2. Theory of Demand

The purpose of the theory of demand is to determine the various factors that affect demand. One often reads that the *raison d'être* of the theory of demand is the establishment of the 'law of demand' (that the market demand is negatively related to the price) but this is misleading in that it concentrates on price as the sole determinant of demand, *ceteris paribus*.

Demand is a multivariate relationship, that is, it is determined by many factors simultaneously. Some of the most important determinants of the market demand for a particular product are its own price, consumers' income, prices of other commodities, consumers' tastes, income distribution, total population, consumers' wealth, credit availability, government policy, past levels of demand, and past levels of income.

The traditional theory of demand has concentrated on four of the above determinants, the price of the commodity, other prices, income and tastes. Some of the other factors have been introduced in the theory of demand recently. We will first examine the traditional static theory of demand and subsequently we will briefly discuss some recent developments in this field.

It should be noted that the traditional theory of demand examines only the final consumers' demand for durables and non-durables. It is partial in its approach in that it examines the demand in one market in isolation from the conditions of demand in other markets. An important implicit assumption of the theory of demand is that firms sell their products directly to the final consumers. This is not the general case in the modern business world (as we will see in section IV), and this has serious implications for the determination of prices. Another shortcoming of the traditional theory is that it does not deal with the demand for investment goods, nor with the demand for intermediate products. Total demand includes final demand and intermediate demand. Final demand is subdivided into consumers' demand and demand for investment goods. Traditional theory of demand deals only with consumers' demand, which is only a fraction[1] of the total demand in the economy as a whole. In this section we examine the traditional theory of consumers' demand. In section IV we look at the demand of the individual firm, and we discuss the various sources of demand for the product of manufacturing firms in particular. This analysis will cover some aspects of the demand for intermediate commodities and for investment goods.

I. THEORY OF CONSUMER BEHAVIOUR

The traditional theory of demand starts with the examination of the behaviour of the consumer, since the market demand is assumed to be the summation of the demands of

[1] Consumers' demand ranges between 30 and 40 per cent of total demand in developed economies.

individual consumers. Thus we will first examine the derivation of demand for an individual consumer.

The consumer is assumed to be rational. Given his income and the market prices of the various commodities, he plans the spending of his income so as to attain the highest possible satisfaction or utility. This is the *axiom of utility maximisation*. In the traditional theory it is assumed that the consumer has full knowledge of all the information relevant to his decision, that is he has complete knowledge of all the available commodities, their prices and his income. In order to attain this objective the consumer must be able to compare the utility (satisfaction) of the various 'baskets of goods' which he can buy with his income. There are two basic approaches to the problem of comparison of utilities, the *cardinalist approach* and the *ordinalist approach*.

The cardinalist school postulated that utility can be measured. Various suggestions have been made for the measurement of utility. Under certainty (complete knowledge of market conditions and income levels over the planning period) some economists have suggested that utility can be measured in monetary units, by the amount of money the consumer is willing to sacrifice for another unit of a commodity. Others suggested the measurement of utility in subjective units, called *utils*.

The ordinalist school postulated that utility is not measurable, but is an ordinal magnitude. The consumer need not know in specific units the utility of various commodities to make his choice. It suffices for him to be able to *rank* the various 'baskets of goods' according to the satisfaction that each bundle gives him. He must be able to determine his *order of preference* among the different bundles of goods. The main ordinal theories are the *indifference-curves approach* and the *revealed preference hypothesis*.

In examining the above approaches we will first state the assumptions underlying each approach, derive the equilibrium of the consumer, and from this determine his demand for the individual products. Finally we point out the weaknesses of each approach.

A. THE CARDINAL UTILITY THEORY[1]

Assumptions

1. *Rationality*. The consumer is rational. He aims at the maximisation of his utility subject to the constraint imposed by his given income.

2. *Cardinal utility*. The utility of each commodity is measurable. Utility is a cardinal concept. The most convenient measure is money: the utility is measured by the monetary units that the consumer is prepared to pay for another unit of the commodity.

3. *Constant marginal utility of money*. This assumption is necessary if the monetary unit is used as the measure of utility. The essential feature of a standard unit of measurement is that it be constant. If the marginal utility of money changes as income increases (or decreases) the measuring-rod for utility becomes like an elastic ruler, inappropriate for measurement.

