Chapter 13

MODELS OF MONOPOLY

Monopoly

- A monopoly is a single supplier to a market
- This firm may choose to produce at any point on the market demand curve

Barriers to Entry (进入壁垒)

- The reason a monopoly exists is that other firms find it unprofitable or impossible to enter the market
- Barriers to entry are the source of all monopoly power
  - there are two general types of barriers to entry
    - technical barriers
    - legal barriers

Technical Barriers to Entry

- The production of a good may exhibit decreasing marginal and average costs over a wide range of output levels
  - in this situation, relatively large-scale firms are low-cost producers
    - firms may find it profitable to drive others out of the industry by cutting prices
    - this situation is known as natural monopoly
    - once the monopoly is established, entry of new firms will be difficult

Technical Barriers to Entry

- Another technical basis of monopoly is special knowledge of a low-cost productive technique
  - it may be difficult to keep this knowledge out of the hands of other firms
- Ownership of unique resources may also be a lasting basis for maintaining a monopoly

Legal Barriers to Entry

- Many pure monopolies are created as a matter of law
  - with a patent, the basic technology for a product is assigned to one firm
  - the government may also award a firm an exclusive franchise to serve a market

Creation of Barriers to Entry

- Some barriers to entry result from actions taken by the firm
  - research and development of new products or technologies
  - purchase of unique resources
  - lobbying efforts to gain monopoly power
- The attempt by a monopolist to erect barriers to entry may involve real resource costs

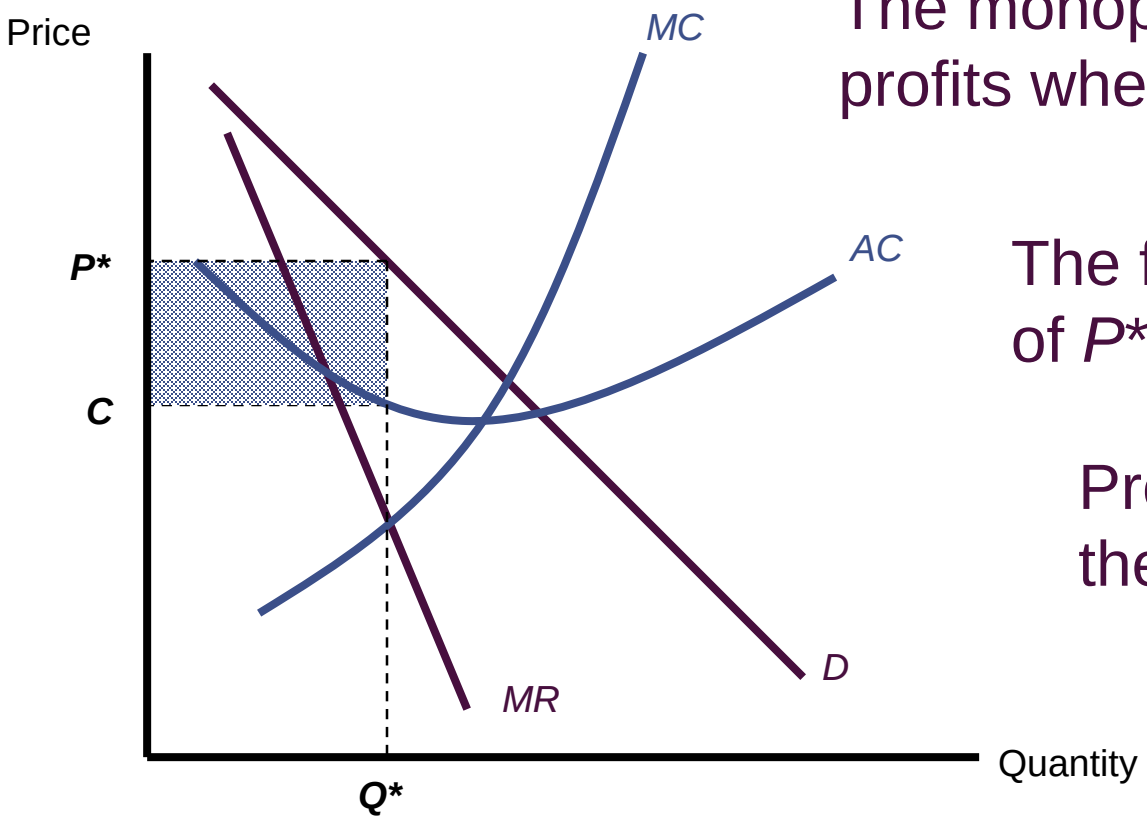
Profit Maximization

- To maximize profits, a monopolist will choose to produce that output level for which marginal revenue is equal to marginal cost
  - marginal revenue is less than price because the monopolist faces a downward-sloping demand curve
    - he must lower its price on all units to be sold if it is to generate the extra demand for this unit

Profit Maximization

- Since *MR* = *MC* at the profit-maximizing output and *P* > *MR* for a monopolist, the monopolist will set a price greater than marginal cost

Profit Maximization



The monopolist will maximize profits where *MR* = *MC*

The firm will charge a price of *P**

Profits can be found in the shaded rectangle

The Inverse Elasticity Rule

- The gap between a firm's price and its marginal cost is inversely related to the price elasticity of demand facing the firm

$$\frac{P - MC}{P} = -\frac{1}{e_{Q,P}}$$

where $e_{Q,P}$ is the elasticity of demand for the entire market

The Inverse Elasticity Rule

- Two general conclusions about monopoly pricing can be drawn:
  - a monopoly will choose to operate only in regions where the market demand curve is elastic
    - $e_{Q,P} < -1$
  - the firm's "markup"（加价） over marginal cost depends inversely on the elasticity of market demand

