

R09 The Firm and Market Structures

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Version 1.0

1. Introduction & Analysis of Market Structures

This reading covers:

- Analysis of market structures: degree of competition, how the management determines pricing and output strategy.
- Characteristics, demand, supply, optimal price, and output for different types of market structures: perfect competition, monopolistic competition, oligopoly, and pure monopoly.
- Techniques used by analysts to identify what market structure a firm is operating in.

Analysis of Market Structures

The market is defined as a group of buyers and sellers that are aware of each other, and are able to agree on a price for the exchange of goods and services.

The market structure is classified into the following four categories:

- Perfect competition
- Monopolistic competition
- Oligopoly
- Monopoly

Perfect competition and monopoly are two extremes of the market structure in terms of number of firms and profits with the other types falling somewhere in between.

Factors that Determine Market Structure

The five factors that determine market structure are:

- The number and relative size of firms supplying the product. The higher the number of firms, the higher the degree of competition.
- The degree of product differentiation.
- Pricing power of the sellers. Are they price takers, or can they influence market prices?
- The relative strength of the barriers to market entry and exit.
- The degree of non-price competition.

The table below summarizes the basic characteristics of the four market structures:

	Perfect Competition	Monopolistic Competition	Oligopoly	Monopoly
Number of Sellers	Many firms	Many firms	Few firms	Single firm
Barriers to Entry and Exit	Very low	Low	High	Very high
Product Differentiation	Homogeneous	Substitutes but differentiated	Close substitutes or differentiated	Unique product

Non-price Competition	None	Advertising and product differentiation	Advertising and product differentiation	Advertising
Pricing Power	None. Price taker.	Some	Some to significant	Considerable
Example	Oranges; Milk; Wheat	Toothpaste	Prices of commercial airlines for a given route	Electricity provider/any utility company (water, cooking gas) as they are typically controlled by a government authority

Note: This table is important from an exam perspective.

The most preferred market structure by producers is monopoly/oligopoly because they offer the highest pricing power. The most preferred market structure by consumers is perfect competition as prices are lower.

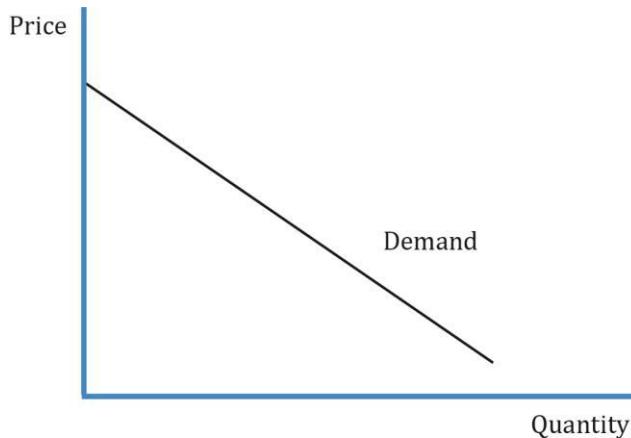
2. Perfect Competition & Demand Analysis in Perfectly Competitive Markets

The characteristics of perfect competition are as follows:

- There are a large number of potential buyers and sellers.
- The products offered by the sellers are homogenous i.e. they are identical.
- There are few or easily surmountable barriers to entry and exit.
- Sellers have no market-pricing power. Each firm is so small relative to the market that it does not have any influence on market prices.
- Non-price competition is absent.

2.1 Demand Analysis in Perfectly Competitive Markets

The graph below shows the market demand curve for a perfectly competitive market. Here price is plotted on the y-axis and quantity on the x-axis and the market demand curve is downward sloping:



To understand this curve, let us assume that the market demand is given by the following equation:

$Q = 50 - 2P$ where Q = quantity demanded and P = product's price.

Rearranging, we get $P = 25 - 0.5Q$

Total revenue: $TR = P * Q = 25Q - 0.5Q^2$

$$MR = \frac{\Delta TR}{\Delta Q} = 25 - Q_P$$

(Using calculus, the first derivative of $0.5 * Q^2$ is $2 * 0.5 * Q = Q$)

We derived this based on two assumptions which are often not true in the real world:

- Only price determines quantity demanded.
- A linear relationship between price and quantity demanded.

Movement along the demand curve happens only if the price and quantity demanded of the product changes, all else constant. If any factor other than price/quantity demanded changes, then there is a shift in the demand curve. For instance, an increase in income will cause the demand curve to shift up.

3. Elasticity of Demand

Price elasticity of demand measures the sensitivity of quantity demanded to a change in price. It depends on the following three factors:

Factors affecting price elasticity of demand	
Substitutes	Elasticity is high if there are more close substitutes i.e. customers are more sensitive to price changes. If the price of a substitute goes down, the quantity demanded of the substitute goes up and the quantity demanded of the original product goes down.

The share of the consumer's budget spent on the item	The greater the share, the higher the price elasticity. Ex: Expensive goods such as cars are highly elastic. Grocery essentials such as cereals, sugar and salt are inelastic. A 10% increase in the price of cars and cereals will affect the demand for cars but not that of cereals.
Length of time within which demand schedule is being considered	The longer the period, the higher the elasticity. Ex: If the price of cooking gas increases, the demand will not change much in the short run; however, demand will decline in the long run as consumers switch to electric stoves.

Numerically, price elasticity of demand falls into three categories:

Price elasticity of demand	
Elastic demand	$ \varepsilon > 1$; a 1% change in price will cause a more than 1% change in quantity demanded. Ex: furniture ($\varepsilon = 3.15$).
Unitary elastic demand	$ \varepsilon = 1$
Inelastic demand	$ \varepsilon < 1$; a 1% change in price will cause a less than 1% change in quantity demanded. Ex: coffee ($\varepsilon = 0.16$).
Special Cases	
Perfectly elastic or horizontal demand schedule	Horizontal demand curve. At a given price, quantity demanded is infinite. $\varepsilon = \infty$. Ex: corn.
Perfectly inelastic or vertical demand schedule	Vertical demand curve. Quantity demanded is fixed irrespective of price. $\varepsilon = 0$. Ex: insulin.

4. Other Factors Affecting Demand

Income elasticity of demand is the percentage change in the quantity demanded, divided by a percentage change in income, all else equal. It measures how sensitive the quantity demanded is to changes in income.

- For normal goods, income elasticity is positive.
- For inferior goods, income elasticity is negative.

Cross-price elasticity of demand measures how the quantity demanded of a good changes when there is a change in the price of another good.

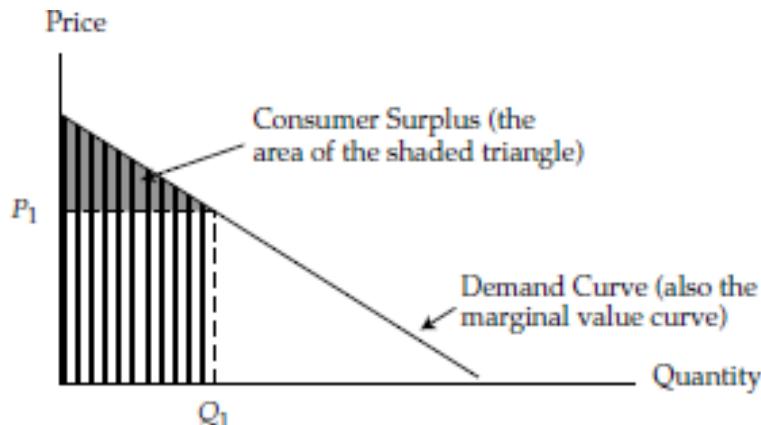
- If the cross-price elasticity is positive, then the two products are substitutes. Ex: cereals and oats.
- If the cross-price elasticity is negative, then the two products are complements. Ex: cereals and milk.