4. *Diminishing marginal utility*. The utility gained from successive units of a commodity diminishes. In other words, the marginal utility of a commodity diminishes as the consumer acquires larger quantities of it. This is the *axiom of diminishing marginal utility*.

[1] The concept of subjective, measurable utility is attributed to Gossen (1854), Jevons (1871) and Walras (1874). Marshall (1890) also assumed independent and additive utilities, but his position on utility is not clear in several aspects.

5. The total utility of a 'basket of goods' depends on the quantities of the individual commodities. If there are n commodities in the bundle with quantities $x_1, x_2, \ldots, x_n$, the total utility is

$$U = f(x_1, x_2, \ldots, x_n)$$

In very early versions of the theory of consumer behaviour it was assumed that the total utility is *additive*,

$$U = U_1(x_1) + U_2(x_2) + \cdots + U_n(x_n)$$

The additivity assumption was dropped in later versions of the cardinal utility theory. Additivity implies independent utilities of the various commodities in the bundle, an assumption clearly unrealistic, and unnecessary for the cardinal theory.

Equilibrium of the consumer

We begin with the simple model of a single commodity x. The consumer can either buy x or retain his money income Y. Under these conditions the consumer is in equilibrium when the marginal utility of x is equated to its market price (P_x). Symbolically we have

$$MU_x = P_x$$

If the marginal utility of x is greater than its price, the consumer can increase his welfare by purchasing more units of x. Similarly if the marginal utility of x is less than its price the consumer can increase his total satisfaction by cutting down the quantity of x and keeping more of his income unspent. Therefore, he attains the maximisation of his utility when $MU_x = P_x$.[1]

If there are more commodities, the condition for the equilibrium of the consumer is the equality of the ratios of the marginal utilities of the individual commodities to their prices

$$\frac{MU_x}{P_x} = \frac{MU_y}{P_y} = \cdots = \frac{MU_n}{P_n}$$

[1] *Mathematical derivation of the equilibrium of the consumer*

The utility function is

$$U = f(q_x)$$

where utility is measured in monetary units. If the consumer buys q_x his expenditure is $q_x P_x$. Presumably the consumer seeks to maximise the difference between his utility and his expenditure

$$U - P_x q_x .$$

The necessary condition for a maximum is that the partial derivative of the function with respect to q_x be equal to zero. Thus

$$\frac{\partial U}{\partial q_x} - \frac{\partial (P_x q_x)}{\partial q_x} = 0$$

Rearranging we obtain

$$\frac{\partial U}{\partial q_x} = P_x \quad \text{or} \quad MU_x = P_x$$

The utility derived from spending an additional unit of money must be the same for all commodities. If the consumer derives greater utility from any one commodity, he can increase his welfare by spending more on that commodity and less on the others, until the above equilibrium condition is fulfilled.

Derivation of the demand of the consumer

The derivation of demand is based on the axiom of diminishing marginal utility. The marginal utility of commodity x may be depicted by a line with a negative slope (figure 2.2). Geometrically the marginal utility of x is the slope of the total utility function $U = f(q_x)$. The total utility increases, but at a decreasing rate, up to quantity

