Principles of Economics

AEM102: Equilibrium & Elasticity of Demand

Dr Shakirat Ibrahim

AE&FM Department

Equilibrium Price And Quantity

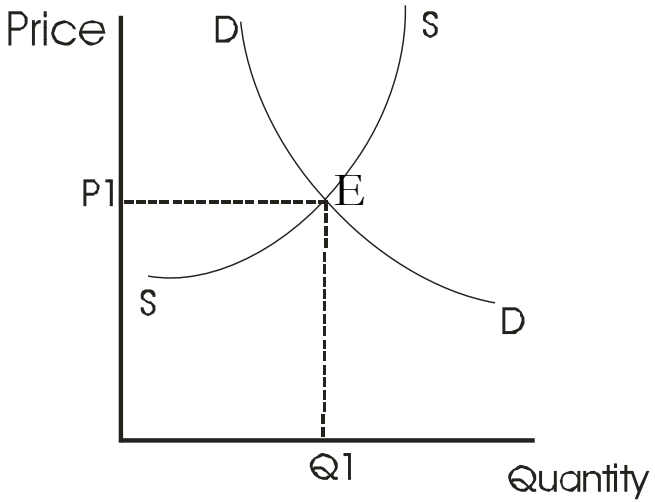


Figure 1: DEMAND , SUPPLY AND EQUILIBRIUM

- Equilibrium:
  - It occurs at the intersection of the market demand and market supply curves, at point E (fig. 1 above)
  - is a situation in which there is no tendency for price or quantity to change.
  - At point E, quantity demanded equals quantity supplied

- At point E, the quantity that individuals are willing to purchase exactly equals the quantity producers are willing to supply

- P_1 and Q_1 are equilibrium price and equilibrium quantity

- **Equilibrium price:**
- price at which quantity demanded equals quantity supplied.

Surplus and Shortage

- A **surplus** exists at prices higher than the equilibrium price; at P3
- At P3, the quantity demanded falls short of the quantity supplied, $Q_d < Q_s$

- At prices lower than the equilibrium price, P2, there is **shortage** of output since quantity demanded exceeds quantity supplied, $Q_d > Q_s$

