

1.1 Economics: Basic Problems

Economics is the study of a process that deals with the mechanism of satisfying unlimited wants with limited resources. This definition of economics is not unique. Citing a unique definition of economics is not an easy job because economists define the discipline in a variety of ways. Sometimes economics has been defined as the science of scarcity and sometimes as the science of wealth. Interestingly, scarcity and wealth are of opposite natures. Scarcity refers to the lack of resources whereas the concept of wealth underlies the prosperity. Indeed, economics is a discipline that examines the nature of scarcity prevailing in a typical society and the techniques of meeting the overriding needs on priority basis. The Philosopher Adam Smith (1776) defines economics as “an inquiry into the nature and causes of the wealth of nations”. J. B. Say (1803) defines economics as the science of production, distribution and consumption of wealth. Alfred Marshall (1920), in his textbook the *Principles of Economics*, provided an extensive definition of economics. According to him, Political Economy or Economics is a study of mankind in the ordinary business of life; it examines that part of individual and social action which is most closely connected with the attainment and with the use of the material requisites of wellbeing. Thus it is on the one side a study of wealth; and on the other, and more important side, a part of the study of man. Lionel Robbins (1935) developed a persuasive definition of economics terming economics as a science. According to Robbins, economics is a science which studies human behaviour as a relationship between ends and scarce means which have alternative uses.

All of the definitions above directly or indirectly justify the fact that economics is a science that deals with the problem of societies' unlimited wants that are to be met with the use of scarce resources.

Wants refer to the willingness of possessing something regardless of the affordability. The inherent nature of human being is that they want more and more, their desire never ends, therefore it is said that wants are unlimited. **Resource** is something that is able to produce goods and/or services. From the definition of resource, it becomes clearer that resource refers to the factors of production. Anything that is unable to produce goods or services is not resource. Resources are, therefore, alternatively termed as productive factors. There are hundreds of factors of production in a typical economy. For the sake of simplicity, economists tell about four categories of factors of production- land, labour, capital and entrepreneurial ability. Whatever the degree of affluence, every nation faces the problem of limited amount of resource. This problem is known as the problem of **scarcity**- one of the central problems of an economy. Because of the problem of scarcity, another interrelated problem is evolved which is known as the problem of **choice**.

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Choice problem refers to the problem of choosing only a few wants from a vast variety. Due to the availability of limited amount of resources, neither the individual nor the state can produce all goods and services at a time, rather they have to select a limited set of goods and services- this problem is known as choice problem. Since choice problem emerges from the problem of scarcity, these two problems are termed as the twin-problem of an economy. Three interrelated problems are generated from these two problems:

1. What to Produce
2. How to Produce
3. For Whom to Produce

The first problem directly resembles the problem of scarcity. The society creates demand for innumerable goods and services. Because of scarce resource, only a few of them can be produced. Individuals- in the micro level, and state- in the aggregate level attempt to solve the problem by making a list of the goods and services to be produced on priority basis. This does not imply the end of problem because of the presence of alternative techniques of production. A given amount of output can be produced by using either **capital-intensive** or **labour-intensive** technology. The production technology that involves comparatively higher amount of capital than labour is called capital-intensive technology. Conversely, the use of labour is comparatively higher in a labour-intensive technology. Densely populated nations should use labour-intensive technology because labour is comparatively cheaper in those countries, hence use of labour-intensive technology is likely to lower the cost of production. Most of the affluent nations have capital abundance and thus capital is relatively cheaper in these societies. Use of capital-intensive technology is recommended for such nations because this will bring efficiency in production. Leontief paradox¹ is an exception to the above proviso. Although sounds simple but choosing the correct technology of production is not so easy a task. Suppose, one decided to produce a given amount of output using labour-intensive technology, but the problem will remain alive until he or she becomes sure that any other low-cost input mix will not be able to produce equal amount of output. Advanced study of economic theory provides explanation of efficient production techniques.