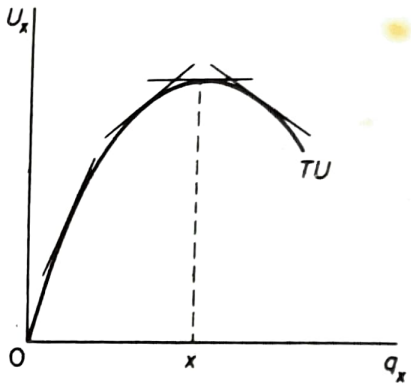

Figure 2.1

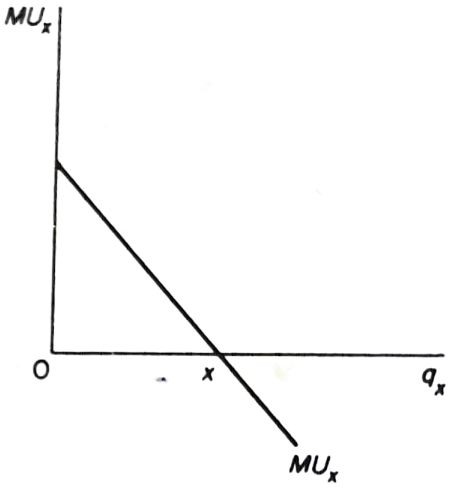

Figure 2.2

x, and then starts declining (figure 2.1). Accordingly the marginal utility of x declines continuously, and becomes negative beyond quantity x. If the marginal utility is measured in monetary units the demand curve for x is identical to the positive segment of the marginal utility curve. At x_1 the marginal utility is MU_1 (figure 2.3). This is equal to P_1, by definition. Hence at P_1 the consumer demands x_1 quantity (figure 2.4). Similarly at x_2 the marginal utility is MU_2, which is equal to P_2. Hence at P_2 the consumer will buy x_2, and so on. The negative section of the MU curve does not form part of the demand curve, since negative quantities do not make sense in economics.

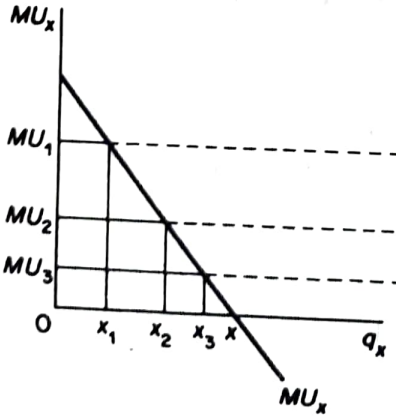

Figure 2.3

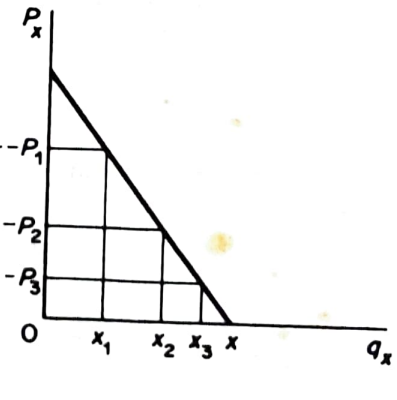

Figure 2.4

Critique of the cardinal approach

There are three basic weaknesses in the cardinalist approach. The assumption of cardinal utility is extremely doubtful. The satisfaction derived from various commodities cannot be measured objectively. The attempt by Walras to use subjective units (*utils*) for the measurement of utility does not provide any satisfactory solution. The assumption of constant utility of money is also unrealistic. As income increases the marginal utility of money changes. Thus money cannot be used as a measuring-rod since its own utility changes. Finally, the axiom of diminishing marginal utility has been 'established' from introspection, it is a psychological law which must be taken for granted.

B. THE INDIFFERENCE-CURVES THEORY[1]

Assumptions

1. *Rationality.* The consumer is assumed to be rational – he aims at the maximisation of his utility, given his income and market prices. It is assumed he has full knowledge (certainty) of all relevant information.

2. *Utility is ordinal.* It is taken as axiomatically true that the consumer can rank his preferences (order the various 'baskets of goods') according to the satisfaction of each basket. He need not know precisely the amount of satisfaction. It suffices that he expresses his preference for the various bundles of commodities. It is not necessary to assume that utility is *cardinally measurable*. Only *ordinal measurement* is required.

3. *Diminishing marginal rate of substitution.* Preferences are ranked in terms of indifference curves, which *are assumed to be convex* to the origin. This implies that the slope of the indifference curves increases. The slope of the indifference curve is called the marginal rate of substitution of the commodities. The indifference-curve theory is based, thus, on *the axiom of diminishing marginal rate of substitution* (see below).

4. The total utility of the consumer depends on the quantities of the commodities consumed

$$U = f(q_1, q_2, \ldots, q_x, q_y, \ldots, q_n)$$

5. *Consistency and transitivity of choice.* It is assumed that the consumer is consistent in his choice, that is, if in one period he chooses bundle A over B, he will not choose B over A in another period if both bundles are available to him. The consistency assumption may be symbolically written as follows:

$$\text{If } A > B, \text{ then } B \not> A$$

Similarly, it is assumed that consumer's choices are characterised by transitivity: if bundle A is preferred to B, and B is preferred to C, then bundle A, is preferred to C. Symbolically we may write the transitivity assumption as follows:

$$\text{If } A > B, \text{ and } B > C, \text{ then } A > C$$

[1] See J. Hicks and R. J. Allen, 'A Reconsideration of the Theory of Value', *Economica* (1934). See also Hicks, *Value and Capital* (Oxford University Press, 1939).

