Chapter 11

Monopoly
Chapter Outline

• Defining Monopoly
• Five Sources Of Monopoly
• Profit-maximizing Monopolist
• A Monopolist Has No Supply Curve
• Adjustments In The Long Run
• Price Discrimination
• Efficiency Loss From Monopoly
• Public Policy Toward Monopoly
Defining Monopoly

• **Monopoly**: a market structure in which a single seller of a product with no close substitutes serves the entire market.
  – A monopoly has significant control over the price it charges.
Five Sources Of Monopoly

1. Exclusive Control over Important Inputs
2. Economies of Scale
3. Patents
4. Network Economies
5. Government Licenses or Franchises
Figure 11.1: Natural Monopoly
The Profit-Maximizing Monopolist

- The monopolist’s goal is to maximize economic profit.
  - choose the level of output for which the difference between total revenue and total cost is greatest.
The Monopolist’s Total Revenue Curve

• Total revenue for the monopolist does not rise linearly with output.
  – Instead, it reaches a maximum value at the quantity corresponding to the midpoint of the demand curve after which it again begins to fall.
  – Total revenue reaches its maximum value when the price elasticity of demand is unity.
Demand, Total Revenue, and Elasticity

• Figure 11.3 depicts linear demand $P = 80 - \frac{1}{5} Q$ with corresponding total revenue

$$TR = PQ = \left(80 - \frac{1}{5} Q\right) Q = 80Q - \frac{1}{5} Q^2$$

• At point A, $P = 60$ and $Q = 100$, so $TR = 6,000$. At point B, $P = 40$ and $Q = 200$, so $TR = 8,000$. At point C, $P = 20$ and $Q = 300$, so $TR = 6,000$.

• The maximum total revenue occurs at point B.
Figure 11.3 Demand, Total Revenue, and Elasticity
Total Cost, Total Revenue, and Profit Curves for a Monopolist

• Figure 11.4 determines profits by calculating the extent that total revenue TR exceeds total cost TC. \( \pi = TR - TC = (P - ATC)Q \)

• At Q = 45, TR = TC = 3200 so \( \pi = 0 \). At Q = 175, TR = 7900 and TC = 4400 so \( \pi = 3500 \). At Q = 305, TR = TC = 6000 so \( \pi = 0 \) again.

• Profits are the highest at Q = 175. Thus 175 is the profit-maximizing quantity.
Figure 11.4: Total Cost, Revenue, and Profit Curves for a Monopolist
Marginal Revenue

• *Optimality condition for a monopolist*: a monopolist maximizes profit by choosing the level of output where marginal revenue equals marginal cost $\text{MR} = \text{MC}$.

• Recall that marginal revenue is the change in total revenue from a one unit increase in quantity sold and marginal cost is the change in total cost from a one unit increase in quantity sold.
Marginal Revenue

• For a single-price monopolist, the marginal revenue curve is always below the demand curve \( MR < P \).

• For a single price monopolist, selling an additional unit of output has two effects: the monopolist collects the price from selling that unit but must then accept this lower price on all existing sales \( MR = P + \Delta PQ \).

• Due to this effect of lower price for existing sales, the marginal revenue for any unit is less than the price received for that unit \( MR - P = \Delta PQ < 0 \).
Changes in Total Revenue Resulting from a Price Cut

• Figure 11.5 illustrates that marginal revenue is less than price for a single-price monopolist.

• At Q = 100, P = 60 and TR = 6000; at Q’ = 150, P’ = 50 and TR’ = 7500.

• By producing 50 additional units, the monopolist gains area B of 50 (150 - 100) = 2500 in additional revenue.

• However, the monopolist also sacrifices area A of (60-50)100 = 1000 in revenue by receiving 60 – 50 = 10 less in price on the Q = 100 units of existing sales.

