$$\text{MRS} = \frac{f_1}{f_2} = \frac{p_1}{p_2} \quad ...(ii)$$

Now taking the second order partial derivatives of U, by f_{11} and f_{22} and the second order cross partial derivatives by f_{12} and f_{21}, we have

$$\frac{\partial^2 U}{\partial q_1^2} = f_{11} + f_{12}\left(\frac{\partial q_2}{\partial q_1}\right) + f_{21}\left(-\frac{p_1}{p_2}\right) + f_{22}$$

$$\left(-\frac{p_1}{p_2}\right)\left(\frac{dq_2}{dq_1}\right) + f_2 \frac{d\left(\frac{-p_1}{p_2}\right)}{dq_1}$$

For utility maximation, the second order derivative $\frac{\partial^2 U}{\partial q_1^2}$ should be less than zero $\left(\frac{\partial^2 U}{\partial q_1^2} < 0\right)$

Now put $f_{11} + f_{12}\left(\frac{\partial q_2}{\partial q_1}\right) + f_{21}\left(-\frac{p_1}{p_2}\right) +$

$$f_{22}\left(-\frac{p_1}{p_2}\right)\left(\frac{q_2}{\partial q^1}\right) + f_2 \frac{\partial\left(\frac{-p_1}{p_2}\right)}{\partial q_1} < 0$$

or $f_{11} + f_{12}\left(\frac{-p_1}{p_2}\right) + f_{21}\left(-\frac{p_1}{p_2}\right) +$

$$f_{22}\left(-\frac{p_1}{p_2}\right)^2 + 0 < 0$$

$$\text{or } f_{11} - 2f_{12}\left(\frac{p_1}{p_2}\right) + f_{22}\left(\frac{-p_1}{p_2}\right)^2 < 0 \quad ...(iii)$$

Thus maximisation of satisfaction is realised when both the conditions for consumer's equilibrium denoted through equations (*ii*) and (*iii*) are satisfied.

4.12. INCOME EFFECT

The equilibrium of the consumer is analysed on the assumption that prices of two commodities, tastes of the consumer and his income remain the same. If other things remain constant but the income of the consumer changes (rises or falls), there will be a shift in the position of equilibrium and the consumer will make changes in his purchases. *The income effect explains the effect of a change in the income of the consumer, when his tastes and prices of two commodities remain unchanged.*

Assumptions

The income effect rests upon the following main assumptions :

(*i*) Two commodities (X and Y) are normal.

(*ii*) Tastes and preferences of the consumer are given.

(*iii*) Prices of two commodities remain the same.

(*iv*) Income of the consumer rises (or falls).

The effect of a change in income upon the equilibrium of the consumer or the purchases of two commodities is explained through Fig. 4.21.

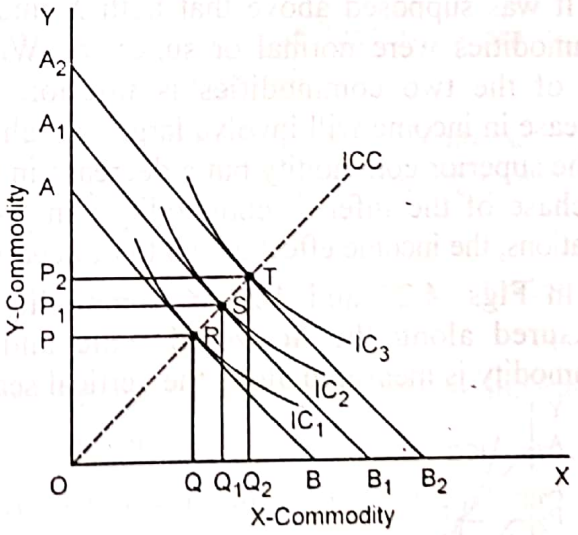

Fig. 4.21

In Fig. 4.21, X-commodity is measured along the horizontal scale and Y-commodity is measured along the vertical scale. Given the prices of two commodities and income of the consumer the price line AB is drawn. If prices remain constant but the income of the consumer rises, the price line will shift to the right to A_1B_1 and A_2B_2. If there is a fall in income, price lines will shift to the left of the original price line. If the indifference map of the consumer

is super-imposed upon the price lines, AB is tangent to the indifference curve IC_1 at R. This is the original position of equilibrium. The consumer buys OQ units of X and OP units of Y at this position. A_1B_1 and A_2B_2 price lines are tangent to IC_2 and IC_3 at S and T respectively. These are new positions of equilibrium, when the income of the consumer rises. By joining R, S and T, it is possible to draw the Income-Consumption Curve (ICC). The income-consumsption curve (ICC) shows what quantities of X and Y commodities are purchased by the consumer, if his income increrases while prices of two commodities remain the same. At S consumer buys OQ_1 units of X and OP_1 units of Y. In the equilibrium position T, he buys OQ_2 units of X and OP_2 units of Y. Thus consumer increrases the purchase of both the commodities, when his income rises. In such a situation, the income effect is said to be *positive* and ICC rises upwards from left to right.

Inferior Commodity

It was supposed above that both X and Y commodities were normal or superior. When one of the two commodities is inferior, the increase in income will involve larger purchase of the superior commodity but a decrease in the purchase of the inferior commodity. In these situations, the income effect is said to be *negative*.

In Figs. 4.22 and 4.23 X commodity is measured along the horizonal scale and Y commodity is measured along the vertical scale.

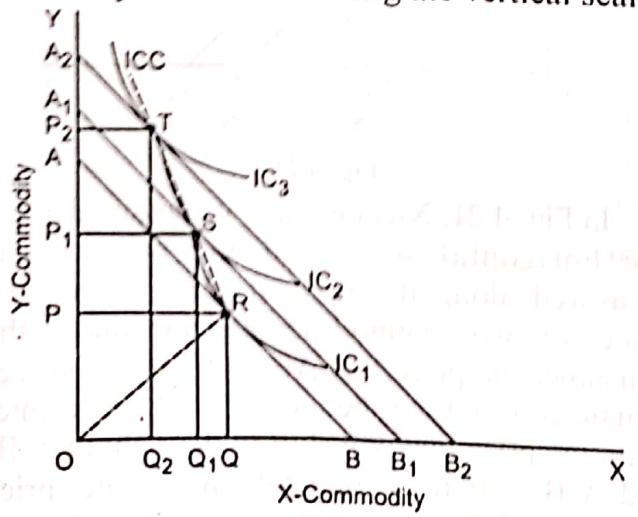

Fig. 4.22

In Fig. 4.22, X commodity is supposed to be *inferior*, while the commodity Y is normal. The original price line is AB. Given the prices of two commodities, the increase in income shifts the price line to A_1B_1 and A_2B_2. If indifference map is superimposed, AB, A_1B_1 and A_2B_2 are tangent to IC_1, IC_2 and IC_3 at R, S and T respectively. Joining these points with origin, the income-consumption curve (ICC) is drawn. It initially slopes upwards from left to right but later slopes negatively or bends backwards towards Y-axis. Originally at R, consumer buys OQ of X and OP of Y. As income rises, he purchase OQ_1 of X and OP_1 of Y at S and OQ_2 of X and OP_2 of Y at T. Thus consumer increases the purchase of normal commodity Y but reduces the purchase of inferior commodity X, subsequent to an increase in income. The reduced purchase of inferior commodity indicates that the income effect is negative.

In Fig. 4.23 the X-commodity is supposed to be normal while the Y commodity is inferior. The price lines AB, A_1B_1 and A_2B_2 are tangent to IC_1, IC_2 and IC_3 at R, S and T respectively. By joining the equilibrium points R, S and T with origin, the income-consumption curve (ICC) has been drawn which initially slopes positively but later slopes negatively or bends downwards towards the X-axis. Originally at R, consumer

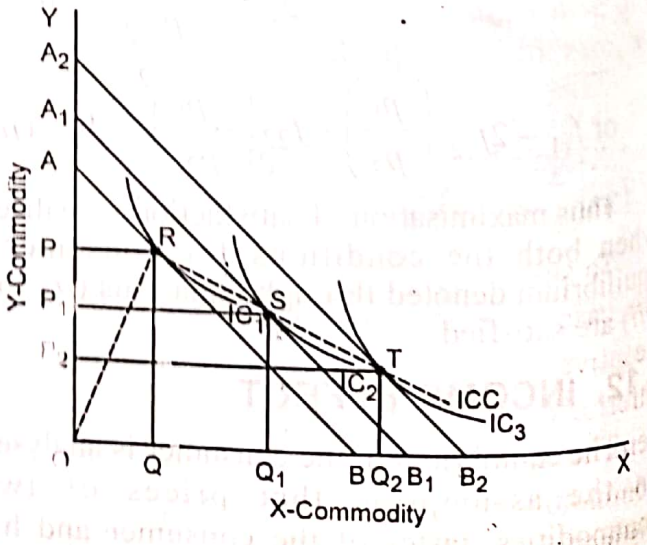

Fig. 4.23

buys OQ of X and OP of Y. At S he buys OQ_1 of X and OP_1 of Y and at T he buys OQ_2 of X and OP_2 of Y, following the rise in income. So the consumer increases the purchase of normal commodity X but reduces the purchase of inferior commodity Y. The reduced purchase of inferior commodity indicates that the income effect is negative even in this case.

