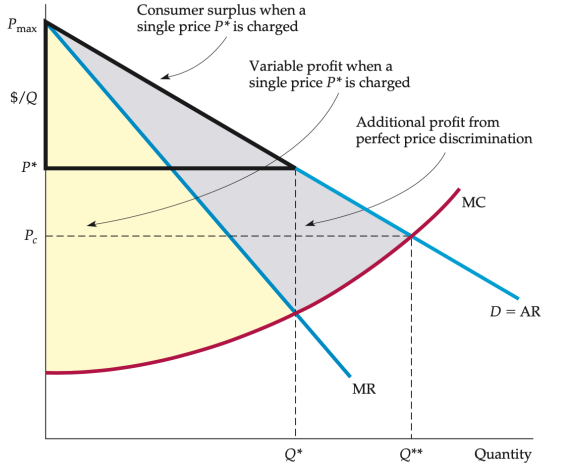
- Price discrimination
  - Practice of charging different prices to different consumers for similar goods
- First-degree price discrimination
  - Charging each customer her reservation price
- Second-degree price discrimination
  - Charging different prices per unit for different quantities of the same good or service
- Third-degree price discrimination
  - Dividing consumers into two or more groups with separate demand curves and charging different prices to each group

# First-Degree Price Discrimination

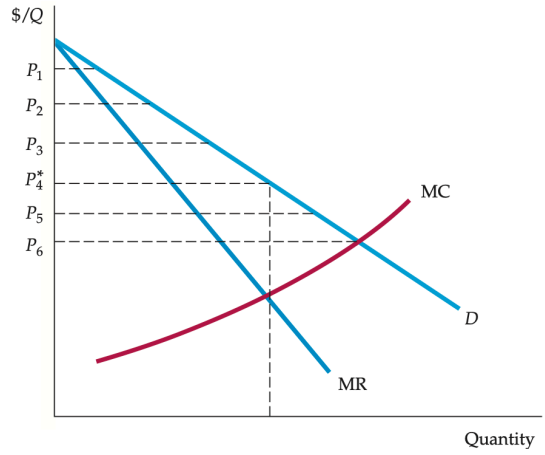
- Charging each customer his or her reservation price, the maximum price that the customer is willing to pay
  - Ideal for a firm
- Perfect price discrimination
  - The price paid for each additional unit is given by the demand curve.
  - All consumer surplus has been captured by the firm.
  - Variable profit is given by the area between the demand and marginal cost curves.
- Imperfect price discrimination
  - In practice, perfect first-degree price discrimination is almost never possible.
  - Impractical to charge each and every customer a different price
  - A firm usually does not know the reservation price of each customer.
  - Firms can discriminate imperfectly by charging a few different prices based on estimates of customers' reservation prices.

## FIGURE 11.2 ADDITIONAL PROFIT FROM PERFECT FIRST-DEGREE PRICE DISCRIMINATION

Because the firm charges each consumer her reservation price, it is profitable to expand output to $Q^{**}$. When only a single price, $P^*$, is charged, the firm's variable profit is the area between the marginal revenue and marginal cost curves. With perfect price discrimination, this profit expands to the area between the demand curve and the marginal cost curve.




Source: *Microeconomics, 9th ed.* (Pindyck and Rubinfeld, 2018), Figure 11.2




## FIGURE 11.3
## FIRST-DEGREE PRICE DISCRIMINATION IN PRACTICE

Firms usually don't know the reservation price of every consumer, but sometimes reservation prices can be roughly identified. Here, six different prices are charged. The firm earns higher profits, but some consumers may also benefit. With a single price $P_4^*$ there are fewer consumers. The consumers who now pay $P_5$ or $P_6$ enjoy a surplus.