Whatever sophisticated production techniques are applied, the amount of produced goods and services would be of limited quantity. Therefore, the state or the concerned section has to be deeply vigilant in distributing goods among individuals. Because of loopholes in the system, some individuals may be under the risk of being deprived and others may occupy too much. Had there been unlimited resources, the amount of produced output would have been plenty. Thus state could ignore the

¹ In 1954, Wassily W. Leontief found that the United States—the most capital-abundant country in the world—specialised in labor-intensive commodities and imported capital-intensive commodities. This finding is paradoxical and hence it came known as Leontief Paradox.

problem of distribution. In real life circumstances, amount of total output is quite inadequate relative to the number of individuals among whom the outputs are to be distributed. Sometimes it is questioned whether outputs will be distributed only among the individuals who took part in production process, and the ones who did not participate in production will be excluded. If this happens to be true then the society will face chaos and crisis because the consumers having purchasing power will buy and the rest will be starving. A balanced society, of course, will focus on distributional justice and efficiency. Again the problem of distribution underlies the problem of scarcity. In the presence of unlimited resources, the quantity of goods and services producible would have been unlimited, hence the problem of exclusion of underprivileged section would have disappeared. This signifies the fact that all problems of an economy stems from the problem of scarcity.

1.2 Mankiw's Ten Principles of Economics

The activities performed by the agents of an economy are much complicated and multidimensional in nature. Mankiw (2011) in his *Principles of Economics* provides The Ten Principles of Economics that offer an overview of what economics is all about. The Ten Principles are briefly discussed below.

- Principle 1. *People Face Tradeoffs.* This principle implies that one has to give up something if he or she wants to gain something. If a person is not ready to sacrifice for reaching his or her goal then the goal cannot be achieved.
- Principle 2. *The Cost of Something is What One Gives Up to Get It.* The cost may be explicit or implicit in nature. Suppose a person wants to pursue higher studies. The cost of higher studies is not only the payment made in terms of money as tuition fees and for other reading materials. This also includes the opportunities that could have been availed if he or she were not studying.
- Principle 3. *Rational People Think at the Margin.* This principle is known as the marginality approach. An agent's decision of an action depends on whether the benefit from the action is greater than the cost of the action. For example, a person would buy a commodity if his utility through the consumption of the commodity exceeds the disutility created through the payment made for the commodity.
- Principle 4. *People Respond to Incentives.* If human beings are given any incentive in the form of cash or kind or else then they will certainly respond. This is most common. If a producer is given subsidy, he will be encouraged to produce more. If a student is informed that she will be rewarded for regular attendance then she will try to attend classes regularly. Only the irrational ones do not respond to the incentives.

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- Principle 5. *Trade Can Make Everyone Better Off.* Mutual trade is always beneficial. All countries or individuals are not equally expert in certain activities. One should specialize in which he or she is more efficient. For example, a manager may not be fluent in typing whereas a typist may be. In such event, it would be more efficient to hire a typist for the manager so that the manager can focus on managerial activities rather than spending much time in typing. The same happens to the typist who is not well-educated or well-trained in managerial activities. Effort of a typist for playing the role of a manager may cause troubles. In case of different countries, trade may occur depending on individual country's performance. For example, if a country has a lot of labour then it should produce labour intensive commodity and export them. In exchange, the country may import capital intensive goods that are likely to be produced by capital abundant country. In this way both countries would be benefitted through trade.
- Principle 6. *Markets Are Usually a Good Way to Organize Economic Activity.* Free operation of market is always advocated. Free operation refers to the interaction of demand and supply without any interruption. A simple example makes this clearer. Suppose a consumer wishes to pay 5 dollars for a product but the seller asks for 7 dollars. A bargaining between consumer and seller would help set a price which both parties would agree to accept. Any third party's interruption would hamper at least one party.
- Principle 7. *Governments Can Sometimes Improve Market Outcomes.* In some special cases when free market operation goes against the interest of majority, government intervention improves overall welfare. For example, emergence of monopoly is always against the interest of consumers because monopolist takes the scope of charging a higher price. A price control policy would go in favour of majority.
- Principle 8. *A Country's Standard of Living Depends on Its Ability to Produce Goods and Services.* This principle is straightforward. If the workers of a country are more capable of producing goods and services then the country's aggregate income would be higher and thereby standard of living would be better.
- Principle 9. *Prices Rise When the Government Prints Too Much Money.* Printing too much money would result in availability of more money for buying limited amount of goods and services. The certain outcome of this activity is price hike.
- Principle 10. *Society Faces a Short-Run Tradeoff Between Inflation and Unemployment.* Increase in inflation would mean a fall in real rate of interest and thus investment will increase. If investment rises then employment rises and unemployment falls. This tradeoff between inflation and unemployment is known as the Phillips curve relation after the name of A. W. Phillips (1958).