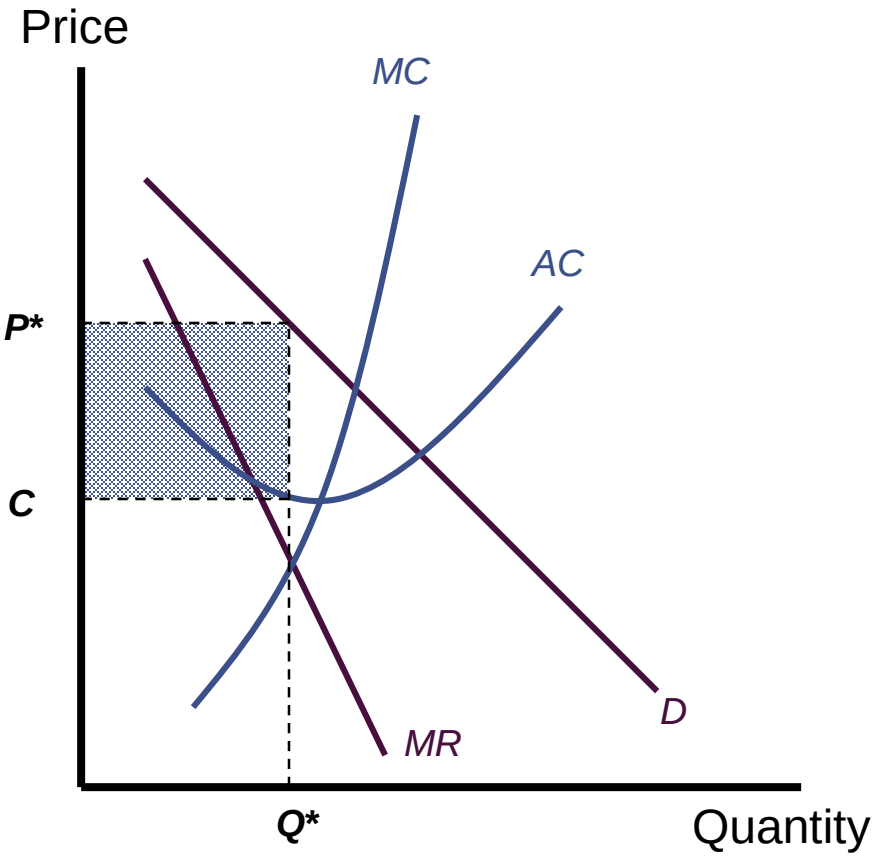
Monopoly Profits

- Monopoly profits will be positive as long as $P > AC$
- Monopoly profits can continue into the long run because entry is not possible
  - some economists refer to the profits that a monopoly earns in the long run as monopoly rents
    - the return to the factor that forms the basis of the monopoly

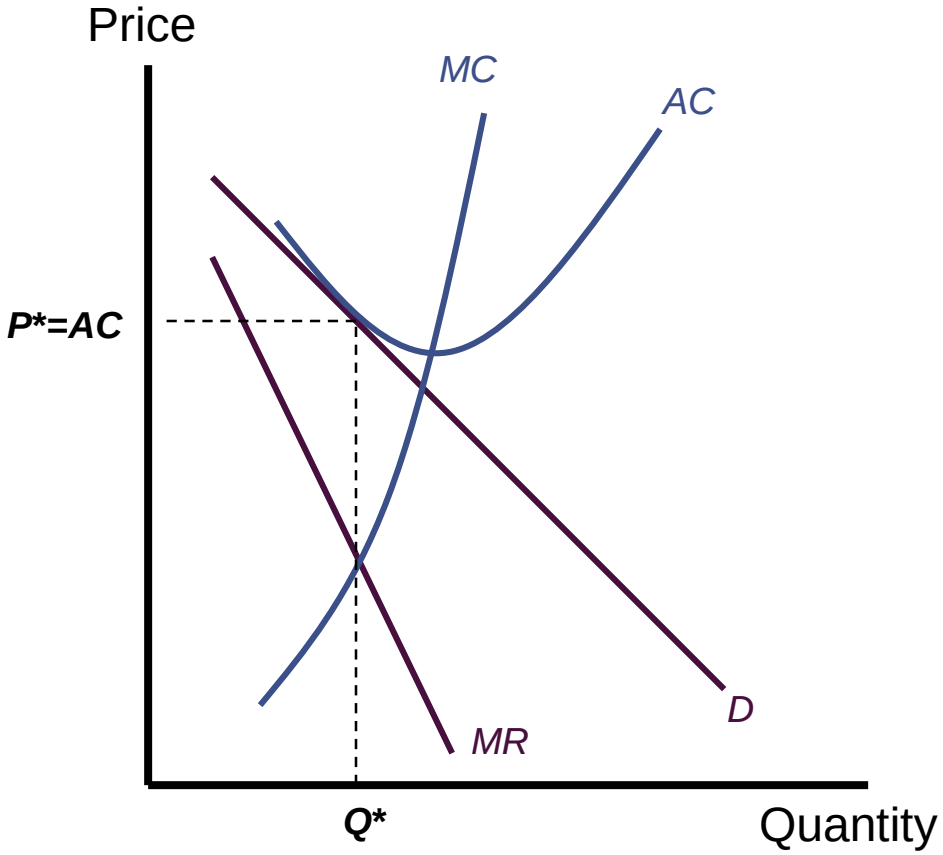
Monopoly Profits

- The size of monopoly profits in the long run will depend on the relationship between average costs and market demand for the product

Monopoly Profits



Positive profits



Zero profit

No Monopoly Supply Curve

- With a fixed market demand curve, the supply “curve” for a monopolist will only be one point
  - the price-output combination where *MR* = *MC*
- If the demand curve shifts, the marginal revenue curve shifts and a new profit-maximizing output will be chosen