Source: *Microeconomics, 9th ed.* (Pindyck and Rubinfeld, 2018), Figure 11.3

# Second-Degree Price Discrimination

- A firm can discriminate according to the quantity consumed by charging different prices for different quantities of the same good or service.
  - In some markets, as each consumer purchases many units of a good over any given period, his reservation price declines with the number of units purchased.
  - Quantity discounts, block pricing

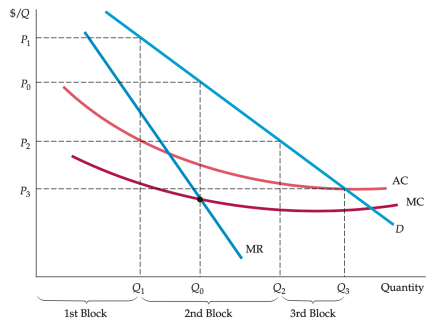



**FIGURE 11.4**
**SECOND-DEGREE PRICE DISCRIMINATION**

Different prices are charged for different quantities, or "blocks," of the same good. Here, there are three blocks, with corresponding prices $P_1$, $P_2$, and $P_3$. There are also economies of scale, and average and marginal costs are declining. Second-degree price discrimination can then make consumers better off by expanding output and lowering cost.

# Third-Degree Price Discrimination

- Dividing consumers into two or more groups with separate demand curves for each group
- The most prevalent form of price discrimination, and examples abound
  - Regular vs. special airline fares
  - Premium vs. non-premium brands
  - Discounts to students

$$MR_1 = MR_2 = MC$$

$$MR = P(1 + 1/E_d)$$

$$\frac{P_1}{P_2} = \frac{1 + 1/E_2}{1 + 1/E_1}$$

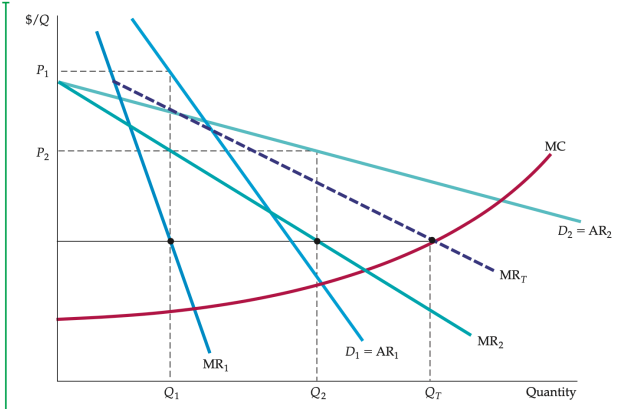


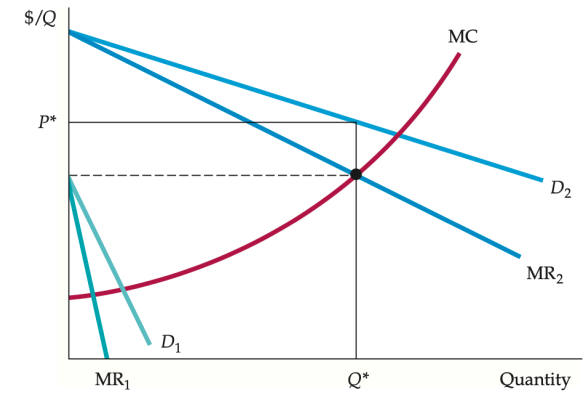

**FIGURE 11.5**
**THIRD-DEGREE PRICE DISCRIMINATION**

Consumers are divided into two groups, with separate demand curves for each group. The optimal prices and quantities are such that the marginal revenue from each group is the same and equal to marginal cost. Here group 1, with demand curve $D_1$, is charged $P_1$, and group 2, with the more elastic demand curve $D_2$, is charged the lower price $P_2$. Marginal cost depends on the total quantity produced $Q_T$. Note that $Q_1$ and $Q_2$ are chosen so that $MR_1 = MR_2 = MC$.