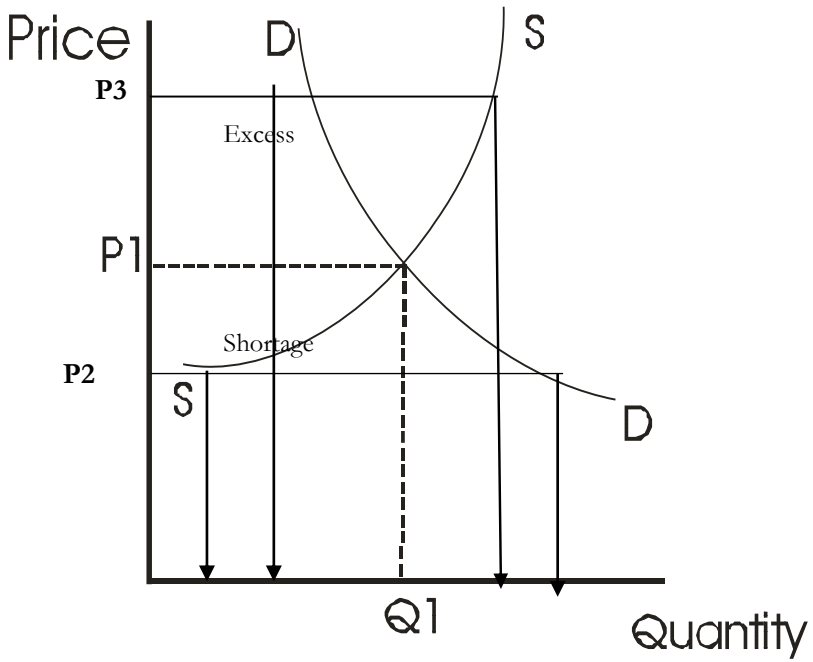


Figure 2: DEMAND SUPPLY AND EQUILIBRIUM

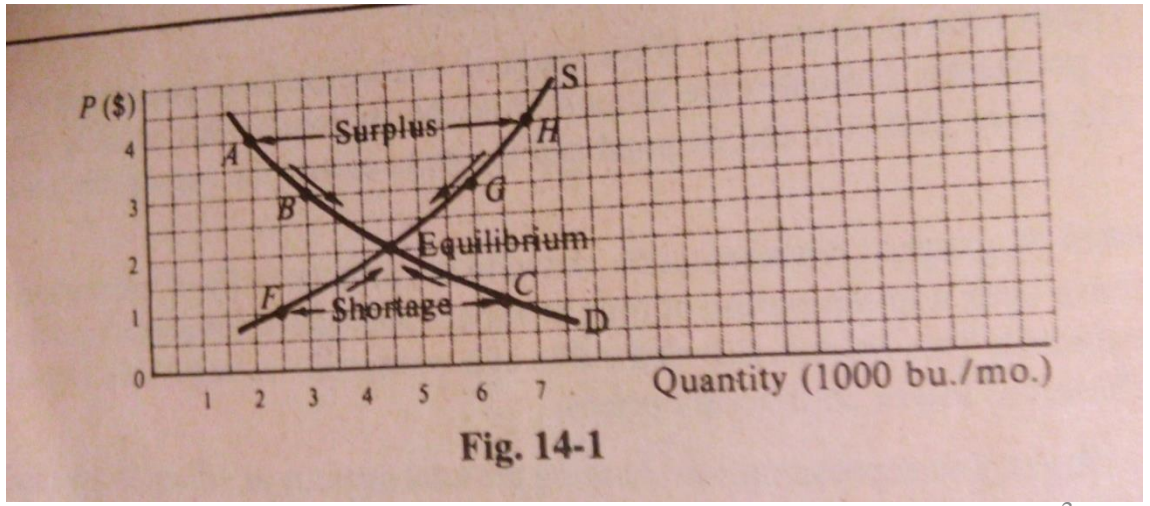


Fig. 14-1

Figure 3: Given DD curve AD and SS curve FS

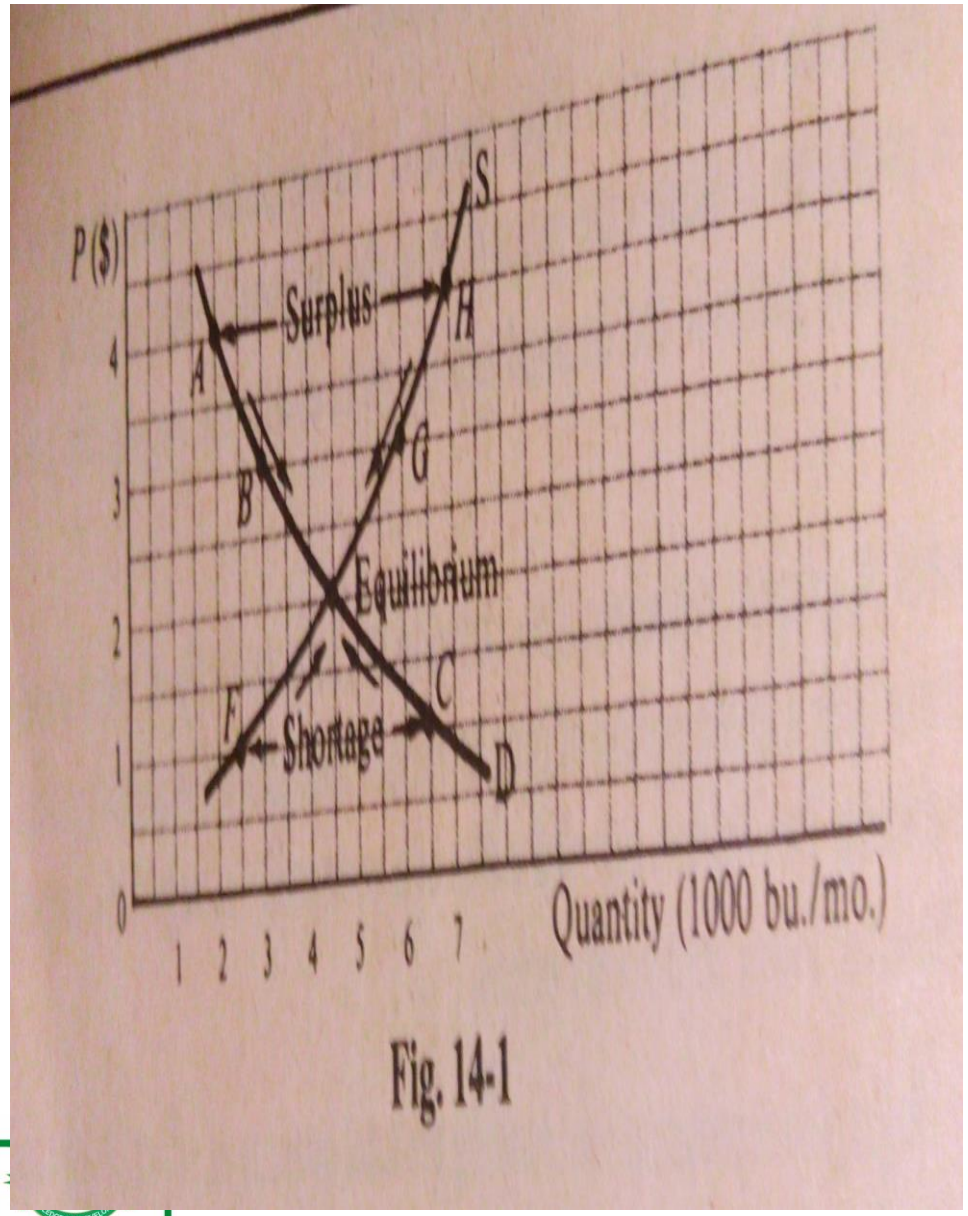


Fig. 14-1

Price	Quantity Demanded	Quantity Supplied	Surplus (+)or Shortage(-)	Pressure on price
4	2 A	7 H	+5	Downward
3	3 B	6 G	+3	Downward
2	4.5 E	4.5 E	0	Equilibrium
1	6.5 C	2.5 F	-4	upward

Calculating Market Equilibrium from Demand Supply Equations

- Given:
- Market demand equation:
  - $Q_d = 100 - 10P$;
- Market supply equation:
- $Q_s = 40 + 20P$
- **NOTE THE SLOPES OF DEMAND AND SUPPLY CURVES**
- Equilibrium price is then found by equating Q_d and Q_s
  - $Q_d = Q_s$

$100 - 10P = 40 + 20P$

$30P = 60$

Therefore, P = N2

- Equilibrium demand and supply is found by substituting equilibrium price in either demand or supply equation
- To get Equilibrium supply