1.3 Circular Flow of Economic Activity

In an oversimplified framework, it is assumed that there remains only two sectors in an economy- the Business Firms and the Households. Households own all of the resources and business firms hire those resources from the households. Using the resources, the business firms produce goods and services and the households buy those goods and services. Households pay to the firms for the goods and services they buy from the firms. Following diagram shows the circular flow of economic activity. Households supply land, labour, capital and entrepreneurship to the business sector, using which firms produce goods and services. Households are paid rent, wages, interest and profit as the compensation for their sacrifice. The amount the households earn is used for buying goods and services.

Flow of resources from the households to firms is termed as the *real flow*. Real flow also includes the flow of goods from the firms to the families. *Monetary flow*, on the other hand, is the flow of compensation from the firms to families and spending from the families to business firms.

If the total spending on goods and services fall below the earning of the families, a portion of the produced output will remain unsold and lead to forming inventory. In order to preserve simplicity, we rule out the possibility of inventory accumulation. The system may be augmented through the inclusion of government and foreign sector but for avoiding complexities they have been excluded.

Circular Flow of Economic Activity

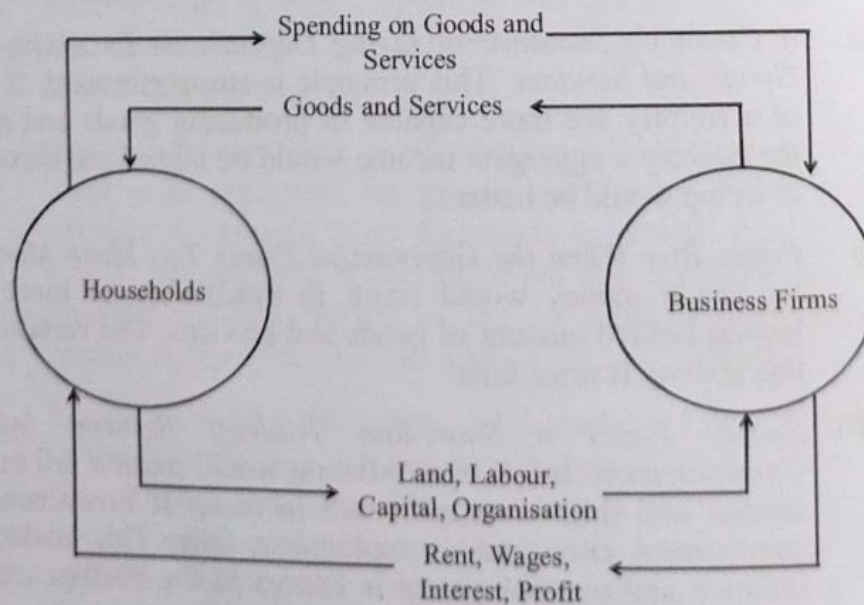


Figure 1.1

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The simple analysis of the circular flow makes it clear that household sector makes demand for goods and services and firms play the role of suppliers. Demand and supply sides are, therefore, the prime issues to be discussed in economics discipline. However, demand and supply may be analyzed from individual or overall perspective depending on if it is a topic of microeconomics or macroeconomics.

