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Engineering Economics: A Prologue

1.1 INTRODUCTION

Engineering economics is concerned with the formulation, estimation and evaluation of the economic outcomes of alternatives that are available to accomplish a defined purpose. Engineering economics can be defined as a collection of mathematical techniques that simplify economic comparison. Engineers use the knowledge of engineering economics in analyzing, synthesizing and drawing conclusions as they work on projects of different sizes. In other words, the techniques and models of engineering economics assist engineers in making decisions. The success of engineering and business projects is normally measured in terms of financial efficiency. A project will be able to achieve maximum financial efficiency when it is properly planned and operated with respect to its technical, social, and financial requirements. Since engineers understand the technical requirements of a project, they can combine the technical details of the project and the knowledge of engineering economics to study and arrive at a sound managerial decision. The basic economic concepts that are essentially factors to be considered in making economy studies are briefly discussed in this chapter.

1.2 INTRODUCTION TO ECONOMICS

Economics is about choice and is at the heart of all decision-making. Individuals, businesses and governments are all faced with making choices in situations where resources are scarce. The principles of economics are applied to a wide range of fields, including business, finance, administration, law, local and national government and, indeed, in most of the aspects of everyday life. While studying economics, we examine topics of obvious importance to the well-being of all humans. Increasingly, policy debates in all areas are being cast in economic terms and understanding most of the current issues requires an understanding of economics.

1.3 NEED TO STUDY ECONOMICS

Studying economics gives insights into the general environment of resource allocation decisions, opportunity costs and project evaluation which are crucial in many areas. Often, these insights are not obvious, and can be counter-intuitive to those who don't apply economic reasoning.

Economics studies economic activities: Humans perform various types of activities in their daily lives like religious, social, political and economic activities. Economics does not deal with all of them. But humans spend the maximum time on economic activities. Therefore, economics is a subject which studies economic activities of humans.

Study of wants → efforts → wealth → satisfaction: Every human being is doing some business and every human being has some wants and these wants are unlimited. To fulfill these wants a person does efforts, by doing efforts he gets wealth and with this earned wealth he satisfies his wants.

Study of human behavior with relation to ends and scarce means: As long as a person is alive, his wants go on increasing. But the person cannot fulfill all the wants. The reason is that the resources required to fulfill these wants are limited. Besides the fact of scarcity of resources, we also find that resources have alternative uses. Hence economics is a subject which studies human behavior as a relationship between ends and scarce means which have alternative uses.

Economics studies problem of choice: Scarcity and choice go together. If things were available in abundance, then there would have been no problem of choice; the point is that “problems of choice” arise because of scarcity. We can summarize the basic economic problems by means of a chart shown in Fig. 1.1.

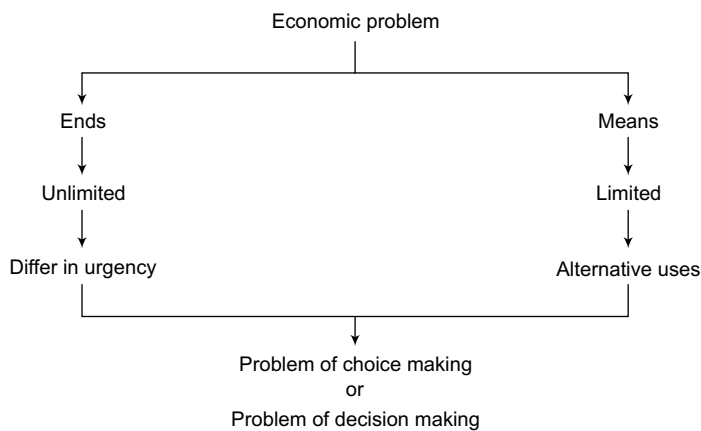


Figure 1.1 Summary chart of basic economic problems

1.4 CIRCULAR FLOW OF ECONOMIC ACTIVITIES

Circular Flow of economic activities is a flow which has neither a beginning nor an end.

