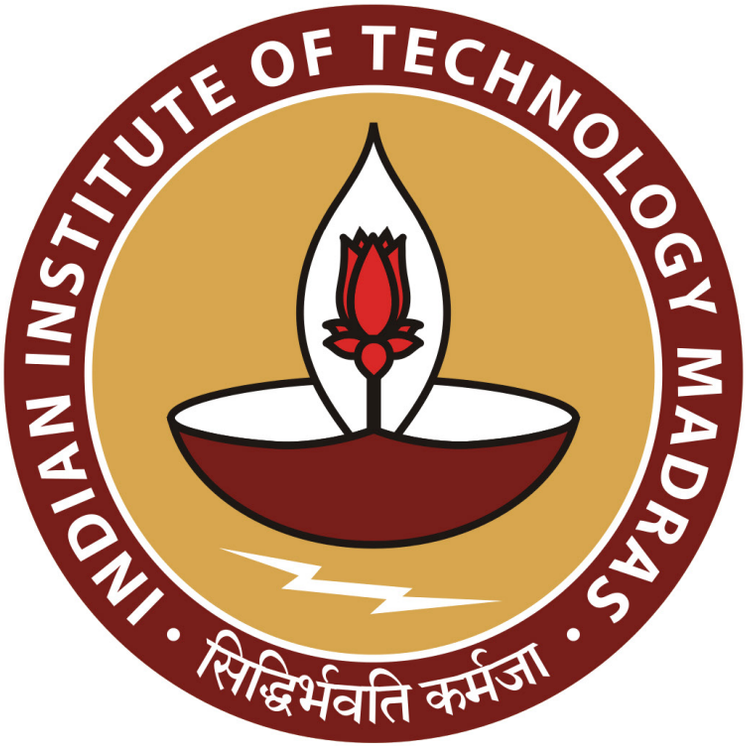


IIT Madras

ONLINE DEGREE

The Theory of Consumer Behavior

The Theory of Consumer Behavior

The principle assumption upon which the theory of consumer behavior and demand is built is:

a consumer attempts to allocate his/her limited money income among available goods and services so as to maximize his/her utility (satisfaction).

Useful for understanding the demand side of the market.

***Utility* - amount of satisfaction derived from the consumption of a commodity ….measurement units ⇒ utils**

Theories of Consumer Choice

Utility Concepts:

- The Cardinal Utility Theory (TUC)
  - Utility is measurable in a cardinal sense
  - ***cardinal utility*** **- assumes that we can assign values for utility. E.g., derive 100 utils from eating a slice of bread**

- The Ordinal Utility Theory (TUO)
  - Utility is measurable in an ordinal sense
  - ***ordinal utility approach*** **- does not assign values, instead works with a ranking of preferences.**

The Cardinal Approach

Nineteenth century economists, such as Jevons, Menger and Walras, assumed that utility was measurable in a cardinal sense, which means that the difference between two measurement is itself numerically significant.

$$U_X = f(X), \qquad U_Y = f(Y), \ldots..$$

Utility is maximized when:

$$MU_X / MU_Y = P_X / P_Y$$

The Cardinal Approach

- ***Total utility*** **(TU) - the overall level of satisfaction derived from consuming a good or service**

- ***Marginal utility*** **(MU)** ***additional satisfaction*** **that an individual derives from consuming an** ***additional unit*** **of a good or service.**

Formula :

$$MU = \frac{\text{Change in total utility}}{\text{Change in quantity}}$$

$$= \frac{\Delta TU}{\Delta Q}$$

The Cardinal Approach

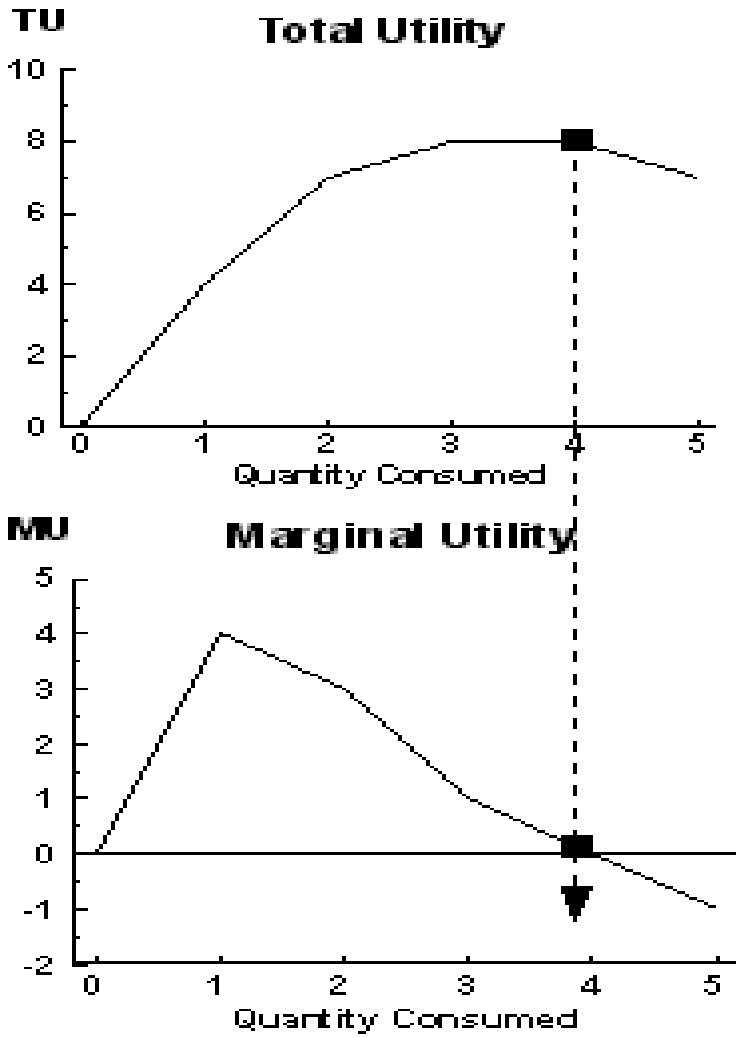
- Law of Diminishing Marginal Utility (Return) = **As more and more of a good are consumed, the process of consumption will (at some point) yield smaller and smaller additions to utility**

- When the total utility maximum, marginal utility = 0

- When the total utility begins to decrease, the marginal utility = negative (-ve)

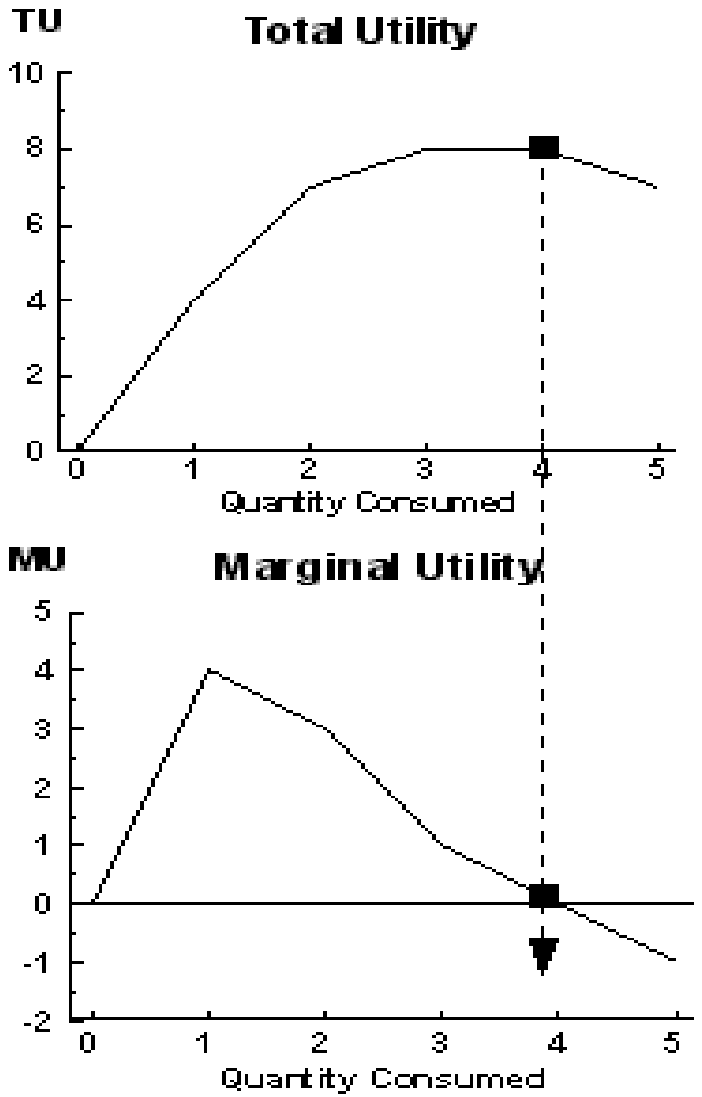
EXAMPLE

Number Purchased	Total Utility	Marginal Utility
0	0	0
1	4	4
2	7	3
3	8	1
4	8	0
5	7	-1



The Cardinal Approach

- TU, in general, increases with Q
- At some point, TU can start falling with Q (see Q = 5)
- If TU is increasing, MU > 0
- From Q = 1 onwards, MU is declining $\Rightarrow$ principle of diminishing marginal utility $\Rightarrow$ As more and more of a good are consumed, the process of consumption will (at some point) yield smaller and smaller additions to utility



Consumer Equilibrium

- So far, we have assumed that any amount of goods and services are always available for consumption

- In reality, consumers face constraints (income and prices):
  - Limited consumers income or budget
  - Goods can be obtained at a price

- Consumer's objective: to maximize his/her utility subject to income constraint
- 2 goods (X, Y)
- Prices Px, Py are fixed
- Consumer's income (I) is given

Consumer Equilibrium

- **Optimizing condition:**

- **If**

$$\frac{MU_X}{P_X} = \frac{MU_Y}{P_Y}$$

$$\frac{MU_X}{P_X} > \frac{MU_Y}{P_Y}$$

$\Rightarrow$ spend more on good X and less of Y

The Ordinal Approach

Economists following the lead of Hicks, Slutsky and Pareto believe that utility is measurable in an ordinal sense—

the utility derived from consuming a good, such as X, is a function of the quantities of X and Y consumed by a consumer.

$$U = f(X, Y)$$

Ordinal Utility Theory (TUO)

- –Can be measured in qualitative, not quantitative, but only lists the main options (indifference curves & budget line).

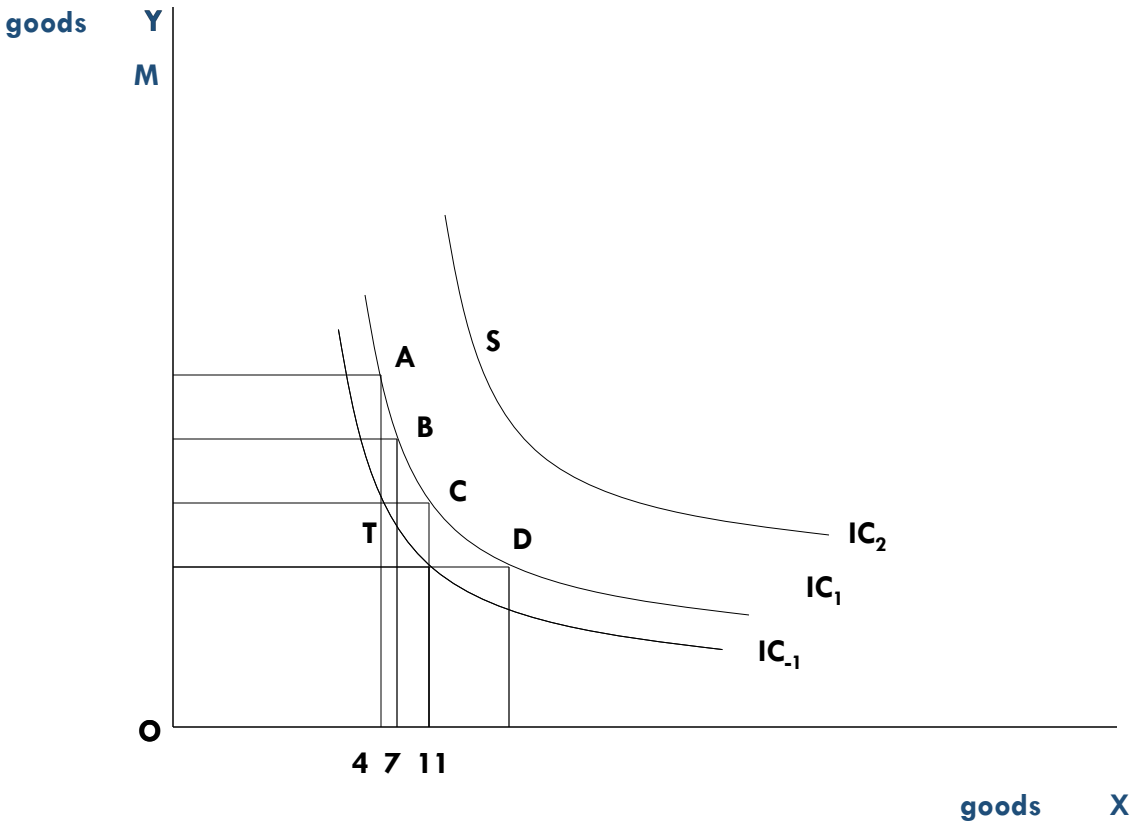
Rational human beings will choose to maximize the utility by selecting the highest utility

Different consumers, difference utilities.

INDIFFERENCE CURVE (IC)

- Curve where the points represent a combination of items when the consumer at indifference situation (satisfaction).
- Axes: both axes refer to the quantity of goods
- For the combination that produces a higher level of satisfaction, the curves shift to the right (IC_2) from the first curve (IC_1)
- In contrast, the curves shift to the left ($IC\text{-}_1$)

INDIFFERENCE CURVE



PROPERTIES OF INDIFFERENCE CURVE

- Downward sloping from left to right: This shows an increase in quantity of certain good.
- Convex to the origin: the marginal rate of substitution (MRS) decreased
  - MRS = quantity of goods Y willing to substitute to obtain one unit of goods X & this substitution is to maintain its position at the same level of satisfaction
- Do not cross (intersect): consumer preferences transitive
  - Eg : Quantities X and Y for the combination of A> a combination of B; $\Rightarrow$ utility A> B *

When cross = C, so the utility A = C & B = C; $\Rightarrow$ utility A = B = C. This is not transitive as above *

- Different ICs show different level of satisfaction. Far from the origin, the higher the satisfaction.