$Q_d = 100 - 10P$

$= 100 - (10*2)$

$Q_d = 100 - 20$

Thus, $Q_d = 80$

- To get Equilibrium supply
- **$Q_s = 40 + 20P$**

$= 40 + (20*2)$

$Q_s = 40 + 40$

Thus, $Q_s = 80$

Figure 4: Equilibrium When Demand Changes

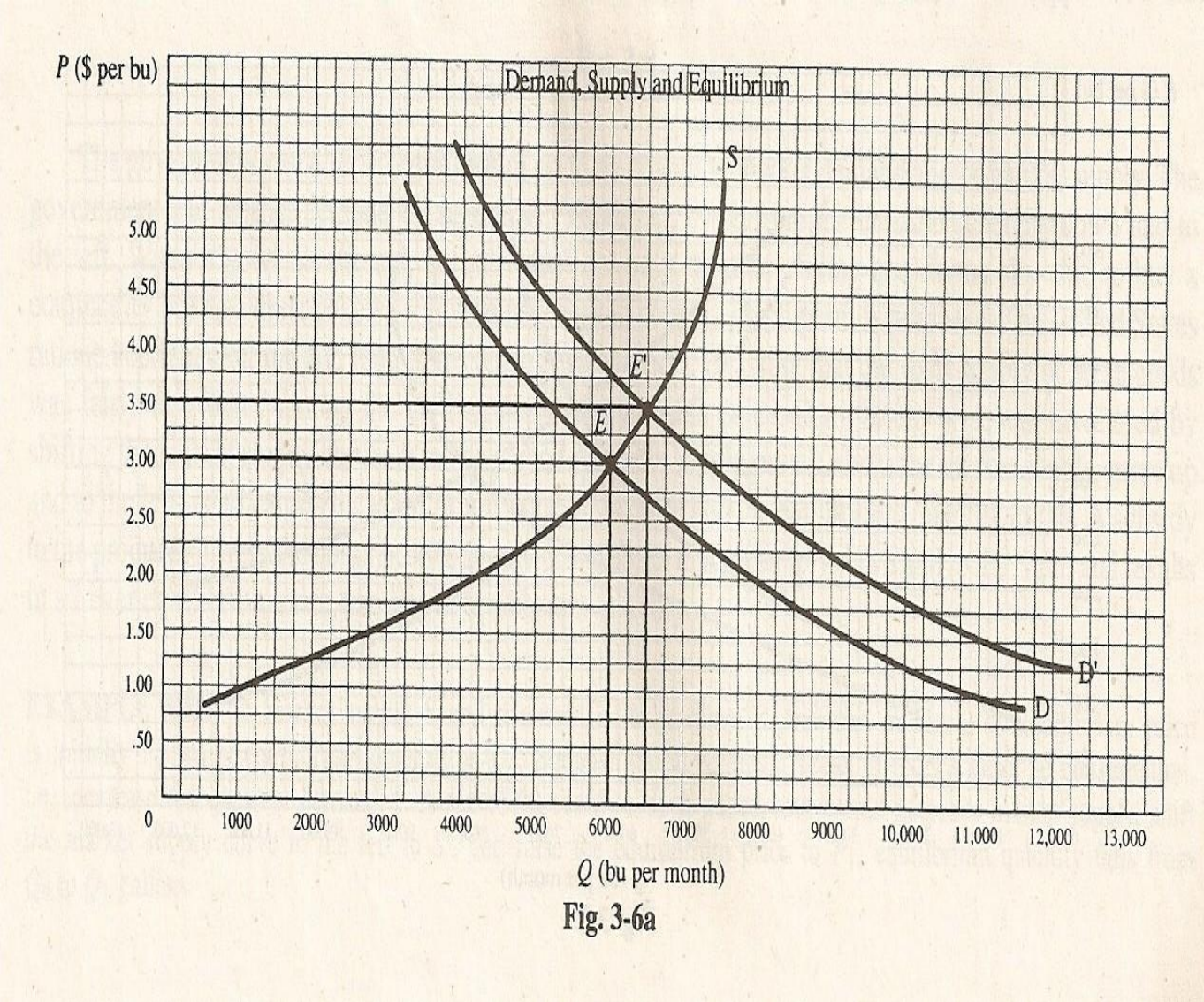
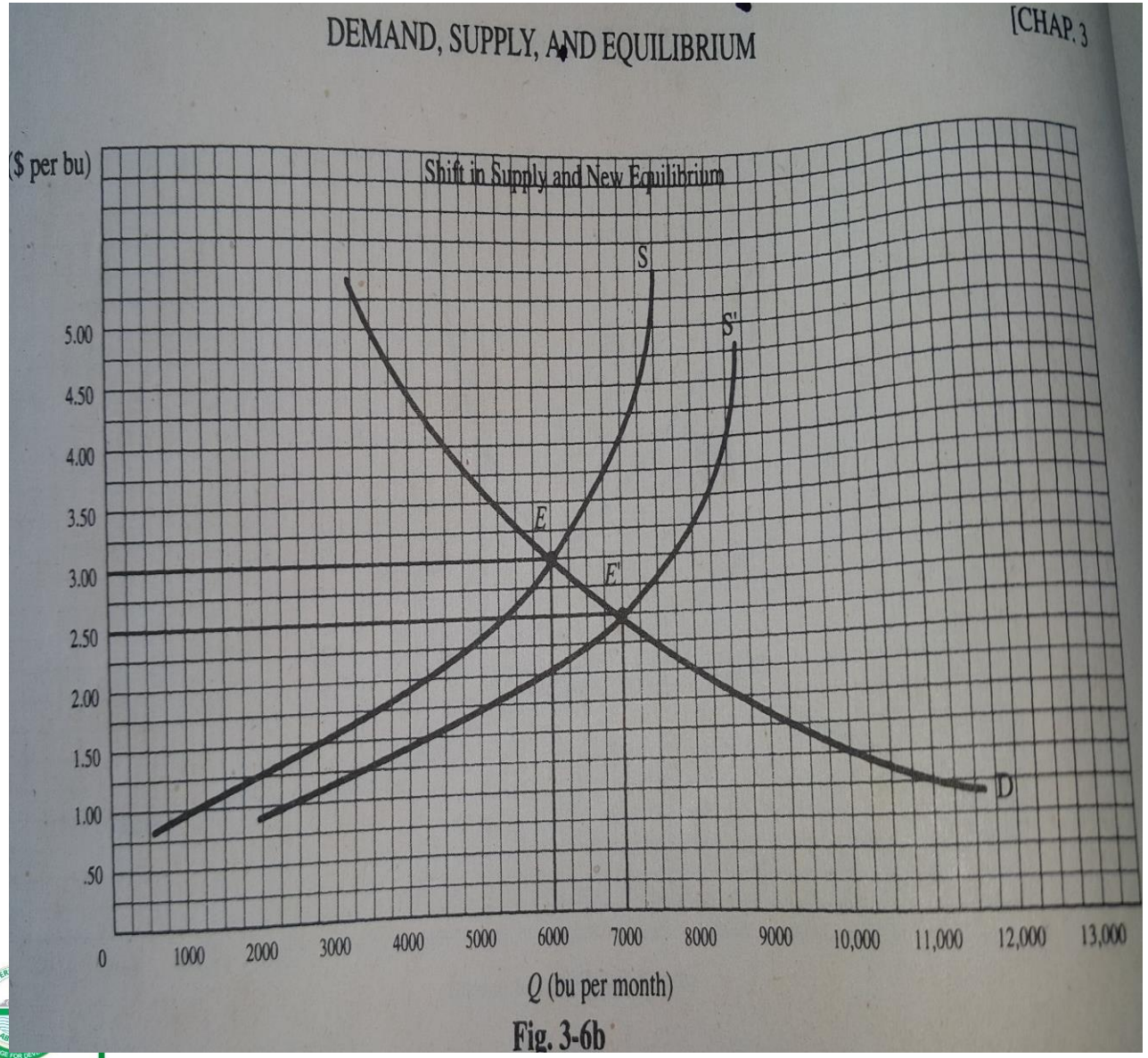


Fig. 3-6a

- When:
  - there is an increase in market demand ie market demand curve shifts up to the right (from D to D'),
  - with no change in location of the market supply curve
- Equilibrium price rises
- Equilibrium quantity also rises

Figure 5: Equilibrium When Supply Changes



- When:
  - there is an increase in market supply ie market supply curve shifts down to the right (from S to S'),
  - the market demand curve remains unchanged
- Equilibrium price falls
- Equilibrium quantity increases