Basic economic activities An economic activity is a systematic endeavor to satisfy a material need. Material needs are the needs for goods and services. We know that human wants are unlimited. We are always busy satisfying one want or the other. “The vital processes or essential functions like production, consumption, investment and distribution, as shown in Fig. 1.2, are those economic activities which are necessary for the working or survival of an economy.”

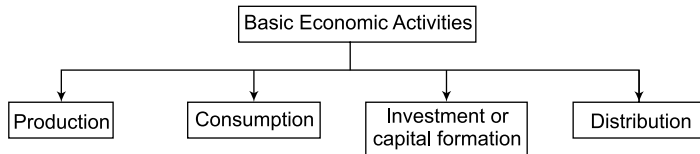


Figure 1.2 Vital economic activities

Production: Production as a process of creation of utility or value in goods or services (or both). Anatol Murad defined this as: “Production may be defined as the creation of utilities.”

Factors of Production: Factors of production are the essential elements which cooperate with one another in the process of production. The various factors of production are shown in Fig. 1.3.

Land: It is that factor of production which is available to humankind as a free gift of nature.

Labor: It is the physical or mental effort of human beings in the process of production. Services of a doctor, lawyer, teacher, worker in the factory, all constitute labor.

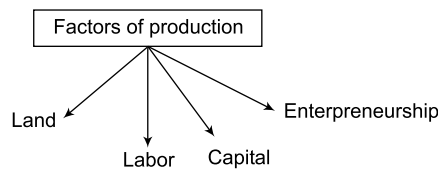


Figure 1.3 Factors of production

Capital: Capital is man-made material and is a source of production. It consists of the part of production which is used for further production.

Entrepreneurship: Entrepreneurship refers to the skills of the entrepreneur:

- (a) to organize business
- (b) to undertake risks of business

Consumption: In economics, consumption has a special meaning; it means the use of or utility of goods and services for the direct satisfaction of individual and collective wants.

For example: When you eat bread, you are using up the want-satisfying capacity of bread, that is, its utility. Different types of consumption are shown in Fig. 1.4.

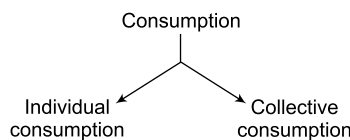


Figure 1.4 Types of consumption

Individual Consumption: It is that consumption which leads to the final satisfaction of the wants of an individual.

Collective consumption: It is that consumption which leads to the final satisfaction of collective wants. For example: Uses of roads, dams, bridges or parks.

Investment or Capital formation: Investment or capital formation is the third vital process or essential activity of an economy. “Investment is that part of production during a year which is not consumed but saved as capital formation for further production.” The excess of production over consumption in an accounting year is called capital formation or investment.

$$I = Y - C$$

I = Investment, Y = Income, C = Consumption.

Some fundamental relationships:

1. Production = Consumption + Investment

$$Q = C + I$$

Q = Production

2. Income = Consumption + Saving

$$Y = C + S$$

S = Saving

3. Saving \equiv Investment

$$S = I$$

$$Q = C + I$$

or $Y = C + I$ ($\because Q = Y$)

and $Y = C + S$

$$C + S = C + I$$

$\therefore S \equiv I$

In other words, the circular flow of income can be explained using the flowchart shown in Fig. 1.5.

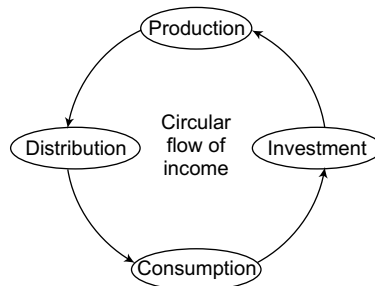


Figure 1.5 Circular flow of income

The flow of production, income and expenditure never stops. It is a circular flow without a beginning or an end. Production generates income, income generates demand for goods and services, and demand generates expenditure on the goods and services which leads to their production, so that the circle of production, consumption and expenditure always continues.