Instructor's Note: Changes in own price causes a movement along the demand curve, whereas, changes in income and price of substitutes cause a shift in the demand curve.

5. Consumer Surplus: Value Minus Expenditure

Consumer surplus is the difference between the price that consumers are willing to pay (value) and the price that they actually pay (expenditure).

On a supply and demand curve, it is the area beneath the demand curve and above the price paid.



The total consumer surplus received from buying Q_1 units at a level price of P_1 per unit is the difference between the area under the demand curve and the area of the rectangle $P_1 \times Q_1$. This is represented by the triangle.

Example:

(This is based on Example 1 from the curriculum.)

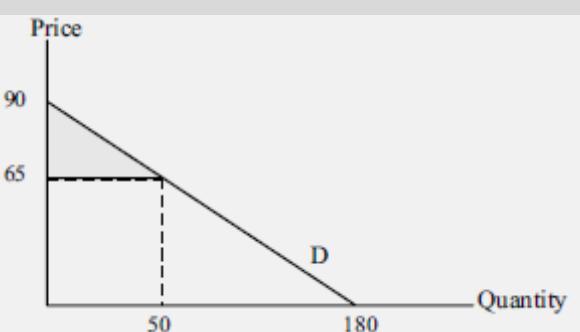
A market demand function is given by the equation $Q_D = 180 - 2P$. Find the value of consumer surplus if price is equal to 65.

Solution:

Quantity demanded at the price of 65 is: $Q_D = 180 - 2(65) = 50$

The inverted demand function is: $P = 90 - 0.5Q_D$

Using this information, we can draw the following demand curve.



Consumer surplus = area of the triangle in the upper section = $\frac{1}{2}(\text{Base})(\text{Height}) = \frac{1}{2}$

(50)(25) = 625

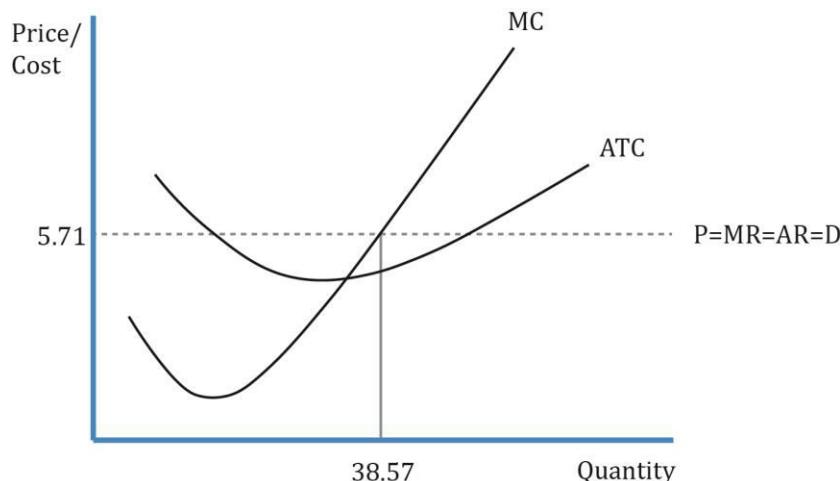
6. Supply Analysis & Optimal Price and Optimal Output in Perfectly Competitive Markets

When market prices increase, firms supply greater quantities. The market supply curve is the sum of the supply curves of the individual firms. Some key terms (covered earlier) are:

- **Economic costs:** These include all explicit costs and implicit opportunity costs that are required to acquire a resource or keep it in production.
- **Opportunity cost:** This is the value of the next best opportunity that is foregone when another alternative is chosen. For example, if a stay-at-home mom was employed, she would earn \$90,000 a year. In this case, the mother staying home had given up the opportunity to work, and with it an income of \$90,000.
- Economic profit = total revenue minus opportunity cost.

6.1 Optimal Price and Output in Perfectly Competitive Markets

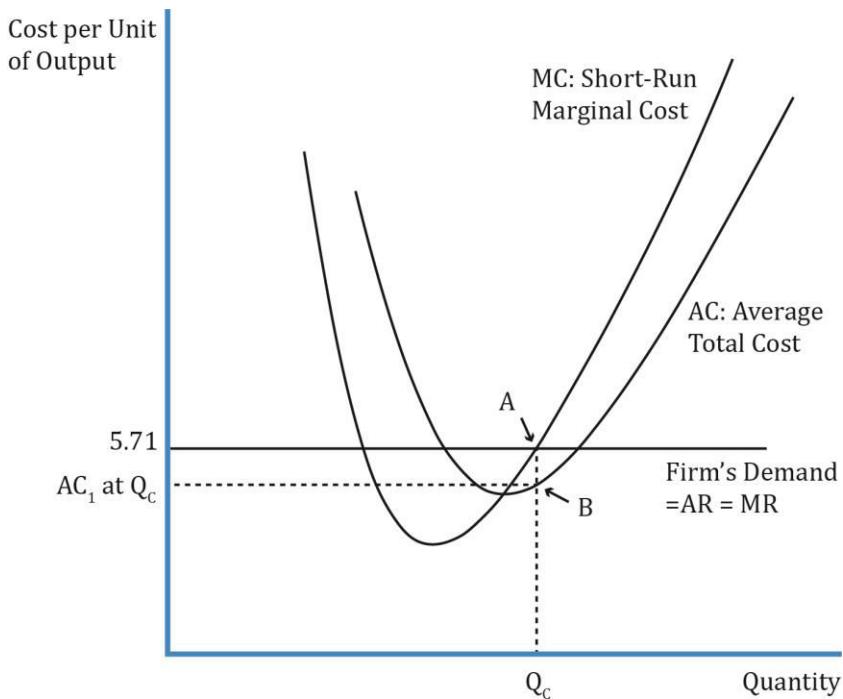
To determine the equilibrium price and quantity, we must equate market supply and demand functions. Say for a given industry the demand function is: $P = 25 - 0.5Q_D$ and the supply function is $P = -2 + 0.2Q_S$. We would solve for the equilibrium quantity and price by using the equation: $P = 25 - 0.5Q_D = -2 + 0.2Q_S$. Solving for Q, we get 38.57. Similarly, $P = 5.71$.



The equilibrium (optimal) price and quantity are 5.71 and 38.57 respectively. Each firm is a price taker, which means each firm in the market must sell the product at 5.71. The equilibrium price is determined by the market and each firm is too small to influence the price. If a firm decides to sell the product at 6 instead of 5.71, then it will not find any consumers who are willing to buy at that price. The quantity produced by each firm is not determined by the market. A firm may produce 10 or 10,000 units of the product to sell at 5.71 each. The optimal quantity is determined by the firm's cost curves.