Figure 6: Equilibrium with shift in Demand and Supply

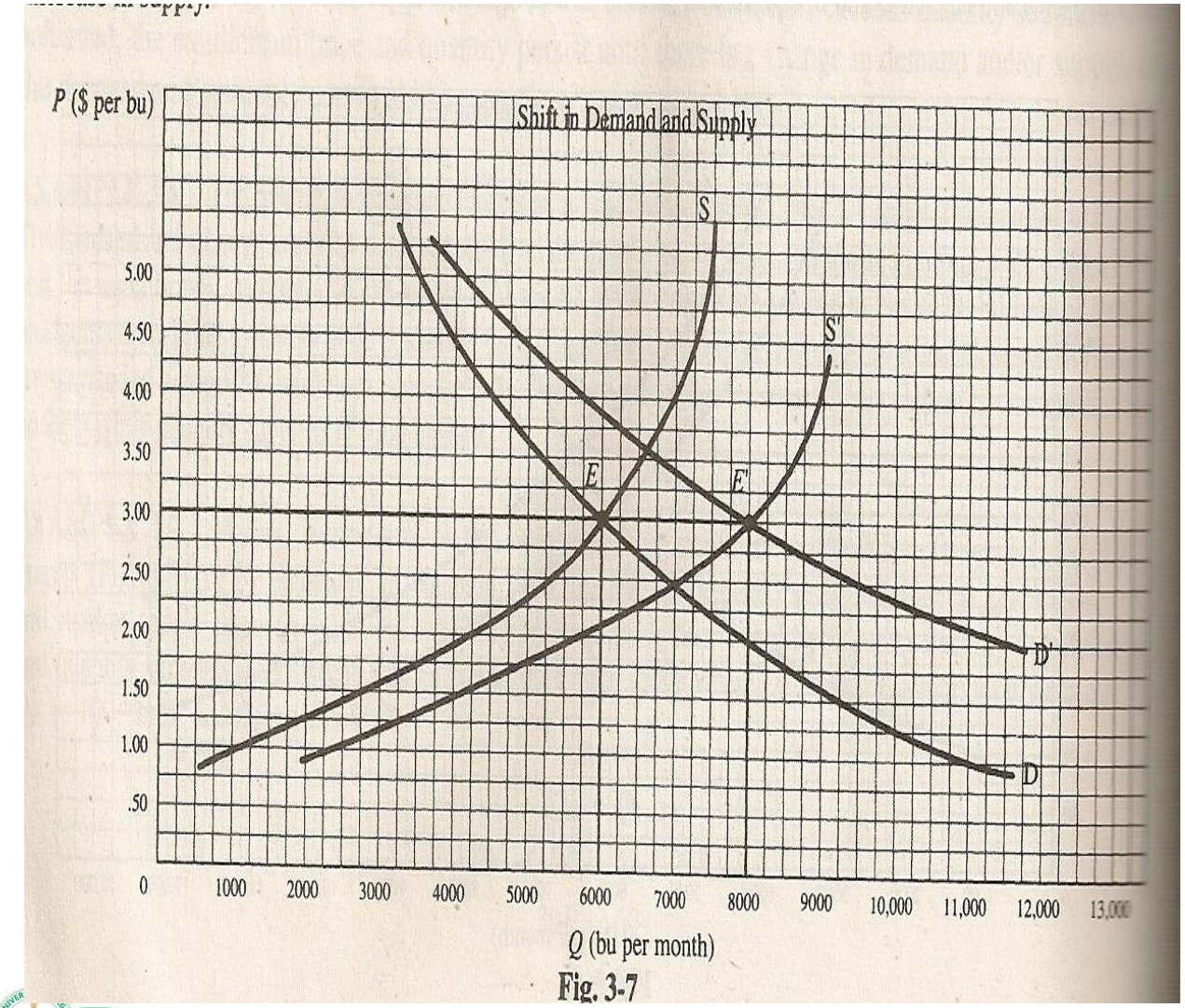


Fig. 3-7

- An increase in both market demand and market supply
- shifts to the right by both supply (S to S') and demand curves (D to D')
- **results in a higher equilibrium quantity;**
- Change in equilibrium price is however indeterminate when the magnitude of the demand and supply shift is unspecified

Elasticity of Demand

- **Elasticity of demand:**
  - measurement of the magnitude of responsiveness of quantity demanded of a product to the change in one of the determinant's factors (such as price and income) of the product
- $\text{Elasticity} = \frac{\%\ change\ in\ Quantity\ Demanded}{=\%\ change\ in\ Determinant}$
- Therefore:

- **Price Elasticity of demand (E_d):** measures the percentage change in the quantity demanded of a commodity as a result of a given percentage change in its price
- $E_d = \frac{\text{percentage change in quantity demanded}}{\text{percentage change in price}}$

- The price elasticity of demand is the relative responsiveness of the quantity demanded to small changes in the commodity's price.

- $E_d = \dfrac{\Delta \text{ in quantity demanded /original quantity demanded}}{\text{Change in price/ original price}}$
- $E_d = \dfrac{\Delta Q/Q}{\Delta P/P} = \left(\dfrac{\Delta Q}{\Delta P} * \dfrac{P}{Q}\right)$ …… Point Price elasticity of demand

- **The coefficient of E_d computed is valid only for very small movements in price and quantity demanded.**

- **Point Price Elasticity Of Demand:**
- **is the price elasticity of demand computed when we have small (infinitesimal) changes in price and quantity demanded of a commodity.**

- Example:
- Given the information below on price and quantity demanded for a product at 2points, A and B, calculate $\mathbf{E_d}$

	Price(P)	**Quantity Demanded(Q)**
• Point A:	29.001 (P_1)	2,999 (Q_1)
• Point B:	29.000 (P_2)	3,000 (Q_2)

- **Solution:**
- **Recall:** $\mathbf{E_d} = \dfrac{\textbf{Δ in quantity demanded /original quantity demanded}}{\textbf{Change in price/ original price}} = \left(\dfrac{\Delta Q}{\Delta P} * \dfrac{P}{Q}\right)$

- Between points A and B:
  - **Change in quantity demanded (ΔQ) = 1; and change in price (ΔP) = -0.001**
  - **These are small changes in quantity demanded and price**

- In the formula for point price elasticity of demand, one must also use the quantities of P and Q. **The question then arises,**
- Should one use P_1 or P_2? OR Should one use Q_1 or Q_2?

For very small changes as above, either P_1 or P_2, Q_1 or Q_2 may be used

Using P_1 and Q_1:

$$E_d = \frac{\Delta Q}{\Delta P} * \frac{P_1}{Q_1} = \frac{1}{-0.001} * \frac{29.001}{2999}$$

$$E_d = -9.67022$$

Using P_2 and Q_2:

$$E_d = \frac{\Delta Q}{\Delta P} * \frac{P_2}{Q_2} = \frac{1}{-0.001} * \frac{29.000}{3000}$$

$$E_d = -9.66667$$

- The difference in the two computed values of E_d elasticity of demand is very small

E_d computation when Changes in Q and P are large

Suppose at points A and B we have coordinates:

	Price	**Quantity Demanded**
Point A:	$(P_1) = 0.60$	$(Q_1) = 400{,}000$
Point B:	$(P_2) = 0.50$	$(Q_2) = 800{,}000$

$\Delta P = -0.10$, $\Delta Q = +400{,}000$,

Lets compute price elasticity of demand using **original price and quantity**

$$\mathbf{E_d} = \frac{\Delta Q}{\Delta P} * \frac{P_1}{Q_1} = \frac{400000}{-0.10} * \frac{0.6}{400000}$$

$$\mathbf{E_d} = \mathbf{-6}$$

E_d computation using new price - quantity figures gives

- $$\mathbf{E_d} = \frac{\Delta Q}{\Delta P} * \frac{P_2}{Q_2} = \frac{400000}{-0.10} * \frac{0.5}{800000}$$
- $\mathbf{E_d} = \mathbf{-2.5}$