Performance of economic activities Economic activities are undertaken by the following sectors of the economy:

Household Sector: This sector includes households, who consumes goods and services, and provides factor services.

Firms or Business Sector: The firm produces goods and services by using factor services.

Government Sector: The government sector undertakes both consumption as well as production.

Flow of income There are two types of flow of income in an economy:

- Real flow of income
- Monetary flow of income

Real flow of income: It involves the flow of factor services from the household sector to the producing sector and the corresponding flow of goods and services from producing sector to household sector. This is explained in Fig. 1.6.

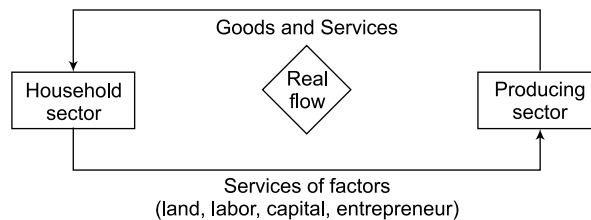


Figure 1.6 Real flow of income

Monetary flow of income: It refers to the flow of factor income e.g.: rent, interest, profit, wages and so on from the producing sector to the household sector as rewards for their factor services. The households spend their income on the goods and services produced by the producing sector. According to it, the money flows back to the producing sector. Fig. 1.7 explains this.

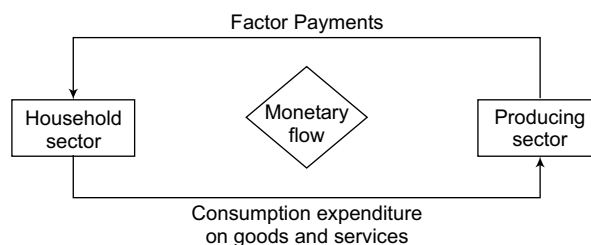


Figure 1.7 Monetary flow of income

1.5 CIRCULAR FLOW OF INCOME IN DIFFERENT SECTORS

Circular flow of Income is analyzed under three different situations based on certain simplifying assumptions:

Two sector model It studies the circular flow of Income between the household and producing sector on the assumption that there are only two sectors in the economy (Fig. 1.8).

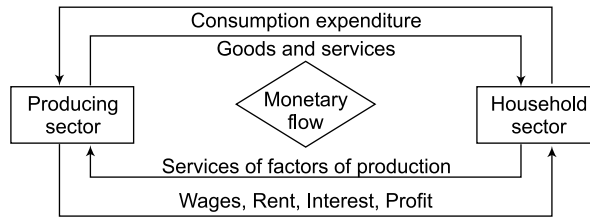


Figure 1.8 Two sector model

Three Sector Model It refers to the study of the circular flow of income among:

- (i) Household sector
- (ii) Producing sector
- (iii) Government sector

Here the assumption that the economy comprises of these three sectors. It is a closed economy (Fig. 1.9).

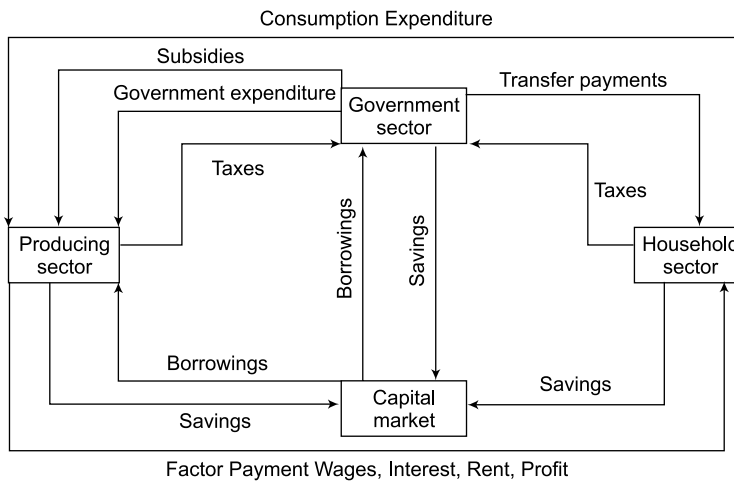


Figure 1.9 Three sector model of circular flow of income

Four Sector Model It studies the study of the circular flow of income among:

- (i) Household sector
- (ii) Producing sector

- (iii) Government sector
- (iv) Foreign sector or rest of the world.