The graph below plots MC and ATC curves for an individual firm in a perfectly competitive

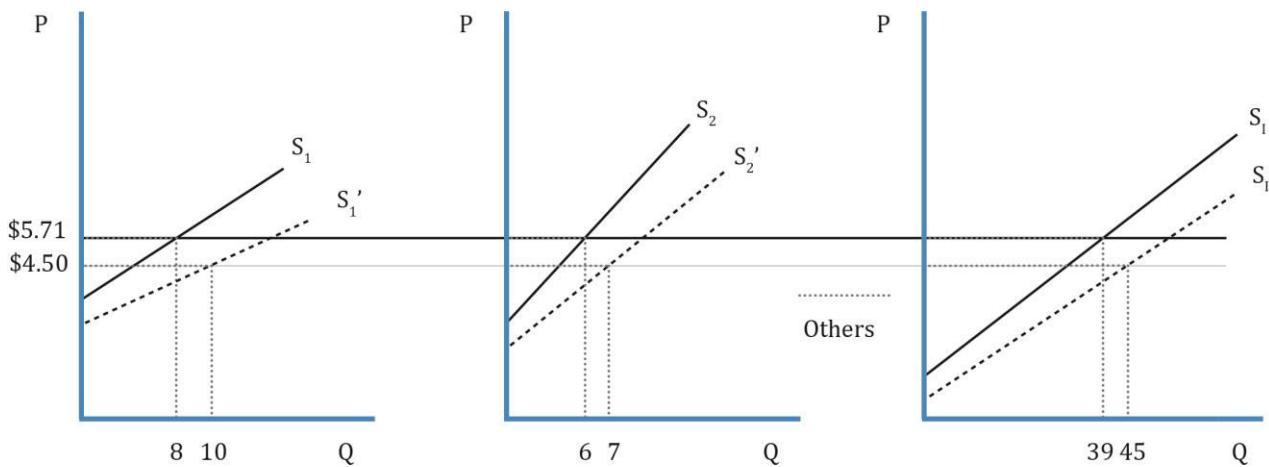
market selling oranges at the market price of 5.71.



Interpretation of the graph:

- This graph plots cost per unit on the y-axis and output quantity on the x-axis.
- Generally, cost curves are U-shaped because of the law of diminishing returns. The cost of selling oranges comes down as the quantity increases until it reaches a minimum. Beyond that point (optimal quantity), increasing the output quantity increases the cost.
- MC curve intersects the ATC curve at its minimum point.
- The horizontal line shows the market price of 5.71. It is also the marginal revenue, average revenue and the demand curve (perfectly elastic). $P = MR = AR = D$.
- Profit-maximization condition: The firm's profit-maximizing condition is $MR = MC$. The corresponding quantity is Q_c .
- Link between a firm's supply and MC curve: A firm's supply curve is the portion of the firm's MC curve above the minimum point of its AVC curve. This is the upward-sloping portion of the MC curve.
Assume the market price of oranges comes down to 4, the total fixed cost is 0, and the variable cost of producing each orange is 5; ATC is 5. So, will the firm sell oranges? No, as the cost is more than the market price. The supply will be zero. That explains why the firm's supply curve is an MC curve above the minimum point of ATC.
- Economic profit = $TR - TC$.

7. Factors Affecting Long-Run Equilibrium in Perfectly Competitive Markets



- Let us continue our orange example. Other firms will be attracted to enter the market to sell oranges when they see this firm makes a positive economic profit. This means more output (supply of oranges), which shifts the supply curve to the right.
- For a given demand curve, the supply curve shifts to the right. Because of the increase in output quantity, the price comes down.
- In the long run, the firm will operate at a point where equilibrium price = MC = MR = minimum ATC. Economic profit will be zero because TR = TC. As economic profit is zero, no more firms will enter the perfectly competitive market.

8. Supply, Demand, Optimal Pricing, and Optimal Output under Monopolistic Competition

This is a market where there are many sellers of slightly differentiated products. *Product differentiation* is the key here. Ex: Burgers sold by KFC, McDonalds, Burger King, etc.

If the firm is able to successfully differentiate the product (e.g. Harley Davidson motorcycles), then the firm acts like a small monopoly.

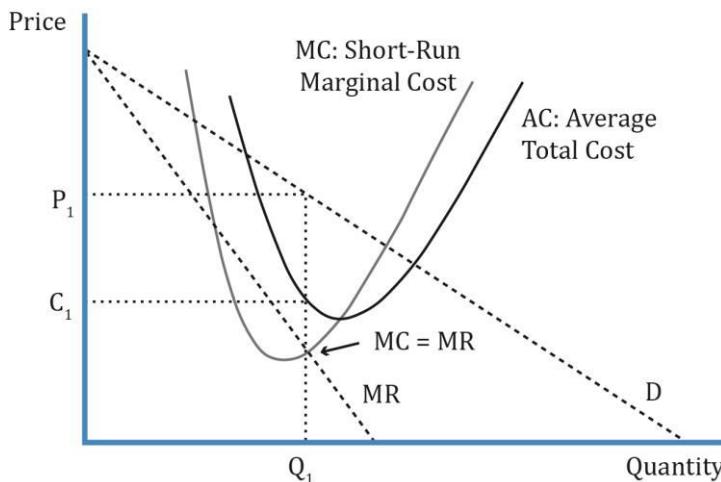
Characteristics:

- There are a large number of potential buyers and sellers.
- The products offered by each seller are close substitutes for the products offered by other firms, and each firm tries to make its product look different.
- Entry into and exit from the market is possible at fairly low costs.
- Firms have some pricing power.
- Firms differentiate their products through advertising and other non-price strategies.

8.1 Demand Analysis in Monopolistically Competitive Markets

The graph below shows the marginal cost (MC), demand and marginal revenue (MR) curve

for a monopolistic firm.



- Since the products are unique, a monopolistic firm has a downward sloping demand curve. MR is steeper and lies below the demand curve.
- Let us consider the toothpaste market. If consumers believe using Sensodyne toothpaste will relieve them of toothaches, then they will buy the product. However, the firm will have a downward sloping curve because if the prices are very high, then consumers will not buy the product, and will look for alternatives. Conversely, demand increases when the price decreases.
- Price and quantity demanded are inversely related.
- In the short run, the profit-maximizing quantity is $MR = MC$. This is Q_1 in the graph. The price is then determined based on the demand curve. This is P_1 in the graph.
- Because the product is differentiated, firms have some pricing power and charge what is determined by the demand curve. But each time a new firm enters the market, the demand curves of other firms fall (i.e., they lose a part of the market share). Since there is high competition, the products are often priced closed to each other.
- Demand is elastic at higher prices and inelastic at lower prices.
- $Total\ revenue = P_1 * Q_1$
- $Cost = C_1 * Q_1$
- In the short run, economic profit = $(P_1 * Q_1) - (C_1 * Q_1)$

8.2 Supply Analysis in Monopolistically Competitive Markets

8.3 Optimal Price and Output in Monopolistically Competitive Markets

Key points related to supply analysis in the context of monopolistic completion are:

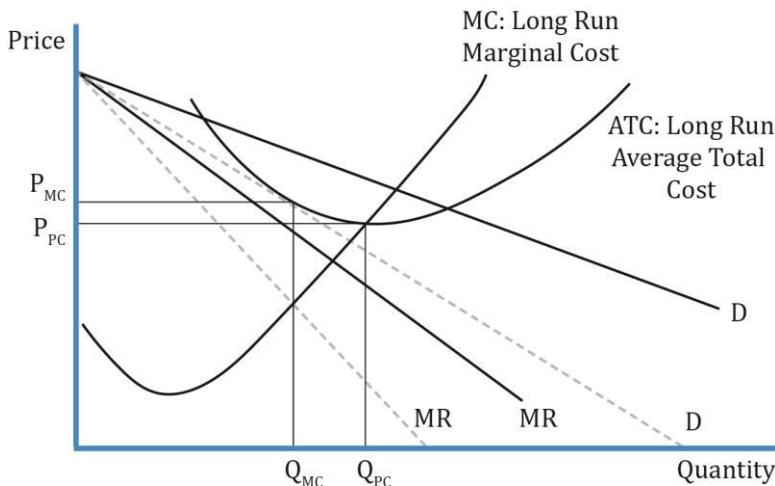
- Output is based on $MR = MC$.
- Price is determined based on the demand curve.
- The supply function is not well-defined in monopolistic competition.
 - Recall that in perfect competition, a firm's output does not affect the price as all units sell at the same price (horizontal demand curve). They are price takers. $P =$

$MR = MC$. But, how much a firm produced was dependent on its MC curve. In the short run, the firm's supply curve was the MC curve above the minimum point of the AVC curve. The MR curve was a flat line and the same as the market price at that point.