Monopoly with Linear Demand

- Suppose that the market for frisbees has a linear demand curve of the form

$$Q = 2{,}000 - 20P$$

or

$$P = 100 - Q/20$$

- The total costs of the frisbee producer are given by

$$C(Q) = 0.05Q^2 + 10{,}000$$

Monopoly with Linear Demand

- To maximize profits, the monopolist chooses the output for which $MR = MC$
- We need to find total revenue

$$TR = P \cdot Q = 100Q - Q^2/20$$

- Therefore, marginal revenue is

$$MR = 100 - Q/10$$

while marginal cost is

$$MC = 0.01Q$$

Monopoly with Linear Demand

- Thus, $MR = MC$ where

$$100 - Q/10 = 0.01Q$$

$$Q^* = 500 \qquad P^* = 75$$

- At the profit-maximizing output,

$$C(Q) = 0.05(500)^2 + 10{,}000 = 22{,}500$$

$$AC = 22{,}500/500 = 45$$

$$\pi = (P^* - AC)Q = (75 - 45)\cdot 500 = 15{,}000$$

Monopoly with Linear Demand

- To see that the inverse elasticity rule holds, we can calculate the elasticity of demand at the monopoly's profit-maximizing level of output

$$e_{Q,P} = \frac{\partial Q}{\partial P} \cdot \frac{P}{Q} = -20\left(\frac{75}{500}\right) = -3$$

Monopoly with Linear Demand

- The inverse elasticity rule specifies that

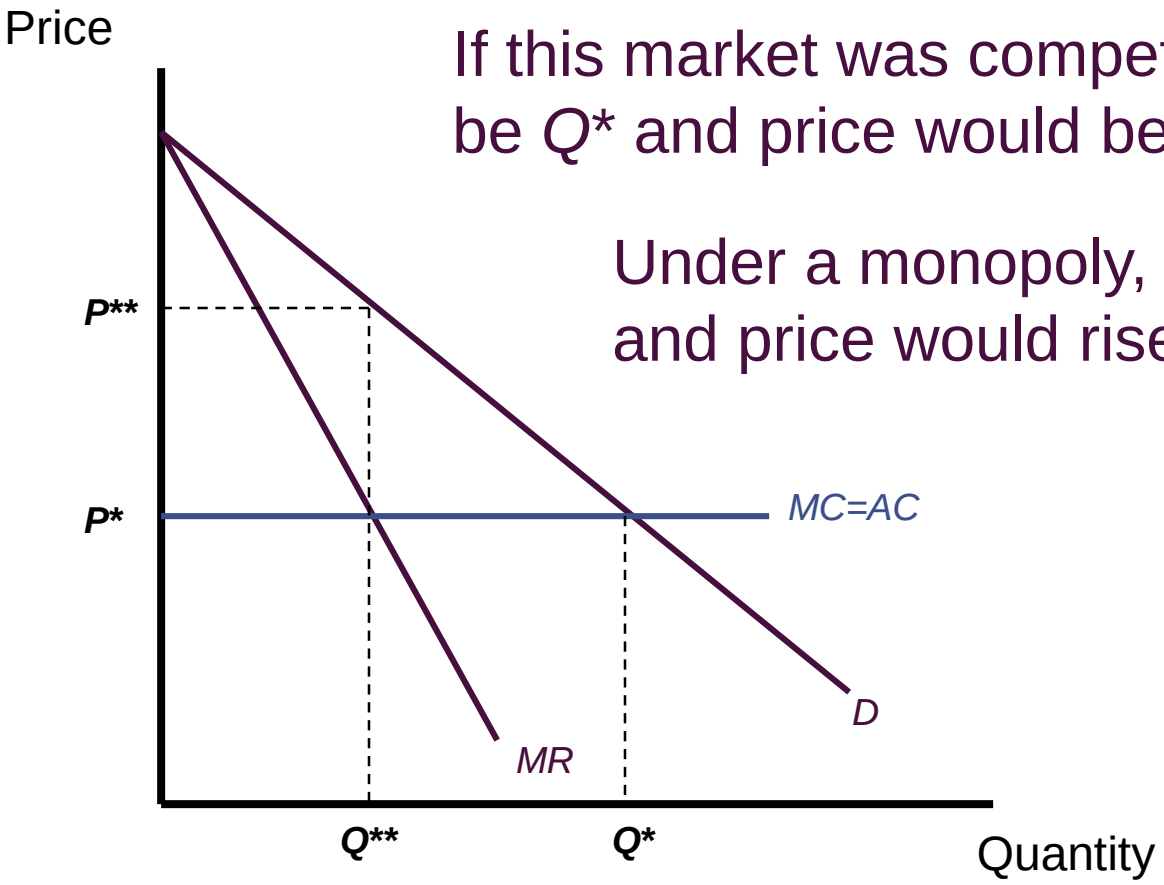
$$\frac{P - MC}{P} = \frac{1}{e_{Q,P}} = \frac{1}{3}$$

- Since $P^* = 75$ and $MC = 50$, this relationship holds

Monopoly and Resource Allocation

- To evaluate the allocational effect of a monopoly, we will use a perfectly competitive, constant-cost industry as a basis of comparison
  - the industry's long-run supply curve is infinitely elastic with a price equal to both marginal and average cost