Equilibrium of the consumer

To define the equilibrium of the consumer (that is, his choice of the bundle that maximises his utility) we must introduce the concept of indifference curves and of their slope (the marginal rate of substitution), and the concept of the budget line. These are the basic tools of the indifference curves approach.

Indifference curves. An *indifference curve* is the locus of points – particular combinations or bundles of goods – which yield the same utility (level of satisfaction) to the consumer, so that he is indifferent as to the particular combination he consumes.[1]

An *indifference map* shows all the indifference curves which rank the preferences of the consumer. Combinations of goods situated on an indifference curve yield the same utility. Combinations of goods lying on a higher indifference curve yield higher level of satisfaction and are preferred. Combinations of goods on a lower indifference curve yield a lower utility.[2]

An indifference curve is shown in figure 2.5 and a partial indifference map is depicted in figure 2.6. It is assumed that the commodities y and x can substitute one another to a

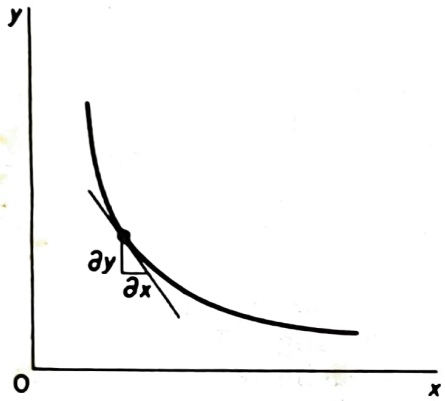

Figure 2.5

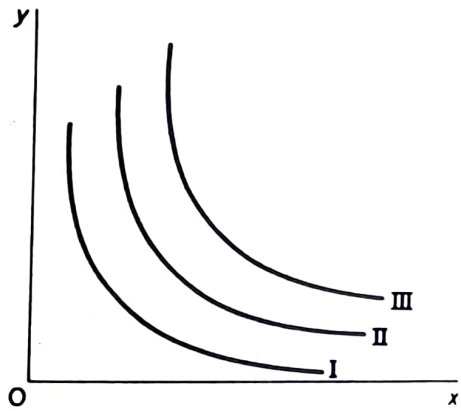

Figure 2.6

certain extent but are not perfect substitutes (see footnote, p. 20). The negative of the slope of an indifference curve at any one point is called the *marginal rate of substitution* of the two commodities, x and y, and is given by the slope of the tangent at that point:

$$\begin{bmatrix} \text{slope of} \\ \text{indifference} \\ \text{curve} \end{bmatrix} = -\frac{dy}{dx} = MRS_{x,y}$$

The marginal rate of substitution of x for y is defined as the number of units of commodity y that must be given up in exchange for an extra unit of commodity x so that the consumer maintains the same level of satisfaction. With this definition the proponents of the indifference-curves approach thought that they could avoid the non-operational concept of marginal utility. In fact, what they avoid is the assumption of diminishing

[1] Symbolically an indifference curve is given by the equation

$$U = f(x_1, x_2, \ldots, x_n) = k$$

where k is a constant.

[2] An indifference map may be derived by assigning to k every possible value.

individual marginal utilities and the need for their measurement. The concept of marginal utility is implicit in the definition of the *MRS*, since it can be proved[1] that the marginal rate of substitution (the slope of the indifference curve) is equal to the ratio of the marginal utilities of the commodities involved in the utility function:

$$MRS_{x,y} = \frac{MU_x}{MU_y} \quad \text{or} \quad MRS_{y,x} = \frac{MU_y}{MU_x}$$

Furthermore, the indifference-curves theorists substitute the assumption of diminishing marginal utility with another which may also be questioned, namely the assumption that the indifference curves are convex to the origin, which implies diminishing *MRS* of the commodities.