- But, in monopolistic competition there is no single price as the firm can set its own price, and does not have to take the price determined by the market. The price here is determined by the demand curve. The firm's supply curve must show the quantity the firm is willing to supply at various prices, which is not shown by the MC curve here. MR is a downward sloping curve. The optimal output is still the intersection of MR and MC.
- Prices are higher and quantity is lower relative to perfect competition (covered in the next section).
- Total profit = $TR - TC$.

9. Long-Run Equilibrium for Monopolistically Competitive Firms

The graph below shows the long-run marginal cost (MC), long-run average cost (ATC), demand and marginal revenue (MR) curve for a monopolistic firm.



Interpretation of the graph:

- The solid lines show the original demand and MR curves.
- The dashed lines show the shift in the demand and MR curves when a new firm enters the market.
- Short-run economic profits of existing firms encourage new firms to enter the market as the barriers to entry are low. When new firms enter, the demand curve shifts to the left and the market share of existing firms falls. The number of products in the market increases.
- In the long run, firms will enter and exit until $P = ATC$. At this point, economic profit will be zero and there will no longer be an incentive for new firms to enter the market. Therefore, long-run equilibrium is established.

- Q_{MC} and P_{MC} are the equilibrium quantity and price respectively, for monopolistic competition. Q_{PC} and P_{PC} are the equilibrium quantity and price respectively, for perfect competition. As you can see, the equilibrium price is higher and the quantity is lower for monopolistic competition.

The table below summarizes the similarities and differences between perfect competition and monopolistic competition.

Perfect Competition (PC) vs. Monopolistic Competition (MC)	
Similarities	Ways in which MC is different from PC.
Long-run economic profit is zero	In the long run, profit-maximizing output quantity of MC is lower than PC.
Profit-maximizing output: $MR = MC$	Economic cost in MC includes advertising cost for product differentiation.
	PC is efficient as surplus is maximized. PC: Price = Marginal Cost MC: Price > Marginal Cost Deadweight loss in MC because firms have some amount of pricing power and consumer surplus is lost.
	Prices are lower in PC, but consumers have little variety.

10. Oligopoly & Demand Analysis and Pricing Strategies in Oligopoly Markets: Pricing Independence Portion

An oligopoly market has few sellers of a product and many buyers. These sellers are large players in their industry who determine the prices or quantities. For example, credit card companies such as Visa, MasterCard, and Amex.

Characteristics:

- There are a small number of potential sellers.
- The products offered by each seller are close substitutes for the products offered by the other firms and may be differentiated by brand or be homogeneous and unbranded.
- Entry into the market is difficult with fairly high costs and significant barriers to competition.
- Firms typically have substantial pricing power. Since there are very few firms, the pricing decisions are interdependent. Whenever a firm makes a decision, it must take into account how the competing firms will react.
- Products are often highly differentiated through marketing, features, and other non-price strategies.
- The pricing is strategic and firms in an oligopoly have a temptation to collude.

10.1 Demand Analysis and Pricing Strategies in Oligopoly Markets

If firms collude, the total market demand is divided among the individual participants. The firms act like a cartel and decide how to divide the demand, and what price to set for the products in order to maximize profit.

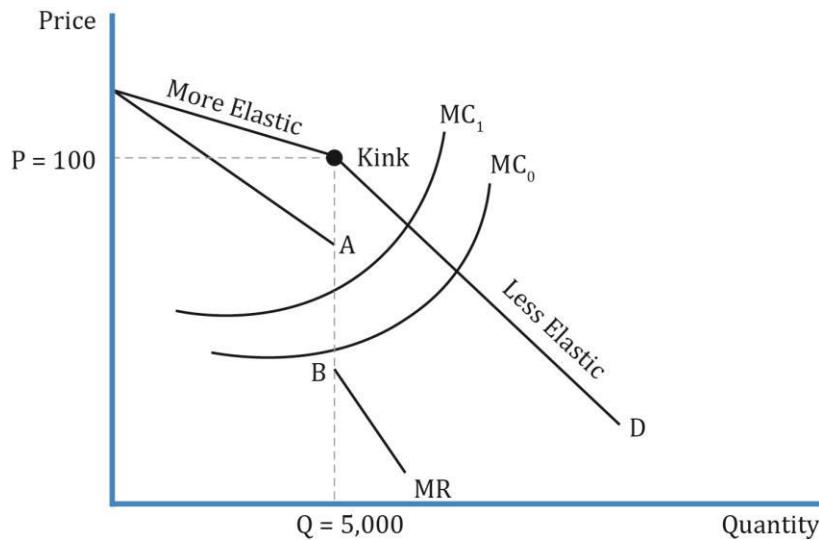
If firms do not collude, each firm faces an individual demand curve and a market demand curve. There are several models that try to explain pricing in oligopoly markets:

- Pricing interdependence
- Cournot assumption
- Nash equilibrium
- Stackelberg model

Pricing Interdependence – Kink Demand Curve

According to this theory, a competitor will not follow a price increase, but will cut prices in response to a price decrease.

Example: Let us assume a town has two cola suppliers: Coke and Pepsi. This type of oligopoly is called a duopoly. Now, assume the initial equilibrium price of 1 liter Coke bottle is 100 and the quantity is 5000.



Effect of price increase: If Coke increases its price from 100 to 105, what will Pepsi do?

According to the interdependence theory, Pepsi will not increase the price and consumers will switch from Coke to Pepsi. The quantity demanded of Coke will decrease (see the elastic portion of the demand curve).

Effect of price decrease: Instead, if Coke decreases the price to 95, then Pepsi will also decrease the price to 95. The quantity demanded of Coke will increase when the price decreases, but not by much because there is no substitution effect. Consumers do not switch from Pepsi to Coke as both are selling at the same price. To the right of the kink, the demand

curve is inelastic.

Some important points:

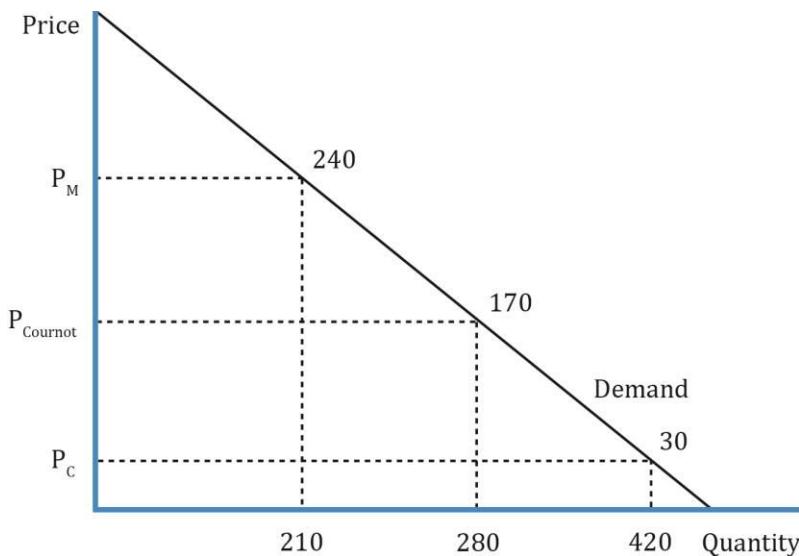
- There are two different demand curves in the model; combining them gives us the overall demand, which is a kinked (bent) curve. A kink in the demand curve leads to a discontinuous (with a gap) marginal revenue curve. One part of the MR curve corresponds to the price increase part of the demand curve and the other to the price decrease part of the demand curve.
- Profit-maximizing rule: $MR = MC$.
- Equilibrium price and quantity do not change so long as the marginal-cost curve of the firm falls between the gaps in the MR curve.
- The MC must change considerably for the firms to change their price.
- Advantage: The model helps explain stable prices.
- Disadvantage: It does not tell us what the prices should be.