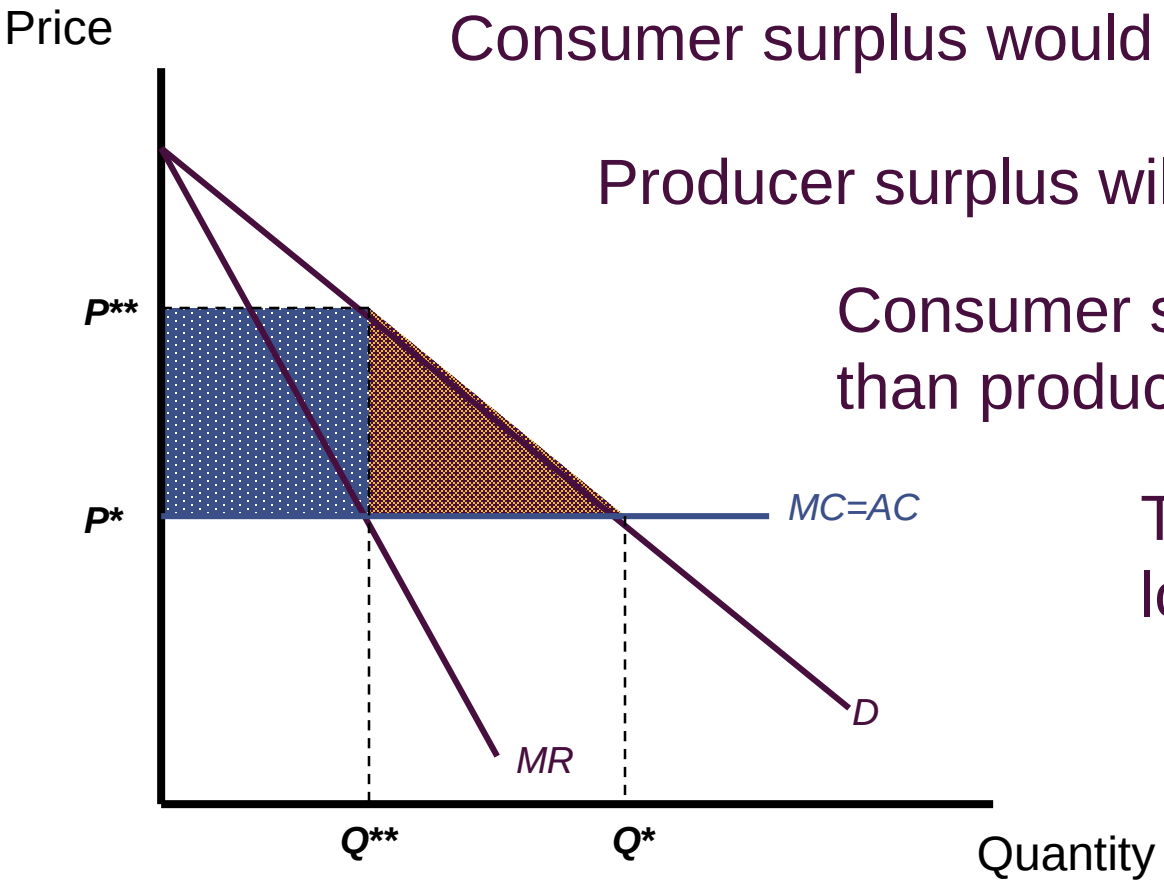
Monopoly and Resource Allocation



If this market was competitive, output would be *Q** and price would be *P**

Under a monopoly, output would be *Q*** and price would rise to *P***

Monopoly and Resource Allocation



Consumer surplus would fall

Producer surplus will rise

Consumer surplus falls by more than producer surplus rises.

There is a deadweight loss from monopoly

Welfare Losses and Elasticity (skipped)

- Assume that the constant marginal (and average) costs for a monopolist are given by *c* and that the compensated demand curve has a constant elasticity:

$$Q = P^e$$

where *e* is the price elasticity of demand ($e < -1$)

Welfare Losses and Elasticity

- The competitive price in this market will be

$$P_c = c$$

and the monopoly price is given by

$$P_m = \frac{c}{1 + \frac{1}{e}}$$

Welfare Losses and Elasticity

- The consumer surplus associated with any price (P_0) can be computed as

$$CS = \int_{P_0}^{\infty} Q(P)dP = \int_{P_0}^{\infty} P^e dP$$

$$CS = \left. \frac{P^{e+1}}{e+1} \right|_{P_0}^{\infty} = -\frac{P_0^{e+1}}{e+1}$$

Welfare Losses and Elasticity

- Therefore, under perfect competition

$$CS_c = -\frac{c^{e+1}}{e+1}$$

and under monopoly

$$CS_m = -\frac{\left(\frac{c}{1+\frac{1}{e}}\right)^{e+1}}{e+1}$$

Welfare Losses and Elasticity

- Taking the ratio of these two surplus measures yields

$$\frac{CS_m}{CS_c} = \left(\frac{1}{1 + \frac{1}{e}} \right)^{e+1}$$

- If $e = -2$, this ratio is ½
  - consumer surplus under monopoly is half what it is under perfect competition

Welfare Losses and Elasticity

- Monopoly profits are given by

$$\pi_m = P_m Q_m - cQ_m = \left(\frac{c}{1+\frac{1}{e}} - c \right) Q_m$$

$$\pi_m = \left(\frac{-\frac{c}{e}}{1+\frac{1}{e}} \right) \cdot \left(\frac{c}{1+\frac{1}{e}} \right)^{e} = -\left(\frac{c}{1+\frac{1}{e}} \right)^{e+1} \cdot \frac{1}{e}$$

Welfare Losses and Elasticity

- To find the transfer from consumer surplus into monopoly profits we can divide monopoly profits by the competitive consumer surplus

$$\frac{\pi_m}{CS_c} = \left(\frac{e+1}{e}\right)\left(\frac{1}{1+\frac{1}{e}}\right)^{e+1} = \left(\frac{e}{1+e}\right)^{e}$$

- If $e = -2$, this ratio is ¼

Monopoly and Product Quality (skipped)

- The market power enjoyed by a monopoly may be exercised along dimensions other than the market price of its product
  - type, quality, or diversity of goods
- Whether a monopoly will produce a higher-quality or lower-quality good than would be produced under competition depends on demand and the firm’s costs

Monopoly and Product Quality

- Suppose that consumers' willingness to pay for quality (X) is given by the inverse demand function $P(Q,X)$ where

$$\partial P/\partial Q < 0 \text{ and } \partial P/\partial X > 0$$

- If costs are given by $C(Q,X)$, the monopoly will choose Q and X to maximize

$$\pi = P(Q,X)Q - C(Q,X)$$

Monopoly and Product Quality

- First-order conditions for a maximum are

$$\frac{\partial \pi}{\partial Q} = P(Q, X) + Q\frac{\partial P}{\partial Q} - C_Q = 0$$

  - *MR* = *MC* for output decisions

$$\frac{\partial \pi}{\partial X} = Q\frac{\partial P}{\partial X} - C_X = 0$$

  - Marginal revenue from increasing quality by one unit is equal to the marginal cost of making such an increase