Properties of the indifference curves. 1. An indifference curve has a negative slope, which denotes that if the quantity of one commodity (y) decreases, the quantity of the other (x) must increase, if the consumer is to stay on the same level of satisfaction.

2. The further away from the origin an indifference curve lies, the higher the level of utility it denotes: bundles of goods on a higher indifference curve are preferred by the rational consumer.

3. Indifference curves do not intersect. If they did, the point of their intersection would imply two different levels of satisfaction, which is impossible.

[1] Proof: The slope of a curve at any one point is measured by the slope of the tangent at that point. The equation of a tangent is given by the total derivative or total differential, which shows the total change of the function as all its determinants change.

The total utility function in the case of two commodities x and y is

$$U = f(x, y)$$

The equation of an indifference curve is

$$U = f(x, y) = k$$

where k is a constant. The total differential of the utility function is

$$dU = \frac{\partial U}{\partial y}\,dy + \frac{\partial U}{\partial x}\,dx = (MU_y)\,dy + (MU_x)\,dx$$

It shows the total change in utility as the quantities of both commodities change. The total change in U caused by changes in y and x is (approximately) equal to the change in y multiplied by its marginal utility, plus the change in x multiplied by its marginal utility.

Along any particular indifference curve the total differential is by definition equal to zero. Thus for any indifference curve

$$dU = (MU_y)\,dy + (MU_x)\,dx = 0$$

Rearranging we obtain

$$\text{either} \quad -\frac{dy}{dx} = \frac{MU_x}{MU_y} = MRS_{x,y} \quad \text{or} \quad -\frac{dx}{dy} = \frac{MU_y}{MU_x} = MRS_{y,x}$$

4. The indifference curves are convex to the origin.[1] This implies that the slope an indifference curve decreases (in absolute terms) as we move along the curve fr the left downwards to the right: the marginal rate of substitution of the commodit is diminishing. This axiom is derived from introspection, like the 'law of diminishi marginal utility' of the cardinalist school. The *axiom of decreasing marginal rate substitution* expresses the observed behavioural rule that the number of units of x t consumer is willing to sacrifice in order to obtain an additional unit of y increases the quantity of y decreases. It becomes increasingly difficult to substitute x for y as move along the indifference curve. In figure 2.9 the fifth unit of y can be substitute for x by the consumer giving up $x_1 x_2$ of x; but to substitute the second unit of y a still retain the same satisfaction the consumer must give up a much greater quanti of x, namely $x_3 x_4$.

The budget constraint of the consumer. The consumer has a given income which se limits to his maximising behaviour. Income acts as a constraint in the attempt fo maximising utility. The income constraint, in the case of two commodities, may b written

$$Y = p_x q_x + p_y q_y \tag{2.1}$$

We may present the income constraint graphically by the budget line, whose equatio is derived from expression 2.1, by solving for q_y:

$$q_y = \frac{1}{P_y} Y - \frac{P_x}{P_y} q_x$$

Assigning successive values to q_x (given the income, Y and the commodity prices, P_x, P_y), we may find the corresponding values of q_y. Thus, if $q_x = 0$ (that is, if the consumer spends all his income on y) the consumer can buy Y/P_y units of y. Similarly, if $q_y = 0$ (that is, if the consumer spends all his income on x) the consumer can buy Y/P_x units of x. In figure 2.10 these results are shown by points A and B. If we join these points

[1] This assumption implies that the commodities can substitute one another, but are not perfect substitutes. If the commodities are perfect substitutes the indifference curve becomes a straight line with negative slope (figure 2.7). If the commodities are complements the indifference curve takes the shape of a right angle (figure 2.8).

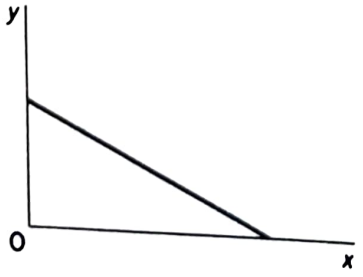

Figure 2.7 Perfect substitutes

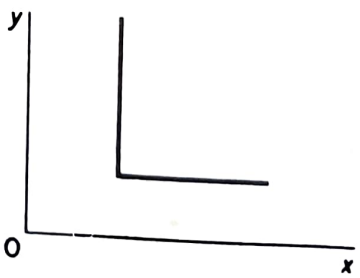

Figure 2.8 Complementary goods

In the first case the equilibrium of the consumer may be a corner solution, that is, a situation in which the consumer spends all his income on one commodity. This