The shape of the income-consumption curve can give the indication of nature of a commodity.

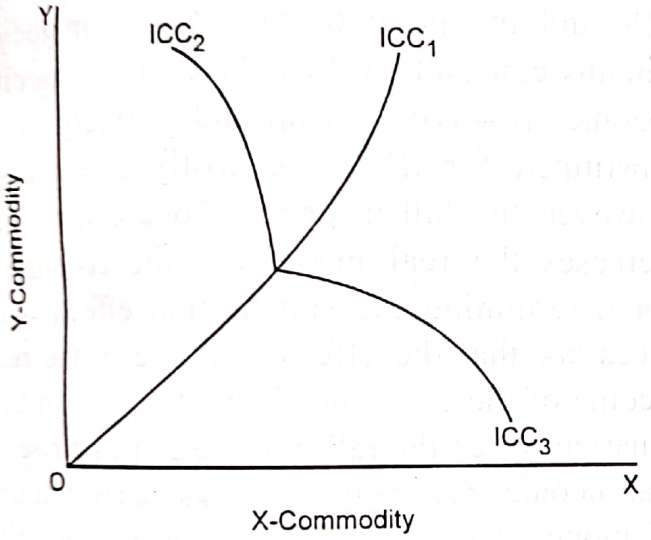

Fig. 4.24

In Fig. 4.24, ICC_1, ICC_2 and ICC_3 are different shapes of income–consumption curves. ICC_1 slopes positively. It show that both X and Y commodities are normal or superior. ICC_2 initially slopes positively and later bends backwards towards Y-axis. It show that X-commodity is inferior, while Y commodity is normal. ICC_3 initially slopes positively but later slopes downwards towards the X-axis. It shows that X-commodity is normal or superior, while Y commodity is inferior.

To sum up, the income effect is positive in the case of normal or superior goods. It is negative, when one of the two commodity is inferior or Giffen good. The income effect is zero, in case a commodity is neutral *i.e.*, the commodity is neither distinctly superior nor distinctly inferior.

4.13. SUBSTITUTION EFFECT

The equilibrium of the consumer can undergo shift not only because of a change in the income of the consumer but also because of substitution of one commodity in place of the other. If there is a relative change in the prices of two related goods, given the money income of the consumer, the cheaper commodity is substituted in place of the relatively more costly commodity. The effect of substitution of one commodity for the other on consumer's purchases is called as the substitution effect. Sometimes substitution takes place in such a way that there is neither gain nor loss in satisfaction. When there is such compensating variation in satisfaction, the consumer is neither better off nor worse off and he remains at the same level of satisfaction.

Assumptions

The substitution effect rests upon the following main assumptions :

(*i*) Two commodities X and Y are related to each other. More specifically, X and Y are substitutable goods.

(*ii*) There is no change in tastes or preferences of the consumer.

(*iii*) There is no change in money income of the consumer.

(*iv*) There is relative change in the prices of two commodities. Suppose the price of X falls and, at the same time, the price of Y rises. The commodity X will be considered as relatively very cheap when compared with Y. Consequently, consumer may start substituting X commodity in place of the Y commodity.

The effect of substitution upon the purchases of the consumer can be explained with the help of Fig. 4.25.

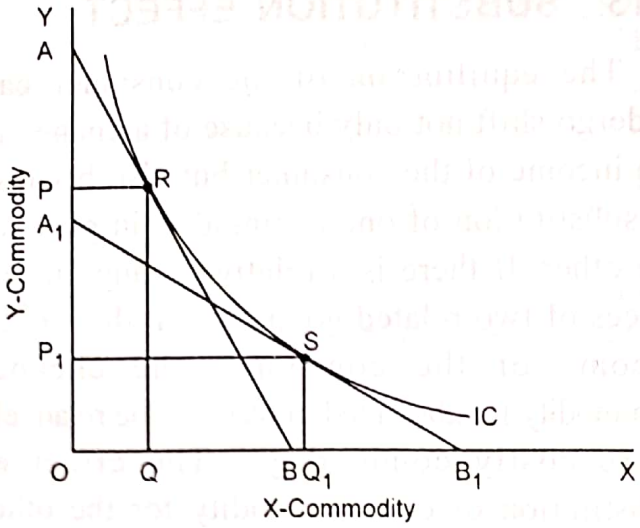

Fig. 4.25

In Fig. 4.25, X-commodity is measured along the horizontal scale and Y-commodity is measured along the vertical scale. Given income of the consumer and prices of two commodities, AB is the price line. If price of X falls and that of Y rises, the new price line is A_1B_1. If the indifference map is super-imposed upon these price lines, AB is tangent to the indifference curve at R and the price line A_1B_1 is tangent to it at point S. At the original equilibrium position, consumer buys OQ quantity of X and OP quantity of Y. At S, the point of final equilibrium, he buys OQ_1 units of X and OP_1, units of Y. It is clear that consumer increases the purchase of X by QQ_1 in place of PP_1 of Y. This is the subsitution effect.

No doubt, the substitution effect shifts the equilibrium of the consumer from R to S. The movement of equilibrium from R to S along the same indifference curve shows that consumer is neither better off nor worse off than before. The level of satisfaction remains the same. The gain in utility due to larger purchase of X is fully neutralised by the loss in utility due to smaller purchase of Y. It is because of this *compensating variation* that the consumer remains at the same level of satisfaction, despite the substitution of cheaper commodity in place of costly commodity.

The substitution effect is normally positive because consumer always tends to substitute the cheaper commodity for the costly commodity.

4.14. HICKS-ALLEN SUBSTITUTION EFFECT

The Hicks-Allen substitution effect explains the effect of a change in the price of a commodity upon the purchase of the consumer, when the real income of the consumer is left unchanged. Suppose the price of one commodity falls and the price of the other commodity remains constant, so that the first commodity becomes relatively cheap and is likely to be substituted for the more costly commodity. However, the fall in price of one commodity increases the real income of the consumer. For determining the substitution effect, it is necessary that the effect of a rise in the real income of the consumer is neutralised. In this situation, when the fall in price causes a rise in real income, according to Hicks, some amount of money should be taken away from the consumer such that he is neither better off nor worse off and is at the same level of satisfaction as in the original position and even after the change in price, the equilibrium of the consumer gets determined at the original indifference curve. Similarly if the price of one of the two commodities rises resulting in a fall in the real income of the consumer, he should be given some more units of money such that his real income remains at the original level and the equilibrium of the consumer after the change in price can still be determined at the original indifference curve. The changes in money income, subsequent upon relative change in prices of two commodities, such that the consumer is neither better off nor worse off is called the *compensating variation in income*. In other words, the compensating variation in income is the change in money income of the consumer that is sufficient to compensate him

The tangency between AB and the indifference curve IC takes place at R where consumer buys OQ of X and OP of Y. If the price of X rises, the price line shifts to AB_1. The rise in price of X causes a fall in the real income of the consumer. In order to compensate the consumer, according to Hicksian principle of compensating variation in income, some amount of money should be given to the consumer. The amount of extra money to be given to consumer should be sufficient to offset the fall in real income such that consumer is again in equilibrium at the original indifference curve at S. At this equilibrium position, OQ_1 of X and OP_1 of Y is bought by the consumer. The movement from R to S represents Hicksian substitution effect. The consumer reduces the purchase of X by QQ_1 because the relatively cheaper commodity Y is substituted for more costly commodity X.

4.15. SLUTSKY SUBSTITUTION EFFECT

An alternative approach to the substitution effect was given by the Russian economist E.E. Slutsky. According to him, if the price of one of the two commodities changes, there is a change in the real income or purchasing power of the consumer. In order to keep the real income at the original level, some increase or reduction in the money income of the consumer has to be made. The variation in income, according to Slutsky, should be large enough to enable the consumer to buy the *original combination of goods*. This approach related to variation in income for neutralising the income effect is called the *cost difference* approach. The cost difference may be explained through an illustration. Suppose the money income of the consumer and price of Y are given. The price of X-commodity is originally Rs. 20 and its quantity purchased is 10 units so that amount of money needed to buy 10 units of X is $P_{X_0} \cdot Q_X = 20 \times 10 = Rs.\ 200$. If the price of X falls to Rs.16 and the consumer has still to buy 10 units of X, the amount of money required is $P_{X_1} \cdot Q_X = 16 \times 10 = Rs.\ 160$. It means the real income of the consumer has increased by Rs. 40. The cost difference approach suggests that the amount of Rs. 40 should be taken away from the consumer so that he should be able to buy the original combination.