Monopoly and Product Quality

- The level of product quality that will be opted for under competitive conditions is the one that maximizes net social welfare

$$SW = \int_0^{Q^*} P(Q, X)dQ - C(Q, X)$$

- Maximizing with respect to X yields

$$\frac{\partial SW}{\partial X} = \int_0^{Q^*} P_X(Q, X)dQ - C_X = 0$$

Monopoly and Product Quality

- The difference between the quality choice of a competitive industry and the monopolist is:
  - the monopolist looks at the marginal valuation of one more unit of quality assuming that *Q* is at its profit-maximizing level
  - the competitve industry looks at the marginal value of quality averaged across all output levels

Monopoly and Product Quality

- Even if a monopoly and a perfectly competitive industry chose the same output level, they might opt for diffferent quality levels
  - each is concerned with a different margin in its decision making

Price Discrimination

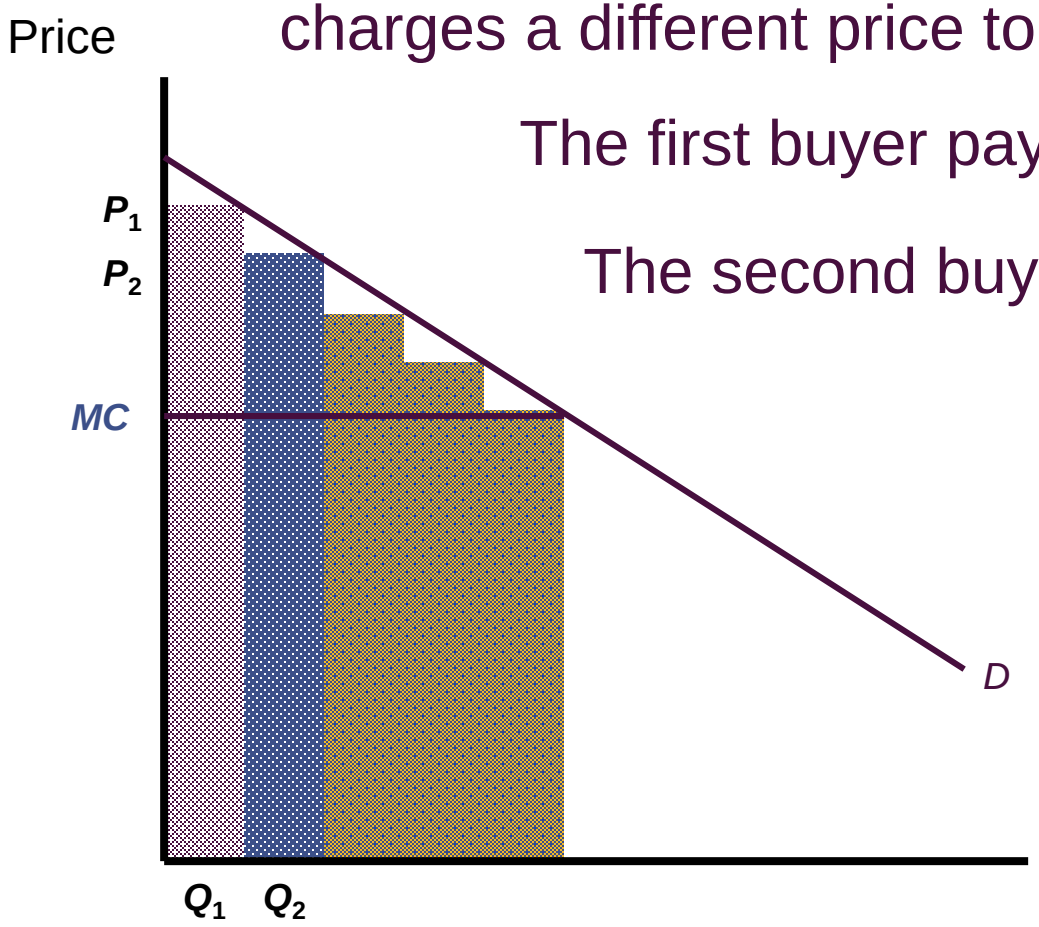
- A monopoly engages in price discrimination if it is able to sell otherwise identical units of output at different prices
- Whether a price discrimination strategy is feasible depends on the inability of buyers to practice arbitrage（套利）
  - profit-seeking middlemen will destroy any discriminatory pricing scheme if possible
    - price discrimination becomes possible if resale is costly

Perfect Price Discrimination

- If each buyer can be separately identified by the monopolist, it may be possible to charge each buyer the maximum price he would be willing to pay for the good
  - perfect or first-degree price discrimination
    - extracts all consumer surplus
    - no deadweight loss

Perfect Price Discrimination

Under perfect price discrimination, the monopolist charges a different price to each buyer



The first buyer pays P_1 for Q_1 units

The second buyer pays P_2 for Q_2-Q_1 units

The monopolist will continue this way until the marginal buyer is no longer willing to pay the good's marginal cost

Perfect Price Discrimination (skipped)

- Recall the example of the frisbee manufacturer
- If this monopolist wishes to practice perfect price discrimination, he will want to produce the quantity for which the marginal buyer pays a price exactly equal to the marginal cost

Perfect Price Discrimination

- Therefore,

$$P = 100 - Q/20 = MC = 0.1Q$$

$$Q^* = 666$$

- Total revenue and total costs will be

$$R = \int_0^{Q^*} P(Q)dQ = 100Q - \frac{Q^2}{40}\Bigg|_0^{666} = 55{,}511$$

$$c(Q) = 0.05Q^2 + 10{,}000 = 32{,}178$$

- Profit is much larger (23,333 > 15,000)

Market Separation

- Perfect price discrimination requires the monopolist to know the demand function for each potential buyer
- A less stringent requirement would be to assume that the monopoly can separate its buyers into a few identifiable markets
  - can follow a different pricing policy in each market
  - third-degree price discrimination