Markets and Competition

Market

- A group of buyers and sellers of a particular good or service

Buyers

- Determine the demand for the product

Sellers

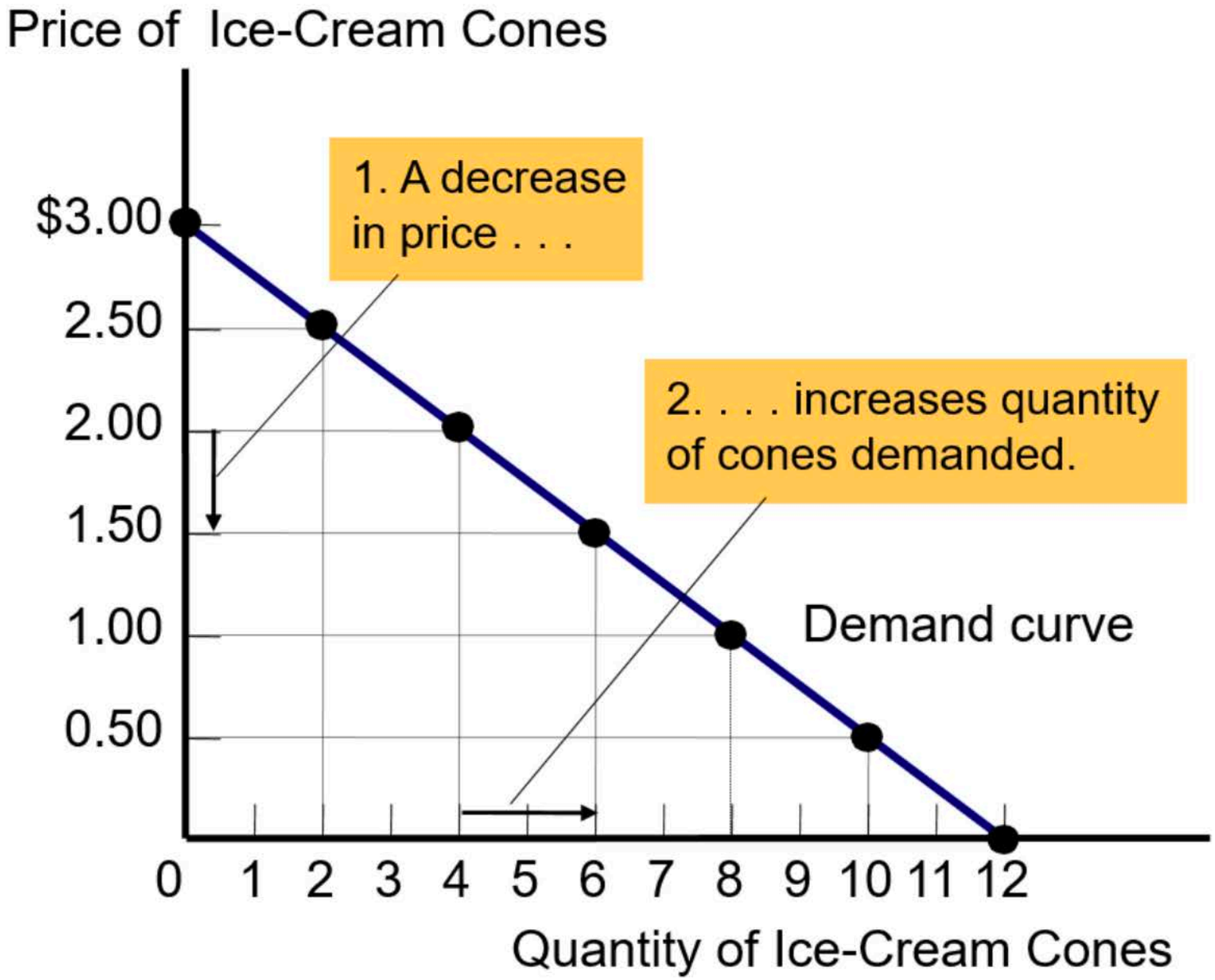
- Determine the supply of the product

Demand

- Quantity demanded
  - Amount of a good that buyers are willing and able to purchase
- Law of demand
  - Other things equal, when the price of the good rises, Quantity demanded of a good falls
- Demand schedule - a table
  - Relationship between the price of a good and quantity demanded
- Demand curve - a graph
  - Relationship between the price of a good and quantity demanded
- Individual demand
  - Demand of one individual

Demand Schedule and Demand Curve

Price of Ice-Cream Cone	Quantity of Cones Demanded
$0.00	12 cones
0.50	10
1.00	8
1.50	6
2.00	4
2.50	2
3.00	0



The demand schedule is a table that shows the quantity demanded at each price. The demand curve, which graphs the demand schedule, illustrates how the quantity demanded of the good changes as its price varies. Because a lower price increases the quantity demanded, the demand curve slopes downward.

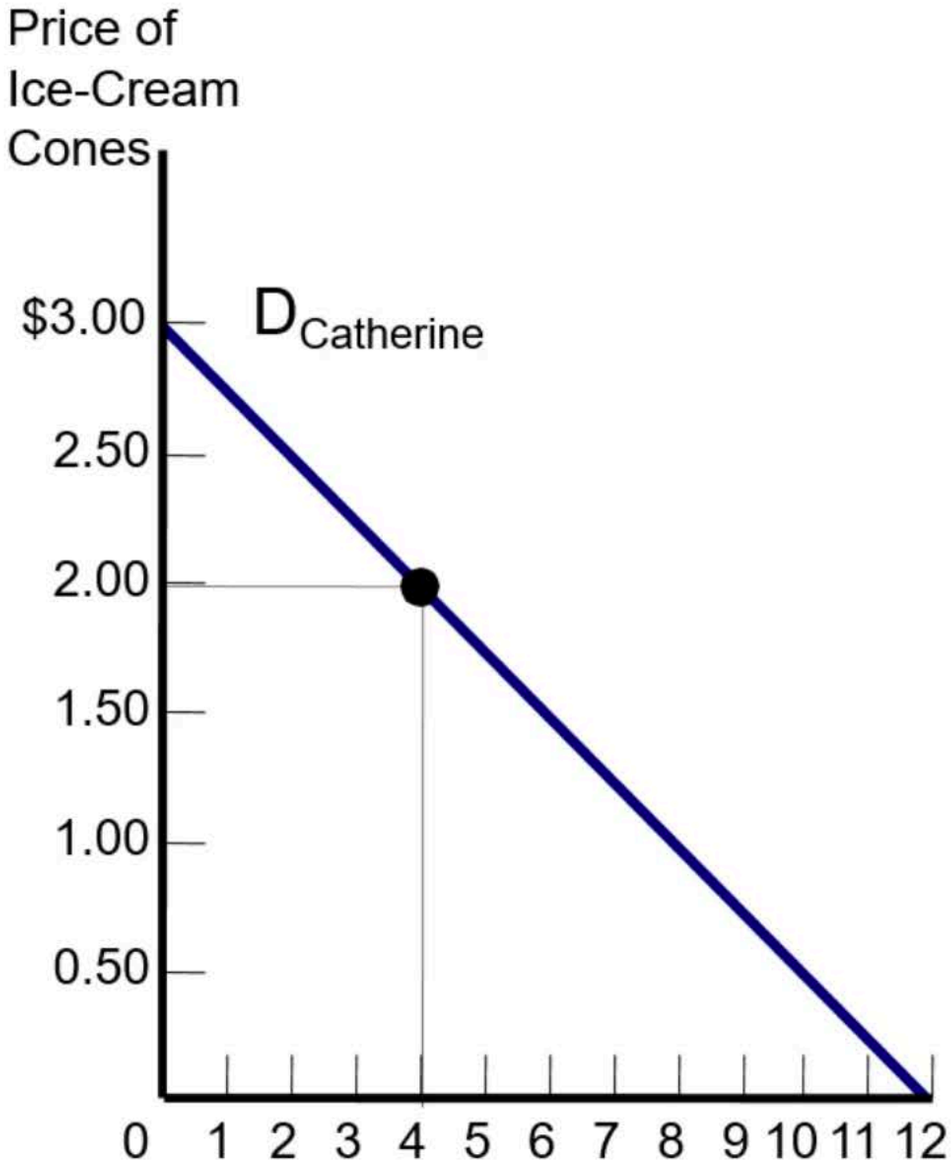
Demand

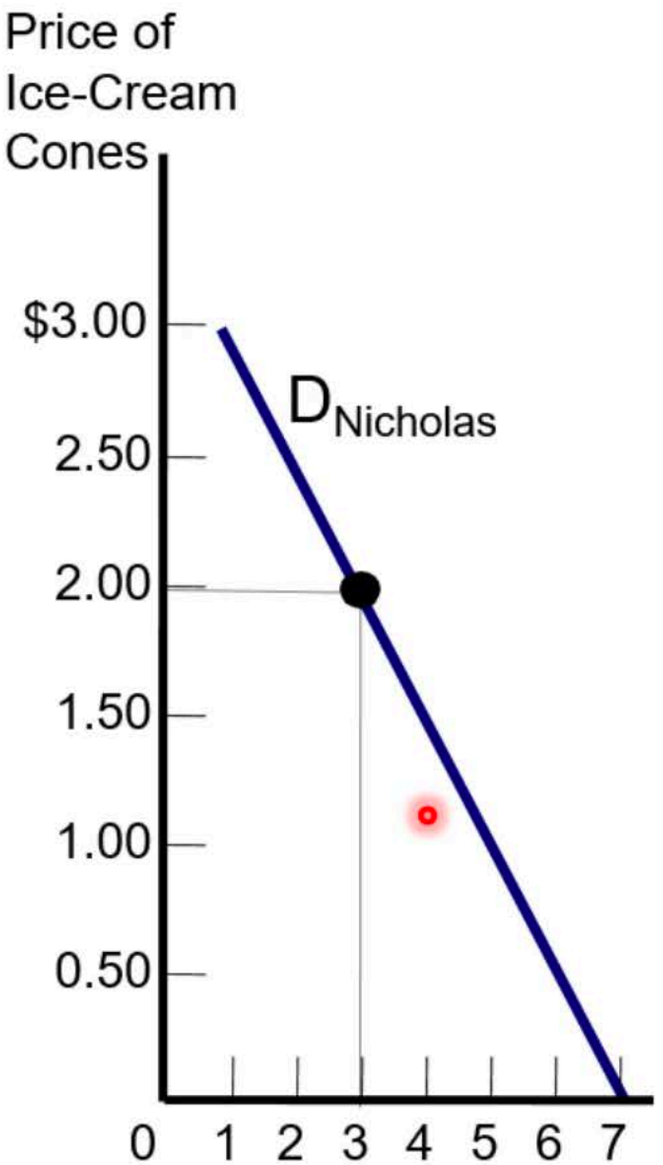
- Market demand curve
  - Sum the individual demand curves horizontally

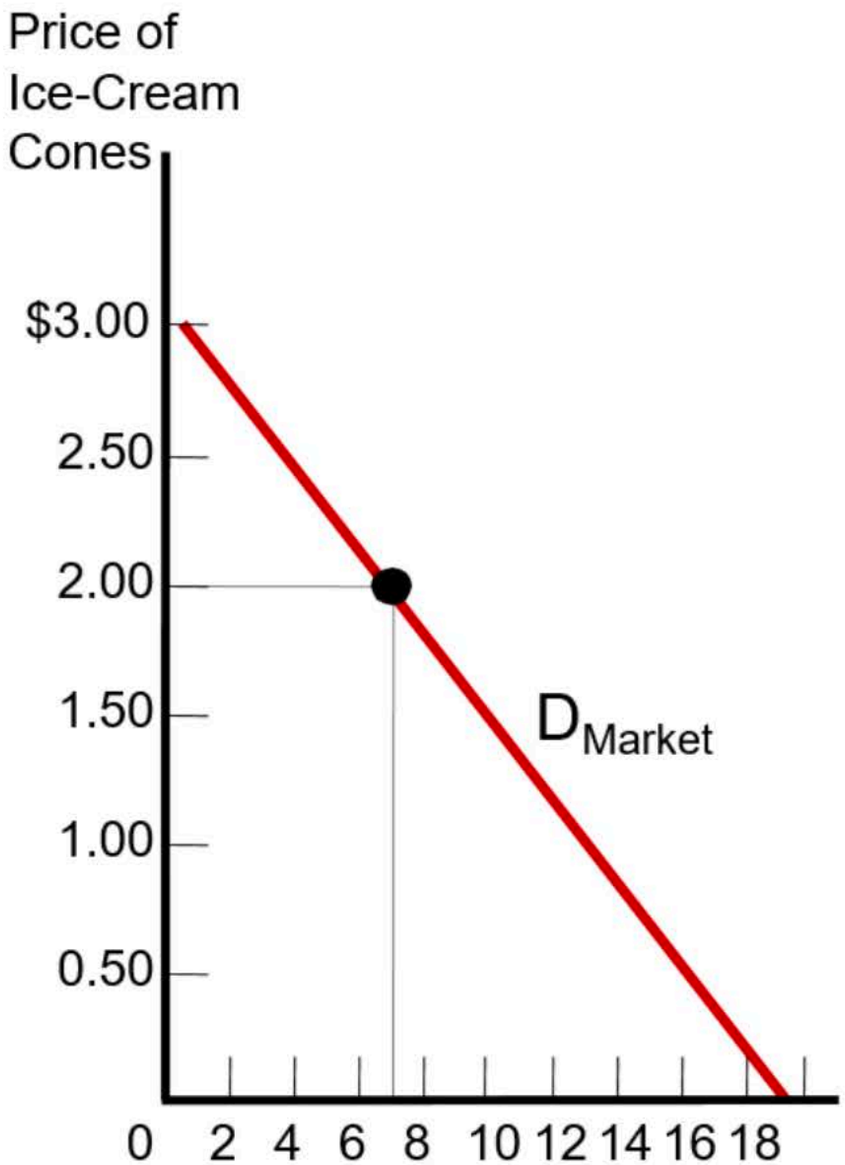
  - Total quantity demanded of a good varies
    - As the price of the good varies
    - Other things constant