Source: *Microeconomics, 9th ed.* (Pindyck and Rubinfeld, 2018), Figure 11.5

## FIGURE 11.6
## NO SALES TO SMALLER MARKET

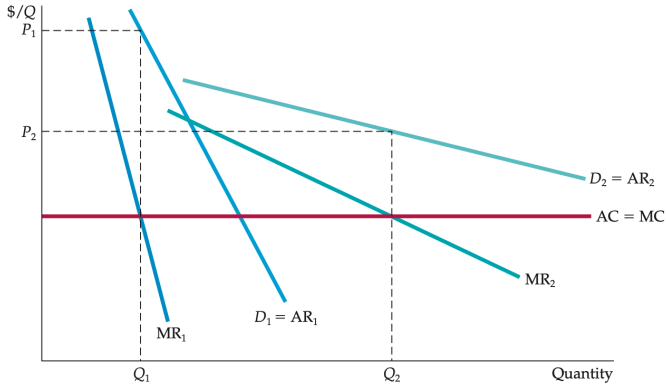
Even if third-degree price discrimination is feasible, it may not pay to sell to both groups of consumers if marginal cost is rising. Here the first group of consumers, with demand $D_1$, are not willing to pay much for the product. It is unprofitable to sell to them because the price would have to be too low to compensate for the resulting increase in marginal cost.




Source: *Microeconomics, 9th ed.* (Pindyck and Rubinfeld, 2018), Figure 11.6

# Intertemporal Price Discrimination

- Charging different prices at different points in time
  - Divide consumers into high-demand and low-demand groups by charging a price that is high at first but falls later
  - e.g., electronic devices:
- Brand-new electronic devices
  - Offering the product initially at the high price (early adopters)
  - Later, after this first group of consumers has bought the product, the price is lowered
- Books
  - A high price for the hardcover edition
  - The paperback version at a much lower price about a year later




## FIGURE 11.7
## INTERTEMPORAL PRICE DISCRIMINATION

Consumers are divided into groups by changing the price over time. Initially, the price is high. The firm captures surplus from consumers who have a high demand for the good and who are unwilling to wait to buy it. Later the price is reduced to appeal to the mass market.

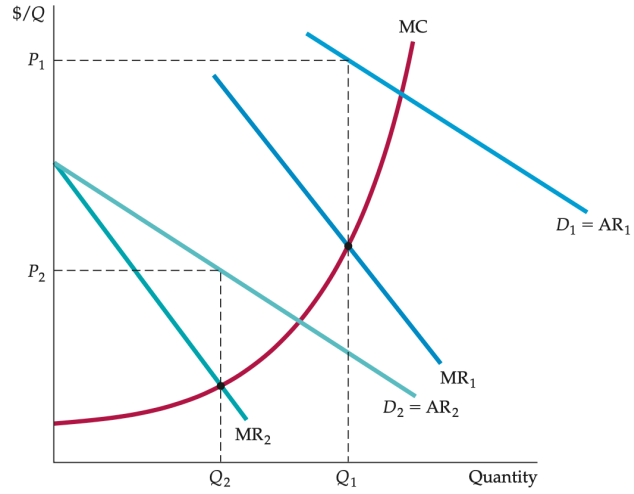
Source: *Microeconomics, 9th ed.* (Pindyck and Rubinfeld, 2018), Figure 11.7

# Peak-Load Pricing

- Charging higher prices during peak periods when capacity constraints cause marginal costs to be high
  - The objective is to increase economic efficiency by charging consumers prices that are close to marginal cost, rather than capturing consumer surplus.
  - Roads and tunnels during commuter rush hours
  - Electricity during late summer afternoons
- Difference from third-degree price discrimination
  - With third-degree price discrimination, marginal revenue must be equal for each group of consumers because the costs of serving the different groups are not independent.
  - This is not so with peak-load pricing.
  - Selling more electricity during off-peak periods will not significantly increase the cost of selling electricity during peak periods.

## FIGURE 11.8
## PEAK-LOAD PRICING

Demands for some goods and services increase sharply during particular times of the day or year. Charging a higher price $P_1$ during the peak periods is more profitable for the firm than charging a single price at all times. It is also more efficient because marginal cost is higher during peak periods.