- In this case, the 2 calculations do not yield similar results , so we need to establish a convention to avoid this problem

- **Economists generally measure E_d in terms of the average quantity and the average price if changes in price and quantity are large, as follows:**

$$E_d = \frac{\Delta \text{ in quantity demanded} / \frac{1}{2} \text{sum of quantities demanded}}{\text{Change in price} / \frac{1}{2} \text{sum of prices}}$$

- **This is because what we have now is NO LONGER point elasticity but elasticity over a range.**

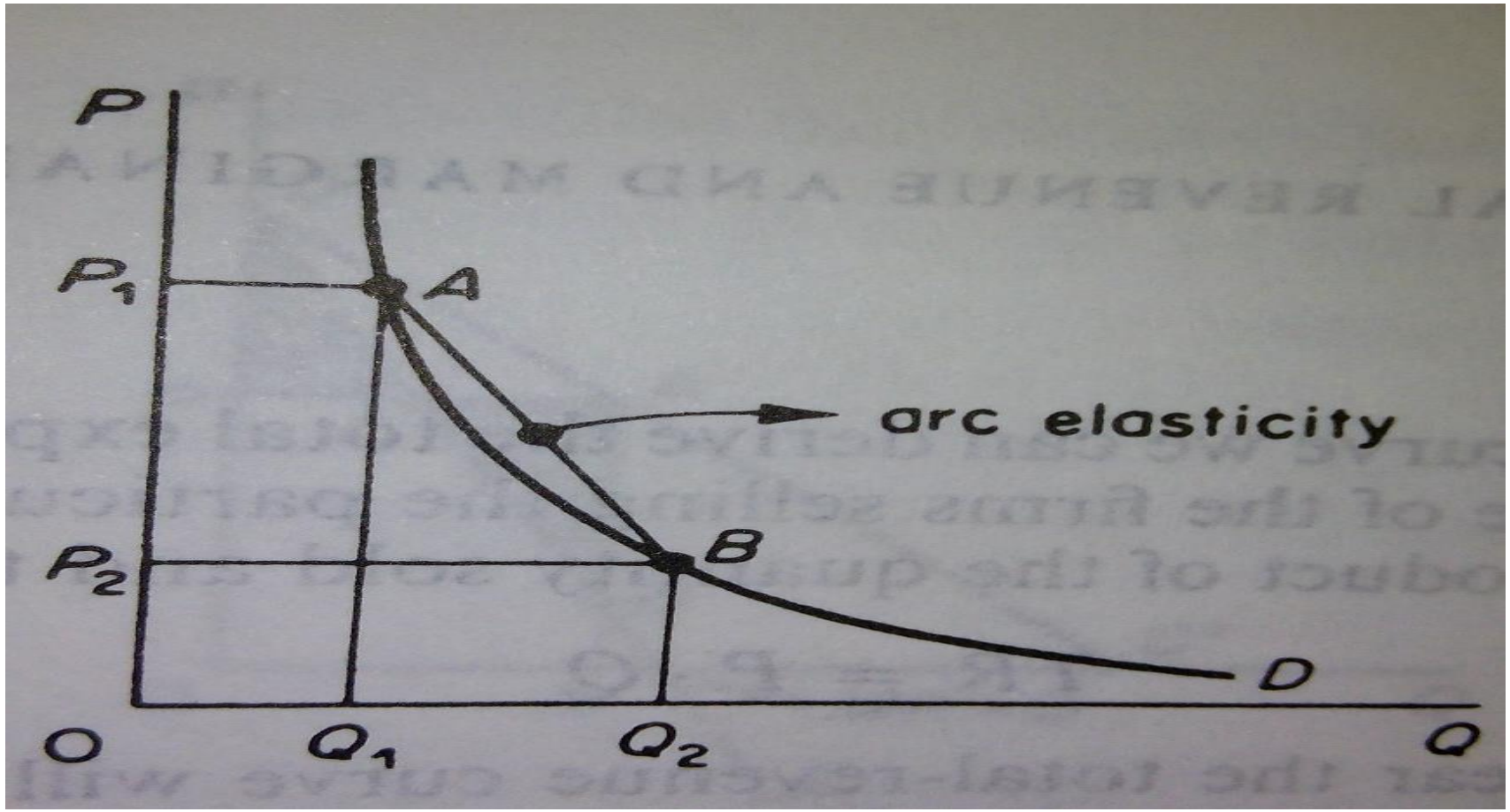
- **We call this ARC elasticity of demand**

Arc Elasticity of Demand

- Economists generally measure arc E_d in terms of the average quantity and average price to avoid the problem of obtaining different results:

- Arc Elasticity of demand E_d=
- $$\frac{\Delta \text{ in quantity demanded/ (sum of quantity demanded). } 1/2}{\text{Change in price/ (sum of price). } 1/2}$$

Arc Elasticity of Demand



Elasticity Between Points A And B: another illustration

- The elasticity between points A and B along the demand curve is calculated using the original, new and average price and quantity
- The price elasticities may differ in different parts of the demand curves
- They thus have to be evaluated there to know the correct elasticity of demand