Market Separation

- All the monopolist needs to know in this case is the price elasticities of demand for each market
  - set price according to the inverse elasticity rule
- If the marginal cost is the same in all markets,

$$P_i\left(1+\frac{1}{e_i}\right)=P_j\left(1+\frac{1}{e_j}\right)$$

Market Separation

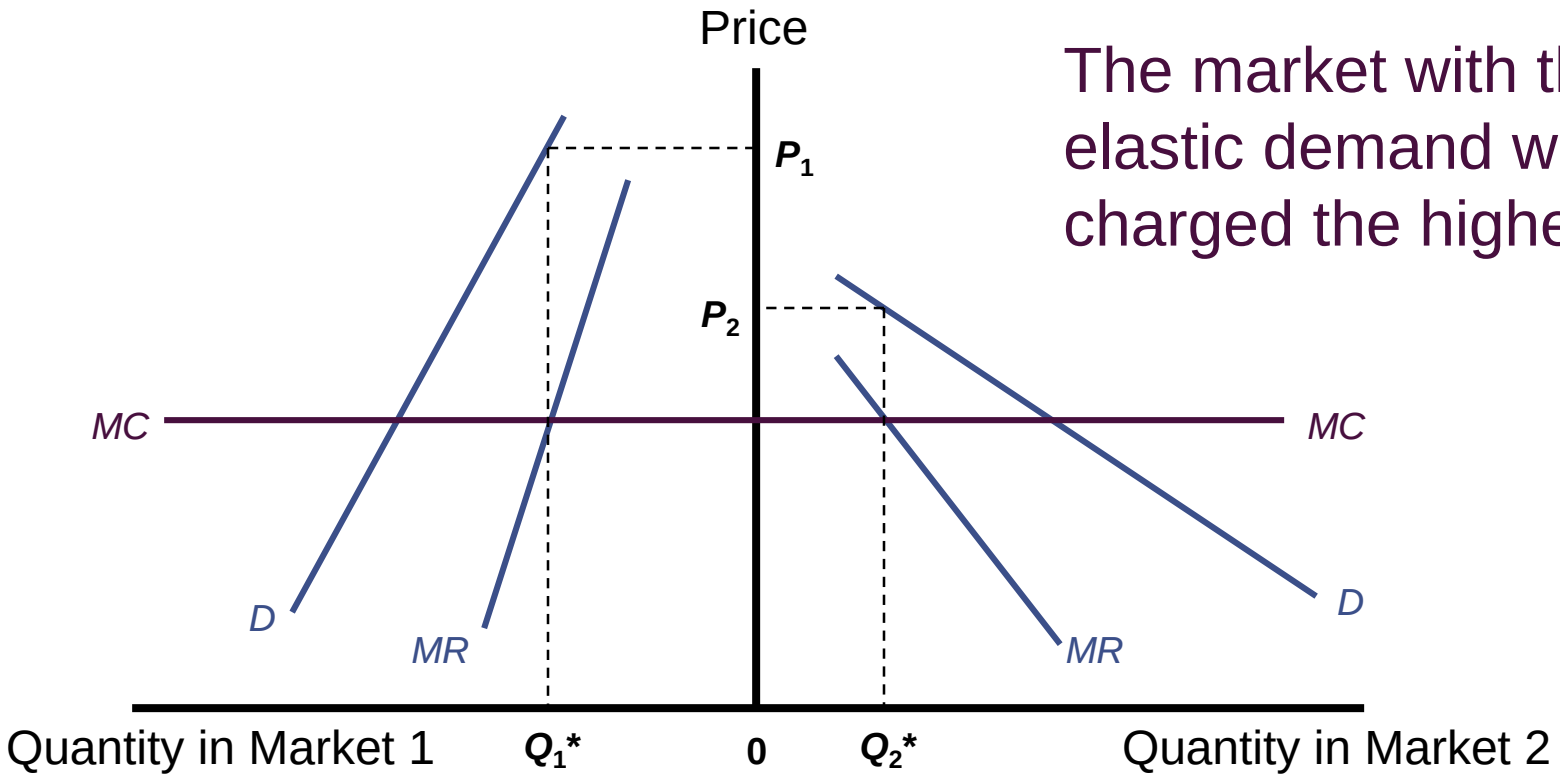
- This implies that

$$\frac{P_i}{P_j} = \frac{(1+\frac{1}{e_j})}{(1+\frac{1}{e_i})}$$

- The profit-maximizing price will be higher in markets where demand is less elastic

Market Separation

If two markets are separate, maximum profits occur by setting different prices in the two markets



The market with the less elastic demand will be charged the higher price

Third-Degree Price Discrimination

- Suppose that the demand curves in two separated markets are given by

$$Q_1 = 24 - P_1$$

$$Q_2 = 24 - 2P_2$$

- Suppose that $MC = 6$
- Profit maximization requires that

$$MR_1 = 24 - 2Q_1 = 6 = MR_2 = 12 - Q_2$$

Third-Degree Price Discrimination

- Optimal choices and prices are

$$Q_1 = 9 \qquad P_1 = 15$$

$$Q_2 = 6 \qquad P_2 = 9$$

- Profits for the monopoly are

$$\pi = (P_1 - 6)Q_1 + (P_2 - 6)Q_2 = 81 + 18 = 99$$

Third-Degree Price Discrimination

- The allocational impact of this policy can be evaluated by calculating the deadweight losses in the two markets
  - the competitive output would be 18 in market 1 and 12 in market 2

$$DW_1 = 0.5(P_1\text{-}MC)(18\text{-}Q_1) = 0.5(15\text{-}6)(18\text{-}9) = 40.5$$

$$DW_2 = 0.5(P_2\text{-}MC)(12\text{-}Q_2) = 0.5(9\text{-}6)(12\text{-}6) = 9$$

Third-Degree Price Discrimination

- If this monopoly was to pursue a single-price policy, it would use the demand function

$$Q = Q_1 + Q_2 = 48 - 3P$$

- So marginal revenue would be

$$MR = 16 - 2Q/3$$

- Profit-maximization occurs where

$$Q = 15 \qquad P = 11$$

Third-Degree Price Discrimination

- The deadweight loss is smaller with one price than with two:

$$DW = 0.5(P-MC)(30-Q) = 0.5(11-6)(15) = 37.5$$

Two-Part Tariffs （skipped）

- A linear two-part tariff occurs when buyers must pay a fixed fee for the right to consume a good and a uniform price for each unit consumed

$$T(q) = a + pq$$

- The monopolist's goal is to choose a and p to maximize profits, given the demand for the product