Source: *Microeconomics, 9th ed.* (Pindyck and Rubinfeld, 2018), Figure 11.8

# The Two-Part Tariff

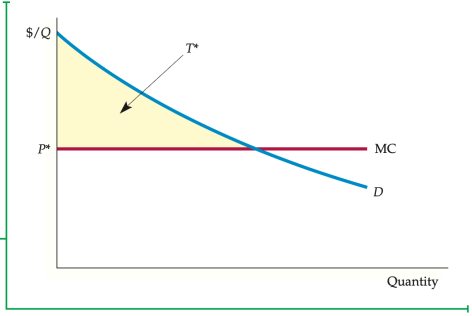
- The two-part tariff
  - Is related to price discrimination and provides another means of extracting consumer surplus.
  - Requires consumers to pay a fee up front for the right to buy a product.
  - Charges an additional fee for each unit of the product consumers wish to consume.
- Amusement park
  - An admission fee to enter
  - A certain amount for each ride
- The problem for the firm
  - How to set the entry fee (T) and the usage fee (P)

# Two-Part Tariff: Single Consumer

- Only one consumer in the market (or many consumers with identical demand curves)
- Set the usage fee P equal to marginal cost and the entry fee T equal to the total consumer surplus for each consumer.

**FIGURE 11.9**
**TWO-PART TARIFF WITH A SINGLE CONSUMER**

The consumer has demand curve *D*. The firm maximizes profit by setting usage fee *P* equal to marginal cost and entry fee *T** equal to the entire surplus of the consumer.




Source: *Microeconomics, 9th ed.* (Pindyck and Rubinfeld, 2018), Figure 11.9

# Two-Part Tariff: Two Consumer

- With two consumers, a firm can set only one entry fee and one usage fee.
- The firm (1) sets the usage fee above marginal cost and (2) sets the entry fee equal to the remaining consumer surplus of the consumer with the smaller demand.

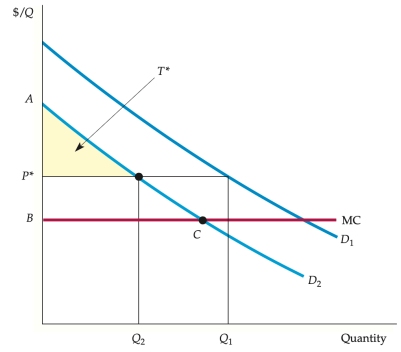



**FIGURE 11.10**
**TWO-PART TARIFF WITH TWO CONSUMERS**

The profit-maximizing usage fee $P^*$ will exceed marginal cost. The entry fee $T^*$ is equal to the surplus of the consumer with the smaller demand. The resulting profit is $2T^* + (P^* - MC)(Q_1 + Q_2)$. Note that this profit is larger than twice the area of triangle *ABC*.

Source: *Microeconomics, 9th ed.* (Pindyck and Rubinfeld, 2018), Figure 11.10

# Two-Part Tariff: Many Consumers

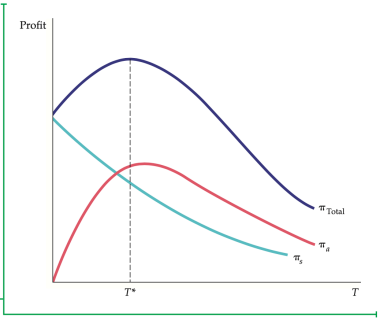
- No simple formula to calculate the optimal two-part tariff in this case
- A trade-off
  - Given $P$, a lower entry fee $T \rightarrow$ more entrants $\rightarrow$ more profits from sales
  - A too low entry fee $T \rightarrow$ the profit derived from the entry fee falls

**FIGURE 11.11**
**TWO-PART TARIFF WITH MANY DIFFERENT CONSUMERS**

Total profit $\pi$ is the sum of the profit from the entry fee $\pi_a$ and the profit from sales $\pi_s$. Both $\pi_a$ and $\pi_s$ depend on $T$, the entry fee. Therefore

$$\pi = \pi_a + \pi_s = n(T)T + (P - MC)Q(n)$$

where $n$ is the number of entrants, which depends on the entry fee $T$, and $Q$ is the rate of sales, which is greater the larger is $n$. Here $T^*$ is the profit-maximizing entry fee, given $P$. To calculate optimum values for $P$ and $T$, we can start with a number for $P$, find the optimum $T$, and then estimate the resulting profit. $P$ is then changed and the corresponding $T$ recalculated, along with the new profit level.