Figure 6: Given DD curve AD and SS curve FS

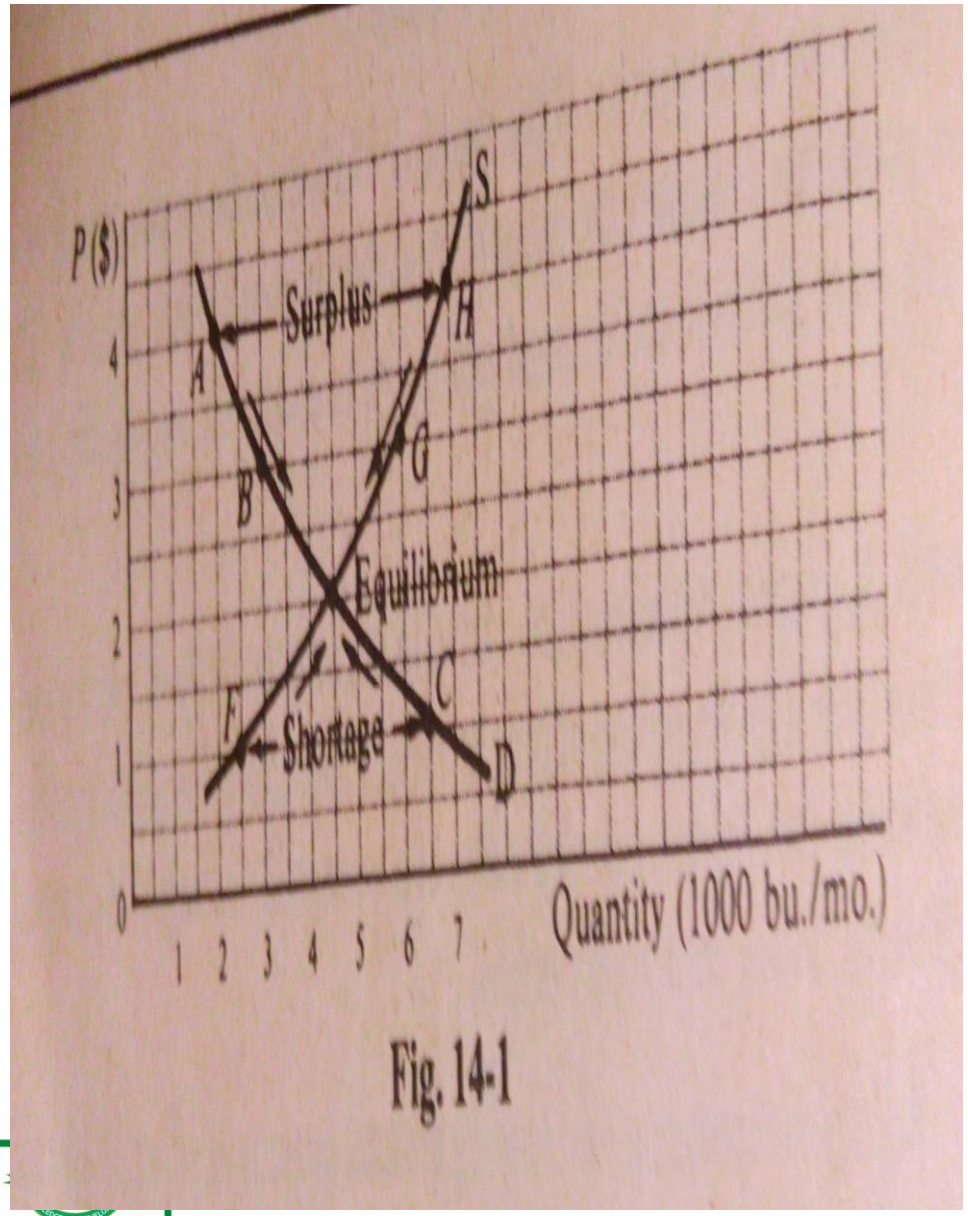


Fig. 14-1

Price	Quantity Demanded	Quantity Supplied	Surplus (+)or Shortage(-)	Pressure on price
4	2 A	7 H	+5	Downward
3	3 B	6 G	+3	Downward
2	4.5 E	4.5 E	0	Equilibrium
1	6.5 C	2.5 F	-4	upward

Calculation of Elasticity Between Points A & B using Figure 6

- $E_d = \frac{(\text{change in quantity/original})}{(\text{change in price/original price})}$
- $E_d = \frac{1/2}{1/4} = 2$, **using original values**
- $E_d = \frac{(\text{change in quantity/new quantity})}{(\text{change in price/ new price})}$
- $E_d = \frac{1/3}{1/3} = 1$, **using new values**

- $E_d = \frac{(\text{change in quantity/sum of quantity/2})}{(\text{change in price/sum price/2})}$
- $E_d = \frac{1/\{(2+3)/2\}}{1/\{(4+3)/2\}}$
- $E_d = (1/2.5)(3.5) = 1.4$, **using average values**

Elasticity Between Points A and B

- We note that different values are also obtained
- Thus by convention, we use the last result of averages of quantities and prices .
- We thus say that the price elasticity of demand (on the average) between points A and B is 1.4.
- **This is because we have an ARC and not a POINT**

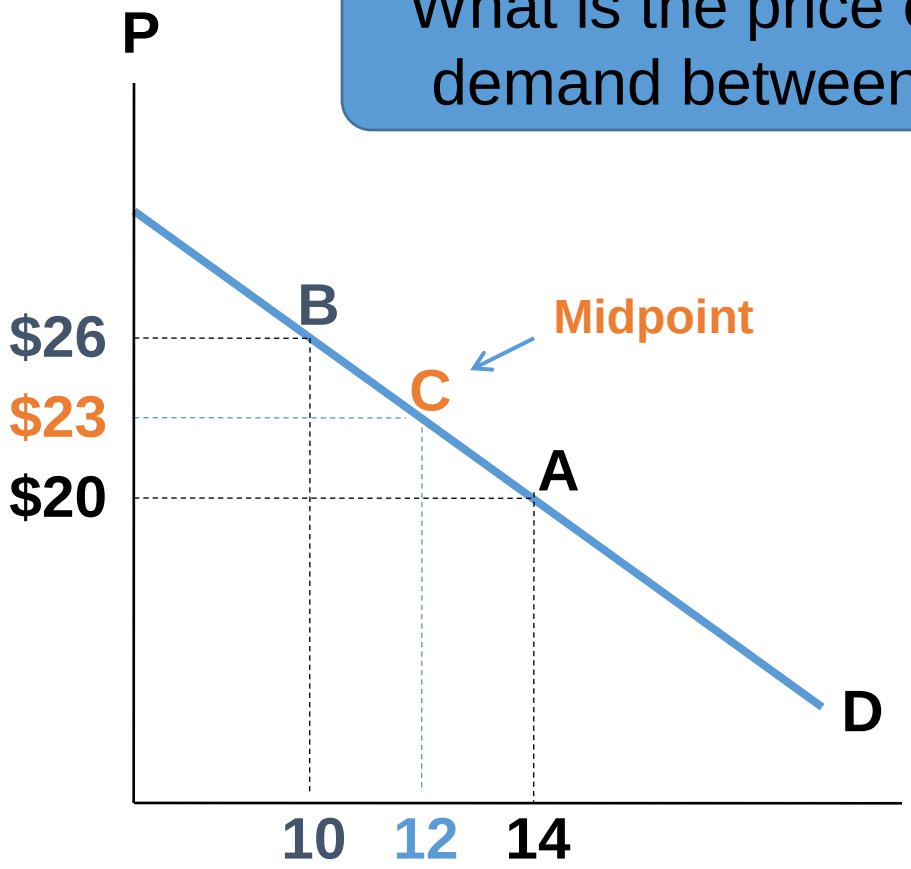
The End-Point Problem

- Economists use the average of the end points to calculate the percentage change.

$$Elasticity = \frac{(Q_2 - Q_1) \Big/ \tfrac{1}{2}(Q_2 + Q_1)}{(P_2 - P_1) \Big/ \tfrac{1}{2}(P_1 + P_2)}$$

Calculating Arc Price elasticity of Demand

What is the price elasticity of demand between A and B?



$$E_D = \frac{\%\Delta Q}{\%\Delta P} = \frac{\frac{Q_2 - Q_1}{\frac{1}{2}(Q_2 + Q_1)}}{\frac{P_2 - P_1}{\frac{1}{2}(P_2 + P_1)}}$$

$$= \frac{\frac{10-14}{\frac{1}{2}(10+14)}}{\frac{26-20}{\frac{1}{2}(26+20)}} = \left|\frac{-.33}{.26}\right| = 1.27$$

Elasticity of demand E_d

- **Elasticity of demand, (E_d) is a pure number**
- As such, it is a better measurement tool than the slope which is expressed in terms of the units of measurement.