• Hence total revenue goes up by only \( \Delta TR = 2500 - 1000 = 1500 \) (from 6000 to 7500).
Figure 11.5: Changes in Total Revenue Resulting from a Price Cut
Changes in Total Revenue Resulting from a Price Cut

• Due to the downward-sloping property of market demand (price falls as quantity rises), eventually selling additional units will require sacrifice of more revenue from existing sales than the revenue generated by an additional unit sold.

• In Figure 11.6, gaining area D from additional sales comes at the expense of a large loss in revenue from existing sales indicated by area C.
Figure 11.6: Marginal Revenue and Position on the Demand Curve
Marginal Revenue and Elasticity

• The less elastic demand is with respect to price, the more price will exceed marginal revenue.
  – For all elasticity values less than 1 in absolute value marginal revenue will be negative.
  – For all elasticity values larger than 1 in absolute value marginal revenue will be positive.
Demand Curve and Corresponding Marginal Revenue Curve

• For a linear market demand curve $P = a - bQ$

• The corresponding total revenue curve is
  \[ TR = PQ = (a - bQ)Q = aQ - bQ^2 \]

• The corresponding marginal revenue curve is
  \[ MR = a - 2bQ \]

• Marginal revenue has same intercept as the demand curve but twice the slope.
Demand Curve and Corresponding Marginal Revenue Curve

• Figure 11.7 graphs market demand curve \( P = 80 - \frac{1}{5}Q \) and corresponding marginal revenue curve \( MR = 80 - \frac{2}{5}Q \).

• Market demand and marginal revenue curve share the same price intercept.

• Since marginal revenue has twice the slope of demand, the quantity intercept for marginal revenue is half the quantity intercept for market demand.
Figure 11.7: Demand Curve and Corresponding Marginal Revenue Curve
A Linear Demand Curve and Corresponding Marginal Revenue

- Figure 11.8 graphs market demand curve $P = 12 - 3Q$ and corresponding marginal revenue curve $MR = 12 - 6Q$.

- Finding the marginal revenue curve is the first step of finding the profit maximizing quantity (and price) for a monopolist.
  - Same price intercept, double the slope on quantity
Figure 11.8: A Specific Linear Demand Curve and the Corresponding Marginal Revenue Curve

\[ P = 12 - 3Q \]

\[ MR = 12 - 6Q \]
Profit-Maximizing Price and Quantity for a Monopolist

• To maximize profits, a firm chooses to produce the quantity where marginal revenue equals marginal cost $MR = MC$.
• The price is then determined by the market demand curve: how much consumers are willing to pay for this quantity.
• To find the profit maximizing quantity and corresponding price that maximize profits for a monopolist:
  1. Find the marginal revenue curve, which is twice as steep as the linear market demand curve.
  2. Find equilibrium quantity $Q$ where $MR = MC$.
  3. Find equilibrium price $P$ for the equilibrium quantity $Q$ using the market demand curve.
Figure 11.9: The Profit-Maximizing Price and Quantity for a Monopolist
Profit-Maximizing Price and Quantity

• In Figure 11.10, a monopolist faces market demand curve $P = 100 - 2Q$, has short-run total costs $TC = 640 + 20Q$ and constant marginal cost $MC = 20$.

• Marginal revenue is the same as the market demand curve but twice the slope $MR = 100 - 4Q$. 
Profit-Maximizing Price and Quantity

• The quantity the monopolist sells to maximize profits is the quantity where marginal revenue equals marginal cost

\[ MR = MC \]
\[ 100 - 4Q = 20 \]
\[ Q = 20 \]

• The price the monopolist charges is the price consumers are willing to pay for this quantity, as determined from the market demand curve

\[ P = 100 - 2Q = 100 - 2(20) = 60 \]
Profit-Maximizing Price and Quantity

• The economic profit the monopolist earns is the difference between price and average total cost for each unit sold

\[ \pi = (P - ATC)Q = (60 - 52)20 = 160 \]

• where average total cost is determined by dividing total cost by quantity \( Q = 20 \)

\[ ATC = \frac{TC}{Q} = \frac{640 + 20Q}{Q} = \frac{640}{20} + 20 = 52 \]
Figure 11.10: Profit-Maximizing Price and Quantity for Specific Cost and Demand Functions
The Profit-Maximizing Monopolist

• If a monopolist’s goal is to maximize profits, she will never produce an output level on the inelastic portion of her demand curve.