When the income effect is offset through the cost difference approach, the price line passes through the original combination of two commodities.

Substitution Effect in Case of a Fall in Price

If the price of X-commodity falls, given the price of Y, the real income of the consumer rises. In order to offset the rise in real income, Slutsky suggested that some amount of money should be taken away from the consumer. The amount of money, according to the cost difference principle of Slutsky, should be such that consumer should still be able to buy the original combination. At the new equilibrium position, there is still larger quantity of X purchased by the consumer in substitution of more costly commodity Y. Slutsky's substitution effect in the event of a fall in the price of X is shown through Fig. 4.28.

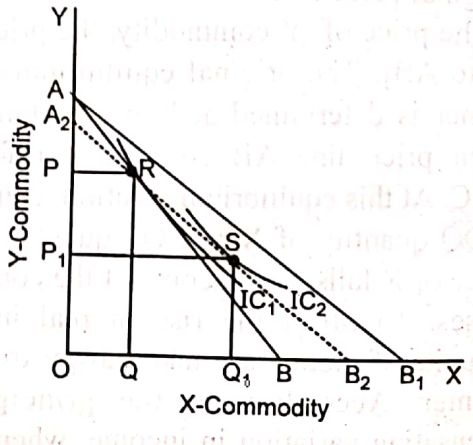

Fig. 4.28

In Fig. 4.28, given the money income and prices of two commodities, AB is originally the price line which is tangent to IC_1 at R. In this original position of equilibrium, the consumer buys OQ units of X and OP units of Y. If the price of X falls, price of Y remaining the same, the price line shifts to AB_1. Fall in the price of X raises the real income of the consumer. According to Slutsky's cost difference principle, some amount of money should be taken away from the consumer such that consumer should still be able to buy the original combination R. So when money income is reduced, the new price line A_2B_2 passes through the point R. This price line is tangent to a higher indifference curve IC_2 at S. At this equilibrium position, consumer buys OQ_1 units of X and OP_1 units of Y. The movement from R to S represents Slutsky's substitution effect. Consumer substitutes QQ_1 quantity of X in place of PP_1 quantity of Y, consequent upon fall in the price of X.

Substitution Effect in Case of Rise in Price

If there is a rise in the price of X-commodity, price of Y remaining constant, there is a fall in the real income of the consumer. In order to offset the fall in real income, the consumer should be compen-sated by giving him some extra amount of money. According to Slutsky-Samuelson cost difference approach, the amount of money to be given to the consumer should be large enough to enable him to buy the original combination. At the new equilibrium position, the consumer will buy lesser quantity of X as there is substitution of cheaper commodity Y in place of the more costly commodity X. Slutsky's substitution effect in the event of a rise in the price of X can be shown with the help of Fig. 4.29.

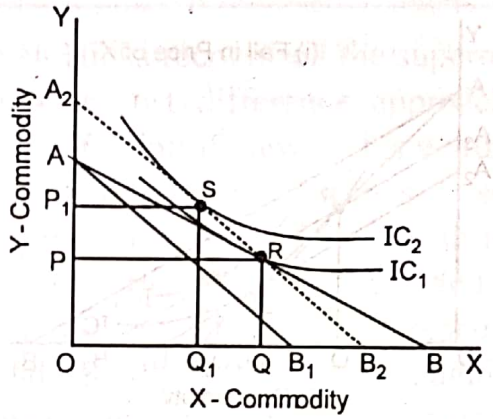

Fig. 4.29

In Fig. 4.29, AB is originally the price line. Its tangency with the indifference curve IC_1 determines the original equilibrium position R where consumer buys OQ quantity of X and OP quantity of Y. As the price of X rises, price of Y remaining the same, the price line shifts to AB_1. Since the price of X has risen, consumer feels that his real income has gone down. In order to compensate the consumer, according to Slutsky's cost difference approach, some amount of money should be given over to the consumer large enough to enable the consumer to buy again the original combination R. Thus, the new price line A_2B_2 passes through the original combination R. This price line is tangent to a higher indifference curve IC_2 at S where consumer buys OQ_1 units of X and OP_1 units of Y. The movement from R to S reflects the substitution effect. The consumer in this case substitutes PP_1 quantity of the cheaper commodity Y in place of QQ_1 quantity of relatively more costly commodity X.

4.16. COMPARISON BETWEEN HICKSIAN APPROACH AND SLUTSKY APPROACH

A comparative study can be attempted about the substitution effects suggested by Hicks and Slutsky. In Fig. 4.31 and Fig. 4.30 given below the substitution effects due to a fall and rise in price of X measured through the two alternative approaches are analysed.

case of the Giffen goods like X bends backwards towards Y-axis. At these equilibrium positions R, S and T, consumer buys OQ, OQ_1 and OQ_2 units of X-commodity respectively.

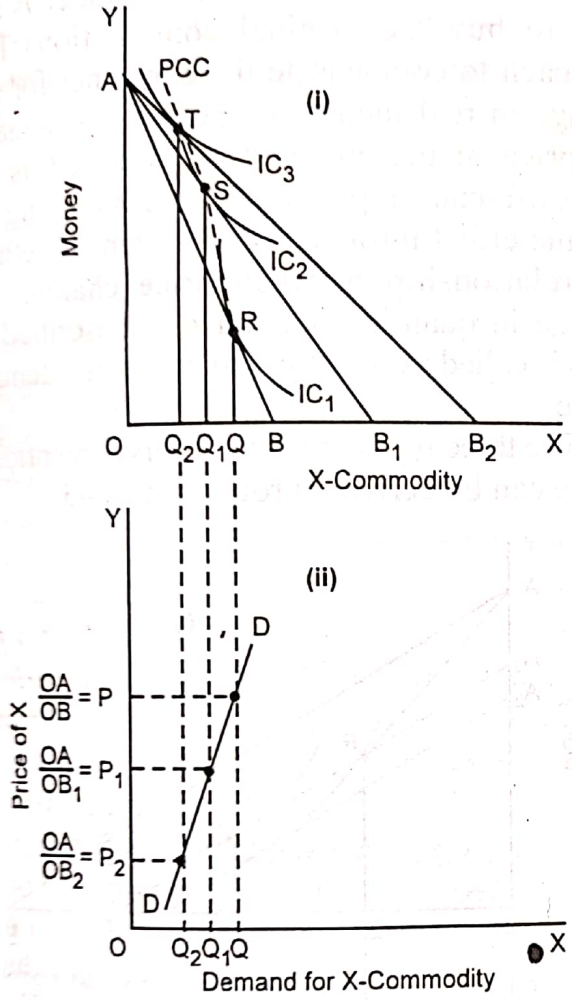

Fig. 4.42

In Part (ii) of Fig. 4.42, given the quantities OQ, OQ_1 and OQ_2 of X-commodity and its price $OA/OB = OP$, $OA/OB_1 = OP_1$ and $OA/OB_2 = OP_2$ respectively, the demand curve DD has been derived. It slopes upwards from left to right. It shows that the law of demand does not hold valid in case of Giffen goods.

4.23. ORDINARY DEMAND CURVE AND COMPENSATED DEMAND CURVES

The traditional cardinal utility approach and the ordinal utility approach gave rise to three different conceptions of demand curve—(1) Marshallian ordinary demand curve, (2) Hicksian compensated demand curve, and (3) Slutsky's compensated demand curve.

1. Marshallian Ordinary Demand Curve

Marshallian ordinary demand curve rests upon cardinalist premise that price of a commodity is equal to its marginal utility (Price = MU). As price falls, there is a fall also in marginal utility. Since lower marginal utility is associated with the larger purchase of a commodity, it implies that the quantity demanded of the commodity rises with a fall in its price and vice-versa. Consequently, Marshallian ordinary demand curve slopes downwards from left to right. This demand curve rests on the simplifying assumptions of constancy of consumer's tastes, money income and prices of related goods. In Marshallian demand curve, the income effect is ignored on the ground that an insignificant amount of money is spent by the consumer on the purchase of any single commodity. Therefore, any income effect due to a change in the price of the commodity is very small and it can be safely ignored. Given such a presumption, there is no need of compensating the consumer for the variations in real income on account of a change in the price of the commodity. Marshallian ordinary demand curve is, therefore, an *uncompensated* demand curve. Had Marshall considered income effect, his demand curve would not have been necessarily a negatively sloping curve. It could have assumed any shape.