Market Demand as the Sum of Individual Demands

Catherine's demand + Nicholas's demand = Market demand







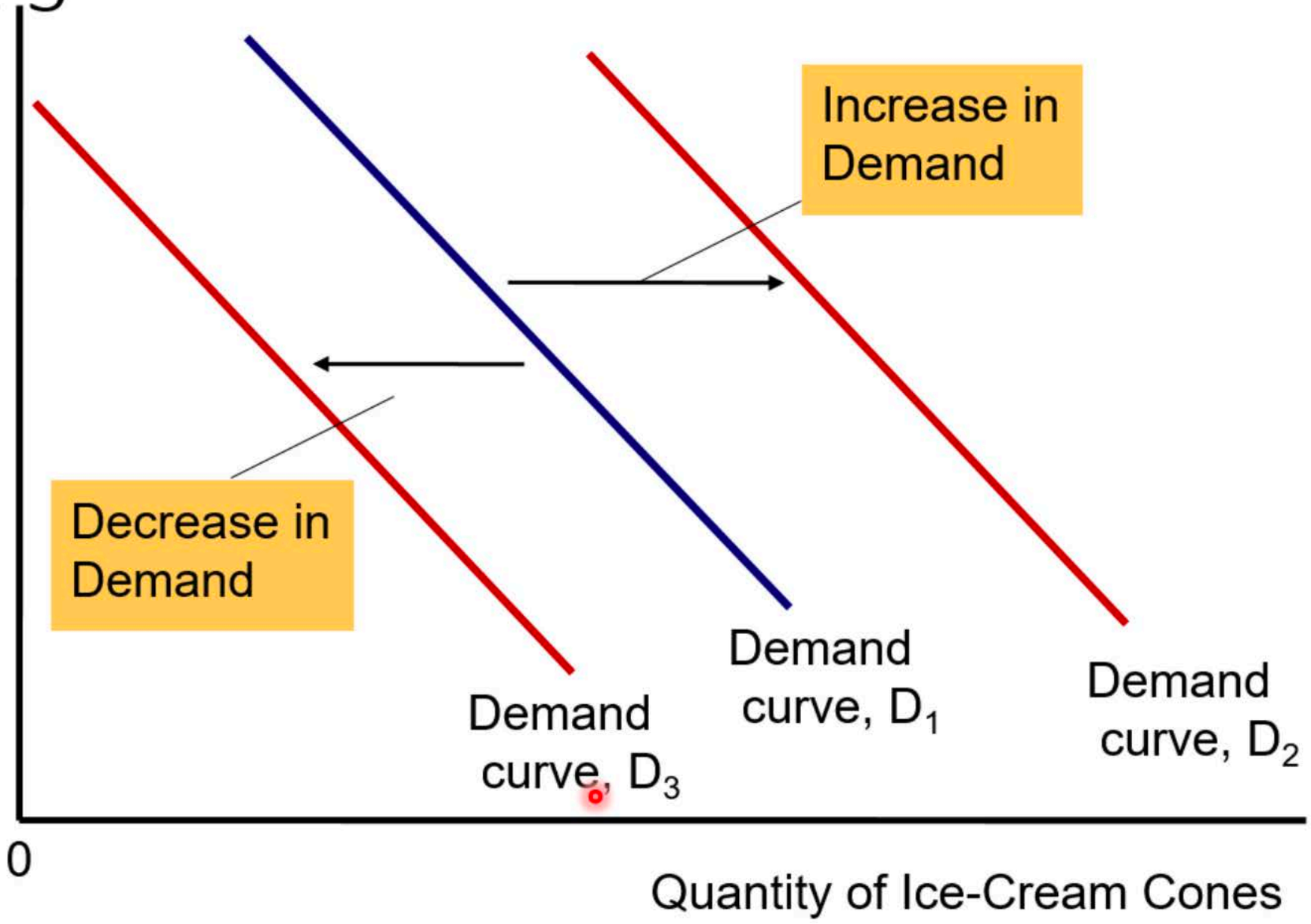
Demand

Shifts in the demand curve

- Increase in demand
  - Any change that increases the quantity demanded at every price
  - Demand curve shifts right
- Decrease in demand
  - Any change that decreases the quantity demanded at every price
  - Demand curve shifts left

Shifts in the Demand Curve

Figure 3



Any change that raises the quantity that buyers wish to purchase at any given price shifts the demand curve to the right. Any change that lowers the quantity that buyers wish to purchase at any given price shifts the demand curve to the left.

Demand

- Variables that can shift the demand curve
  - Income
  - Prices of related goods
  - Tastes
  - Expectations
  - Number of buyers

Demand

- Income
  - Normal good
    - Other things constant
    - An increase in income leads to an increase in demand
  - Inferior good
    - Other things constant
    - An increase in income leads to a decrease in demand

- Prices of related goods
  - Substitutes - two goods
    - An increase in the price of one
    - Leads to an increase in the demand for the other
  - Complements – two goods
    - An increase in the price of one
    - Leads to a decrease in the demand for the other

Demand

Tastes

- Change in tastes – changes the demand

Expectations about the future

- Expect an increase in income
  - Increase in current demand
- Expect higher prices
  - Increase in current demand

Number of buyers – increase

- Market demand - increases

Variables That Influence Buyers

Table 1

Variable	A Change in This Variable . . .
Price of the good itself	Represents a movement along the demand curve
Income	Shifts the demand curve
Prices of related goods	Shifts the demand curve
Tastes	Shifts the demand curve
Expectations	Shifts the demand curve
Number of buyers	Shifts the demand curve

This table lists the variables that affect how much consumers choose to buy of any good. Notice the special role that the price of the good plays: A change in the good's price represents a movement along the demand curve, whereas a change in one of the other variables shifts the demand curve.

Supply and Demand Together

Equilibrium - a situation

- Supply and demand forces are in balance

- A situation in which market price has reached the level where
  - Quantity supplied = quantity demanded
- Supply and demand curves intersect

Supply and Demand Together

Equilibrium price

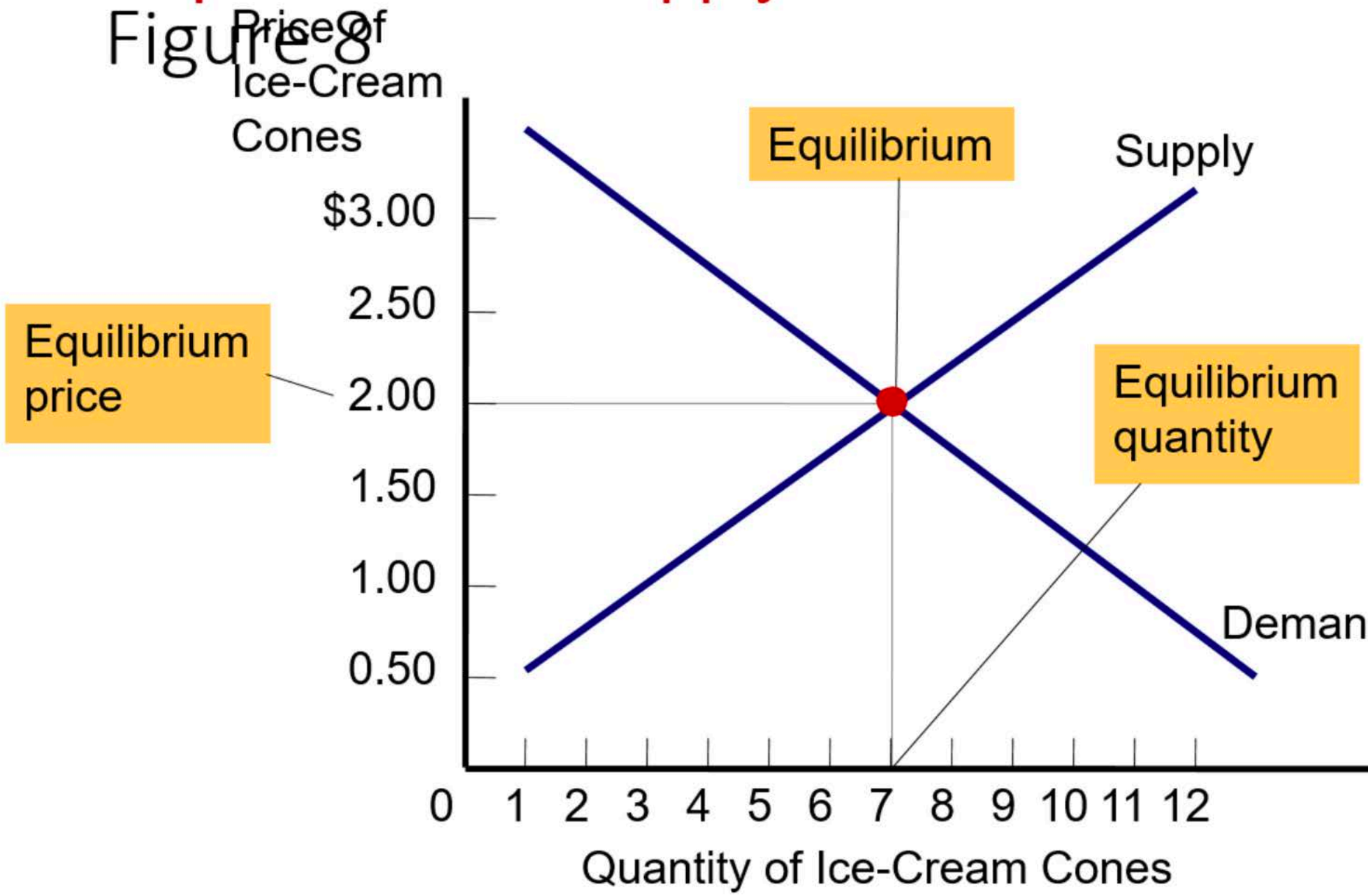
- Balances quantity supplied and quantity demanded
- Market-clearing price

Equilibrium quantity

- Quantity supplied and quantity demanded at the equilibrium price

The Equilibrium of Supply and Demand

Figure 8



The equilibrium is found where the supply and demand curves intersect. At the equilibrium price, the quantity supplied equals the quantity demanded. Here the equilibrium price is $2.00: At this price, 7 ice-cream cones are supplied, and 7 ice-cream cones are demanded.

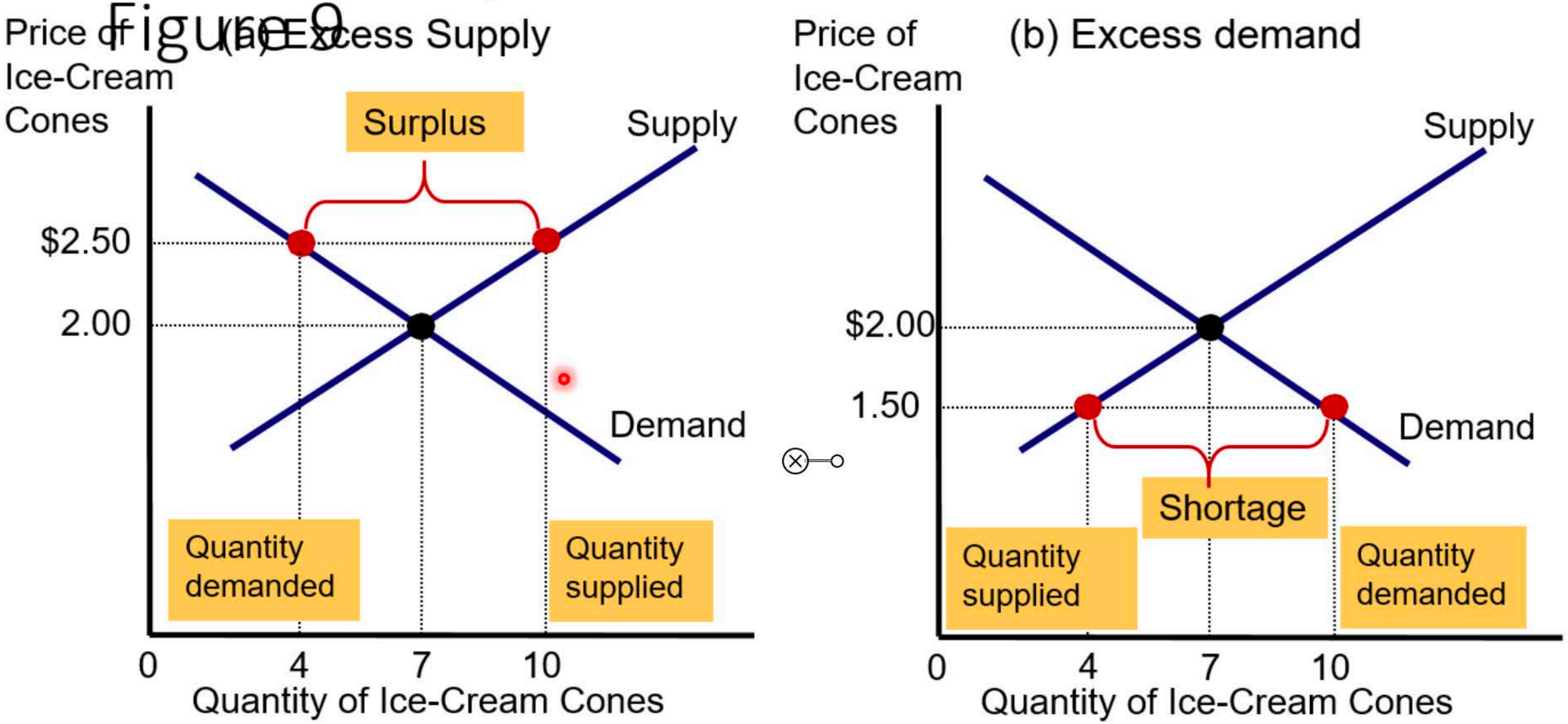
Supply and Demand Together

- Surplus
  - Quantity supplied > quantity demanded
  - Excess supply (surplus)
  - Downward pressure on price
    - Movements along the demand and supply curves
    - Increase in quantity demanded
    - Decrease in quantity supplied

- Shortage
  - Quantity demanded > quantity supplied
  - Excess demand (shortage)
  - Upward pressure on price
    - Movements along the demand and supply curves
    - Decrease in quantity demanded
    - Increase in quantity supplied