- The value of the price elasticity of demand is **negative** because the slope of the demand curve is negative, that is, the demand curve is downward sloping
- **However,**
- **E_d is always expressed as a positive number, even though price and quantity demanded move in opposite direction.**
- The demand is said to be:

Elastic, if $E_d > 1$,

Unitary, if $E_d = 1$, and

Inelastic, if $E_d < 1$.

Demand Elasticity Categories	Notation	Interpretation
Elastic	$E_d > 1$	The percentage increase in quantity demanded of the commodity exceeds the percentage decline in price
Inelastic	$E_d < 1$	The percentage increase in quantity demanded of the commodity is less than the percentage decline in price
Unitary	$E_d = 1$	The percentage increase in quantity demanded of the commodity equals the percentage decline in price

Total Revenue & Elasticity of Demand

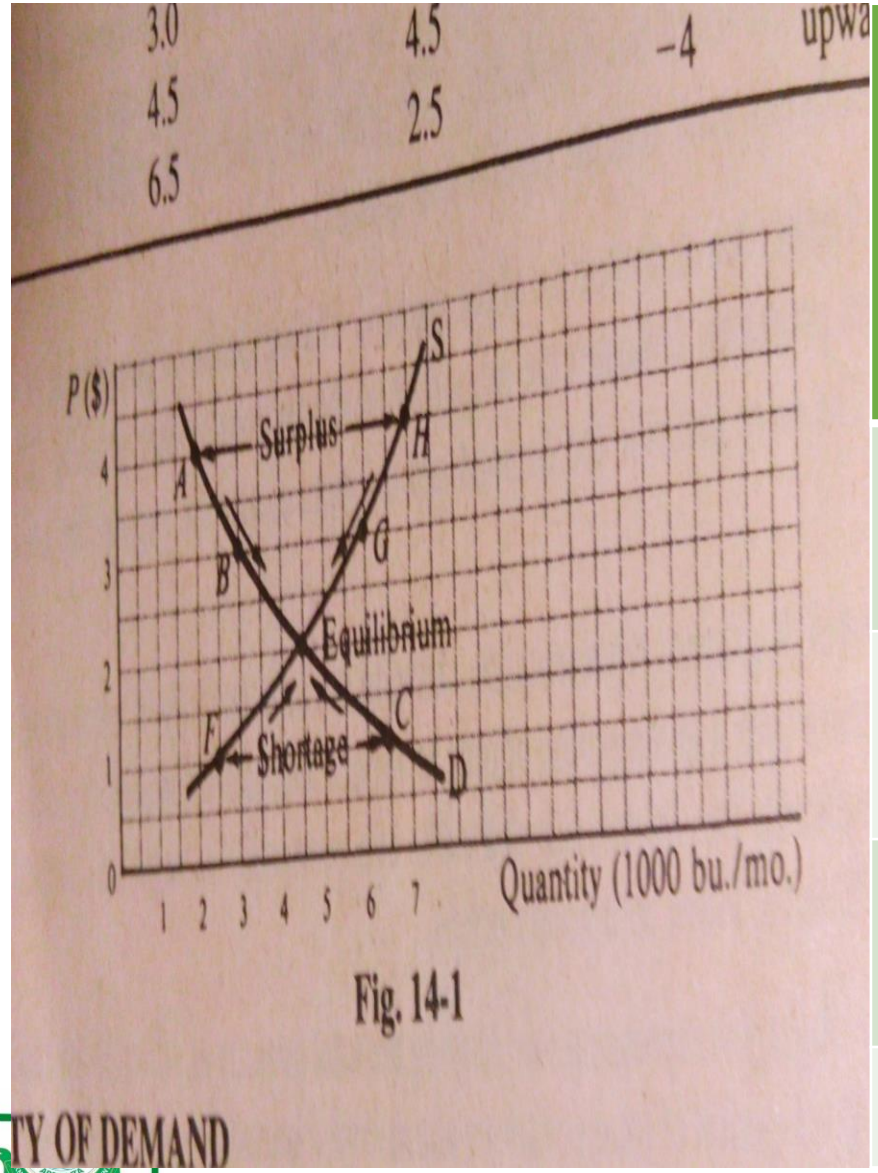
- **Total revenue:**
  - the income or the amount of money suppliers earn from the sale of goods and services.
  - **Total Revenue (TR) = price of commodity x quantity of commodity sold**
- Changes in the price of a commodity will either lead to:
  - an increase TR
  - decrease in the TR, **depending on the value of elasticity of demand for the commodity**
- **Illustration:** When the price of a commodity falls:
  - **If E_d>1, the Total Revenue (TR) of producers increases**
  - **If E_d= 1, Producers Total Revenue remains unchanged**
  - **If E_d< 1, Producers Total Revenue decreases or falls**

When demand is inelastic i.e when elasticity is less than 1, a fall in price will cause a decrease in consumers' total expenditure on the commodity and consequently a fall in total revenue.

- But when demand is elastic, an decrease in the price of the commodity will increase consumers' total expenditure on the commodity and total revenue.

Value of elasticity	Price of Commodity	Commodity's Total Revenue
Greater than one	Fall	Increase
Greater than one	Rise	Decrease
Less than one	Fall	Decrease
Less than one	Rise	Increase
Equal to one	Rise or Fall	Unchanged

Given fig 7: DD and SS curve AD and FS with their coordinates



Points	Price N/KG	Demand in market	Points	Quantity supplied in market	Surplus + Shortage _	Pressure on price
A	4	2	H	7	+5	downward
B	3	3	G	6	+3	downward
C	2	4.5	E	4.5	0	Equilibrium
D	1	6.5	F	2.5	-4	upward