11. Oligopoly & Demand Analysis and Pricing Strategies in Oligopoly Markets: The Cournot Assumption Part

Cournot Assumption

Firms compete simultaneously to determine a profit-maximizing output, based on the assumption that the other firms' output will not change. In the long run, change in price or quantity will NOT increase profits. As the number of firms in an oligopoly increase, the equilibrium point moves closer to perfect competition.

Assume there are two firms with the output levels q_1 and q_2 respectively. Firm 1 chooses its output as q_1 to maximize profit based on the assumption that firm 2's output level q_2 is constant in the future. Similarly, firm 2 chooses its output as q_2 to maximize profits by assuming that firm 1's output level is constant. Firms choose q_1 and q_2 simultaneously. Let us now look at the price and quantity numbers associated with the Cournot assumption.



- With a monopoly, the price is highest and quantity is lowest.
- In a perfect competition market structure, the price is lowest and quantity is highest.
- In a duopoly market characterized by the Cournot assumption, both the price and quantity will lie somewhere in between. As the number of firms increase, the equilibrium point moves towards perfect competition.

12. Oligopoly & Demand Analysis and Pricing Strategies in Oligopoly Markets: The Nash Equilibrium part

The Nash Equilibrium in a Duopoly Market

Unlike perfect competition, in oligopoly there is a lot of strategic interdependence between firms. Since the number of firms are few, the actions one takes affects the others.

Nash Equilibrium: A set of choices/strategies among two or more participants is called a Nash equilibrium if, holding the strategies of all other participants constant, no participant has an incentive to choose a different strategy. In an oligopoly, firms arrive at an equilibrium strategy after considering the actions of other firms (interdependence). Once they arrive at equilibrium, no firm wants to change its strategy.

Assumptions made in Nash equilibrium:

- The firms do the best they can, given the actions of their rivals.
- The actions are interdependent.
- The firms do not cooperate (collude); each firm wants to maximize its own profits.

Example: WesCo and RifCo sell a similar product. Each company can employ a high-price strategy or a low-price strategy. The profit for each strategy is shown. What is the Nash equilibrium?

The four possible strategies are shown in the four boxes. For example, box 1 on the top-left corner has WesCo adopting a low price strategy and RifCo adopting a low price strategy as

well. The profit for WesCo is 50 and that for RifCo it is 70. At any point in time, the companies can be in only one box. It is not possible for WesCo to adopt a low price strategy with profit of 50 (box 1) and RifCo to adopt a high price strategy with profit of 0 (box 2).

	WesCo - Low Price 50 RifCo - Low Price 70	WesCo - Low Price 80 RifCo - High Price 0
WesCo - High Price 300 RifCo - Low Price 350		WesCo - High Price 500 RifCo - High Price 300
RifCo - Low Price 350		RifCo - High Price 300

No matter where the companies start, they will end up in box 4 (lower left box).

Let's start with box 1. The total profit of WesCo and RifCo is 120. They are both selling the products at a lower price. It is in WesCo's best interest to increase prices, and their profits jump from 50 to 300 in box 4. It is in RifCo's best interest as well if WesCo increases the price, as RifCo can also increase the price. RifCo's profit jumps from 70 to 350. The combined profit of box 4 now is 650.

The combined profits are the highest in box 3, which is 800. Both the companies are charging high prices. Box 3 is in WesCo's best interest as it earns its maximum profit of 500, but it's possible only if RifCo also charges the high price. But RifCo is not happy here and would lower the prices to increase its profit from 300 (box 3) to 350 (box 4).

When RifCo lowers its price to make a profit of 350 in box 4, WesCo's profit falls from 500 to 300. The Nash equilibrium position in box 4 is what they arrive at finally.

Can both companies be better if they collude? Yes, if both the companies agree to collude and charge high prices. If WesCo and RifCo agree to split the maximum profit of 800 equally, then each company makes a profit of 400, which is better than the Nash equilibrium profit of 300 and 350 profit respectively. Companies are said to form a **cartel** when they engage in collusive agreements openly.

Factors that affect the chances of successful collusion:

1. Number and size of sellers: The number of firms should be small.
2. Similarity of products: Products must be homogeneous.
3. Cost structure: Firms must have a similar cost structure.
4. Order size and frequency: Orders must be small and frequent.
5. Retaliation: Less likely to break collusive agreement if the threat of retaliation by other firms is severe. Threat from competitors is weak.
6. Degree of external competition: Collusion increases overall profitability of the market

which attracts external competition.

Stackelberg Model

There is one dominant large firm and many small firms. The large firm sets the price and has the first mover advantage.

In the Stackelberg model, the decision-making happens sequentially (recall it happens simultaneously in the Cournot assumption). The leader firm chooses the output first and then the follower firm chooses its output.

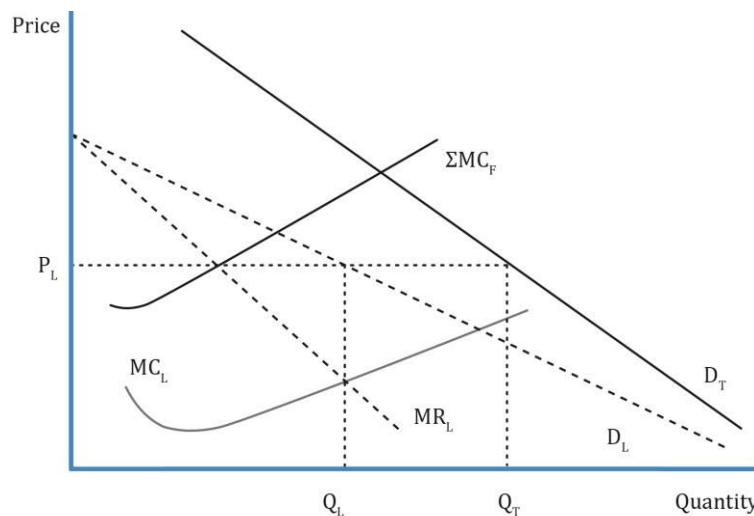
13. Supply Analysis & Optimal Price and Output & Long-Run Equilibrium in Oligopoly Markets

The curriculum discusses the supply analysis for only one type of oligopoly – the dominant firm oligopoly.

- As in monopolistic competition, the supply function is not well defined.
- We cannot determine equilibrium output and price without considering the demand function and competitive strategies.
- Profit-maximizing condition: $MR = MC$.
- The equilibrium price is based on the demand curve.

Example: Say we have an oligopoly market where one firm has a significantly lower cost of production than its competitors and has a 40% market share. A **dominant or leader** firm is a firm with at least 40 % market share, greater capacity, lower cost structure, and is price maker. A follower firm is a small firm that is a price taker – i.e. it accepts the price set by the leader firm. Let us say there are five such firms in this market.

The graph below shows the quantity that will be supplied and the price charged by the market leader, as well as by the other firms.