Two-Part Tariffs

- Because the average price paid by any demander is

$$p' = T/q = a/q + p$$

this tariff is only feasible if those who pay low average prices (those for whom q is large) cannot resell the good to those who must pay high average prices (those for whom q is small)

Two-Part Tariffs

- One feasible approach for profit maximization would be for the firm to set $p = MC$ and then set a equal to the consumer surplus of the least eager buyer
  - this might not be the most profitable approach
  - in general, optimal pricing schedules will depend on a variety of contingencies

Two-Part Tariffs

- Suppose there are two different buyers with the demand functions

$$q_1 = 24 - p_1$$

$$q_2 = 24 - 2p_2$$

- If $MC = 6$, one way for the monopolist to implement a two-part tariff would be to set $p_1 = p_2 = MC = 6$

$$q_1 = 18 \qquad q_2 = 12$$

Two-Part Tariffs

- With this marginal price, demander 2 obtains consumer surplus of 36
  - this would be the maximum entry fee that can be charged without causing this buyer to leave the market
- This means that the two-part tariff in this case would be

$$T(q) = 36 + 6q$$

Regulation of Monopoly

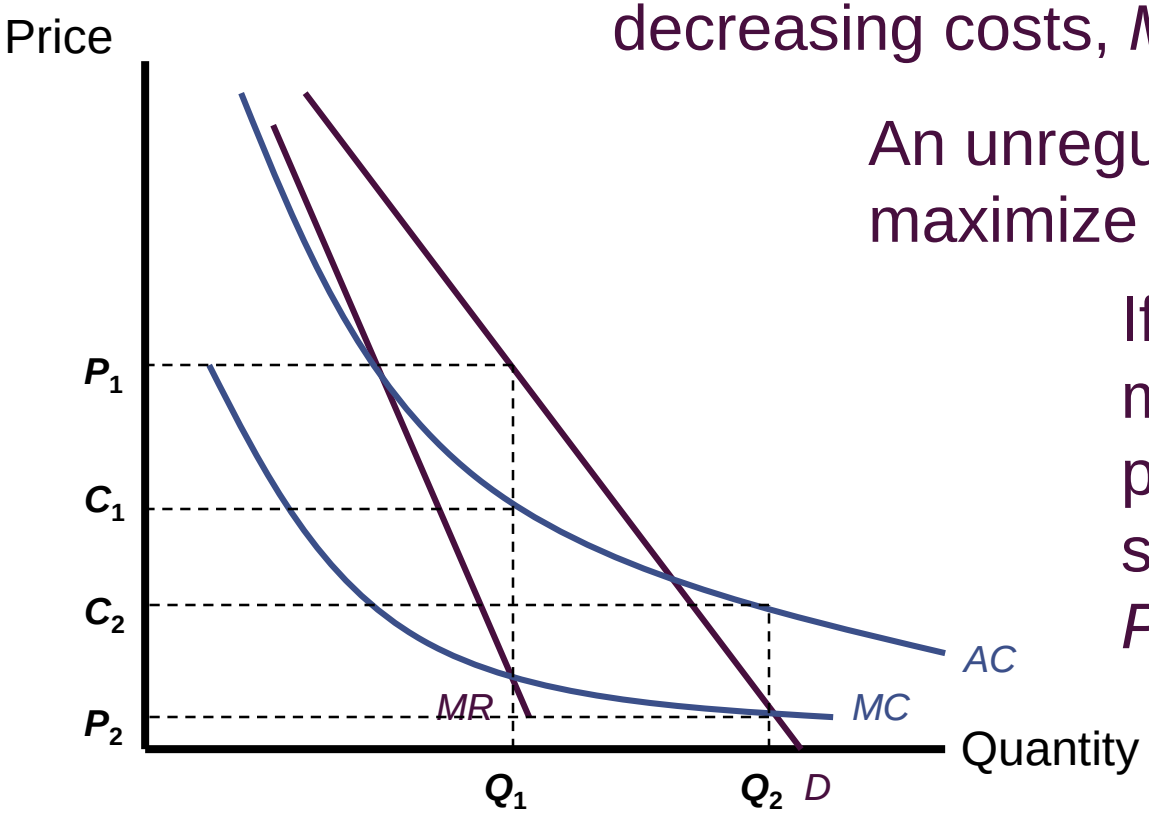
- Natural monopolies such as the utility, communications, and transportation industries are highly regulated in many countries

Regulation of Monopoly

- Many economists believe that it is important for the prices of regulated monopolies to reflect marginal costs of production accurately
- An enforced policy of marginal cost pricing will cause a natural monopoly to operate at a loss
  - natural monopolies exhibit declining average costs over a wide range of output