Marshallian assumption of constancy of money income is put to objection as in case of luxury commodities, the consumer spends a significantly large proportion of income even on the purchase of a single commodity. Milton Friedman seems to have accepted the assumption of constancy of real income. However, in his opinion, a meaningful demand curve can be derived, if the assumption of constancy of prices of related goods is dropped. He suggested that the assumption should have been taken that the average price of all other goods moves inversely with every change in the price of the good in question. It amounts to

assuming compensating variation in price instead of compensating variation in income so as to keep the real income constant. For instance, if price of commodity X falls, the real income of the consumer rises. This rise in real income should not be offset by reduction in money income of the consumer but through rise in the average price of all other commodities. Milton Friedman believed that Marshall had perhaps this notion of demand curve in his mind. This interpretation given by Friedman has the merit of clarity. It is also amenable to empirical testing.

Despite Friedman's interpretation, the fact of the matter is that income effect remained ignored in Marshall's demand curve. He did not separate income and substitution effects from price effect. The entire change in the quantity demanded of a commodity stands attributed only to the change in the price of given commodity.

2. Hicksian Compensated Demand Curve

Hicks attempted to explain the relation between price and demand, not by ignoring the income effect but by neutralising the effect of a change in real income through the method of compensating variation in income. In this method, Hicks suggested that the money income of the consumer should either by raised or lowered to neutralise any variation in real income consequent upon a change in the price of the given commodity. The change in money income should be of the magnitude that consumer remains at the original level of satisfaction or the equilibrium of the consumer after compensating variation in income gets determined at the original indifference curve. The price demand relation after making compensating variation in income or after offsetting income effect can give a demand curve termed as Hicksian compensated demand curve.

3. Slutsky's Compensated Demand Curve

Slutsky suggested an alternative way for neutralising the income effect resulting from a change in the price of the commodity. In order to keep the real income of the consumer constant, according to Slutsky, the money income of the consumer should be raised or lowered by such a magnitude that the consumer is still able to buy the original combination. This approach to compensate the consumer for any change in real income caused by a change in the price of the commodity is termed as the cost difference approach. After eliminating the income effect through cost difference method, the relationship between price change and change in quantity demanded is described by what is called as Slutsky's compensated demand curve.

The three types of demand curves mentioned above can be derived through Fig. 4.43.

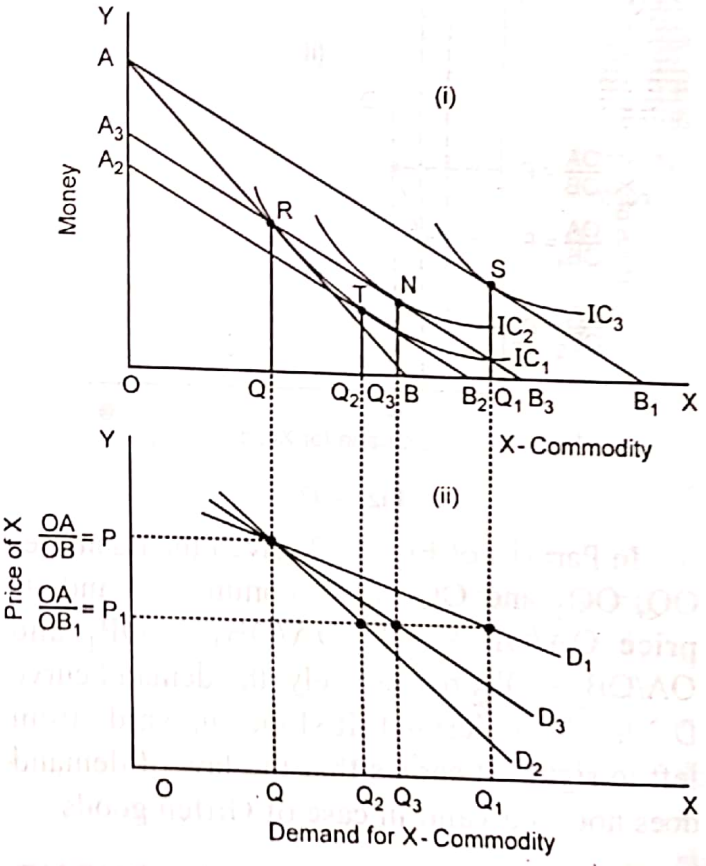

Fig. 4.43

In Fig. 4.43 (*i*), units of X-commodity are measured along the horizontal scale. Money is measured along the vertical scale. Given OA units of money and some price of X-commodity, OB quantity of X can be bought and price line is AB. As price of X falls, the price line shifts to AB_1. Price line AB is tangent to IC_1 at R

and AB_1 is tangent to IC_3 at S. The movement from R to S measures the total price effect which is measured by QQ_1 quantity of X-commodity. Since fall in the price of X raises real income of the consumer, Hicks suggested a reduction in money income of the consumer, according to the principle of compensating variation in income, such that the equilibrium of the consumer gets determined at the original indifference curve or at the original level of satisfaction. As money income of the consumer is reduced, the price line is A_2B_2 which is tangent to IC_1 at T. The movement from S to T is the income effet. After eliminating it, the Hicksian substitution effect is QQ_2. So according to Hicks, real income remaining the same, the given fall in price of X causes a rise in quantity bought of X by QQ_2.

According to Slutsky, if a fall in the price of X causes a rise in real income, some amount of money should be reduced such that consumer is still able to buy the original combination R. According to Slutsky's cost difference approach, when money income of the consumer is reduced, the new price line is A_3B_3 which passes through the original combination R. This price line is tangent to a higher indifference curve IC_3 at N. The movement from S to N is the income effect. After eliminating the income effect Q_1Q_3 from the price effect QQ_1, Slutsky's substitution effect is QQ_3. So according to Slutsky, real income remaining constant, the given fall in price of X causes a rise in quantity bought of X by QQ_3.

In Fig. 4.43 (*ii*), demand for X-commodity is measured along the horizontal scale. Price of X is measured along the vertical scale. From Q, Q_1, Q_2 and Q_3 verticals are dropped on Fig. 4.43 (*ii*). Originally, given the amount of money OA and maximum quantity that can be bought as OB_1, the initial price of X is $\frac{OA}{OB} = OP$. Subsequently given the amount of money OA and quantity of X that can be bought as OB_1, the price of X falls to $\frac{OA}{OB_1} = OP_1$. The Marshallian ordinary demand curve is D_1 which shows that fall in price from OP to OP_1 causes a rise in demand from OQ to OQ_1 which is equal to the total price effect. In this demand curve, the income effect has been altogether ignored. In Hicksian analysis, after eliminating the income effect the rise in quantity demanded due to a fall in price from OP to OP_1 is from OQ to OQ_2. D_2 is the Hicksian compensated demand curve. In Slutsky's cost difference approach, after the elimination of income effect, the quantity demanded rises from OQ to OQ_3 due to the given fall in the prie of X from OP to OP_1. This relation is expressed by the demand curve D_3 which is Slutsky's compensated demand curve.

While Marshallian ordinary demand curve D_1 shows quite large rise in demand QQ_1 due to PP_1 fall in the price of X, Hicksian compensated demand curve D_2 shows relatively much smaller extension in demand QQ_2 due to PP_1 fall in price. Slutsky's compensated demand curve D_3 shows that rise in quantity demanded QQ_3 is relatively more than that shown by the Hicksian compensated demand curve on account of PP_1 fall in the price of X-commodity. Marshallian ordinary demand curve is the most elastic. Hicksian compensated demand curve is the least elastic and Slutsky's compensated demand curve is more elastic than the Hicksian demand curve.

4.24. COMPARISON BETWEEN CARDINAL UTILITY ANALYSIS AND ORDINAL UTILITY ANALYSIS

The ordinal utility analysis or indifference curves analysis was developed by the writers like Pareto, Edgewroth, Fisher, Hicks and Allen as an alternative approach to the cardinal utility approach. Although the indifference curves theory is fundamentally different from the cardinal utility analysis, yet certain similarities existing between them can not be overlooked.

5 Elasticities of Demand and Supply

5.1. INTRODUCTION

The law of demand makes a *qualitative* statement about the relation between price and demand. It explains that demand rises with a fall in price and vice-versa, if other things remain constant. So the law of demand deals only with direction of change in demand due to a change in price. But law of demand fails to explain what will be the extent of change in demand due to given change in price. The *quantitative* relation between demand and price was not considered by that law. It is the concept of elasticity of demand which deals with this aspect. If a small change in price, say 10 percent, causes a 12 percent change in demand, the demand is said to be more sensitive or more responsive or more elastic. On the opposite, if the price changes by 10 percent but demand changes only by 8 percent, the demand is less sensitive, less responsive or less elastic. The elasticity of demand indicates the degree of sensitiveness or responsiveness of demand for a particular commodity, to a given change in the variable like price, income or price of related commodity. Given these three main determinants of demand, the concept of elasticity of demand is understood to have three main types–(*i*) Price Elasticity of Demand, (*ii*) Income Elasticity of Demand and (*iii*) Cross Elasticity of Demand.