• The profit-maximizing level of output must lie on the elastic portion of the demand curve.
When Will a Monopolist Shutdown?

• **Shutdown condition for a monopolist:** cease production whenever average revenue is less than average variable cost at every level of output.

• Average revenue is just price, and price is determined from the market demand curve.

• Thus, monopolist shuts down if AVC everywhere above the market demand curve.
  – On average, any quantity of sales would fail to collect enough revenue to cover variable costs.

• Having a monopoly is not a guarantee of profits.
Figure 11.11: When Will a Monopolist Shutdown?
A Monopolist Has No Supply Curve

• A supply curve shows the quantity supplied for various prices. But for a monopolist, the same price can lead to many different quantities supplied based on market demand.
  – So there is no unique correspondence between the price a monopolist charges and the amount she chooses to produce.

• Monopoly has a supply rule, which is to pick quantity to equate marginal revenue and marginal cost.
Long-Run Equilibrium for a Profit-Maximizing Monopolist

• In the long run, a monopolist maximizes profits by producing the quantity where marginal revenue equals long-run marginal cost \( MR = LMC \).

• Figure 11.12 displays how find intersection of marginal revenue and long-run marginal cost \( MR = LMC \) to determine the profit-maximizing quantity, then read price for that quantity off the market demand curve.
Figure 11.12: Long-Run Equilibrium for a Profit-Maximizing Monopolist
Price Discrimination

• Monopolists in some cases may be able to lessen the problem of having to lower price on existing sales to make an additional sale.

• *Price discrimination*: a practice where the monopolist charge different prices to different buyers.

• *Third-degree price discrimination*: charging different prices to buyers in completely separate markets.

• *First-degree price discrimination*: is the term used to describe the largest possible extent of market segmentation.
Profit-Maximizing Monopolist Who Sells in Two Markets

• Figure 11.13 depicts market demand for two markets, where a monopolist can charge a different price in these two markets.

• The marginal revenue curves in each market are determined as usual: they are twice as steep as the linear market demand curves.

• The marginal revenue in market one and the marginal revenue in market two are horizontally summed to find the total marginal revenue for the monopolist.
Profit-Maximizing Monopolist Who Sells in Two Markets

• The monopolist finds total sales where marginal cost equals this total marginal revenue.

• The monopolist determines allocation of these total sales to the two markets by setting marginal revenue in each market equal to the level of marginal cost established in the total market.

• Then the price for the quantity sold is found by reading off the market demand curve for each market.
Figure 11.13: Profit-Maximizing Monopolist Who Sells in Two Markets
A Monopolist with a Perfectly Elastic Foreign Market

• For Figure 11.14, a monopolist has marginal costs $MC = Q$ and market demand $P = 30 - Q$.

• To find the monopolist's equilibrium price and quantity, note that linear demand curve $P = 30 - Q$ has associated marginal revenue of $MR = 30 - 2Q$.

• The profit maximizing level of output occurs where marginal revenue equals marginal cost at quantity $30 - 2Q = Q, 30 = 3Q, Q = 10$.

• The price charged for this quantity is read off the demand curve as $P = 30 - Q = 30 - 10 = 20$. 

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A Monopolist with a Perfectly Elastic Foreign Market

• Now the monopolist can sell to a foreign market at a constant price $P_F = 12$.

• The profit maximizing level of output for a monopolist selling to segmented markets occurs where $\Sigma MR = MC$.

• The horizontal sum of the marginal revenues across markets is the home marginal revenue function up to home output where $MR_H = MR_F$, and then the foreign marginal revenue function $MR_F = 12$ for any further units.
A Monopolist with a Perfectly Elastic Foreign Market

• Total marginal revenue equals marginal cost at 
  \( Q = 12 \).