Source: *Microeconomics, 9th ed.* (Pindyck and Rubinfeld, 2018), Figure 11.11

Pricing with Market Power

Monopolistic Competition

Oligopoly

# Perfect Competition, **Monopolistic Competition**, and Monopoly

- Perfect competition
  - Many firms
  - Free entry and exit
  - Homogeneous goods
- Monopolistic competition (YouTube Clip)
  - Many firms
  - Free entry and exit
  - Differentiated goods: firms can utilize their own market power and adjust prices.
- Monopoly
  - One firm
  - Barriers to entry
  - A monopolized good

# Monopolistic Competition

- In many industries, the products are differentiated.
  - Consumers view each firm' s brand as different from other brands.
  - Coffee brands: Starbucks, Compose, Mega, Ediya, Hollys, Paik's Coffee
  - Starbucks has monopoly power. But its monopoly power is limited because consumers can easily substitute other brands if the price of Starbucks rises.
- Two key characteristics of a monopolistically competitive market
  - Firms compete by selling **differentiated products that are highly substitutable** for one another but not perfect substitutes. In other words, the cross-price elasticities of demand are large but not infinite.
  - There is **free entry and exit**: It is relatively easy for new firms to enter the market with their own brands and for existing firms to leave if their products become unprofitable.

# Equilibrium in the Short Run and the Long Run

- In the short run,
  - As with monopoly, in monopolistic competition firms face downward-sloping demand curves.
  - They have some monopoly power.
  - But this does not mean that monopolistically competitive firms are likely to earn large profits.
- Because there is free entry in the long run,
  - The potential to earn profits will attract new firms with competing brands, driving economic profits down to zero.

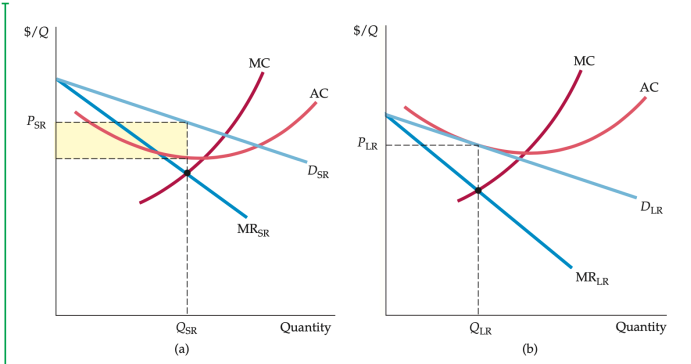



**FIGURE 12.1**
**A MONOPOLISTICALLY COMPETITIVE FIRM IN THE SHORT AND LONG RUN**

Because the firm is the only producer of its brand, it faces a downward-sloping demand curve. Price exceeds marginal cost and the firm has monopoly power. In the short run, described in part **(a)**, price also exceeds average cost, and the firm earns profits shown by the yellow-shaded rectangle. In the long run, these profits attract new firms with competing brands. The firm's market share falls, and its demand curve shifts downward. In long-run equilibrium, described in part **(b)**, price equals average cost, so the firm earns zero profit even though it has monopoly power.

Source: *Microeconomics, 9th ed.* (Pindyck and Rubinfeld, 2018), Figure 12.1

# Monopolistic Competition and Economic Efficiency

- Two sources of inefficiency in a monopolistically competitive industry
- The equilibrium price exceeds marginal cost
  - If output were expanded to the point where the demand curve intersects the marginal cost curve, total surplus could be increased
- Output is below that which minimizes average cost
  - Entry of new firms drives profits to zero in both perfectly competitive and monopolistically competitive markets
  - In a perfectly competitive market, each firm faces a horizontal demand curve, so the zero-profit point occurs at minimum average cost.
  - In a monopolistically competitive market, however, the demand curve is downward sloping, so the zero- profit point is to the left of minimum average cost.