Interpretation of the graph:

- Price is plotted on the y-axis and quantity on the x-axis.
- The solid line represents an aggregate market demand. The following are the curves for the dominant firm:
 - Dashed line – the demand curve.
 - MRL – the marginal revenue curve; it lies below the demand curve and is steeper
 - MC_L – the marginal cost curve.
 - P_L – optimal price.
- Assuming the other five firms will take the price established by the leader, the overall market demand is given as Q_T . The small/follower firms have no incentive to slash prices as it will lead to price wars with the leader, who is a low-cost producer.
- Quantity supplied by the leader firm = Q_L ; quantity supplied by the other firms = $Q_T - Q_L$.
- Notice that the demand curves of the industry and of the dominant firm are not parallel to each other. As the price decreases, the difference between the curves diminishes. The reasons are:
 - The dominant firm is a low cost producer. When prices start falling, the other smaller firms exit the industry because they do not want to sell below cost.
 - The dominant firm gets a greater market share as other firms exit, and Q_L (quantity supplied by the leader) increases.

13.1 Optimal Price and Output in Oligopoly Markets

There is no single optimum price and output model that works for all oligopoly market situations because of different strategies and pricing methods. The process for determining the optimal price for a few methods is listed below:

- Kinked demand curve: Price at the kink in demand function.
- Dominant firm: Price at the quantity where $MR = MC$. Followers take the leader's price.
- Cournot assumption: No changes in price and output by other firms once the dominant firm chooses its output level where $MR=MC$.
- Nash equilibrium: Each firm acts in its best interest under the given circumstances. No certainty of price and output level.

13.2 Factors Affecting Long-Run Equilibrium in Oligopoly Markets

Long-run economic profits are possible, but empirical evidence suggests that over time the market share of the dominant firm declines.

14. Monopoly & Demand & Supply & Optimal Price and Output in Monopoly Markets

This is a market structure in which a single company makes up the entire market. It is on the opposite end of the spectrum as compared to perfect competition.

Characteristics:

- Single seller of a highly differentiated product.
- No close substitute.
- Significant barriers to entry.
- Considerable pricing power.
- Product is differentiated through non-price strategies such as advertising.

Ex: Government created monopolies such as electricity or water supply in a major city.

How monopolies are created:

- Patent or copyright.
- Control over critical resources – Ex: De Beers' control of mining resources in South Africa.
- Government authorization – Ex: utilities like electricity, water, etc.
- Strong brand loyalty which creates high barriers to entry (Rolex watches).
- Network effect (Microsoft).

A natural monopoly is one where cost decreases with quantity. The firm is able to meet most of the quantity demanded at a low cost, making it difficult for new firms to enter the market.

14.1 Demand Analysis in Monopoly Markets

The demand curve in a monopoly is downward sloping. Let us take the example of electricity. As a consumer, the quantity demanded is still dependent on the price. To sell an additional unit of the good, the producer must lower the price to increase quantity. This explains why the demand curve is downward sloping.

Let us say the quantity demanded is given by:

$$Q = 400 - 0.5P$$

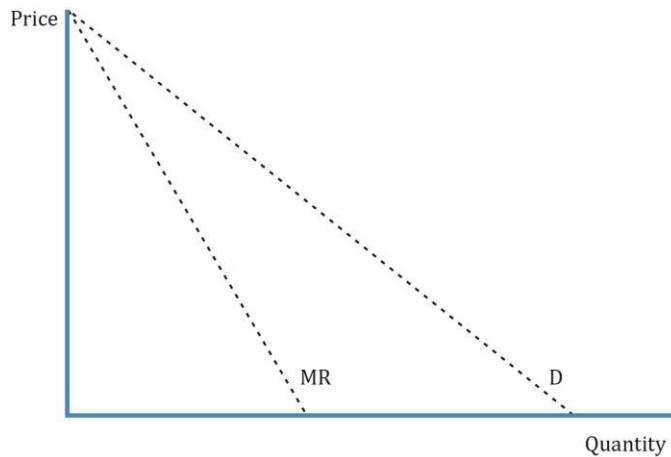
Rewriting the demand function, we get $P = 800 - 2Q$

$$TR = P * Q = 800Q - 2Q^2$$

$$MR = \Delta TR / \Delta Q = 800 - 4Q$$

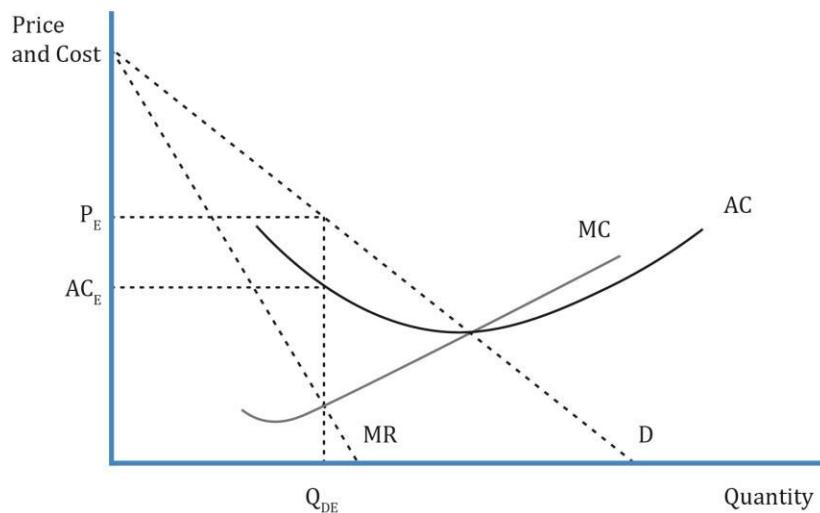
$$AR = 800 - 2Q$$

The average revenue for a demand curve is the same as the demand curve.



14.2 Supply Analysis in Monopoly Markets

The graph below shows the demand, MR, AC, and MC curves for a monopoly firm.



The profit-maximizing level of output, Q , is when $MR = MC$. The corresponding price, P_E , at this level of output is determined by the demand curve.

Profit is based on the demand curve = $TR - TC$. Let us say TC is given by:

$$TC = 20000 + 50Q + 3Q^2 \text{ (the } TC \text{ equation will be given; you need not derive it)}$$

From TC , we can derive $MC = \Delta TC / \Delta TQ = 50 + 6Q$.

Given the total cost function, you can derive the MC curve as shown above. Supply and demand can be equated to determine the profit-maximizing output.

$$800 - 4Q = 50 + 6Q$$

$$Q = 750/10 = 75$$

14.3 Optimal Price and Output in Monopoly Markets

In the previous section, we calculated the optimal output by equating $MR = MC$.

Another way of determining the profit-maximizing output is to equate $\frac{\Delta\pi}{\Delta Q} = 0$. At this point there is no change in profit when output changes.

The price at the profit-maximizing output level of 75 is:

$$P = 800 - 2(75) = 650$$

If $\pi = -20000 + 750Q - 5Q^2$, at what quantity is profit maximized?

$$\frac{\Delta\pi}{\Delta Q} = 750 - 10Q$$

Equating it to 0, we get $750 - 10Q = 0 \rightarrow Q = 75$.