5.2. PRICE ELASTICITY OF DEMAND

Price elasticity of demand indicates the degree of responsivensess or sensitiveness of demand for a commodity to a given change in its price. Suppose the price of cloth falls by 10 percent and its demand expands by 15 percent. It shows the response of demand to price is greater. In other words, the demand for cloth is more elastic. On the opposite, if the price of wheat rises by 10 percent but its demand falls only by 4 percent, it indicates that the demand for wheat is less responsive to the change in price. It signifies that demand for wheat is less elastic. The different writers have defined the price elasticity of demand as below :

In the words of **Marshall,** "*The elasticity (or responsiveness) of demand in a market is great or small according as the amount demanded*" increases much or little for a given fall in price and diminishes much or little for a given rise in price.

According to **Stonier and Hague,** "*Elasticity of demand is, therefore, a technical term used by the economists to describe the degree of responsiveness of the demand for a good to a fall in its price.*" **Cairncross** sates : "*The elasticity of demand for a commodity is the rate at which quantity bought changes as the price changes.*" In the words of **Meyers,** "*The elasticity of demand is a measure of the relative change in amount purchased in response to a relative change in price on a given demand curve.*"

According to **Boulding** "*The elasticity of*

demand may be defined as the percentage change in the quantity demanded which would result from the percentage change in price." **Samuelson** writes, "*This concept indicates the degree of responsiveness of quantity demanded to change in price.*"

To sum up, the price elasticity of demand expresses the degree of co-relation between demand and price.

5.3. DEGREES OF PRICE ELASTICITY OF DEMAND

The price elasticity of demand is the measure of relative change in demand for a commodity to a change in its price. There are the following main degrees of the price elasticity of demand :

(i) *Perfectly elastic demand* : The demand is said to be perfectly elastic, when any quantity of a commodity can be bought at the same price. A slight rise in a price above the given level, results in demand falling down to zero. A slight fall in price below the given level, causes an infinite expansion in demand. A perfectly elastic demand means the co-efficient of price elasticity of demand is equal to infinity ($E_p = \infty$).

(ii) *Perfectly inelastic demand* : The demand is said to be perfectly inelastic when the demand for the commodity remains unchange even though price rises or falls. Suppose the demand for cloth is 100 metres at the price of Rs. 50 per metre. If price falls to Rs. 40 or it rises to Rs. 60 but demand remains at 100 metres, the demand is perfectly inelastic. The perfectly inelastic demand means that the co-efficient of price elasticity of demand is zero ($E_p = 0$).

(iii) *Relatively more elastic demand* : If the percentage change in demand for a commodity is more than the percentage change in its price, the demand is supposed to be relatively more elastic. If price of cloth falls by 10 percent and its demand expands by 16 percent, the demand is relatively more elastic. In such a situation, the co-efficient of price elasticity of demand is greater than unity ($E_p > 1$).

(iv) *Relatively less elastic demand* : If the percentage change in demand for a commodity is less than the percentage change in its price, the demand is relatively less elastic. Suppose price of wheat falls by 10 percent but it demand expands only by 6 percent, the demand is relatively less elastic. In this case, the co-efficient of price elasticity of demand is less than unity ($E_p < 1$).

(v) *Unitary elastic demand* : If the percentage change in demands is exactly equal to the percentage change in price, the demand is said to be unitary elastic. If the price of ball pen falls by 10 percent and the demand for them rises also by exactly 10 percent, the demand is unitary elastic. In case of unitary elastic demand, the price elasticity co-efficient is equal to unity ($E_p = 1$).

The above cases indicating the different degree of price elasticity of demand can be shown with the help of Fig. 5.1.

In Fig. 5.1 (i) to (v), demand is measured along the horizontal scale and price is measured along the vertical scale. In Fig. 5.1(i), the demand curve DD is a horizontal straight line. At the price OP, consumer may buy any quantity OQ or OQ_1. In this case, price elasticity of demand is said to be infinity ($E_p = \infty$). In Fig. 5.1 (ii), the demand curve DD is a vertical straight line. Originally demand is OQ at price OP. If price rises to OP_1 or falls to OP_2 the quantity demand remains unchanged at OQ. Since demand is completely insensitive to price, the price elasticity of demand is said to be zero ($E_p = 0$). In Fig. 5.1 (iii). DD is the demand curve. At OP price, demand is OQ. If price slightly falls to OP_1 demand expands by a large measure from OQ to OQ_1. In this case, the price elasticity of

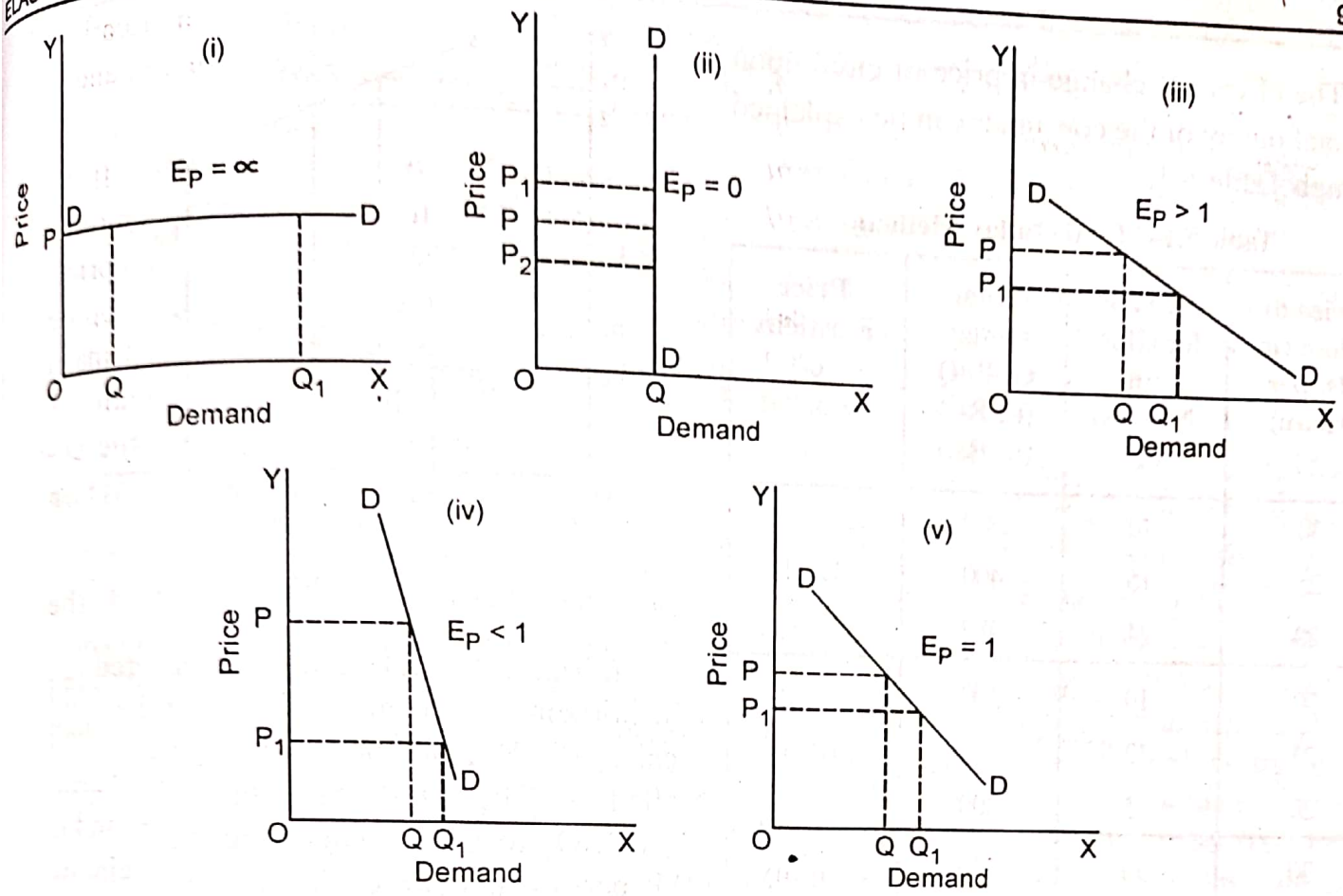

Fig. 5.1

demand is greater than unity. ($E_P > 1$). In Fig. 5.1 (iv), DD is the demand curve. The demand is OQ at the price OP. If price falls to OP_1, there is a relatively small percentage rise in demand to OQ_1. In this case, the price elasticity of demand is less than unity ($E_P < 1$). In Fig. 5.1 (v), DD is the demand curve. At OP price, the demand is OQ. When price falls to OP_1, the demand rises to OQ_1 in the same proportion as price falls. In this case, the price elasticity of demand is equal to unity ($E_P=1$).