• Marginal cost for this level of output equals home marginal revenue at
  \[
  30 - 2Q_H = 12,18 = 2Q_H, Q_H = 9
  \]
  with the remaining units sold abroad
  \[
  Q_F = Q - Q_H = 12 - 9 = 3
  \]

• In the home market, the monopolist charges
  \[
  P_H = 30 - Q_H = 30 - 9 = 21
  \]
A Monopolist with a Perfectly Elastic Foreign Market

• Any further units sold at home would yield marginal revenue less than 12.
• Since sales to the foreign market yield a constant marginal revenue of 12, shifting sales to the home market would decrease profits due to the lost marginal revenue for each unit shifted.
Figure 11.14: A Monopolist with a Perfectly Elastic Foreign Market
Perfect Price Discrimination

• Suppose a monopolist can charge a different price to each consumer and knows the willingness to pay of each.
• Again, suppose consumers are not able to resell to other consumers to arbitrage the price difference.
• To maximize profits, the monopolist will sell the quantity where marginal cost intersects the demand curve.
• For each unit sold, the monopolist will charge the maximum price consumers will pay, as read off the demand curve.
• The monopolist sells all units that consumers value more than the marginal cost of production, but the monopolist extracts all consumer surplus.
Perfect Price Discrimination

• The monopolist charges $P_1$ for $Q_1$, $P_2$ for $Q_2$, and so on.

• In the limit as the size of a unit of quantity becomes very small, the monopolist collects revenue equal to the full area under the demand curve out to the number of units sold.

• The monopolist sells up to the point where SMC intersects demand.

• Profits are the full area under the demand curve, down to SAC (that is ATC) for the quantity produced and out to the quantity sold.
Figure 11.15: Perfect Price Discrimination
Figure 11.16: The Perfectly Discriminating Monopolist
Second-Degree Price Discrimination

• Suppose a monopolist cannot tell consumers apart, but again can keep consumers from buying or selling on a resale market.

• The monopolist can offer price-quantity pairs that induce consumers to separate.
  – Larger quantities sell at a lower price per unit.

• As the number of pairs offered increases, the monopolist can approach the outcome under perfect discrimination.

• In Figure 11.17, the monopolist offers quantities zero up to $Q_1$ at a price $P_1$, additional quantities up to $Q_2$ at price $P_2$, and so on.
Figure 11.17: Second-Degree Price Discrimination
Second-Degree Price Discrimination

- **Second-degree price discrimination**: price discrimination where the same rate structure is available to every consumer and the limited number of rate categories tends to limit the amount of consumer surplus that can be captured.
Efficiency Loss From Monopoly

- **Deadweight loss from monopoly**: the loss of efficiency due to the presence of a monopoly.
  - Is the result of failure to price discriminate perfectly.
Efficiency Loss From Monopoly

- A monopolist who sets one price does not achieve the allocative efficiency of perfect competition.
- Under a monopoly, some units are not sold where marginal benefit to consumers exceeds the marginal cost of production.
- Output is too low in a monopoly.
Welfare Loss from a Single-Price Monopoly

• In Figure 11.19, allocative efficiency requires producing \( Q_c \) where LMC equals the marginal value consumers place on a unit of output, as read off the market demand curve.

• A single price monopolist instead produces \( Q^* \) determined by intersection of LMC and MR.

• Marginal revenue lies below the demand curve because the monopolist must lower price on existing sales to sell an additional unit.
Welfare Loss from a Single-Price Monopoly

• Thus the monopoly level of output is below the level needed to achieve allocative efficiency $Q^* < Q_c$.

• The loss due to this output distortion is the triangular area under the demand curve and above LMC from the monopoly output $Q^*$ out to the ideal output $Q_c$.