Regulation of Monopoly

Because natural monopolies exhibit decreasing costs, *MC* falls below *AC*

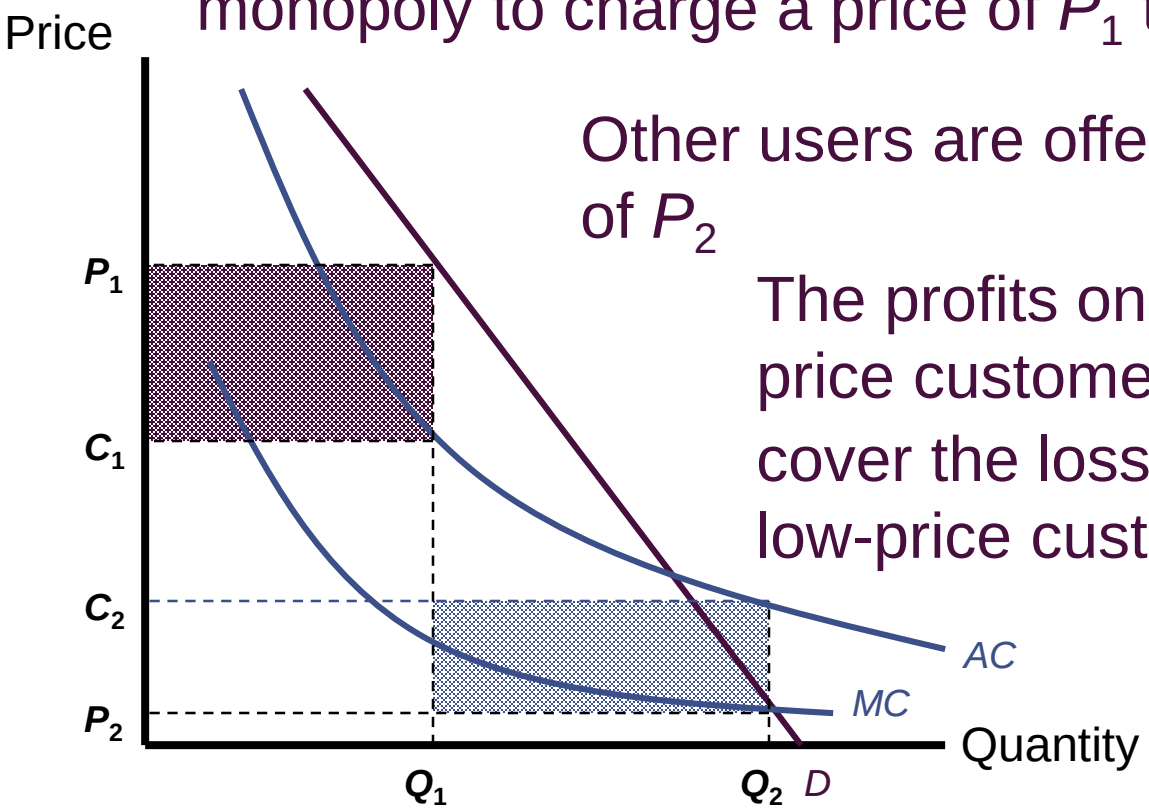


An unregulated monopoly will maximize profit at Q_1 and P_1

If regulators force the monopoly to charge a price of P_2, the firm will suffer a loss because $P_2 < C_2$

Regulation of Monopoly

Suppose that the regulatory commission allows the monopoly to charge a price of P_1 to some users



Other users are offered the lower price of P_2

The profits on the sales to high-price customers are enough to cover the losses on the sales to low-price customers

Regulation of Monopoly

- Another approach followed in many regulatory situations is to allow the monopoly to charge a price above marginal cost that is sufficient to earn a "fair" rate of return on investment
  - if this rate of return is greater than that which would occur in a competitive market, there is an incentive to use relatively more capital than would truly minimize costs

Regulation of Monopoly

- Suppose that a regulated utility has a production function of the form

$$q = f(k,l)$$

- The firm's actual rate of return on capital is defined as

$$s = \frac{pf(k,l) - wl}{k}$$

Regulation of Monopoly

- Suppose that s is constrained by regulation to be equal to s_0, then the firm's problem is to maximize profits

$$\pi = pf(k,l) - wl - vk$$

subject to this constraint

- The Lagrangian for this problem is

$$\mathbf{L} = pf(k,l) - wl - vk + \lambda[wl + s_0k - pf(k,l)]$$

Regulation of Monopoly

- If $\lambda=0$, regulation is ineffective and the monopoly behaves like any profit-maximizing firm
- If $\lambda=1$, the Lagrangian reduces to

$$\mathbf{L} = (s_0 - v)k$$

which (assuming $s_0 > v$), will mean that the monopoly will hire infinite amounts of capital – an implausible result

Regulation of Monopoly

- Therefore, $0<\lambda<1$ and the first-order conditions for a maximum are:

$$\frac{\partial \mathbf{L}}{\partial l} = pf_l - w + \lambda(w - pf_l) = 0$$

$$\frac{\partial \mathbf{L}}{\partial k} = pf_k - v + \lambda(s_0 - pf_k) = 0$$

$$\frac{\partial \mathbf{L}}{\partial \lambda} = wl + s_0 - pf(k,l) = 0$$

Regulation of Monopoly

- Because $s_0 > v$ and $\lambda < 1$, this means that

$$pf_k < v$$

- The firm will hire more capital than it would under unregulated conditions
  - it will also achieve a lower marginal productivity of capital

Dynamic Views of Monopoly

- Some economists have stressed the beneficial role that monopoly profits can play in the process of economic development
  - these profits provide funds that can be invested in research and development
  - the possibility of attaining or maintaining a monopoly position provides an incentive to keep one step ahead of potential competitors

Important Points to Note:

- The most profitable level of output for the monopolist is the one for which marginal revenue is equal to marginal cost
  - at this output level, price will exceed marginal cost
  - the profitability of the monopolist will depend on the relationship between price and average cost

Important Points to Note:

- Relative to perfect competition, monopoly involves a loss of consumer surplus for demanders
  - some of this is transferred into monopoly profits, whereas some of the loss in consumer surplus represents a deadweight loss of overall economic welfare
  - it is a sign of Pareto inefficiency

Important Points to Note:

- Monopolies may opt for different levels of quality than would perfectly competitive firms
- Durable good monopolists may be constrained by markets for used goods

Important Points to Note:

- A monopoly may be able to increase its profits further through price discrimination – charging different prices to different categories of buyers
  - the ability of the monopoly to practice price discrimination depends on its ability to prevent arbitrage among buyers

Important Points to Note:

- Governments often choose to regulate natural monopolies (firms with diminishing average costs over a broad range of output levels)
  - the type of regulatory mechanisms adopted can affect the behavior of the regulated firm