In other words, it studies the flow of income in an open economy. The model studies all sectors of the economy, dropping all the simple assumptions made earlier (Fig. 1.10).

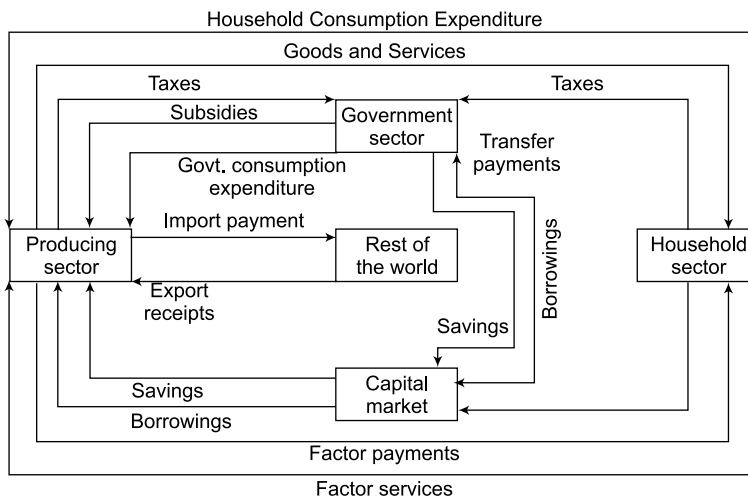


Figure 1.10 Four sector model

1.6 DEMAND THEORY

In economics, we are concerned with the demand for a commodity faced by a firm. Demand is regarded as the lifeline of a business enterprise. Demand analysis seeks to identify and measure the forces that determine sales.

Meaning of demand In ordinary language, the terms need, desire, want and demand are used in the same sense. But in economics, all these terms have different meanings. For instance, a sick child needs medicine, a worker desires to have a car, but such needs and desire do not constitute demand.

Demand is the want of a person, which will become demand when he is ready to buy the goods at a given price and at a given point of time. So demand may, then, be defined as the quantity of a commodity which a consumer is willing and able to purchase at a given price, during some specific period of time.

There are seven essentials of demand:

1. Desire for a commodity.
2. Capacity to pay for it.
3. Willingness to pay for it.
4. Quantity bought and sold.

5. At a given price.
6. At a given time.
7. At a given place.

Definition of Demand According to Veera Anstey, “the demand for a particular good is the amount that will be purchased at a given time and at a given price.” In the words of Ferguson, “demand refers to the quantities of a commodity that the consumers are able and willing to buy at each possible price during a given period of time, other things being equal.”

1.6.1 Law of Demand

Meaning Law of demand states that other things being equal, the demand for a good extends with a fall in price and contracts with a rise in price. There is an inverse relationship with a price and the quantity demanded.

Definition of Law of Demand According to Samuelson, “the law of demand states that people will buy more at lower prices and buy less at higher prices, ceteris paribus, or the other things remaining the same.” According to Marshall, “the law of demand states that amount demanded increases with a fall in price and diminishes when price raises, other things being equal.”

1.6.2 Assumptions Used in Defining Demand

- (i) There should be no change in the price of related goods.
- (ii) There should be no change in the income of the consumer.
- (iii) There should be no change in the taste and preference of the consumer.
- (iv) The consumer does not expect any change in the price of the commodity in the near future.
- (v) There is no change in size or age-composition of the population.
- (vi) There is no change in the range of goods available to the consumers.
- (vii) There is no change in government policy.
- (viii) There is no change in income of the consumer and the community.

1.6.3 Demand Schedule

A hypothetical individual demand schedule is given in Table 1.1.