5.4. MEASUREMENT OF PRICE ELASTICITY OF DEMAND

The price elasticity of demand can be measured through the following methods : (*i*) Total outlay method, (*ii*) Proportionate method, (*iii*) Point method, (*iv*) Arc method, (*v*) Revenue method. These methods are discussed below :

(1) Total Outlay Method

The total outlay method for the measurement of price elasticity of demand was suggested by Alfred Marshall. This method attempts to measure the elasticity of demand through the change in total outlay or total expenditure subsequent to a change in the price of the commodity.

(*a*) If with a fall in the price of a commodity, demand changes in such a way that total outlay increases and with a rise in price, the total outlay falls, the price elasticity of demand is greater than unity ($E_P > 1$).

(*b*) If with a rise or fall in price of the commodity, the total outlay remains the same, the price elasticity of demand is equal to unity ($E_P = 1$).

(*c*) If with a fall in price, demand rises in such a way that total outlay also falls and with a rise in price, the total outlay also rises, the price elasticity of demand is said to be less than unity ($E_P < 1$).

6 Consumer and Producer's Surplus

6.1. INTRODUCTION

A consumer sometimes feels that he has received some extra satisfaction from the purchase of a commodity. This happens when the commodity becomes available at a price lower than the price expected by the consumer. This extra satisfaction is called as consumer's surplus. This concept was originally developed by French economist A.J. Dupuit in 1844. It was later modified by Marshall in 1879 and was named *consumer's surplus*. Boulding called it as *Buyer's surplus*. J.R. Hicks employed indifference curves for its measurement. The different aspects of the concept of consumer's surplus will be discussed in the present chapter.

6.2. CONCEPT OF CONSUMER'S SURPLUS

When a consumer spends some amount of money on the purchase of commodity, he sometimes experiences that the satisfaction from the commodity is in excess of the money spent. This extra or additional satisfaction is regarded as the consumer's surplus. Suppose a person is willing to pay Rs. 300 for a ticket of a cricket test match. Actually the ticket is available to him at a price of Rs. 150. It means the consumer has received an extra satisfaction equivalent to the satisfaction from Rs. 150. This extra satisfaction is the consumer's surplus.

When a consumer spends some amount of money on a commodity, there is some loss in utility. If the satisfaction from the commodity more than offsets the loss in utility, there is surplus satisfaction to him. Suppose a consumer spends 50 paise on a match box. The loss in utility is equal to 50 paise. If the toal utility from match box is more than 50 paise, he gets extra satisfaction identified as consumer's surplus.

The concept of consumer's surplus was defined by **Marshall** in these words, "*The excess of the price which a person would be willing to pay rather than go without the thing over that which he actually does pay is the economic measure of this surplus satisfaction. It may be called as consumer's surplus.*" According to **Penson,** "*The difference between what we would pay and what we have to pay is called the consumer's surplus.*" In the words of **Taussig,** "*Consumer's surplus is the difference between the potential price and the actual price.*" **Koutsoyiannis** writes, "*Consumer's surplus is equal to the difference between the amount for a commodity which a consumer actually pays and the amount that he would be willing to pay for this quantity.*" According to **Samuelson,** "*There is always a sort of gap between total utility and total market value. This gap is in the nature of a surplus, which the consumer gets because he receives more than he pays for.*"

In the words of **J.K. Mehta,** "*Consumer's surplus obtained by a person from a*

commodity is the difference between the satisfaction which he derives from it and that which he foregoes in order to procure that commodity."

6.3. ASSUMPTIONS OF CONSUMER'S SURPLUS

The concept of consumer's surplus is based upon the following main assumptions :

(*i*) The utility from a commodity is measured through the cardinal system.

(*ii*) The marginal utility of money remains constant.

(*iii*) Each commodity is independent of the other commodities. It implies that the utilities and prices of other commodities cannot affect the utility of the given commodity.

(*iv*) There is no change in tastes, fashion, customs and income of the consumer.

(*v*) There is no change in income.

(*vi*) There are no substitutes or complements for the given commodity.

(*vii*) There is a direct and proportional relation between utility and satisfaction.

(*viii*) The law of diminishing marginal utility applies on the purchases of the consumer.

6.4. MEASUREMENT OF CONSUMER'S SURPLUS THROUGH CARDINAL UTILITY APPROACH

The concept of consumer's surplus was defined by Marshall and many subsequent writers in terms of the difference between the price which a consumer is willing to pay and the price which he actually pays.

Consumer's Surplus = Price which he is willing to pay – Price which he actually pays.

Suppose a consumer wants to pay Rs. 35 per kg. of mangoes but the actual market price is Rs. 25 per kg. Through this purchase, the consumer, gets extra satisfaction or consumer's surplus equivalent to 35 – 25 = Rs. 10.

If consumer purchases more than one units of the commodity, the consumer's surplus from the entire purchase can be measured by the difference between the amount which he is willing to pay and the amount which he actually pays.

Consumer's Surplus = Amount which he is willing to pay – Amount which he actually pays.

Suppose a consumer wants to purchase 12 Kg. of apples by spending Rs. 360. If the actual price is Rs. 25 per Kg., he spends Rs. 300 for buying this quantity. The consumer's surpluse will be 360 – 300 = Rs. 60.

The amount which a consumer wants to pay is always equal to the total utility from the total quantity bought. The amount actually spent is determined by the product of units of the commodity bought and market price. So the consumer's surplus can also be measured as below :

Consumer's Surplus = Total Utility – (No. of Unit Purchased × Market Price).

The mesurement of consumer's surpluse can be explained through Table 6.1.

Table 6.1—Consumer's Surplus

Units of Apples	Marginal Utility	Price (in Paisa)	Consumer's Surplus
1	136	80	136 – 80 = 56
2	128	80	128 – 80 = 48
3	116	80	116 – 80 = 36
4	100	80	100 – 80 = 20
5	80	80	80 – 80 = 0

In the Table 6.1, it is assumed that each unit of utility is equal to 1 paise. As consumer has more and more units of apples, the marginal utility falls due to the law of diminishing utility. The price which a consumer is willing to pay is equal to the marginal utility. If price per apples is 80 paise, consumer will buy 5 units of apples because, at this point, the marginal utility becomes equal to price (MU = Price). 5th unit is the marginal unit. Consumer's surplus is available on the *intra-marginal units* (units prior to the 5th unit). When first apple is bought, the M.U. or price which consumer is willing to pay is 136 paise and actual price is 80 paise, so that consumer's surplus is 136 – 80 = 56 paise. In the case of second, third and fourth units of apples, the consumer's surplus amounts to 48, 36 and 20 respectively. From the fifth or marginal unit, the consumer's surplus is (80 – 80) = 0. The consumer's surplus from the successive units decreases due to the law of diminishing marginal utility. From the entire purchase of 5 units of apples, the consumer's surplus is 56 + 48 + 20 + 0 = 160 paise. Alternatively, the consumer's surplus can be measured with the help of total utility and the amount actually spent. The total utility from five units of apples is 136 + 128 + 116 + 100 + 80 = 560 paise. The amount actually spent is determined by multiplying number of units bought and the market price. It amounts to 5 × 80 = 400 paise. So the consumer's surplus is 560 – 400 = 160 paise.

Consumer's Surplus = Total Utility – (No. of Units Purchased × Market Price)

$$= 560 - (5 \times 80)$$

$$= 560 - 400 = 160$$

The measurement of consumer's surplus can be explained also through Fig. 6.1.

In Fig. 6.1, units of apples are measured along the horizontal scale and marginal utility and price are measured along the vertical scale. DD_1 is the demand curve or marginal utility curve. If price is OP, the consumer will buy OQ units of apples and the total utility is OQRD. The amount actually spent is determined by the product of OQ units of apples and the market price OP. Thus the amount actually spent is OQ × OP = OQRP. Now the Consumer's Surplus = OQRD – OQRP = PRD.

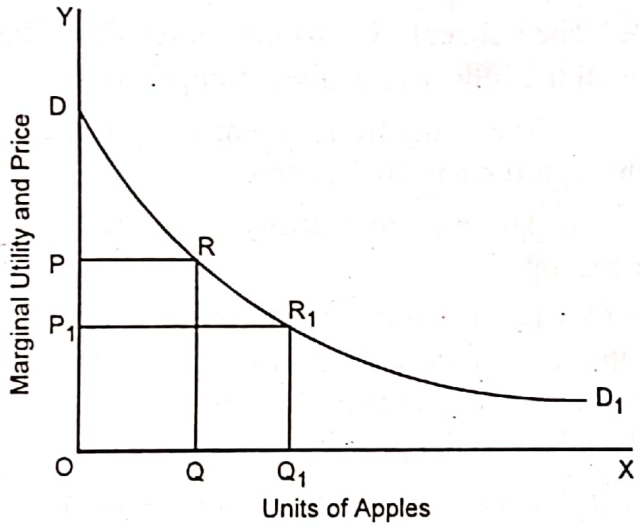

Fig. 6.1

There is an inverse relation between price of the commodity and the consumer's surplus. If the price of the commodity falls, there is an increase in consumer's surplus and vice-versa. If the price of apples falls from OP to OP_1, the consumer buy OQ_1 units. The total utility, in this case is OQ_1R_1D and the amount spent is $OQ_1 \times OP_1 = OQ_1R_1P_1$. Consquently, the consumer's surplus is $OQ_1R_1D - OQ_1R_1P_1 = P_1R_1D$ which is more than before.