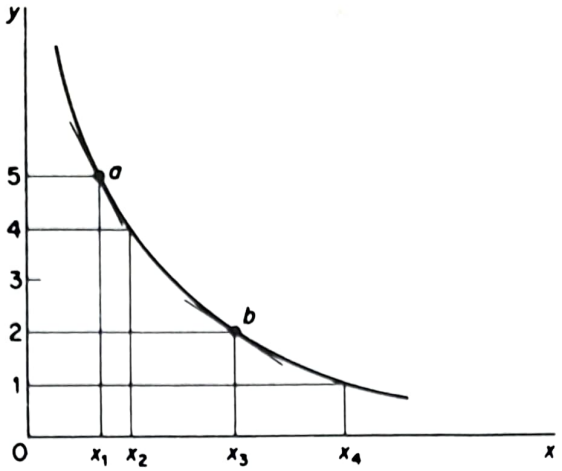

Figure 2.9

with a line we obtain the budget line, whose slope is the ratio of the prices of the two commodities. Geometrically the slope of the budget line is

$$\frac{OA}{OB} = \frac{Y/P_y}{Y/P_x} = \frac{P_x}{P_y}$$

Mathematically the slope of the budget line is the derivative

$$\frac{\partial q_y}{\partial q_x} = \frac{P_x}{P_y}$$

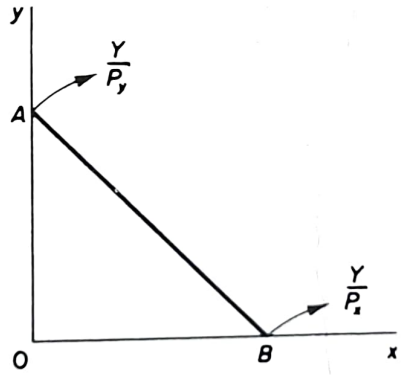

Figure 2.10

Derivation of the equilibrium of the consumer. The consumer is in equilibrium when he maximises his utility, given his income and the market prices. Two conditions must be fulfilled for the consumer to be in equilibrium.

The first condition is that the marginal rate of substitution be equal to the ratio of commodity prices

$$MRS_{x,y} = \frac{MU_x}{MU_y} = \frac{P_x}{P_y}$$

This is a necessary but not sufficient condition for equilibrium. The second condition is that the indifference curves be convex to the origin. This condition is fulfilled by the

axiom of diminishing $MRS_{x,y}$, which states that the slope of the indifference curve decreases (in absolute terms) as we move along the curve from the left downwards to the right.

Graphical presentation of the equilibrium of the consumer. Given the indifference map of the consumer and his budget line, the equilibrium is defined by the point of tangency of the budget line with the highest possible indifference curve (point e in figure 2.11).

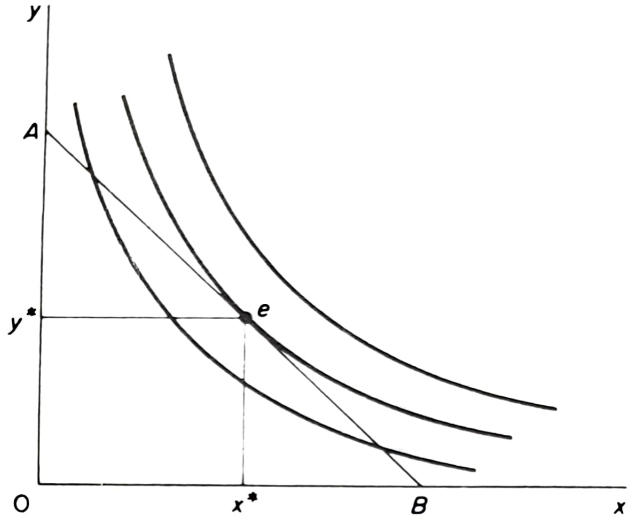

Figure 2.11

At the point of tangency the slopes of the budget line (P_x/P_y) and of the indifference curve ($MRS_{x,y} = MU_x/MU_y$) are equal:

$$\frac{MU_x}{MU_y} = \frac{P_x}{P_y}$$

Thus the first-order condition is denoted graphically by the point of tangency of the two relevant curves. The second-order condition is implied by the convex shape of the indifference curves. The consumer maximises his utility by buying x^* and y^* of the two commodities.