Table 1.1 Demand schedule

Price per unit (₹)	Quantity demanded (units)
1	4
2	3
3	2
4	1

1.6.4 Demand Curve

Using demand schedule in Table 1.1, a demand curve is drawn in Fig. 1.11.

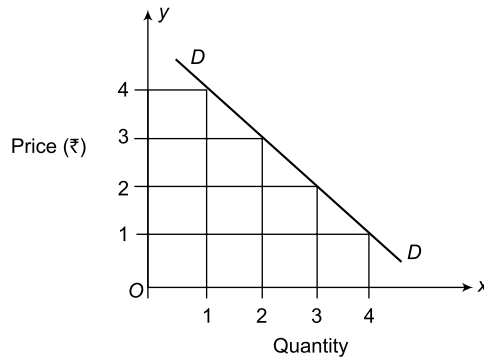


Figure 1.11 Individual demand curve

In Fig. 1.11, axis OX represents the quantity demanded and axis OY axis represents the price. DD is the demand curve. Each point on the demand curve expresses the relation between price and demand. At a price of ₹4 per unit, the demand is for 1 unit and at a price of ₹1 per unit, the demand is for 4 units. The demand curve slopes downwards from left to right, meaning that when price is high demand is low and when price is low demand is high.

1.6.5 Determinants of Demand

The demand for a commodity Q_x^d depends upon many factors as listed below:

1. Price of the commodity (P_x)
2. Prices of the related goods (P_r)
3. Income of the consumer (Y)
4. Taste and preference of the consumer (T)
5. Expectation of price change of the commodity (E)
6. Size and composition of population (P)
7. Distribution of income (Y_d)

$$Q_x^d = (P_x, P_r, Y, T, E, P, Y_d)$$

Price of the commodity Basically, demand for a commodity depends upon its price. If the price rises, the demand falls, and if the price falls, the demand rises.

Price of related goods The demand for a commodity is also influenced by changes in the price of related goods like substitutes and complements.

Substitute goods: The demand of tea depends not only on its price, but also on the price of its substitute, coffee. If the price of coffee falls, while that of tea remains the same, the demand of tea falls.

Complementary goods: The demand for petrol depends not only on its own price, but also on the price of cars and scooters.

Income of the consumer Income levels determine the demand to a great extent. Usually, there is a direct relationship between income and demand. In case of normal goods, if income rises, demand increases and if income falls demand decreases.

Price expectations Demand for a commodity is also influenced by the expected changes in prices. If people anticipate a rise in price in the future, they buy more now and store the commodities, and vice-versa.

Taste and preference These terms are used in a broad sense. They include fashions, habits, customs, etc. Demand for those goods goes up for which consumers develop a taste.

Population Increase in population leads to more demand for all types of goods and services and decrease in population leads to a fall in demand.

Distribution of income If income is equitably distributed, there will be more demand, if the income is not evenly distributed, then there will be less demand.

1.7 ELASTICITY OF DEMAND

Demand for a commodity is affected by several factors, including its own price, consumer's income, price of related goods, etc. Elasticity of demand is a measure of the sensitiveness of demand to changes in factors affecting demand. Elasticity of demand is classified into following broad categories:

- (i) Price elasticity of demand
- (ii) Income elasticity of demand
- (iii) Cross elasticity of demand

1.7.1 Price Elasticity of Demand

Price elasticity can be defined as the responsiveness in the quantity demanded of a commodity to a change in its price. Total revenue (and hence the profits) of a firm can either increase or decrease due to change in price of the commodity which the firm produces. Thus, it is necessary to measure the probable effect of price changes on total revenue in order to minimize the uncertainty involved in the pricing decision made by the firm. The effect of price change on total revenue can be measured by the price elasticity of demand, which is mathematically defined as the ratio of the percentage changes in quantity demanded to the percentage change in price, as given in equation (1.1).

$$E_p = \frac{\% \Delta Q}{\% \Delta P} \quad (1.1)$$

where E_p is price elasticity of demand

Δ represents the change

Q is quantity demanded

P is price