6.5. MEASUREMENT OF CONSUMER'S SURPLUS THROUGH INDIFFERENCE CURVES APPROACH

The measurement of consumer's surplus through cardinal utility approach was based on several faulty and unrealistic assumptions. Hicks explained the measurement of consumer's surplus with the help of indifference curves or ordinal utility approach as shown through Fig. 6.2.

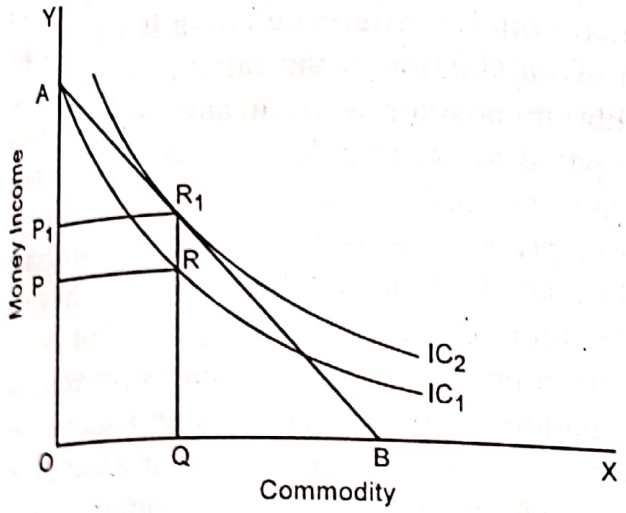

Fig. 6.2

In Fig. 6.2, X-commodity is measured along the horizontal scale and money income is measured along and the vertical scale. Consumer has OA amount of money. The indifference curve IC_1 shows different combinations of X-commodity and money which the consumer wants to have. Suppose consumer wants to have the combinations R. In this combination, consumer wants to have OQ units of X-commodity and keep OP amount of money. It means the consumer is willing to spend OA – OP = AP amount of money. If price of X-commodity is given, AB price line can be drawn. If consumer wants to have OQ units of X, the relevant combination is R_1 where the price line AB is tangent to indifference curve IC_2. At R_1, consumer buys OQ units of X and keeps OP_1 units of money. So the consumer actually spends $OA - OP_1 = AP_1$ amount of money and the consumer's surplus is $AP - AP_1 = PP_1$ units of money.

If there is a fall in the price of the commodity, the consumer's surplus rises. On the opposite, if the price rises, there is decrease in the consumer's surplus. The increase in consumer's surplus due to a fall in price is shown through Fig. 6.3.

In Fig. 6.3, X-commodity is measured along the horizontal scale and money income is measured along the vertical scale. In the beginning, given the price line AB, the consumer's surplus is PP_1.

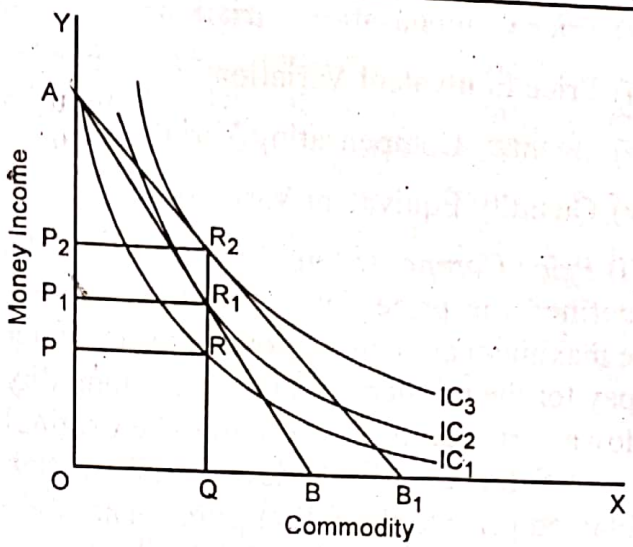

Fig. 6.3

If there is a fall in the price of the commodity, the price line shifts to the right to AB_1. Since consumer wants to buy OQ units of X, the relevant combination is R_2 when price line AB_1 is tangent to the indifference curve IC_3. Combination R_2 signifies that consumer has OQ units of X and retains OP_2 units of money. It means the amount actually spent is $OA - OP_2 = AP_2$. Now the consumer is willing to spend AP units of money but he actually spends AP_2 unit of money. Thus the consumer's surplus is $AP - AP_2 = PP_2$. It is, therefore, clear that the fall in the price of X-commodity brings about a rise in consumer's surplus from PP_1 to PP_2.

6.6. HICKSIAN COMPENSATING VARIATION AND EQUIVALENT VARIATION OF PRICE CHANGE

In Marshallian analysis of consumer's surplus, the marginal utility of money was assumed to be constant and income effect due to a change in the price of a commodity had been ignored. Hicks attempted a more detailed and precise analysis of the concept of consumer's surplus. He considered income effect resulting from a price change in a more explicit manner. In this analysis related to consumer's surplus, he dealt with the following four types of variations in income :

(*i*) Price Compensating Variation

(*ii*) Price Equivalent Variation

(*iii*) Quantity Compensating Variation

(*iv*) Quantity Equivalent Variation.

(*i*) *Price Compensating Variation* : Hicks has defined the price compensating variation as the maximum amount of money the consumer will pay for the privilege of buying a commodity at a lower price so that he obtains the original level of satisfaction, *i.e.*, the level of satisfaction he obtained prior to the fall in price. The price compensating variation is explained through Fig. 6.4.

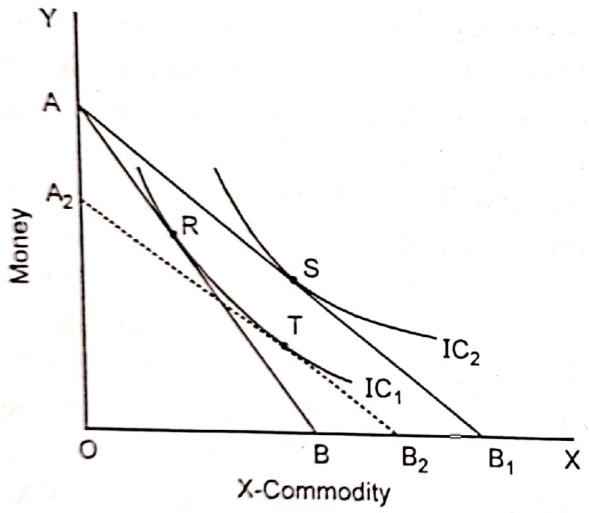

Fig. 6.4

In Fig. 6.4, X-commodity is measured along the horizontal scale and money is measured along the vertical scale. Given the money income OA and price of X-commodity, the price line is AB. The equilibrium of the consumer occurs at point R where price line AB is tangent to indifference curve IC_1. As the price of X falls, the price line shifts to AB_1 and the equilibrium of the consumer shifts to S where price line AB_1 is tangent to the indifference curve IC_2 at S where he secures more satisfaction than at R. Now the question arises, how much money the consumer is prepared to pay so that he can buy X-commodity and yet has the same satisfaction as at the original equilibrium position R. If the price line A_2B_2 is drawn parallel to AB_1 but it is tangent to the original indifference curve IC_1 at T, the level of satisfaction is the same at T as at the equilibrium position R. It means the consumer is prepared to give up AA_2 amount of money for the privilege of purchasing X-commodity at a lower price while remaining at the original level of satisfaction. He had been purchasing combination R at a higher price but with greater money income. He can purchase the combination T yielding the same satisfaction at a lower price of X but with smaller amount of money. AA_2 is, therefore, price compensating variation.

(*ii*) *Price Equivalent Variation* : Price equivalent variation in income, according to Hicks, is the minimum amount of money which a consumer is to be given over for sacrificing the opportunity to buy the commodity at a lower price such that the level of satisfaction remains the same as at the lower price. The price equivalent variation in income may be shown through Fig. 6.5.