the MRS requires [illegible] order condition for any two commodities may be written as

$$\frac{MU_x}{MU_y} = \frac{P_x}{P_y} = MRS_{x,y}$$

Hence the concept of marginal utility is implicit in the definition of the slope of the indifference curves, although its measurement is not required by this approach. What is needed is a diminishing marginal rate of substitution, which of course does not require diminishing marginal utilities of the commodities involved in the utility function.

Derivation of the demand curve using the indifference-curves approach

Graphical derivation of the demand curve. As the price of a commodity, for example of x, falls, the budget line of the consumer shifts to the right, from its initial position (AB) to a new position (AB'), due to the increase in the purchasing power of the given money income of the consumer. With more purchasing power in his possession the consumer can buy more of x (and more of y). The new budget line is tangent to a higher indifference curve (e.g. curve II). The new equilibrium occurs to the right of the original equilibrium (for normal goods) showing that as price falls more of the commodity will be bought. If we allow the price of x to fall continuously and we join the points of tangency of successive budget lines and higher indifference curves we form the so-called price–consumption line (figure 2.12), from which we derive the demand curve for commodity x. At point e_1 the consumer buys quantity x_1 at price y_1. At point e_2 the price, y_2, is lower than y_1, and the quantity demanded has increased to x_2, and so on. We may plot the price–quantity pairs defined by the points of equilibrium (on the price–consumption line) to obtain a demand curve, as shown in figure 2.13.

The demand curve for normal commodities[1] will always have a negative slope, denoting the 'law of demand,' (the quantity bought increases as the price falls).

In the indifference-curves approach the 'law of demand' is derived from what is known as *Slutsky's theorem*, which states that *the substitution effect of a price change is always negative* (relative to the price: if the price increases, the quantity demanded decreases and vice versa). The formal proof of Slutsky's theorem involves sophisticated mathematics. However, we may show graphically the implications of this theorem.

We saw that a fall in the price of x from P_1 to P_2 resulted in an increase in the quantity demanded from x_1 to x_2. This is the *total price effect* which may be split into two separate

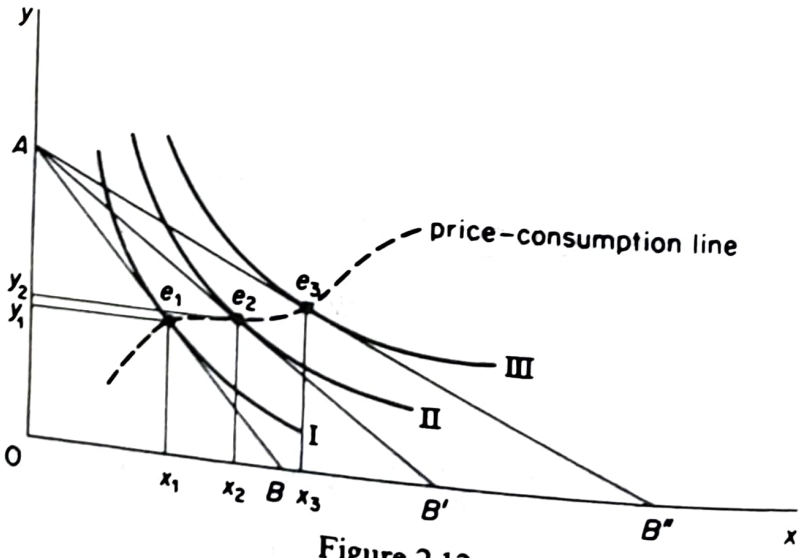

Figure 2.12

[1] A commodity is defined as 'normal' when its demand changes in the same direction as income. If the demand of a commodity decreases when income increases, the commodity is called 'inferior'.