Markets Not in Equilibrium

Figure 9



In panel (a), there is a surplus. Because the market price of $2.50 is above the equilibrium price, the quantity supplied (10 cones) exceeds the quantity demanded (4 cones). Suppliers try to increase sales by cutting the price of a cone, and this moves the price toward its equilibrium level. In panel (b), there is a shortage. Because the market price of $1.50 is below the equilibrium price, the quantity demanded (10 cones) exceeds the quantity supplied (4 cones). With too many buyers chasing too few goods, suppliers can take advantage of the shortage by raising the price. Hence, in both cases, the price adjustment moves the market toward the equilibrium of supply and demand

Supply and Demand Together

- Law of supply and demand
  - The price of any good adjusts
    - To bring the quantity supplied and the quantity demanded for that good into balance
  - In most markets
    - Surpluses and shortages are temporary

- Prices
  - Signals that guide the allocation of resources
  - Mechanism for rationing scarce resources
  - Determine who produces each good and how much is produced

Changes in Demand and Elasticities

- Price elasticity of demand
  - Percentage change in quantity demanded divided by the percentage change in price

- Elastic demand
  - Quantity demanded responds substantially to changes in price

- Inelastic demand
  - Quantity demanded responds only slightly to changes in price

The Elasticity of Demand

- Elasticity
  - Measure of the responsiveness of quantity demanded or quantity supplied
  - To a change in one of its determinants

- Price elasticity of demand
  - How much the quantity demanded of a good
  - Responds to a change in the price of that good

- Determinants of price elasticity of demand
  - Availability of close substitutes
    - Goods with close substitutes – more elastic demand
  - Necessities vs. luxuries
    - Necessities – inelastic demand
    - Luxuries – elastic demand

Computing the price elasticity of demand

- Percentage change in quantity demanded divided by percentage change in price
- Use absolute value (drop the minus sign)

Variety of demand curves

- Demand is elastic
  - Price elasticity of demand > 1
- Demand is inelastic
  - Price elasticity of demand < 1
- Demand has unit elasticity
  - Price elasticity of demand = 1

Variety of demand curves

- Demand is perfectly inelastic
  - Price elasticity of demand = 0
  - Demand curve is vertical
- Demand is perfectly elastic
  - Price elasticity of demand = infinity
  - Demand curve is horizontal

The flatter the demand curve

- The greater the price elasticity of demand
- But elasticity is NOT just the slope, but also the position on the curve

Computing the price elasticity of demand

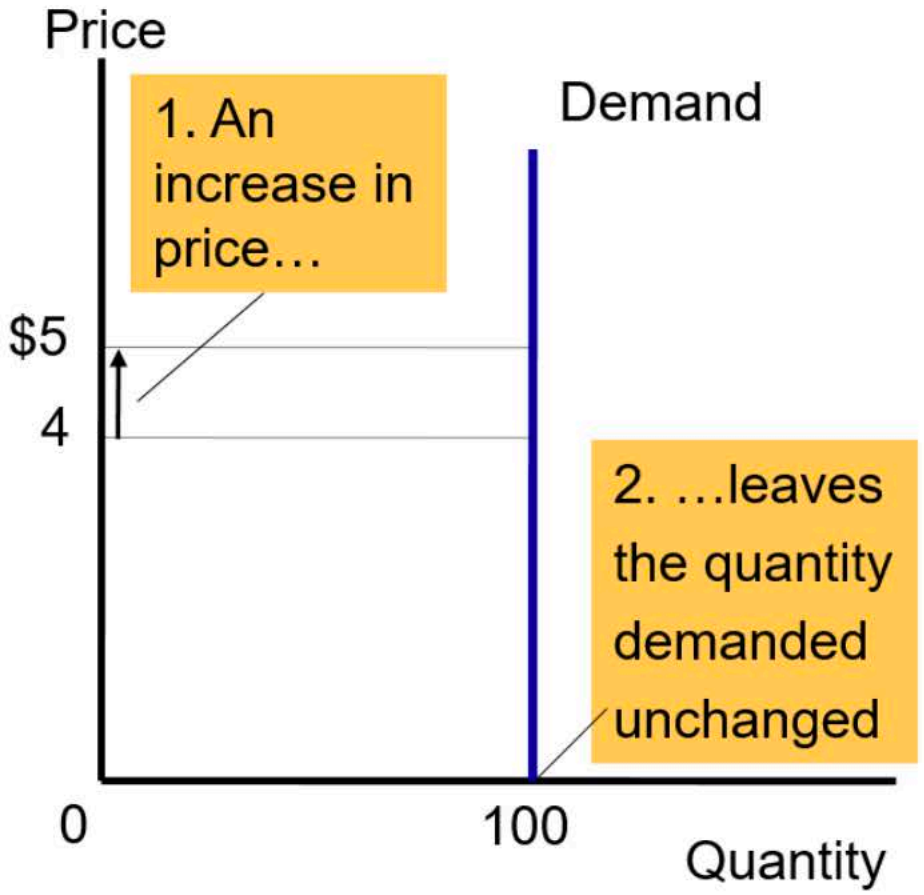
- Percentage change in quantity demanded divided by percentage change in price
- Use absolute value (drop the minus sign)

Variety of demand curves

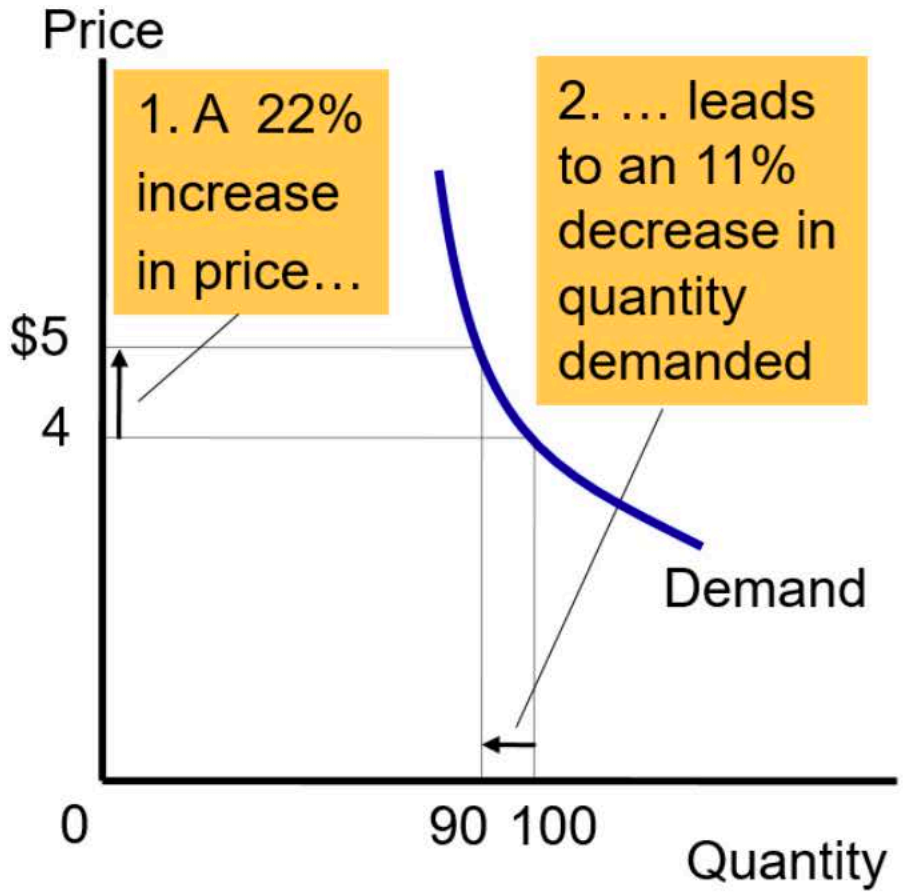
- Demand is elastic
  - Price elasticity of demand > 1
- Demand is inelastic
  - Price elasticity of demand < 1
- Demand has unit elasticity
  - Price elasticity of demand = 1

The Price Elasticity of Demand (a, b)

(a) Perfectly Inelastic Demand: Elasticity Equals 0

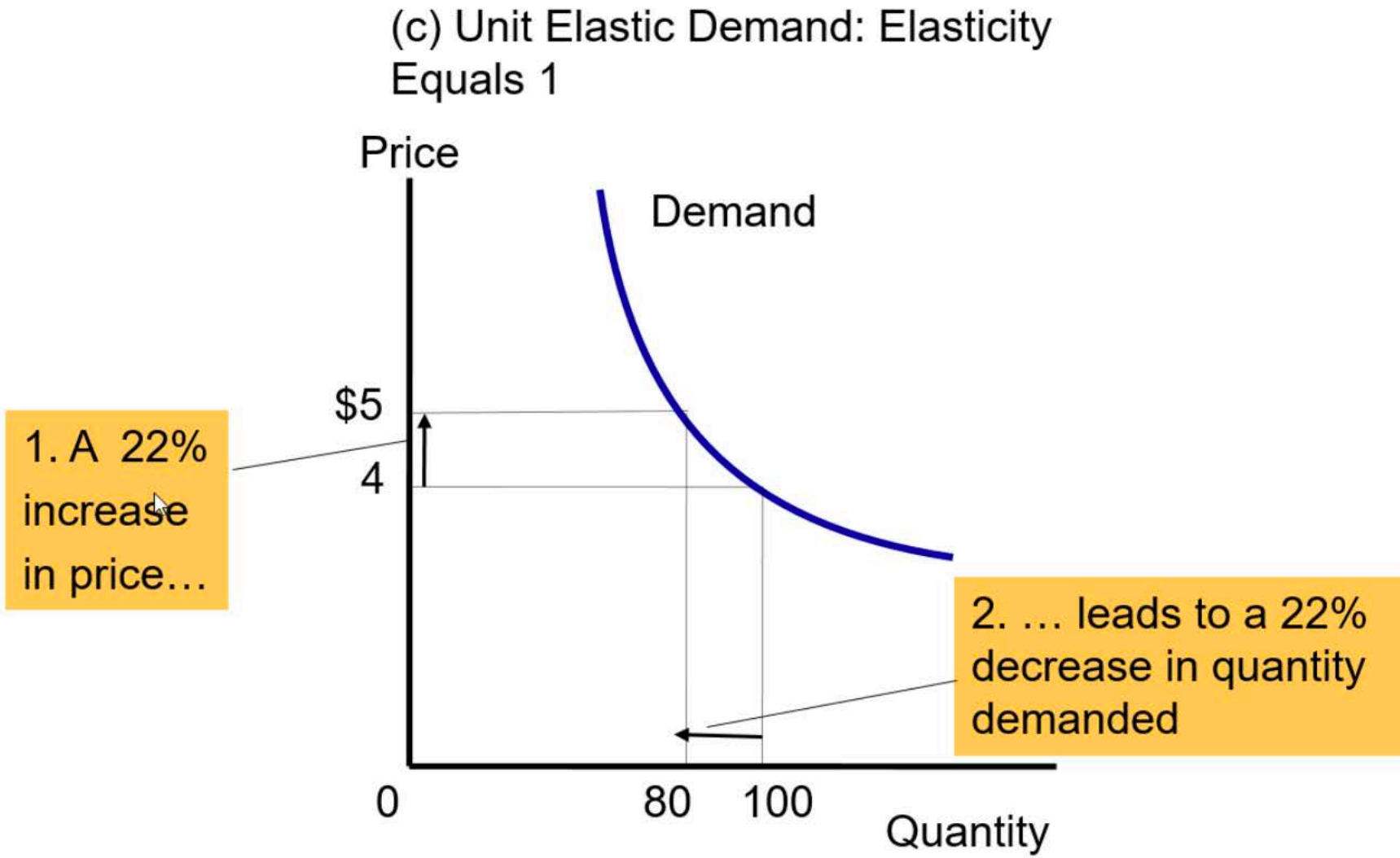


(b) Inelastic Demand: Elasticity Is Less Than 1



The price elasticity of demand determines whether the demand curve is steep or flat. Note that all percentage changes are calculated using the midpoint method.

The Price Elasticity of Demand (c)



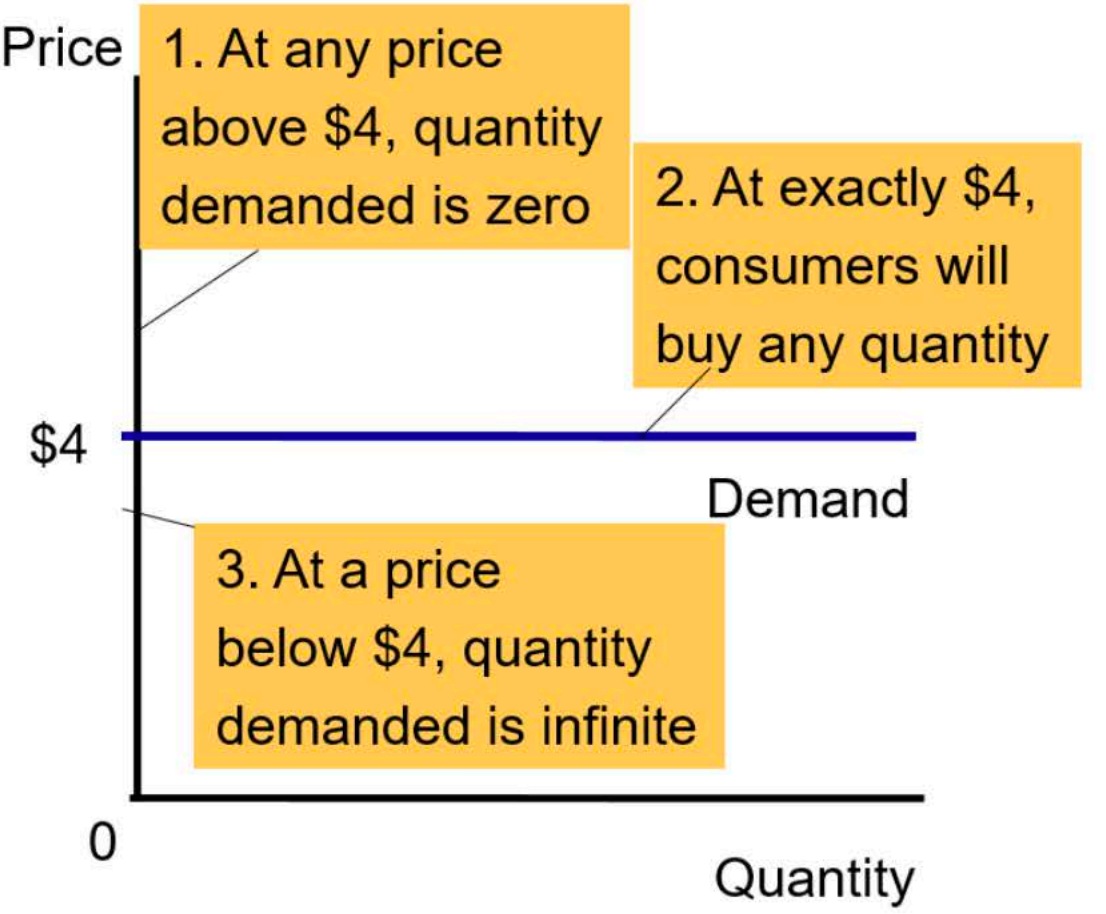
The price elasticity of demand determines whether the demand curve is steep or flat.