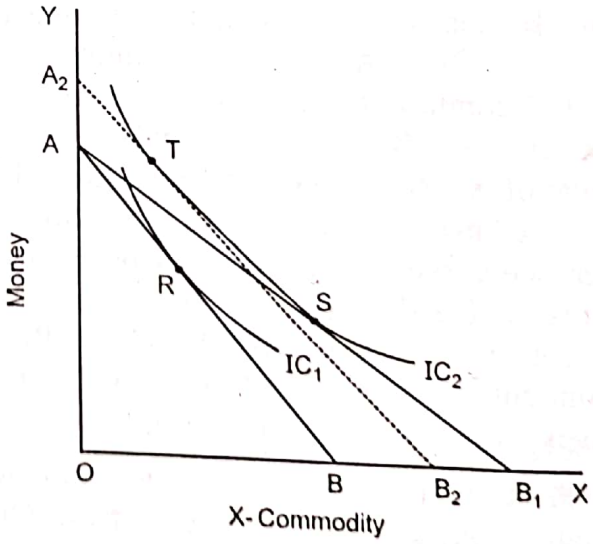

Fig. 6.5

In Fig. 6.5, given the amount of money OA and price of X-commodity, the price line is AB. It is tangent to indifference curve IC_1 at R. As the price of X falls, the price line shifts to AB_1 and the equilibrium of the consumer shifts to S where price line AB_1 is tangent to IC_2 at S. The level of satisfaction is higher at

S than at R. If consumer is given some extra amount of money so that he can remain at the same level of satisfaction as at S, the price line shifts to A_2B_2 and equilibrium takes place at T by the tangency of the price line A_2B_2 and the indifference curve IC_2. The equilibrium positions S and T exist at the same indifference curve IC_2. The increment in satisfaction due to a fall in the price of X is exactly equal to increment in satisfaction due to transfer of extra money AA_2 to the consumer. Therefore, AA_2 represents price equivalent variation in income.

(*iii*) ***Quantity Compensating Variation*** : In the opinion of Hicks, quantity compensating variation is the maximum amount of money which a consumer is willing to pay for the privilege of purchasing a good at a lower price, if along with this privilege, he is compelled to buy the quantity of the good which he would buy at the lower price, in the absence of any compensating payment. The quantity compensating variation in income may be shown through Fig. 6.6.

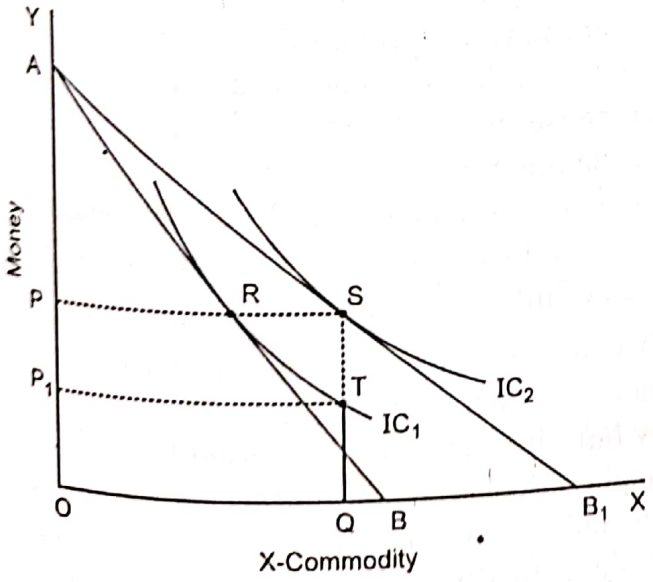

Fig. 6.6

In Fig. 6.6, given the amount of money OA and price of X-commodity, the price line is AB and original equilibrium takes place at R through the tangency between AB and indifference curve IC_1. If price of X falls, the price line shifts to AB_1. This price line is tangent to a higher indifference curve IC_2 at S where OQ quantity of X is bought. If the consumer has to buy the same quantity OQ of X-commodity and has also to remain at the original level of satisfaction at R, the relevant point is T at IC_1, the amount of money which he should be willing to give up is PP_1. Hence the amount of money PP_1 represents the quantity compensating variation in income.

(*iv*) ***Quantity Equivalent Variation*** : Hicks has defined the quantity equivalent variation in income as the minimum amount of money which will have to be paid to the consumer for foregoing the opportunity of purchasing the commodity at the lower price, provided he is required to purchase the same quantity of the commodity as he actually purchases at the old higher price. The quantity equivalent variation in income may be explained through Fig. 6.7.

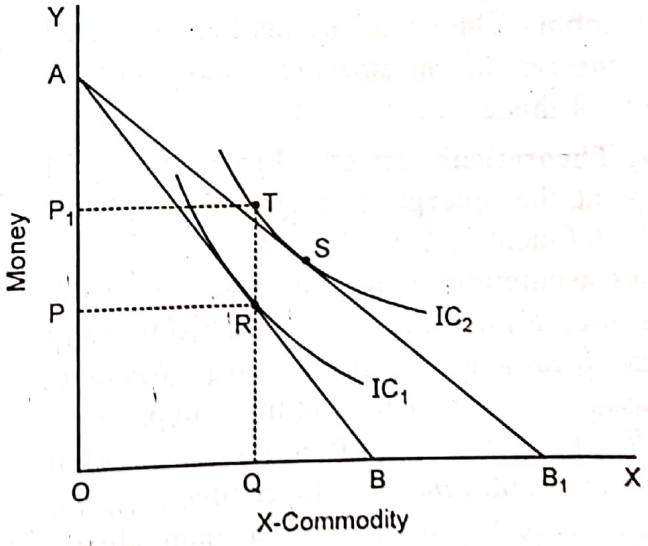

Fig. 6.7

In Fig. 6.7, given the money income OA and price of X-commodity, the price line is AB. The equilibrium is initially determined at R where consumer buys OQ quantity of X. If the price of X falls, the price line shifts to AB_1 and the equilibrium is determined at S where price line AB_1 is tangent to higher indifference curve IC_2. Consumer in this position obtains

greater satisfaction but he is buying more quantity of X in this position. If consumer wants to have the same satisfaction as at S and he is also constrained to buy OQ quantity of X, the relevant combination on higher indifference curve IC_2 is T. In this combination of X, there is the same quantity OQ as in the original position but consumer should have more amout of money OP_1. It means consumer should be given PP_1 extra amount of money to enable him to buy OQ quantity of X and also have the same satisfaction as in the case of a fall in the price of X. PP_1 amount of money, therefore indicates quantity equivalent variation in income.

6.7. CRITICISM OF CONSUMER'S SURPLUS

The Marshallian concept of consumer's surplus came to be severely criticised at the hands of writers like Robinson, Nicholson, Cannan, Taussig, Hicks, Allen, Davenport and Ulise Gobbi. The criticism has been directed at the *theoretical, measurement* and *practical* aspects of this concept.

(*a*) Theoretical Aspect : From theoretical viewpoint, the concept of consumer's surplus is highly deficient and invalid. It is based upon various asumptions which are not true in the actual life. *Firstly*, the utility is subjective and its exact measurement is not possible. *Secondly*, the cardinal measurement of utility is impossible. *Thirdly*, the marginal utility of money does not remain constant, *Fourthly*, the commodities are not independent. The utility of a commodity is greatly affected by the utilities and prices of related goods like substitutes and complementary goods. *Fifthly*, there are frequent changes in tastes, fashion and income of the consumer. *Sixthly*, the substitutes or complements exist for almost all the commodities. Since the different assumptions on which this concept is based are not valid, it is clear that the concept of consumer's surplus is theoretically unsound and faulty.

(*b*) Measurement Aspect : The conce of consumer's surplus has been attacked als because its accurate measurement involve serious difficulties. It seems that consumer surplus can be easilty measured through a simpl relationship given below :

Consumer's Surplus = Total Utility – (No of Units Purchased × Market Price)

But in reality, the measurement o consumer's surplus involves severa complications discussed below :

(i) Difficulty in case of necessaries of life and conventional necessaries : In case of necessaries of life like air, water and food or conventional necessaries of life, the consumer may become willing to pay any price, if they become scarce. It means the consumer's surplus from such commodities becomes indefinite and infinite and its measurement is very difficult. In this context, S.N. Patten has discussed the concepts of *pain economy* and *pleasure economy*. About pain economy, it may be stated that the non-availability of necessaries results in pain. In the region of pain economy, consumers may be prepared to pay any price and, therefore, the consumer's surplus is infinite and immeasurable. After the *removal* of pain the consumption of those commodity can *provide satisfaction or pleasure*. It is termed as pleasure economy. In this region, the consumer's surplus may be definite or measurable.

(ii) Commodities of distinction : Certain commodities such as gold, platinum, diamonds, luxury buildings etc. are purchased by the rich for display. These commodities confer social prestige and distinction and they may be willing to pay fantastically high prices. If the prices of such commodities fall, the consumer's surplus does not increase. There is a decrease in it becuase, in that situation, those commodities do not confer distinction. In the opinion of Taussig, it is difficult to measure consumer's surplus is case of these commodities.