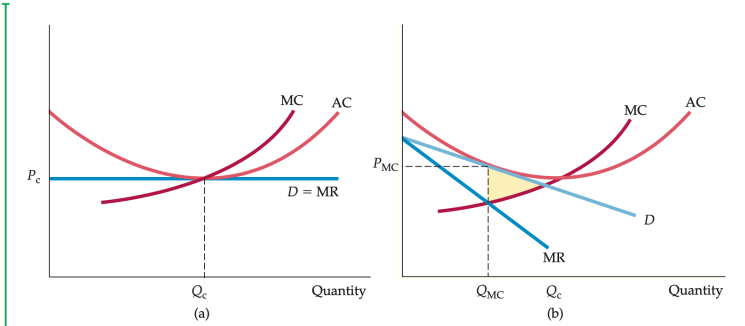



**FIGURE 12.2**
**COMPARISON OF MONOPOLISTICALLY COMPETITIVE EQUILIBRIUM AND PERFECTLY COMPETITIVE EQUILIBRIUM**

Under perfect competition, as in **(a)**, price equals marginal cost, but under monopolistic competition, price exceeds marginal cost. Thus there is a deadweight loss, as shown by the yellow-shaded area in **(b)**. In both types of markets, entry occurs until profits are driven to zero. Under perfect competition, the demand curve facing the firm is horizontal, so the zero-profit point occurs at the point of minimum average cost. Under monopolistic competition the demand curve is downward-sloping, so the zero-profit point is to the left of the point of minimum average cost. In evaluating monopolistic competition, these inefficiencies must be balanced against the gains to consumers from product diversity.

Source: *Microeconomics, 9th ed.* (Pindyck and Rubinfeld, 2018), Figure 12.2

# Regulation May Be Unnecessary.

- Monopoly power is small.
  - Usually enough firms compete, with brands that are sufficiently substitutable.
  - Deadweight loss will therefore be small.
  - Firms' demand curves will be fairly elastic, average cost will be close to the minimum.
- Product diversity can be balanced against inefficiency.
  - Most consumers value the ability to choose among a wide variety of competing products and brands that differ in various ways.
  - The gains from product diversity can be large and may easily outweigh the inefficiency costs resulting from downward-sloping demand curves.

Pricing with Market Power

Monopolistic Competition

Oligopoly

# Perfect Competition, **Oligopoly**, and Monopoly

- Perfect competition
  - Many firms
  - Free entry and exit
  - Homogeneous goods
- Oligopoly (YouTube Link)
  - A few firms (e.g. 2 10)
  - Barriers to entry
  - Homogeneous or differentiated goods
- Monopoly
  - One firm
  - Barriers to entry
  - A monopolized good

# Oligopoly

- In oligopolistic markets,
  - Only a few firms account for most or all of total production.
  - The products may or may not be differentiated.
  - Some or all firms could earn substantial profits over the long run because barriers to entry make it difficult or impossible for new firms to enter.
- Oligopoly is a prevalent form of market structure.
  - Automobiles, steel, aluminum, petrochemicals, electrical equipment, and computers.
- Why might barriers to entry arise?
  - Scale economies, patents, technology, market reputation.
  - Incumbent firms taking **strategic** actions to deter entry.
  - When making decisions, each firm must weigh its competitors' reactions, knowing that these competitors will also weigh its reactions to their decisions.

# Equilibrium in a Competitive or Monopolistic Market

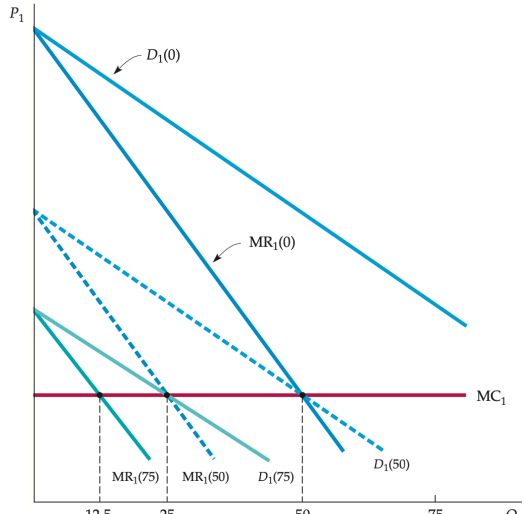
- The price and quantity prevailing in equilibrium
  - Perfectly competitive market: $Q_D(P) = Q_S(P)$
  - Monopoly: $MR = MC$
  - Monopolistic competition: The entry of new firms drives profits to zero in the long run.
- In these markets, each firm could take price or market demand as given and largely ignore its competitors.
- Note that, when a market is in equilibrium, firms are doing the best they can and have no reason to change their price or output.