Note that all percentage changes are calculated using the midpoint method.

The Price Elasticity of Demand (d, e)

(d) Elastic demand:
Elasticity > 1

(e) Perfectly elastic demand:
Elasticity equals infinity



The price elasticity of demand determines whether the demand curve is steep or flat.
Note that all percentage changes are calculated using the midpoint method.

Income Elasticity of Demand

Income elasticity of demand

- How much the quantity demanded of a good responds to a change in consumers' income
- Percentage change in quantity demanded
  - Divided by the percentage change in income

Income Elasticity of Demand

Normal goods

- Positive income elasticity
- Necessities
  - Smaller income elasticities
- Luxuries
  - Large income elasticities

Inferior goods

- Negative income elasticities

Cross-Price Elasticity of Demand

Cross-price elasticity of demand

- How much the quantity demanded of one good responds to a change in the price of another good

- Percentage change in quantity demanded of the first good
  - Divided by the percentage change in price of the second good

The Elasticity of Demand

Substitutes

- Goods typically used in place of one another
- Positive cross-price elasticity

Complements

- Goods that are typically used together
- Negative cross-price elasticity

The Elasticity of Supply

Price elasticity of supply

- How much the quantity supplied of a good responds to a change in the price of that good
- Percentage change in quantity supplied
  - Divided by the percentage change in price
- Depends on the flexibility of sellers to change the amount of the good they produce

The Elasticity of Supply

Elastic supply

- Quantity supplied responds substantially to changes in the price

Inelastic supply

- Quantity supplied responds only slightly to changes in the price

Determinant of price elasticity of supply

- Time period
  - Supply is more elastic in long run

The Elasticity of Supply

Computing price elasticity of supply

- Percentage change in quantity supplied divided by percentage change in price
- Always positive

Variety of supply curves

- Supply is unit elastic
  - Price elasticity of supply = 1
- Supply is elastic
  - Price elasticity of supply > 1
- Supply is inelastic
  - Price elasticity of supply < 1

Income and Substitution Effects of a Price Change

- Income effect – a change in a consumer's real purchasing power brought about by a change in the price of a good

- Substitution effect – an incentive to increase consumption of a good whose price falls, at the expense of other, now relatively more expensive, goods

Price and Income Elasticities of Demand

Income elasticity measures **shifts** in the demand curve

Price elasticity measures **movements** along the curve

Normal and Inferior Goods

Normal goods have a **positive** income elasticity

Inferior goods have a **negative** income elasticity

Necessities and Luxuries

Necessities typically have an income elasticity between 0 and 1

Luxuries typically have an income elasticity greater than 1

Elasticities of Demand

Price elasticity measures **movements** along the curve

Income elasticity measures **shifts** in the demand curve

Cross-price elasticity measures **shifts** in the demand curve

Substitutes and Complements

Goods are said to be substitutes if $\varepsilon_{ij} > 0$

Demand goes up as other price goes up

Goods are said to be complements if $\varepsilon_{ij} < 0$

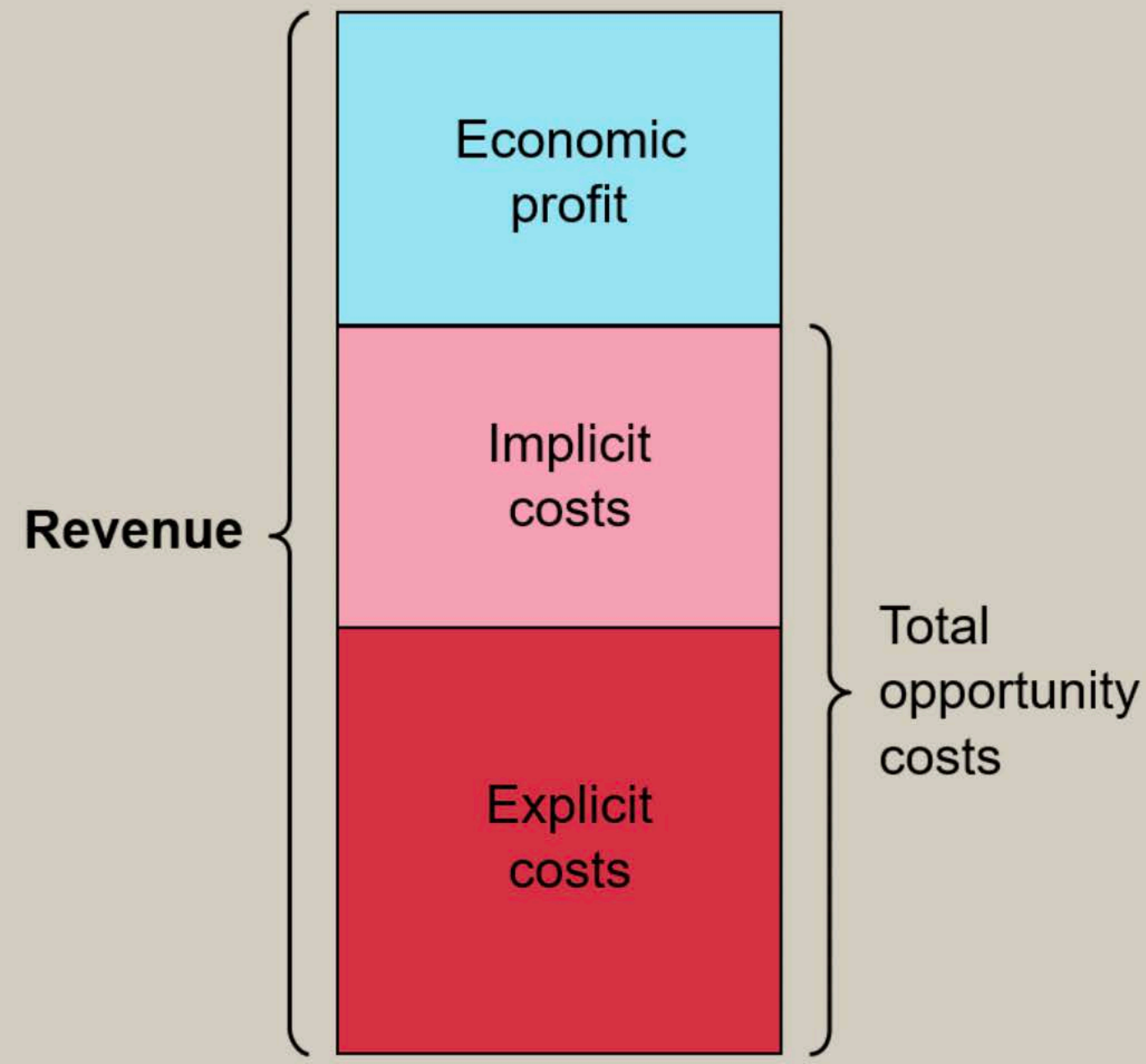
Demand goes down as other price goes up

Goods are said to be close substitutes if $\varepsilon_{ij} >> 0$

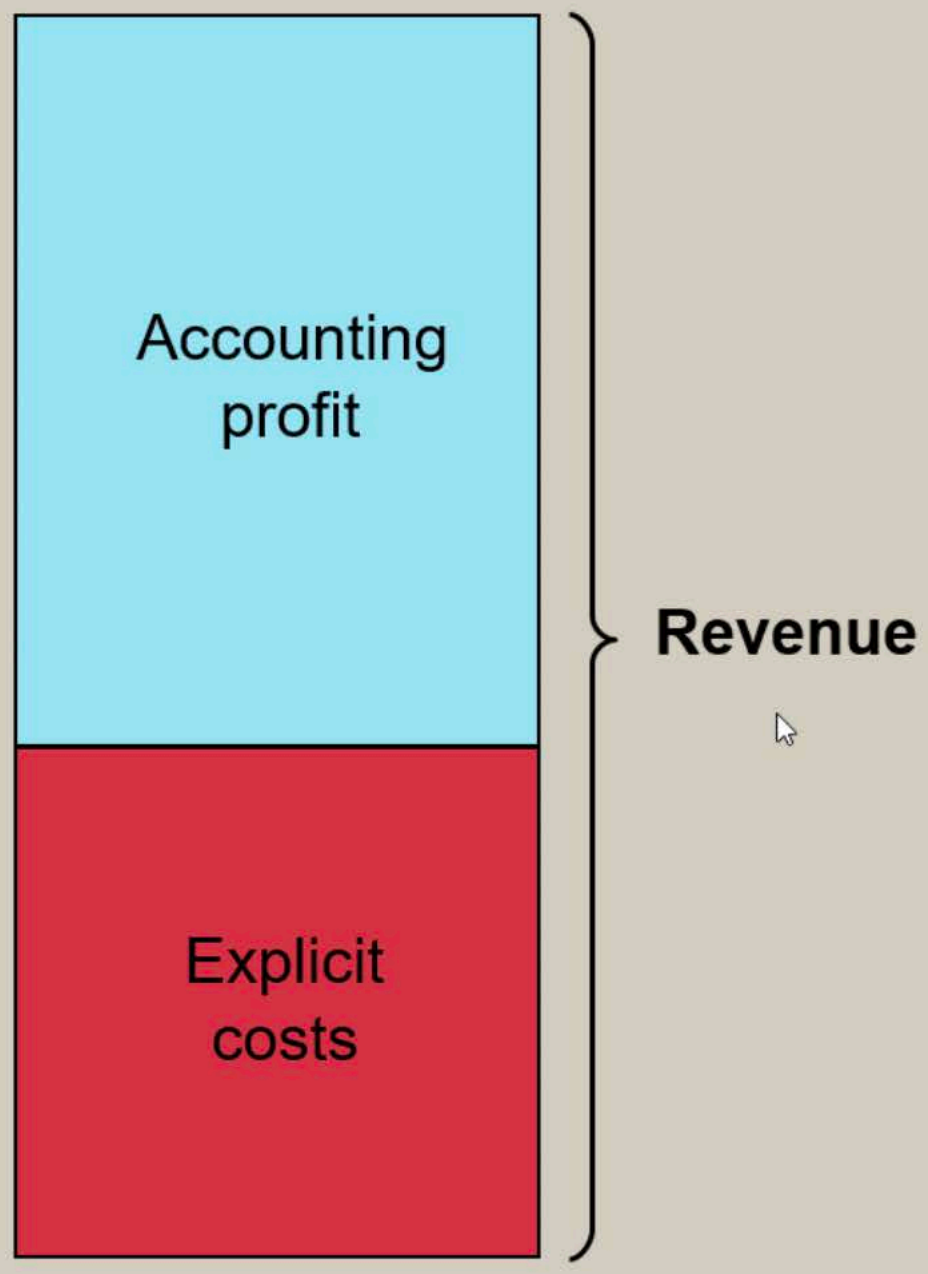
The Costs of Production

Economic versus Accounting concepts

How an Economist Views a Firm



How an Accountant Views a Firm



Types of costs

- Opportunity cost and actual cost
- Direct and indirect cost
- Explicit and implicit cost
- Historical and replacement cost
- Fixed cost and variable cost
- Real and prime cost
- Total,average,and marginal cost

Opportunity cost and actual cost

Opportunity cost : Cost incurred for loosing next best alternative

Actual cost : An actual amount paid or incurred, as opposed to estimated cost or standard cost.

Explicit and implicit cost

Explicit cost refers to the money expended to buy or hire resources from outside the organization for the process of production

Implicit cost refers to the cost of use of the self owned resources of organization that are used in production

Direct and Indirect cost

Direct cost is a cost.

Direct Cost: Direct costs are those cost that have directly accountable to specific cost object such as a process or product

Ex:wages paid ,salary paid labor, material...etc

Indirect cost:

Indirect cost are those costs which are not directly accountable to specific cost object or not directly related to production

Ex: insurance, mentainence ,telecom, ...etc

Historical and replacement cost

Historical cost refers to the original (actual) cost incurred at the time the asset was acquired

The **replacement cost** is the price that an entity would pay to replace an existing assets at current market price that may not be market value of that asset.