Relationship between MR and price elasticity is: $MR = P [1 - \frac{1}{E}]$

Profit maximization condition in monopoly: $MR = MC$

$$MC = P [1 - \frac{1}{E}]$$

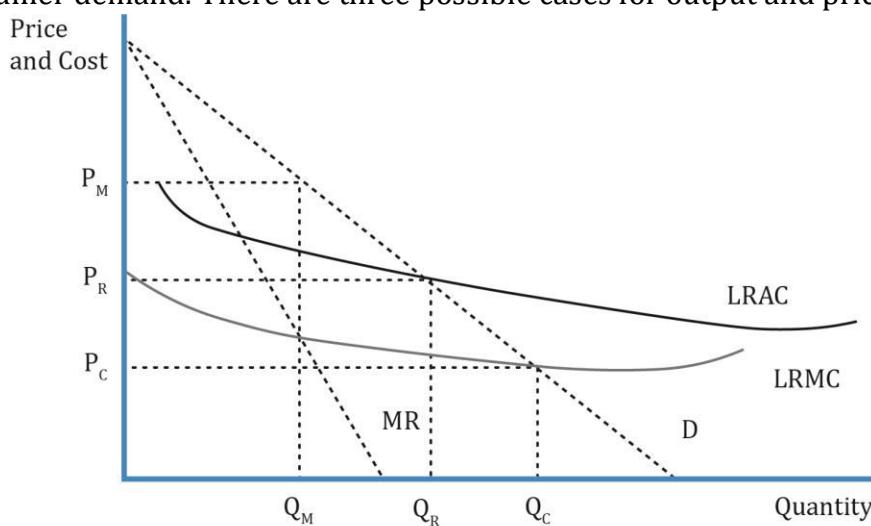
$$\text{Profit-maximizing price} = \frac{MC}{[1 - \frac{1}{E}]}$$

If $MC = 75$ and the own price elasticity of demand = 1.5, what is the profit-maximizing price?

$$\text{Profit-maximizing price} = \frac{75}{[1 - \frac{1}{1.5}]} = 225.$$

Natural Monopoly in Regulated Pricing Environment

A natural monopoly is a market where the average cost of production falls over the relevant range of consumer demand. There are three possible cases for output and pricing:



Natural Monopoly Under Different Environments				
Case	Condition	Output	Price	Comments
No regulation of monopoly.	$LRMC = MR$	Q_M	P_M (the corresponding price on the demand curve)	Profit is maximized by producing this output. Notice that the price is highest and quantity produced is lowest.
Perfect competition	$P = MC$	Q_C	P_C	Quantity produced is higher while the price is lower. Price does not cover the average cost of production, and there is an economic loss. So the government must subsidize the monopoly: $LRAC - P_C$
Regulated monopoly	Set price such that $LRAC = AR$	Q_R	P_R	The monopoly earns a normal profit, i.e. economic profit is zero at this output level.

- Left unregulated, monopoly will maximize profits by producing the quantity for which $MR = MC$
- Government regulation may attempt to improve resource allocation by requiring average cost pricing or marginal cost pricing.

15. Price Discrimination and Consumer Surplus

What a monopolist charges for their product and how much quantity is supplied lie on two extremes: On one end the price and quantity supplied may be equal to that of perfect competition where there is a uniform price, and on the other end is discriminating consumers on some grounds, which leads to different prices for the same product.

Ex: In restaurants, lunch is cheaper than dinner, or weekday prices are different from Friday-Sunday prices.

First-degree price discrimination:

- Consumer is charged the maximum that he is willing to pay; sellers are able to capture all consumer surplus.
- Consumers are charged different prices for the same product (airline tickets).
- The monopolist is able to measure exactly how much each consumer is willing to pay and what their preferences are. Prices vary for each consumer and unit. In some cases, public price disclosure may not be permitted. So one customer is not aware of how much another customer is paying for the same product.

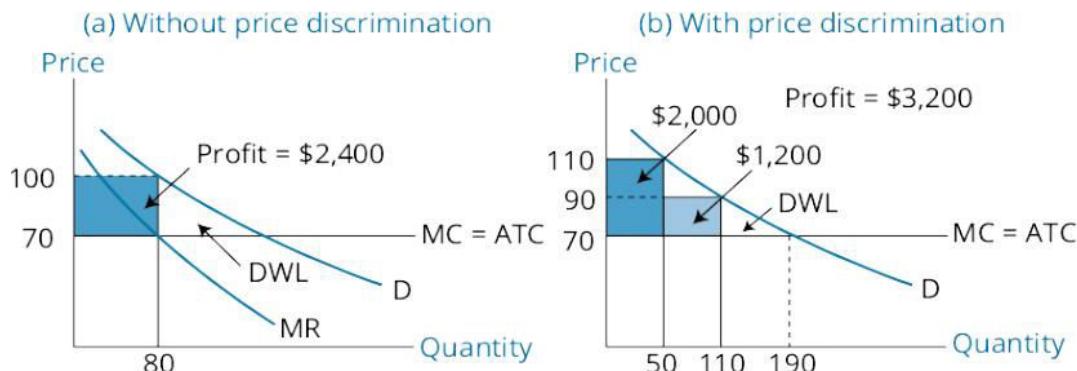
Second-degree price discrimination:

- Unlike first-degree, the monopolist is not able to measure the consumer's exact preferences, or his willingness to pay before pricing the product.

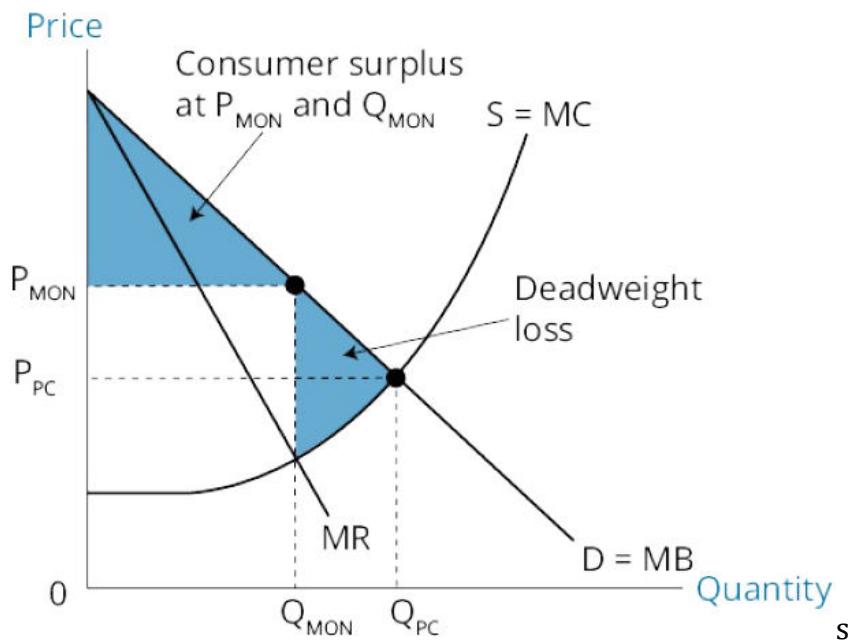
- Consumer charged differently based on how much he values the product. Ex: a TI BAII Plus Professional.
- Another instance is where consumers are charged differently based on the quantity sold. Ex: Quantity discounts (the price per unit decreases as the number of units sold to a consumer is higher) are often seen. Family-fare airline tickets (different fare if the number of passengers traveling is more than 2) is another example.
- Some amount of consumer surplus is captured in this form of discrimination.

Third-degree price discrimination:

- Consumers segregated based on demographic or other traits (gender, age).
- Example: One-day (business travelers) vs. round-trip airline tickets, milk prices within the state/outside state. Student vs. professional version of many software packages.



Perfect Competition vs. Monopoly



Example

My monthly demand for visits to the local gym is given by: $Q = 25 - 5P$ where Q is the number of visits per month and P is the price per visit. The gym's marginal cost is 1 per visit.

1. What are the X-axis and Y-axis intercepts for the demand curve?
2. If the gym charged a price per visit equal to its marginal cost, how many visits would I make per month?
3. What is my surplus at this price?
4. How much could the club charge per month for a membership fee?

Solution:

$$1. Q = 25 - 5P, P = 5 - \frac{1}{5} * Q$$

X-axis intercept when $P = 0$ is $Q = 25$.