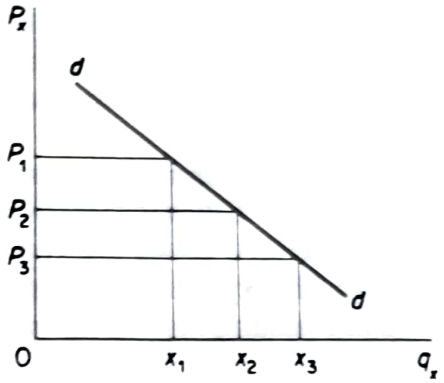

Figure 2.13

effects, a *substitution effect* and an *income effect*. The substitution effect is the increase in the quantity bought as the price of the commodity falls, after 'adjusting' income so as to keep the real purchasing power of the consumer the same as before. This adjustment in income is called *compensating variation* and is shown graphically by a parallel shift of the *new* budget line until it becomes tangent to the initial indifference curve (figure 2.14). The purpose of the compensating variation is to allow the consumer to remain on the same level of satisfaction as before the price change. The '*compensated-budget line*' will be tangent to the original indifference curve (I) at a point (e'_1) to the right of the original tangency (e_1), because this line is parallel to the new budget line which is less steep than the original one when the price of x falls. The movement from point e_1 to e'_1 shows the substitution effect of the price change: the consumer buys more of x now that it is cheaper, substituting y for x. However, the compensating variation is a device which enables the isolation of the substitution effect, but does not show the new equilibrium of the consumer. This is defined by point e_2 on the higher indifference curve II. The consumer has in fact a higher purchasing power, and, if the commodity is normal, he will spend some of his increased *real income* on x, thus moving from x'_1 to x_2. This is the income effect of the price change. The *income effect of a price change* is negative[1] for normal goods and it reinforces the negative substitu-

Thus the demand for x is negatively related to its own price p_x and positively to income Y.

Similarly the demand for y is obtained by substituting $q_x p_x$ in the budget constraint:

$$q_y = \frac{1}{2p_y} Y$$

In our particular example the demand curves are symmetric due to the particular multiplicati form of the consumer's utility function which we assumed.

Critique of the indifference-curves approach

The indifference-curves analysis has been a major advance in the field of consumer demand. The assumptions of this theory are less stringent than for the cardinal utilit approach. Only ordinality of preferences is required, and the assumption of constar utility of money has been dropped.

The methodology of indifference curves has provided a framework for the measure ment of the 'consumer's surplus', which is important in welfare economics and in desig ing government policy. The measurement of the consumers' surplus is discussed i section D below (p. 32).

Perhaps the most important theoretical contribution of this approach is the establish ment of a better criterion for the classification of goods into substitutes and comple ments. Earlier theorists were using the total effect of a price change for this purpos without compensating for the change in real income. The classification was based on th sign of the cross-elasticity of demand

$$e_{yx} = \frac{\partial q_y}{\partial p_x} \cdot \frac{p_x}{q_y}$$

where the total change in the quantity of y was considered as a result of a change in th price of x. A positive sign of the cross-elasticity implies that x and y are substitutes a negative sign implies that the commodities are complements. This approach may easil lead to absurd classifications if the change in the price of x is substantial. For example if the price of beef is halved it is almost certain that both the consumption of beef an of pork will be increased, due to the increase of the real income of the consumer. Thi would imply a negative cross-elasticity for pork, and hence pork would be classified a a complementary commodity to beef!

Hicks[1] suggested measuring the cross-elasticity after compensating for changes i real income. Thus, according to Hicks, goods x and y are substitutes if, after com pensating for the change in real income (arising from the change in the price of x) a decrease in the price of x leads to a decrease in the quantity demanded of y.

Although this criterion is theoretically more correct than the usual approach base on the total change in the quantity of y as a result of a change in the price of x, in practic its application is impossible because it requires knowledge of the individual preferenc functions, which cannot be statistically estimated. On the other hand, the usual approac of the total price effect is feasible because it requires knowledge of the market demand functions which can be empirically estimated.

Although the advantages of the indifference-curves approach are important, th theory has indeed its own severe limitations. The main weakness of this theory is its axio matic assumption of the existence and the convexity of the indifference curves. Th theory does not establish either the existence or the shape of the indifference curves. I assumes that they exist and have the required shape of convexity. Furthermore, it i

[1] J. Hicks, *Value and Capital* (Oxford Universiy Press, 1946) 2nd edn, pp. 42–52.