Fixed and variable cost

Fixed cost is the cost that remains unchanged irrespective of the output level or sales revenue such as intrest,rent,salaries etc

Variable cost are thoese costs that vary depending on a company's production volume; they raise as production increases and fall as production decreases

Real cost and Prime cost

Real cost of a production refers to the physical quantities of various factors used in producing commodity

Ex: Real cost of a table composes of a carpenter's labor to cubic feet of a wood ,a dozen of nails, half a bottle of varnish.....etc

" *Real cost thus signifies the aggregate of real productive resources absorbed in the production*"

Prime cost

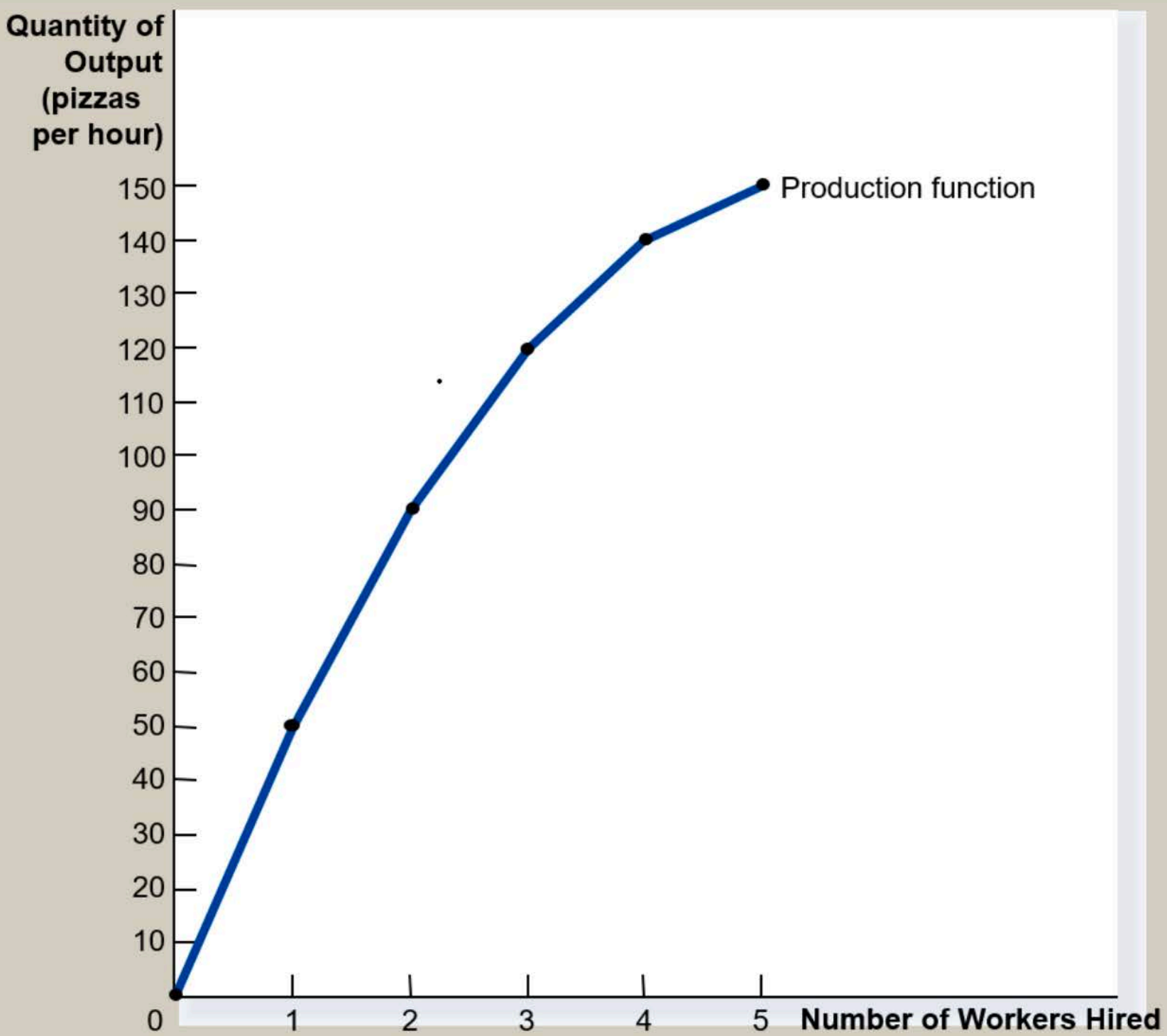
The direct cost of commodity in terms of the materials and labor involved in its production excluding fixed cost

By calculating prime cost the firm can decide how much should be their selling price to earn profit

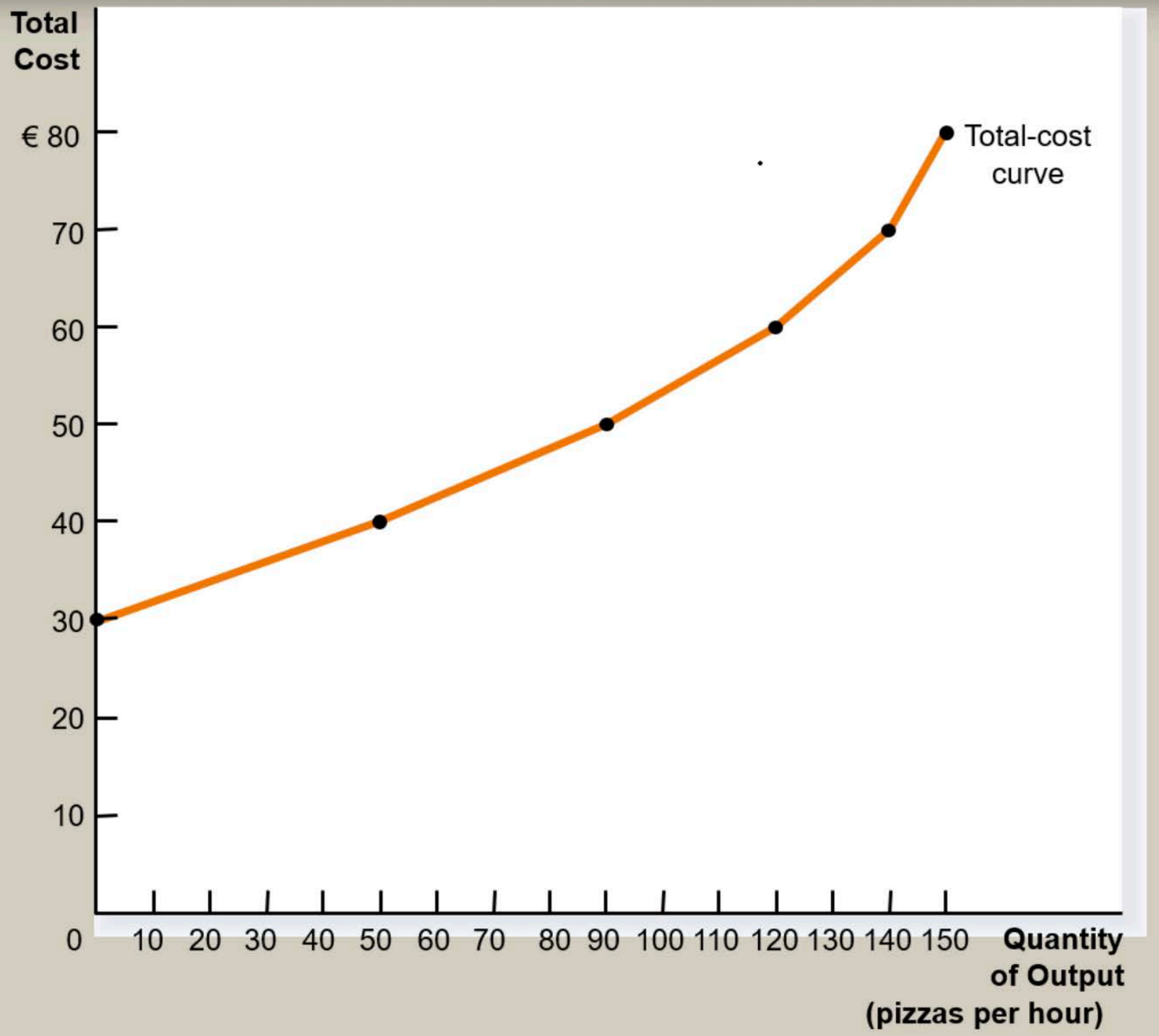
A Production Function and Total Cost: A Pizza Factory

Number of workers	Output (quantity of pizzas produced per hour)	Marginal product of labour	Cost of factory	Cost of workers	Total cost of inputs (cost of factory + cost of workers)
0	0		€30	€0	€30
		50			
1	50		30	10	40
		40			
2	90		30	20	50
		30			
3	120		30	30	60
		20			
4	140		30	40	70
		10			
5	150		30	50	80

Production Function



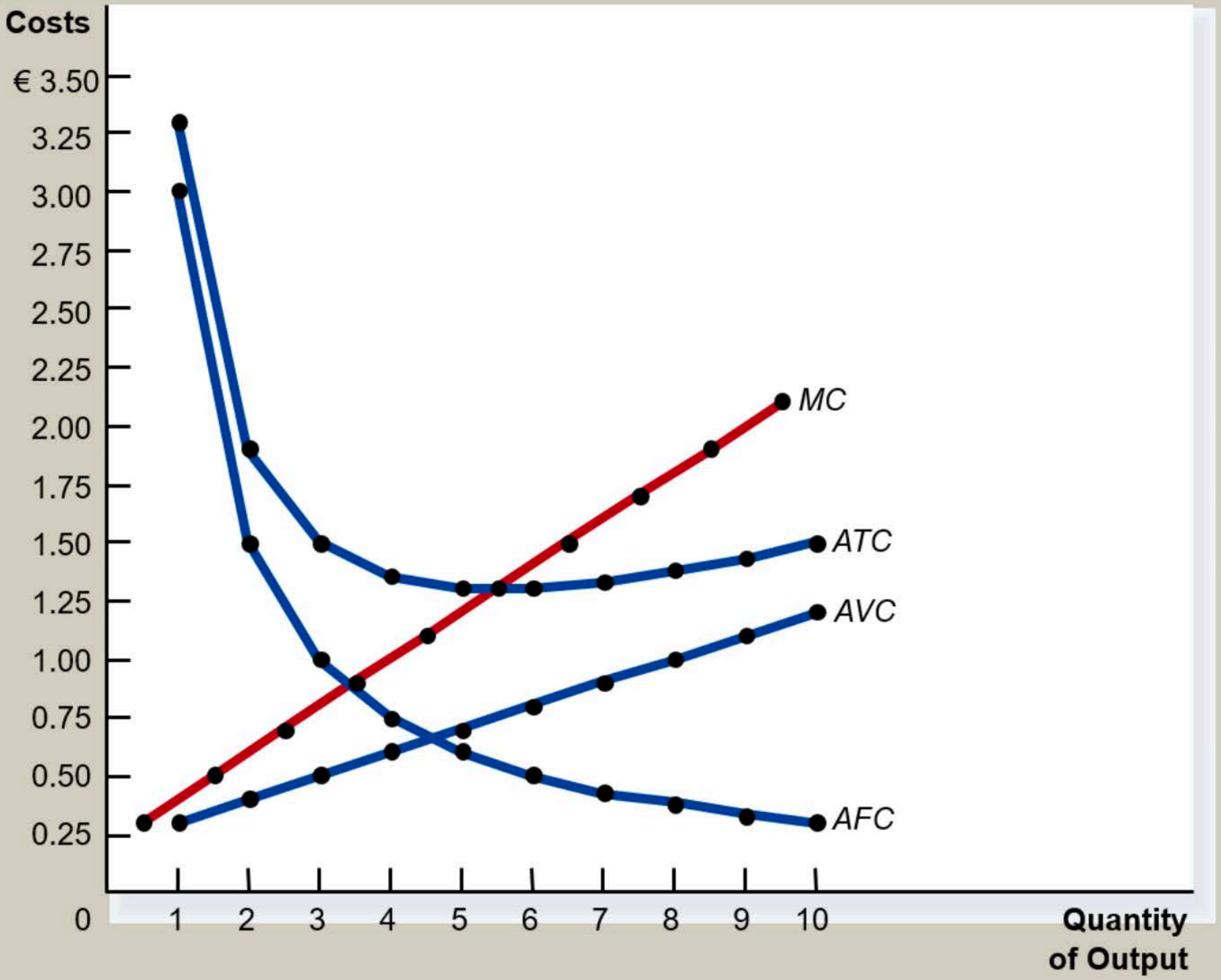
Total Cost Curve



The Various Measures of Cost: Lemonade Shop

Quantity of lemonade glasses (per hour)	Total cost	Fixed cost	Variable cost	Average fixed cost	Average variable cost	Average total cost	Marginal cost
0	€3.00	€3.00	€0.00	–	–	–	€0.30
1	3.30	3.00	0.30	€3.00	€0.30	€3.30	0.50
2	3.80	3.00	0.80	1.50	0.40	1.90	0.70
3	4.50	3.00	1.50	1.00	0.50	1.50	0.90
4	5.40	3.00	2.40	0.75	0.60	1.35	1.10
5	6.50	3.00	3.50	0.60	0.70	1.30	1.30
6	7.80	3.00	4.80	0.50	0.80	1.30	1.50
7	9.30	3.00	6.30	0.43	0.90	1.33	1.70
8	11.00	3.00	8.00	0.38	1.00	1.38	1.90
9	12.90	3.00	9.90	0.33	1.10	1.43	2.10
10	15.00	3.00	12.00	0.30	1.20	1.50	