Illustration of Figure 7

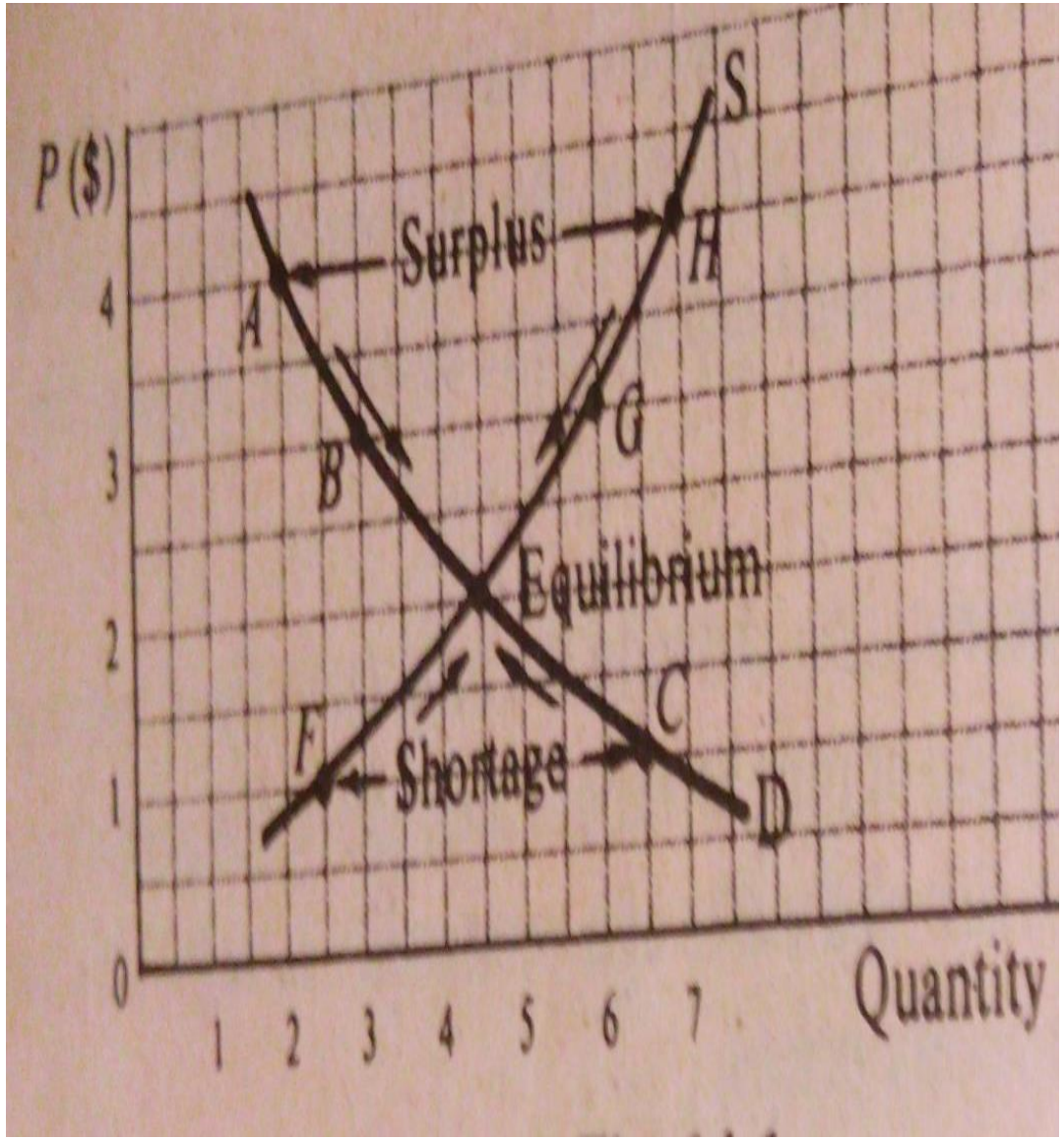
- Recall: Elasticity between two points (e.g A and B) along the demand curve can be calculated using:
  - **Original quantity and price**
  - **New quantity and price**
  - **Average quantities and prices**
- **Required:**
- **Use the information on figure 7 to calculate the elasticity of demand between points C and D using the above three methods**

Using Total Revenue Rule to Determine Elasticity Of Demand

Points	Price	Quantity Demanded	Total revenue	Ed
A	4	2	8	
				Elastic
B	3	3	9	
				Unitary
C	2	4.5	9	
				inelastic
D	1	6.5	6.5	

Using Total Revenue rule

- Using the TR rule, the market demand curve is:
  - **Elastic between points A and B because $TR_2 > TR_1$**
  - **Market demand curve has Unitary elasticity between points B and E, because $TR_2 = TR_1$**
  - **Market demand curve is Inelastic between points E and C, because $TR_2 < TR_1$**



Another Example

Given:

- At ₦25/ bottle, 100 bottles of coca-cola are sold.

- If the price drops to ₦20 / bottle, the week's sales increased to 110 bottles.

Is the demand elastic or inelastic?

Solution:

P_1 = ₦25; $Q_1 = 100$;

P_2 ₦20; $Q_2 = 110$

$TR_1 = P_1 \times Q_1 = 25 \times 100 =$ ₦ 2500.

$TR_2 = P_2 \times Q_2 = 20 \times 110 =$ ₦2200.

- **Since $TR_2 < TR_1$, the price elasticity of demand is inelastic.**

Factors affecting price elasticity of demand

- **Availability of substitute goods:**
  - The more and better the substitutes for a good, the greater its price elasticity
  - Goods with few and poor substitutes- eg. wheat and salt, tend to have low price elasticities
  - Goods with many substitutes (e.g wool, for which cotton and man made fibres can be substituted) have high elasticities

- **The number of uses to which a good may be put:**
  - The greater the number of possible uses of a commodity, the greater its price elasticity
  - A commodity such as wool, which can be used in producing clothing, carpeting, upholstery, draperies and tapestries will tend to have a higher price elasticity of demand than a commodity with only one or few uses, e g butter

Factors affecting price elasticity of demand

- The period of time considered:
  - The longer the period of time considered, the more the price elasticity of demand for the good

- The nature of the need that the commodity satisfies.
- The proportion of income spent on the particular commodity

Income Elasticity of Demand (E_y)

- Income elasticity of demand:
  - the percentage change in quantity demanded of a commodity due to a percentage change in income.
  - Proportional change in the demand for a good divided by the proportional change in income.

- $E_Y = \dfrac{\text{percentage change in quantity demanded}}{\text{percentage change in income}} = \dfrac{\Delta_Q}{Q} * \dfrac{\Delta Y}{Y} = \dfrac{\Delta_Q}{\Delta_Y} * \dfrac{Y}{Q}$

Where:

- Y is income; Q is quantity demanded
- Δ_Y is the change in income; Δ_Q is the change in quantity demanded

Income Elasticity of Demand (E_Y)

- **If Ey < 1, it implies that:**
  - The commodity is income inelastic
  - The commodity is a necessity good; as such,
  - The quantity demanded is not very responsive to changes in income.
  - Consumption remains about same irrespective of income level

- **Ey > 1, it implies that:**
  - The commodity is income elastic
  - The commodity is a luxury good
  - The quantity demanded is highly responsive to changes in income.

Income Elasticity of Demand (E_Y)

- **Ey = 1, it implies that:**
  - The commodity has unitary income elasticity
  - The quantity demanded responds in the same manner to changes in income.
- **If Ey < 0 (negative), it implies that:**
  - The commodity in question is an **inferior good**
- According to **Christian Lorenz Ernst Engel**,:
  - The income elasticity of demand for food is low,
  - Those for clothing and shelter are about unity
  - While the income elasticities of demand for recreation, medical care and other luxury goods are in excess of one