Y-axis intercept when $Q = 0$ is $P = 5$.

$$2. \text{ If } P = 1, \text{ then } Q = 25 - 5 * 1 = 20$$

I would make 20 visits per month.

$$3. \text{ Consumer surplus} = \frac{1}{2} * b * h = \frac{1}{2} * 20 * 4 = 40.$$

4. The club could charge a membership fee of 40 to extract all the consumer surplus. In addition, it must charge 1 per visit. This pricing method is called a two-part tariff.

Example

Monopolists have considerable pricing power and may charge consumers in different ways. Exporters charging higher prices for denim jeans in the international market compared to local markets is an example of:

- A. First-degree price discrimination.
- B. Second-degree price discrimination.
- C. Third-degree price discrimination.

Solution: C

Third-degree price discrimination occurs when customers are segregated by demographics. Dividing the customers into two groups, local and international; and charging two different prices is an example of third-degree price discrimination. The first degree of price discrimination allows a monopolist to charge the highest price each customer is willing to pay. The second degree of price discrimination is when the monopolist charges different people different prices using the quantity purchased as an indicator of how highly the

customer values the product.

16. Factors Affecting Long-Run Equilibrium in Monopoly Markets

Unregulated monopolies can earn economic profits in the long run as all factors of production are variable in the long run.

For regulated monopolies, there are several possible solutions in the long run:

- Price = marginal cost. But this will be less than long-run average cost. So there must be a government subsidy to compensate for the loss. Ex: Amtrak.
- National ownership. But the problem is consumers are not willing to accept price increases once the price is fixed even if the input price increases.
- Regulated, authorized monopoly. $P = LRAC$. Investors make a normal profit, but the challenge is to identify the monopolist's realistic $LRAC$.
- Franchise monopolistic firm through a bidding war to select a firm whose $P = LRAC$.

17. Identification of Market Structure

Analysts are interested in investing in markets with high pricing-power as it drives profitability. If there are very few large firms in an industry, then the price tends to be high and the quantity supplied low. When there is a possible merger, analysts should consider the impact of competition law (anti-trust law) as regulators might prevent the merger to keep the industry competitive. In many countries, competition law has been introduced to regulate the degree of market competition in different industries of different countries.

17.1 Econometric Approaches

Econometric approaches can be used for measuring market concentration or market power. Some key points in this context are as follows:

- Use regression analysis to estimate elasticity of demand and supply.
- If demand is inelastic, then it indicates companies may have market power.
- The disadvantage is that though it is theoretically appealing, but data is not easily available.

17.2 Simpler Measures

Simpler approaches to estimate elasticity that avoid the drawbacks in regression analysis include the N-firm concentration ratio and Herfindahl-Hirshman Index (HHI).

N-Firm Concentration Ratio and HHI

N-Firm concentration ratio: It is the sum of the market shares of the largest N firms. It is almost zero for perfect competition and 100 for monopoly.

For example, in an industry, assume the five largest firms in the industry have a market share of 25%, 15%, 10%, 10% and 10%. The 5-firm concentration ratio would be 70%.

Advantages:

- Data is easily available.
- Simple to use and understand.

Disadvantages:

- Unaffected by mergers among top firms. Assume the top two firms by market share merge and the market shares of five largest firms are 40%, 10%, 10%, 10% and 2% now. The 5-firm concentration ratio would be 72% instead of 70%, which is not very different from what it was earlier. But the largest firm has a high market share of 40%, which is not evident in the concentration ratio number.
- Does not quantify market power.
- Does not consider barriers to entry.
- Does not consider elasticity of demand.

Herfindahl-Hirschman Index (HHI)

- Sum of squared market shares of N largest firms in a market (ranges from 0 to 1). A number close to 1 indicates it is concentrated or monopolistic.
- For example, assume the market shares of four firms are 50%, 20%, 10% and 20%. The HHI is $0.5^2 + 0.2^2 + 0.1^2 + 0.2^2 = 0.34$.

Advantage:

Simple and commonly used by regulators.

Disadvantage:

- Does not consider barriers to entry.
- Does not consider elasticity of demand.

Summary

LO.a: Describe characteristics of perfect competition, monopolistic competition, oligopoly, and pure monopoly.

	Perfect Competition	Monopolistic Competition	Oligopoly	Monopoly
Number of Sellers	Many firms	Many firms	Few firms	Single firm
Barriers to Entry	Very low	Low	High	Very high
Nature of Substitute Products	Very close substitutes	Substitutes but differentiated	Very close substitutes or differentiated	No good substitutes
Nature of Competition	Price only	Price, marketing, & features	Price, marketing, & features	Advertising
Price Power	None	Some	Some to significant	Significant

LO.b: Explain relationships between price, marginal revenue, marginal cost, economic profit, and the elasticity of demand, under each market structure.

Perfect Competition:

- Price = marginal revenue = marginal cost (in equilibrium).
- Firm-demand curve is perfectly elastic.
- Zero economic profit in equilibrium.

Monopolistic Competition:

- Price $>$ marginal revenue = marginal cost (in equilibrium).
- Downward sloping firm demand curve.
- Zero economic profit in long-run equilibrium.

Oligopoly:

- Price $>$ marginal revenue = marginal cost (in equilibrium).
- Downward sloping firm demand curve.
- May have positive economic profit in long-run equilibrium.
- Trends towards zero economic profit over time.

Monopoly:

- Price $>$ marginal revenue = marginal cost (in equilibrium).
- Downward sloping firm demand curve.
- May have positive economic profit in long-run equilibrium.
- Profits may be zero because of expenditures to preserve monopoly.

LO.c: Describe a firm's supply function under each market structure.

- Under perfect competition, a firm's short-run supply curve is the portion of the firm's short-run marginal cost curve above its average variable cost. Its long-run supply curve is the portion of the firm's long-run marginal cost curve above its average total cost.
- Under monopolistic competition, oligopoly, and monopoly, supply functions are not well-defined. Neither marginal-cost curves nor average-cost curves are supply curves.

LO.d: Describe and determine the optimal price and output for firms under each market structure.

- In perfect competition, monopoly, and monopolistic competition, profits are maximized by producing the quantity for which marginal revenue equals to marginal cost.
- In oligopoly, optimal pricing depends on our assumptions regarding the reaction of firms to other firms' actions.

LO.e: Explain factors affecting long-run equilibrium under each market structure.

In the long run,

- the perfectly competitive firm and the monopolistically competitive firm cannot make economic profits.
- the oligopoly firm can make economic profit, but history shows that the dominant firm's share declines.
- the unregulated monopoly firm can make economic profit.

LO.f: Describe pricing strategy under each market structure.

In equilibrium,

- Perfect Competition: Price = marginal revenue = marginal cost.
- Monopolistic Competition: Price > marginal revenue = marginal cost.
- Oligopoly: Price > marginal revenue = marginal cost.
- Monopoly: Price > marginal revenue = marginal cost.

LO.g: Describe the use and limitations of concentration measures in identifying market structure.

N-Firm Concentration Ratio:

- Sum of the percentage market shares of the N largest firms in an industry.
- Market share = Firm sales / Total market sales.
- Advantage: Simple to use and understand.
- Disadvantages: Ignores barriers to entry and does not directly measure market power or elasticity of demand.

Herfindahl-Hirschman Index (HHI):

- HHI = sum of squared market shares of N largest firms in a market
- Ranges from 0 to 1 – where 0 indicates perfect competition and 1 indicates a perfect

monopoly.

- Advantage: Simple and commonly used by regulators.
- Disadvantage: Does not consider barriers to entry and elasticity of demand.

LO.h: Identify the type of market structure within which a firm operates.

Same as LO.a.