• The vertical distance that the demand curve lies above long-run marginal cost represents the extent that consumers value a unit more than the marginal cost of producing that unit.
Figure 11.19: Welfare Loss from a Single-Price Monopoly
Public Policy Toward Natural Monopoly

• State Ownership And Management
• State Regulation of Private Monopolies
• Exclusive Contracting For Natural Monopoly
• Vigorous Enforcement of Antitrust Laws
• A Laissez-faire Policy Toward Natural Monopoly
Figure 11.20: A Natural Monopoly
Figure 11.21: Cross-Subsidization to Boost Total Output

(a) Market 1: $/Q vs. Q
- Price $P_1'$
- ATC$_1$
- MC$_1$
- MR$_1$
- Profit $\Pi_1$

(b) Market 2: $/Q vs. Q
- Price $P_2'$
- ATC$_2$
- MC$_2$
- Profit $\Pi_2$
Figure 11.22: The Efficiency Losses from Single-Price and Two-Price Monopoly
Problem 1

1. A monopolist has a demand curve given by $P = 100 - Q$ and a total cost curve given by $TC = 16 + Q^2$. The associated marginal cost curve is $MC = 2Q$. Find the monopolist’s profit maximizing quantity and price. How much economic profit will the monopolist earn?
Solution 1

1. Marginal revenue $MR = 100 - 2Q$. Set marginal cost equal to marginal revenue $2Q = 100 - 2Q$, $4Q = 100$, $Q = 25$. Price from demand curve $P = 100 - Q = 100 - 25 = 75$. Profit $TR - TC = PQ - 16 - Q^2 = 75(25) - 16 - (25)^2 = 1875 - 641 = 1234$. 

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Solution 1 Figure

[Graph showing supply and demand curves, with price on the y-axis and quantity on the x-axis.]
Problem 2

2. Now suppose the monopolist in the previous problem has a total cost curve given by $TC = 32 + Q^2$. The corresponding marginal cost curve is still $MC = 2Q$, but fixed costs have doubled. Find the monopolist’s profit maximizing quantity and price. How much economic profit does the monopolist earn?
2. Marginal revenue still $MR = 100 - 2Q$. Set marginal cost equal to marginal revenue $2Q = 100 - 2Q, 4Q = 100, Q = 25$ so quantity unchanged. Price from demand curve $P = 100 - Q = 100 - 20 = 75$ and price unchanged. Profit $TR - TC = PQ - 16 - Q^2 = 75(25) - 32 - (25)^2 = 1875 - 657 = 1218$ is 16 less than before (reduced by how much fixed costs increased).
Problem 3

3. Now suppose the monopolist has a total cost curve given by $TC = 16 + 4Q^2$. The corresponding marginal cost curve is now $MC = 8Q$, and fixed costs have returned to their original level. Find the monopolist’s profit maximizing quantity and price. How much economic profit does the monopolist earn?
Solution 3

3. Marginal revenue still \( MR = 100 - 2Q \). Set marginal cost equal to marginal revenue \( 8Q = 100 - 2Q, 10Q = 100, Q = 10 \), lower than before. Price from demand curve \( P = 100 - Q = 100 - 10 = 90 \), higher than before. Profit \( TR - TC = PQ - 16 - 4Q^2 = 90(10) - 16 - 4(10)^2 = 900 - 416 = 484 \), lower than before.
Problem 4

4. Now suppose the original monopolist also has access to a foreign market in which he can sell whatever quantity he chooses at a constant price of 60. How much will he sell in the foreign market? What will his new quantity and price be in the original market?
4. Marginal revenue follows home $MR_H = 100 - 2Q$ until $Q_H = 20$ then fixed at foreign level $MR_F = 60$. Set marginal cost equal to marginal revenue $2Q = 60$, $Q = 30$. 20 of the units sold at home and remaining 10 units abroad. Home price from demand curve $P = 100 - Q = 100 - 20 = 80$. 
Solution 4 Figure

[Graph showing supply and demand curves with equilibrium at Q=20 and P=80. The graph includes the demand curve (D), marginal revenue curves (MR_H and MR_F), and marginal cost (MC).]