# Equilibrium in an Oligopolistic Market

- In an oligopolistic market,
  - A firm sets price or output based partly on strategic considerations regarding the behavior of its competitors.
  - At the same time, competitors' decisions depend on the first firm' s decision.
- **Nash equilibrium**
  - Each firm is doing the best it can, given what its competitors are doing.
  - The concept was first explained clearly by the mathematician John Nash in 1951.
  - This equilibrium concept will be discussed in more detail next week.
- Duopoly
  - We will focus on markets in which two firms are competing with each other.
  - Each firm has just one competitor to take into account in making its decisions.

# The Cournot Model

- First introduced by the French economist Augustin Cournot in 1838
- The firms produce a homogeneous good and know the market demand curve.
- Each firm must decide how much to produce.
- The two firms make their decisions at the same time.
- Note that
  - When making its production decision, each firm takes its competitor into account.
  - It knows that its competitor is also deciding how much to produce.
  - The market price will depend on the total output of both firms.
  - Each firm treats the output level of its competitor as fixed when deciding how much to produce.




## FIGURE 12.3
## FIRM 1'S OUTPUT DECISION

Firm 1's profit-maximizing output depends on how much it thinks that Firm 2 will produce. If it thinks Firm 2 will produce nothing, its demand curve, labeled $D_1(0)$, is the market demand curve. The corresponding marginal revenue curve, labeled $MR_1(0)$, intersects Firm 1's marginal cost curve $MC_1$ at an output of 50 units. If Firm 1 thinks that Firm 2 will produce 50 units, its demand curve, $D_1(50)$, is shifted to the left by this amount. Profit maximization now implies an output of 25 units. Finally, if Firm 1 thinks that Firm 2 will produce 75 units, Firm 1 will produce only 12.5 units.

Source: *Microeconomics, 9th ed.* (Pindyck and Rubinfeld, 2018), Figure 12.3

# Reaction Curves: $Q_1^*(Q_2)$

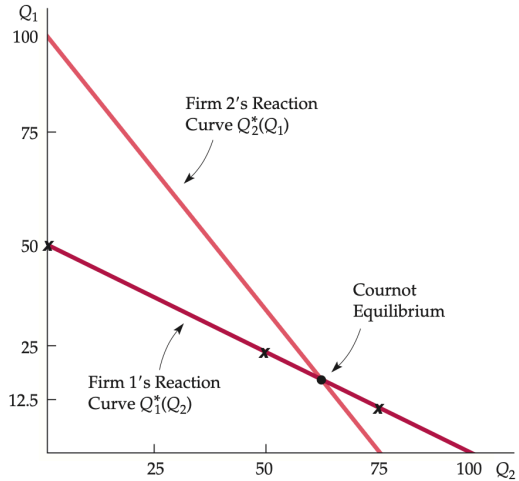
- Relationship between a firm's profit-maximizing output($Q_1$) and the amount it thinks its competitor will produce($Q_2$).
- Firm 1's profit-maximizing output is thus a decreasing schedule of how much it thinks Firm 2 will produce.

$$\frac{d}{dQ_2} Q_1^*(Q_2) < 0$$

- We can go through the same kind of analysis for Firm 2.
  - A reaction curve for Firm 2, $Q_2^*(Q_1)$
  - If Firm 2's marginal revenue or marginal cost curve is different from that of Firm 1, its reaction curve will also differ in form.