Average Cost and Marginal Cost Curves



Average Cost and Marginal Cost Curves

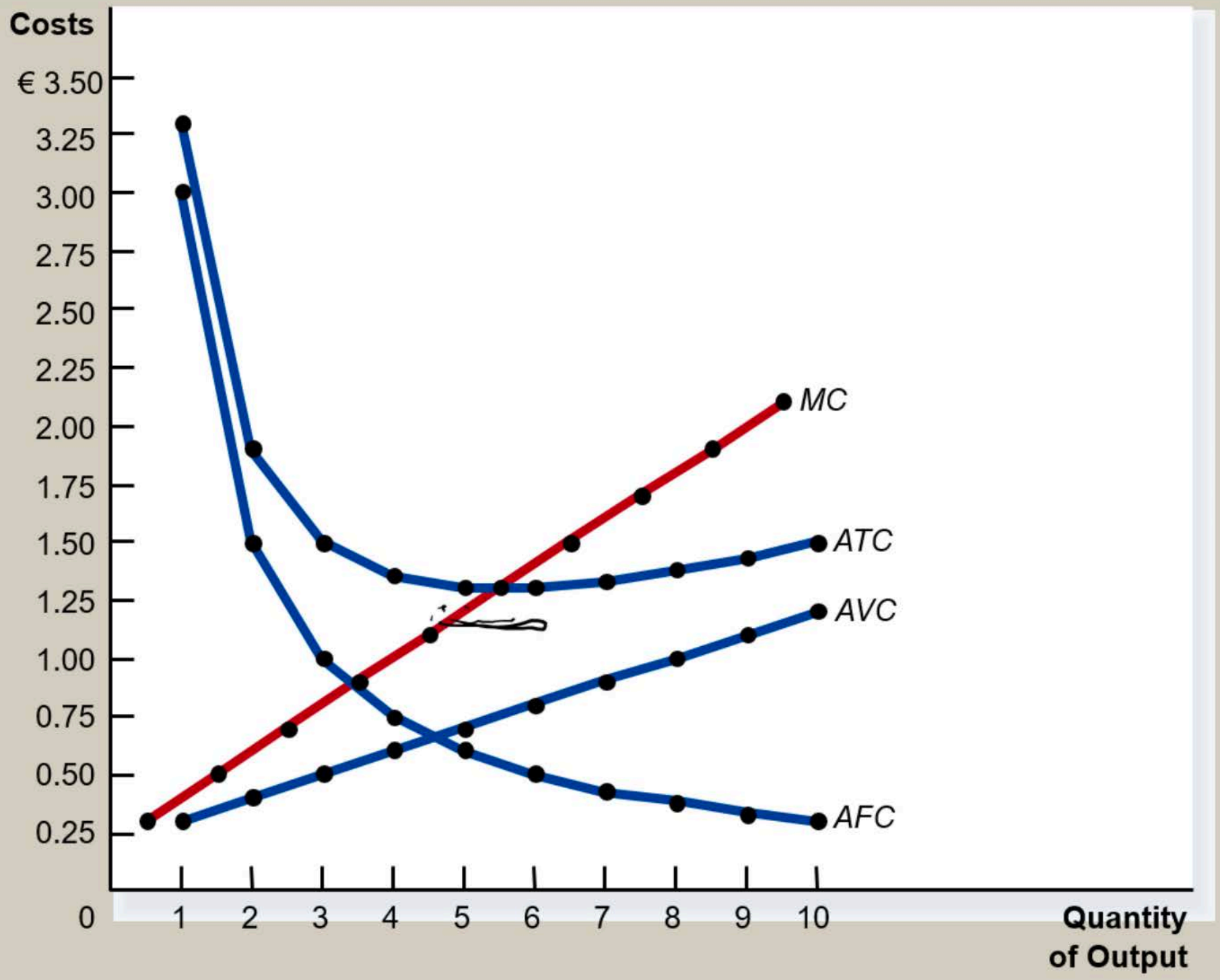
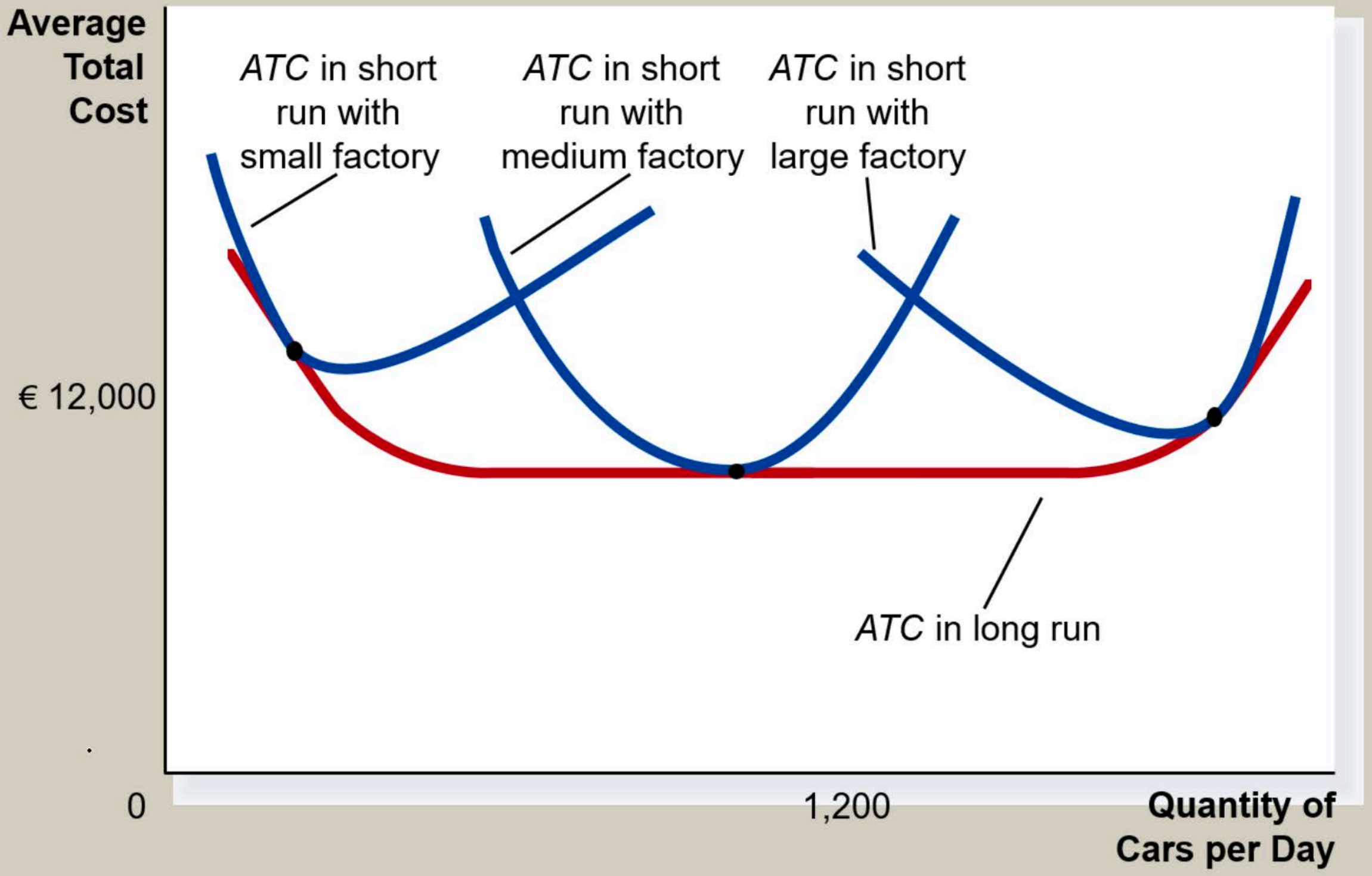


Figure 7 Average Total Cost in the Short and Long Run



Key questions

- Make or Buy decisions – If making, how much to make?

- Pricing decisions

- Given cost and technology, producer can decide quantity and/or price depending the extent of market competition

- In competitive markets, only quantity can be controlled.

- Price competition becomes different in the presence of multiple competitors, so other instruments of competition are used.

Financials of 14 cement companies (Unit % change)

	Q2-FY21		y-o-y	
	q-o-q	y-o-y	H1-FY20	H1-FY21
Net Sales	27.2%	3.9%	7.0%	-12.1%
Total Expenditure	27.6%	-3.7%	1.5%	-15.8%
Cost of Services & Raw Materials	43.6%	-3.1%	-1.5%	-25.3%
Electricity Power & Fuel Cost	35.9%	-10.2%	-3.2%	-22.9%
Selling & Distribution Expenses	36.8%	3.6%	-2.1%	-11.1%
Operating Profit	16.7%	32.1%	36.9%	2.5%
Profit after tax	46.3%	73.3%	103.0%	-1.4%

	Q2-FY20	Q1-FY21	Q2-FY21	H1-FY20	H1-FY21
OPM (%)	19.4	26.8	24.6	22.0	25.6
NPM (%)	5.3	7.7	8.8	7.4	8.3
ICR (times)	3.7	4.8	6.1	4.6	5.4

Reference: ACE Equity, CARE Ratings

UltraTech Cement – Key operating parameters

Key Operating Parameters

	FY20				FY21						FY21	Var.
Per ton analysis (INR/ton)	**1Q**	**2Q**	**3Q**	**4Q**	**1Q**	**2Q**	**3QE**	**4QE**	**FY20**	**FY21E**	**1QE**	**Var (%)**
Volume (m ton)	21.42	18.69	20.90	21.44	14.65	20.06	23.88	25.80	82.33	84.28	22.86	4
YoY Change (%)	8.3	-1.0	-4.0	-15.7	-31.6	7.3	14.3	20.3	-3.9	2.4	9.4	
Realization (incl RMC)	**5,331**	**5,147**	**4,954**	**5,012**	**5,236**	**5,178**	**5,132**	**5,182**	**5,117**	**5,183**	**5,101**	1
YoY Change (%)	10.5	5.1	3.2	3.0	-1.8	0.6	3.6	3.4	5.3	1.3	3.0	
RM Cost	733	804	856	678	822	835	751	788	767	795	780	-4
Power & Fuel	1,094	1,052	976	988	942	920	1,006	1,077	1,029	996	991	1
Staff Cost	278	342	297	305	384	282	256	245	305	281	262	-3
Freight & Forwarding	1,211	1,143	1,121	1,249	1,097	1,146	1,193	1,202	1,181	1,168	1,156	3
Other Expenditure	639	781	697	653	572	649	630	601	692	616	640	-1
Total Expenditure	**3,954**	**4,121**	**3,946**	**3,874**	**3,818**	**3,833**	**3,836**	**3,914**	**3,973**	**3,856**	**3,829**	0
EBITDA	**1,377**	**1,026**	**1,008**	**1,138**	**1,418**	**1,345**	**1,296**	**1,269**	**1,143**	**1,327**	**1,272**	2

Reference: Motilal Oswal, January 2021

UltraTech – Profit & Loss

Y/E March	FY16	FY17	FY18	FY19	FY20	FY21E	FY22E	FY23E
Total Income from Operations	**251,532**	**253,749**	**309,786**	**416,088**	**421,248**	**436,812**	**497,871**	**547,805**
Change (%)	3.3	0.9	22.1	34.3	1.2	3.7	14.0	10.0
Raw Materials	44,175	44,926	52,888	69,831	63,131	66,971	71,959	79,387
Employees Cost	14,450	15,223	18,102	22,911	25,094	23,717	25,919	27,686
Other Expenses	143,898	141,476	177,344	249,877	239,167	234,307	277,067	299,889
Total Expenditure	**202,523**	**201,625**	**248,335**	**342,619**	**327,106**	**324,994**	**374,945**	**406,962**
% of Sales	80.5	79.5	80.2	82.3	77.7	74.4	75.3	74.3
EBITDA	**49,010**	**52,124**	**61,452**	**73,469**	**94,142**	**111,818**	**122,926**	**140,843**
Margin (%)	19.5	20.5	19.8	17.7	22.3	25.6	24.7	25.7
Depreciation	13,772	13,484	18,479	24,507	27,022	26,828	27,460	28,738
EBIT	**35,238**	**38,640**	**42,972**	**48,962**	**67,121**	**84,989**	**95,466**	**112,105**
Int. and Finance Charges	5,663	6,401	12,376	17,779	19,857	14,495	9,723	7,359
Other Income	4,638	6,481	5,886	4,634	6,478	8,542	8,551	11,365
PBT bef. EO Exp.	**34,213**	**38,721**	**36,482**	**35,818**	**53,742**	**79,036**	**94,294**	**116,111**
EO Items	0	0	-3,466	-1,139	19,788	-1,574	0	0
PBT after EO Exp.	**34,213**	**38,721**	**33,016**	**34,679**	**73,530**	**77,462**	**94,294**	**116,111**
Total Tax	9,417	11,586	10,770	10,681	15,413	23,991	29,178	35,920
Tax Rate (%)	27.5	29.9	32.6	30.8	21.0	31.0	30.9	30.9
Minority Interest	16	-14	24	-37	-32	5	5	5
Reported PAT	**24,780**	**27,149**	**22,222**	**24,035**	**58,148**	**53,466**	**65,111**	**80,186**
Adjusted PAT	**24,780**	**27,149**	**24,557**	**24,823**	**38,360**	**54,552**	**65,111**	**80,186**
Change (%)	18.1	9.6	-9.5	1.1	54.5	42.2	19.4	23.2
Margin (%)	9.9	10.7	7.9	6.0	9.1	12.5	13.1	14.6

Reference: Motilal Oswal, January 2021

UltraTech Cement – Trend in key operating parameters

INR/ton	3QFY21	3QFY20	YoY (%)	2QFY21	QoQ (%)
Realization	**5,132**	**4,954**	**4%**	**5,178**	**-1%**
RM Cost	751	856	-12%	835	-10%
Power & Fuel	1,006	976	3%	920	9%
Staff Cost	256	297	-14%	282	-9%
Freight & Forwarding	1,193	1,121	6%	1,146	4%
Other Expenditure	630	697	-10%	649	-3%
Total Expenditure	**3,836**	**3,946**	**-3%**	**3,833**	**0%**
EBITDA	**1,296**	**1,008**	**29%**	**1,345**	**-4%**

Reference: Motilal Oswal, January 2021

Production Decisions

Production Function

- **Production function:** defines the relationship between inputs and the maximum amount that can be produced within a given period of time with a given level of technology

$$Q = f(X_1, X_2, \ldots, X_k)$$

Q = level of output

$X_1, X_2, \ldots, X_k$ = inputs used in production

Production Function

- For simplicity we will often consider a production function of two inputs:

$$Q=f(X, Y)$$

Q = output

X = labor

Y = capital

Production Function

- **Short-run production function:** the maximum quantity of output that can be produced by a set of inputs
  - Assumption: the amount of at least one of the inputs used remains unchanged

- **Long-run production function:** the maximum quantity of output that can be produced by a set of inputs
  - Assumption: the firm is free to vary the amount of all the inputs being used

Short-run Analysis of Total, Average, and Marginal Product

- **Marginal product** (MP) = change in output (Total Product) resulting from a unit change in a variable input

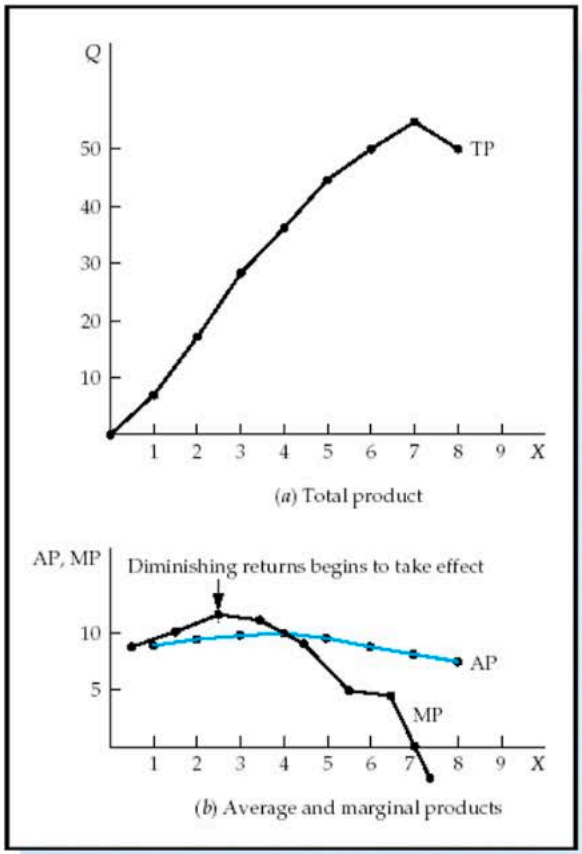
$$MP_X = \frac{\Delta Q}{\Delta X}$$

- **Average product** (AP) = Total Product per unit of input used

$$AP_X = \frac{Q}{X}$$

Short-run Analysis of Total, Average, and Marginal Product

- if MP > AP then AP is rising
- if MP < AP then AP is falling
- MP=AP when AP is maximized