## FIGURE 12.4
## REACTION CURVES AND COURNOT EQUILIBRIUM

Firm 1's reaction curve shows how much it will produce as a function of how much it thinks Firm 2 will produce. (The xs at $Q_2 = 0$, 50, and 75 correspond to the examples shown in Figure 12.3.) Firm 2's reaction curve shows its output as a function of how much it thinks Firm 1 will produce. In Cournot equilibrium, each firm correctly assumes the amount that its competitor will produce and thereby maximizes its own profits. Therefore, neither firm will move from this equilibrium.




Source: *Microeconomics, 9th ed.* (Pindyck and Rubinfeld, 2018), Figure 12.4

# Cournot Equilibrium

- Each firm correctly assumes how much its competitor will produce and sets its own production level accordingly.
  - Each firm's reaction curve tells it how much to produce, given the output of its competitor.
  - In equilibrium, each firm sets output according to its own reaction curve.
  - The equilibrium output levels are therefore found at the intersection of the two reaction curves.
- This Cournot equilibrium is an example of a Nash equilibrium (and thus it is sometimes called a Cournot-Nash equilibrium).
  - Remember that in a Nash equilibrium, each firm is doing the best it can, given what its competitors are doing.
  - As a result, no firm would individually want to change its behavior.

# An Example: The Linear Demand Curve

- Two identical firms facing a linear "market" demand Curve

$$P = 30 - Q, \quad Q = Q_1 + Q_2$$

- Both firms have zero marginal cost: $MC_1 = MC_2 = 0$.
- The reaction curve for Firm 1: $MR_1 = MC_1$

$$MR_1 = \frac{d}{dQ_1} R_1 = \frac{d}{dQ_1}(30 - Q_1 - Q_2)Q_1 = 30 - 2Q_1 - Q2 = 0$$

$$Q_1 = 15 - Q_2/2$$

- The reaction curve for Firm 2 is symmetric: $Q_2 = 15 - Q_1/2$.
- Cournot equilibrium

$$Q_1 = Q_2 = 10, \quad Q = 20, \quad P = 10$$

# What If They Do Not Compete But Collude?

- They would set their outputs to maximize total profit, and presumably they would split that profit evenly.

$$R = PQ = (30 - Q)Q = 30Q - Q^2$$

$$MR = \frac{dR}{dQ} = 30 - 2Q$$

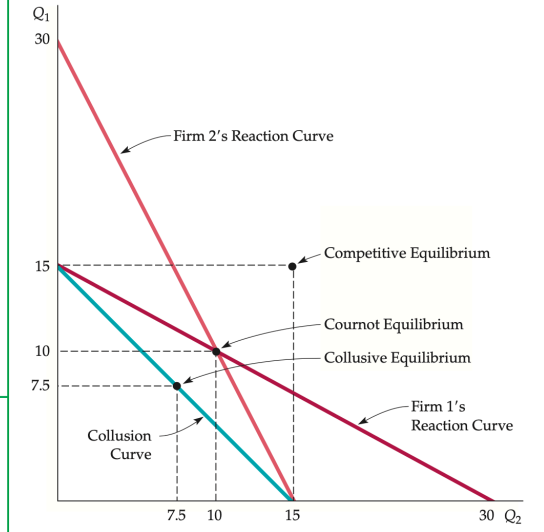
$$MR = MC = 0 \quad \Rightarrow \quad Q = 15, \quad P = 15, \quad \Pi = PQ = 225$$

- Competitive output level

$$P = MC = 0 \quad \Rightarrow \quad Q = 30, \quad \Pi = 0$$

## FIGURE 12.5
## DUOPOLY EXAMPLE

The demand curve is $P = 30 - Q$, and both firms have zero marginal cost. In Cournot equilibrium, each firm produces 10. The collusion curve shows combinations of $Q_1$ and $Q_2$ that maximize *total* profits. If the firms collude and share profits equally, each will produce 7.5. Also shown is the competitive equilibrium, in which price equals marginal cost and profit is zero.




Source: *Microeconomics, 9th ed.* (Pindyck and Rubinfeld, 2018), Figure 12.5