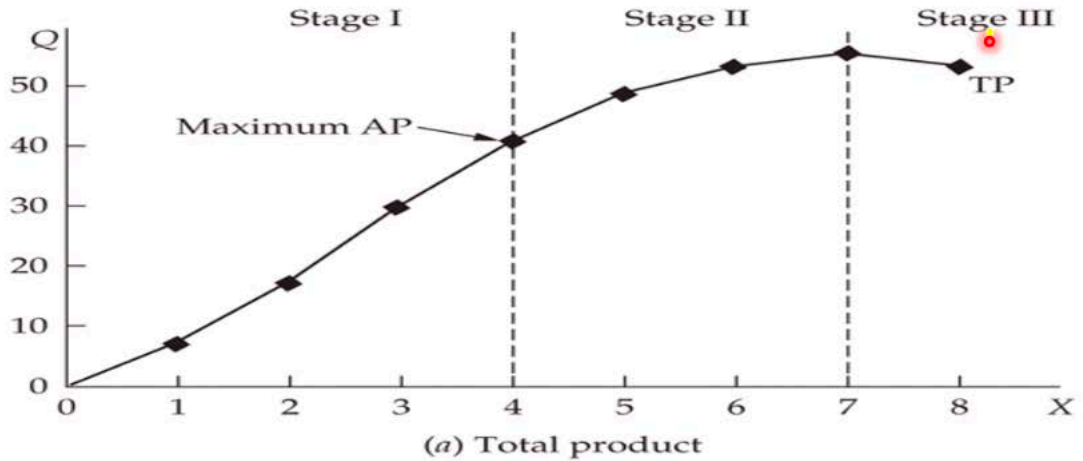


Short-run Analysis of Total, Average, and Marginal Product

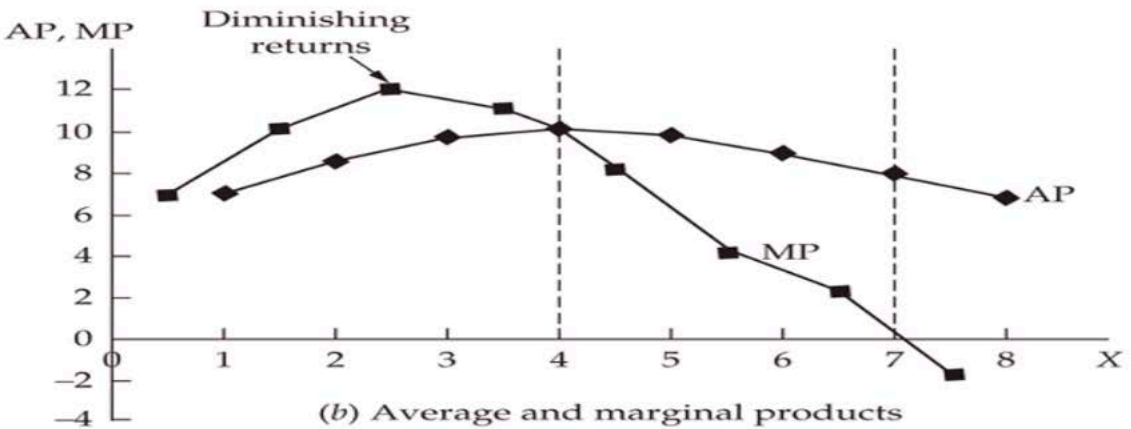
- **Law of diminishing returns:** as additional units of a variable input are combined with a fixed input, after some point the additional output (i.e., marginal product) starts to diminish
  - nothing says *when* diminishing returns will start to take effect
  - all inputs added to the production process have the same productivity

Short-run Analysis of Total, Average, and Marginal Product

- The **Three Stages of Production** in the short run:
  - Stage I: from zero units of the variable input to where AP is maximized (where MP=AP)
  - Stage II: from the maximum AP to where MP=0
  - Stage III: from where MP=0 on



(*a*) Total product



(*b*) Average and marginal products

Long-run Production Function

- In the long run, a firm has enough time to change the amount of *all* its inputs

- The long run production process is described by the concept of **returns to scale**

- Returns to scale = the resulting increase in total output as all inputs increase

Long-run Production Function

- If all inputs into the production process are doubled, three things can happen:
  - output can more than double
    - 'increasing returns to scale' (IRTS)
  - output can exactly double
    - 'constant returns to scale' (CRTS)
  - output can less than double
    - 'decreasing returns to scale' (DRTS)

Estimation of Production Functions

- Production function examples
  - Cobb-Douglas function: exponential for two inputs

$$Q = aL^bK^c$$

if $b + c > 1$, IRTS
if $b + c = 1$, CRTS
if $b + c < 1$, DRTS

Estimation of Production Functions

Statistical estimation of production functions

- inputs should be measured as 'flow' rather than 'stock' variables, which is not always possible
- usually, the most important input is labor
- most difficult input variable is capital
- must choose between time series and cross-sectional analysis

Estimation of Production Functions

Aggregate production functions: whole industries or an economy

Gathering data for aggregate functions can be difficult:

- for an economy: GDP could be used
- for an industry: data from Annual Survey of Industries , CMIE etc
- for labor: data from Labor Bureau, CMIE etc

Importance of Production Functions in Managerial Decision Making

- **Capacity planning:** planning the amount of fixed inputs that will be used along with the variable inputs

Good capacity planning requires:

- accurate forecasts of demand
- effective communication between the production and marketing functions

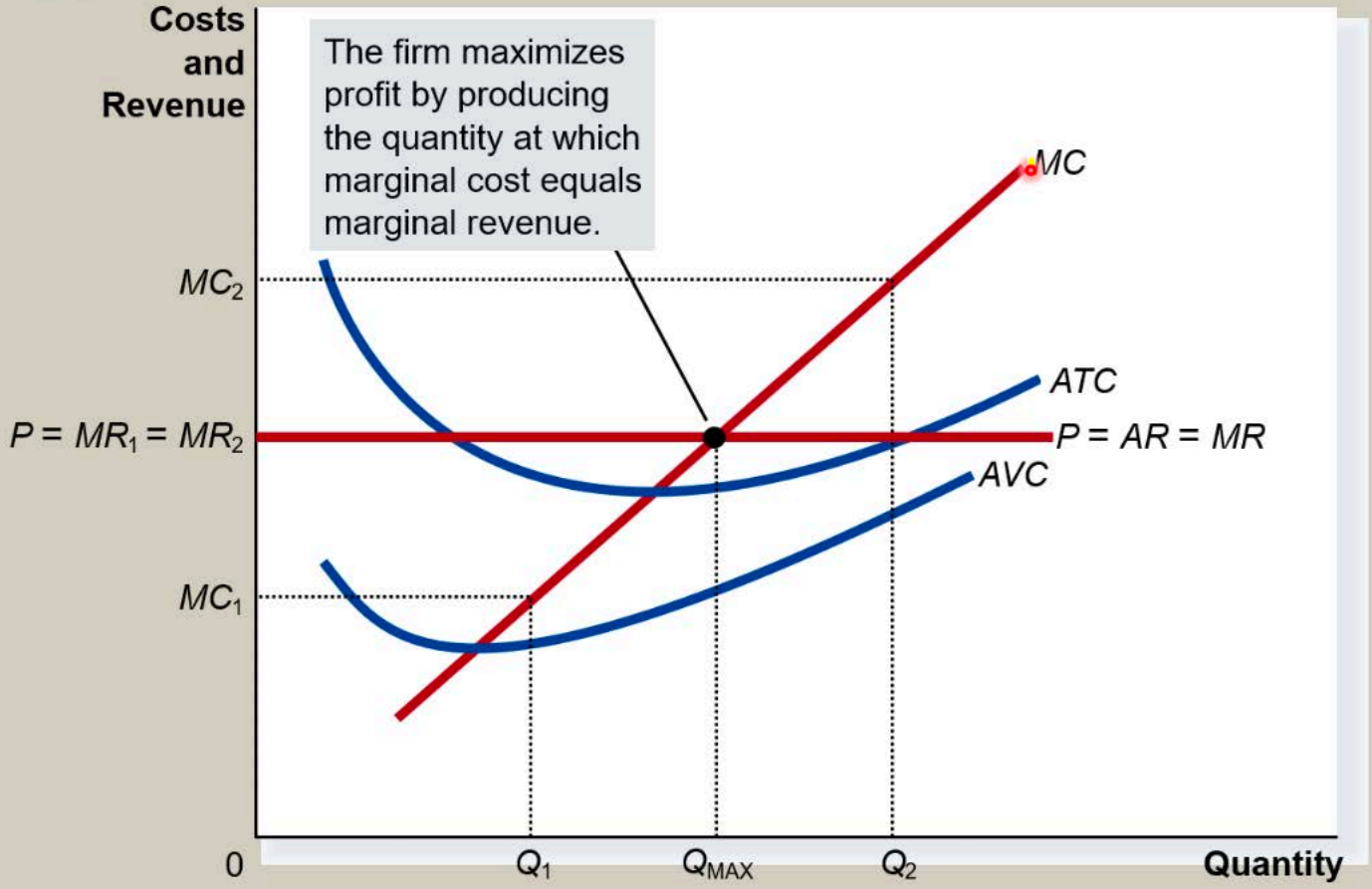
Total, Average, and Marginal Revenue for a Competitive Firm

Quantity	Price	Total revenue	Average revenue	Marginal revenue
(Q)	(P)	($TR = P \times Q$)	($AR = TR/Q$)	($MR = \Delta TR/\Delta Q$)
1 litre	€6	€6	€6	
				€6
2	6	12	6	
				6
3	6	18	6	
				6
4	6	24	6	
				6
5	6	30	6	
				6
6	6	36	6	
				6
7	6	42	6	
				6
8	6	48	6	

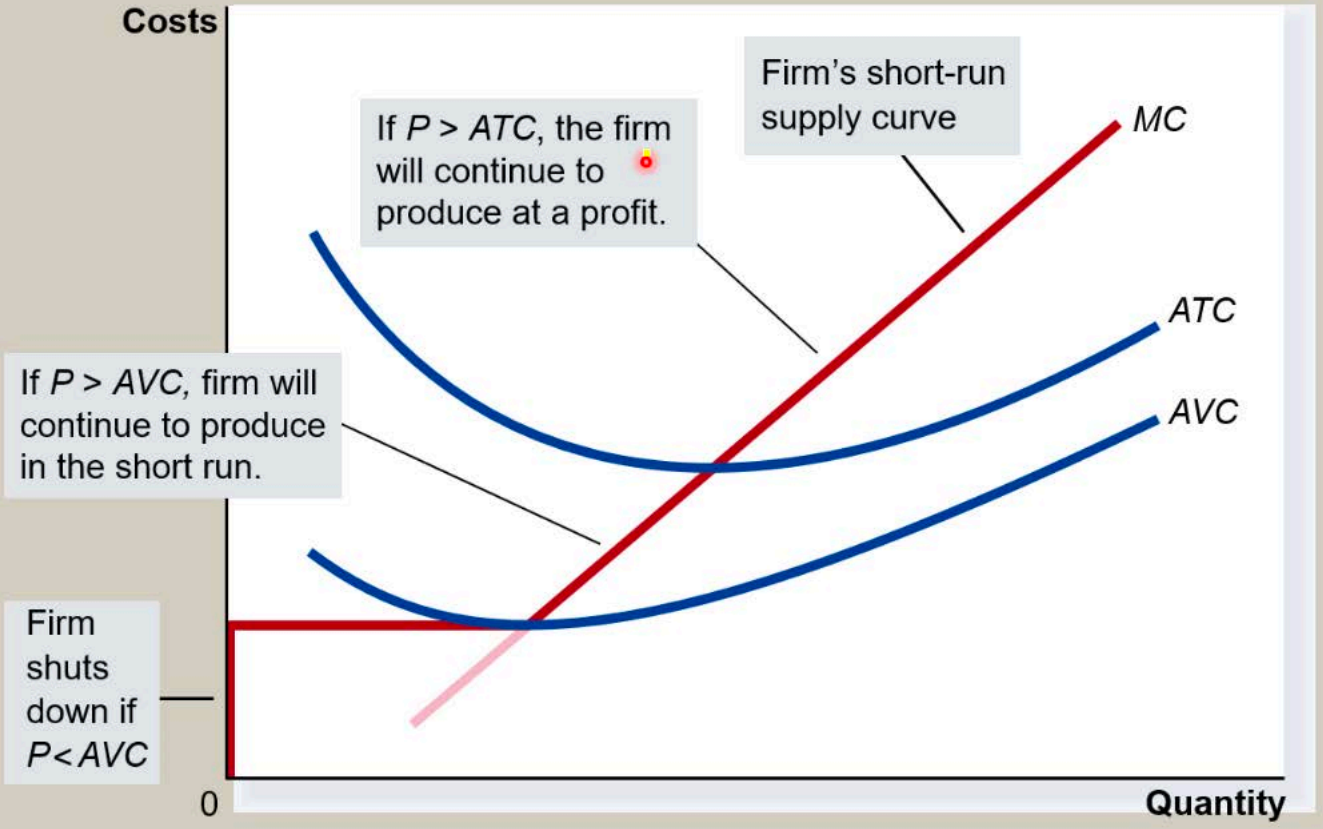
Profit Maximization: A Numerical Example

Quantity	Total revenue	Total cost	Profit	Marginal revenue	Marginal cost	Change in profit
(*Q*)	(*TR*)	(*TC*)	(*TR* – *TC*)	(*MR* = Δ*TR*/Δ*Q*)	(*MC* = Δ*TC*/Δ*Q*)	(*MR* – *MC*)
0 litres	€0	€3	–€3			
				€6	€2	€4
1	6	5	1			
				6	3	3
2	12	8	4			
				6	4	2
3	18	12	6			
				6	5	1
4	24	17	7			
				6	6	0
5	30	23	7			
				6	7	–1
6	36	30	6			
				6	8	–2
7	42	38	4			
				6	9	–3
8	48	47	1			

Profit Maximization for a Competitive Firm



The Competitive Firm's Short Run Supply Curve



The Competitive Firm's Long-Run Supply Curve