1.4 Positive Economics versus Normative Economics

Positive economics deals with the issues that occur in an economy. The occurrences may or may not be expected. Normative economics is value-based economics. Normative economics illustrates what should be done in order for the attainment of certain objectives or goals. For example, profit maximization is the objective of a producer. Positive economics describes how profit is maximized by lowering cost and boosting revenue. Normative economics examines whether the profit maximizing activity is logical or not. Profit may be maximized by producing variety of goods, of which some may be harmful for health or for the society. Positive economics does not care whether the commodity produced is good or bad for the society but normative economics focuses the good and bad sides of the production activity. Same holds for the consumer. A consumer's utility maximization through the consumption of any kind of commodity is described in positive economics but normative economics refutes the consumption of the commodities that involve health or moral hazard. Positive economic statements can be verified, they can be proved or disproved but normative statements are opinion-based and thus cannot be verified in a universal manner. This so happens because the same normative argument may be supported by few and unsupported by others.

1.5 Different Types of Economic System

Economic systems are differentiated on the basis of the nature of factor ownership. Factors of production may be owned by the private individuals or by the representatives of the society or even by the state. Consumption and production activities may be performed on the basis of positive economic principles or may be guided by certain values. Four different types of economic systems are discussed below.

1.5.1 Capitalism

In capitalism, individuals are the owners of factors of production. The person who can acquire more factors becomes richer and can dominate the poorer. Market price is determined through the interaction between demand and supply. If excess demand prevails then price goes up and in the presence of excess supply price goes down. Final equilibrium is achieved automatically. Government has limited or no role in the market. Only the persons having purchasing power can buy goods and services and the rest would be deprived. The distinguishing feature of capitalism is the free competition. People compete freely without any interruption by the government or any other agency.

1.5.2 Communism

In communism there is no private ownership of property. All factors of production are likely to be owned by the government. Karl Marx, the proponent of communism, thought that capitalism is the source of deprivation. Because of private ownership of properties and free competition, the gap between rich and poor grows day by day. Under communism government controls the entire economy in the name of people. In a typical communist society, there will have no class, no hierarchy, no currency and no personal property. People will work in harmony, solve their problems without confrontation and produce enough goods and services. Since the government decides everything, personal freedom is completely absent in communism.

1.5.3 Socialism

Socialism is a mild variant of communism. In socialism all properties are not acquired by the government but major portions are. There are two types of private property- some are purely personal and others are not. The property that generates personal enjoyment is purely personal. Consumer goods are the example of purely personal property. Socialism does not call for government ownership of purely personal property. Privately owned factors of production do not generate personal enjoyment, rather they are used to produce goods and services that would generate personal enjoyment. Under socialism this type of property should be owned by the government. Perfect elimination of private property is not the principle of socialism. The main goal of socialism is to narrow down the gap between rich and poor. The difference between socialism and communism lies in this. Communism struggles for total elimination of rich and poor but socialism is not as extreme as communism. Under socialism, rich and poor would exist but the gap would be narrow. In fact, socialism may be viewed as the transition phase of the emergence of communism from the abolition of capitalism.

1.5.4 Islamic Economic System

Islamic economic system is a faith-based economic system that outlines how to gain wealth, invest and distribute so that not a single person remains destitute among the people. Consumption and production activities are guided by Islamic principles. Properties would be owned by both private individuals and government. Complete abolition of private freedom lowers productivity; hence Islamic economics does not support this. However, private freedom does not imply free riding and free competition. People would be cooperative rather than competitive. If there is any possibility of the emergence of monopoly through the private ownership of some factors then government would interfere. Islamic consumers are not like conventional ones. They do not consume the goods and services that are

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prohibited in Islam. Similarly, producers produce only the goods and services supported by Islam. Islamic economic system strongly denies interest which is viewed as the means of exploitation. Interest is to be replaced by the concept of profit. In an Islamic economy, justice is properly maintained, needs of the people are rightly addressed so that they can be saved from poverty. Islamic economic system identifies unemployment, poor consumption habits, weak distribution, hoarding commodities and cheating with prices as the main reasons for poverty. The system preserves human wealth from corruption and loss. The Islamic state shoulders the responsibility of the poor and disabled people.

1.6 Microeconomics versus Macroeconomics

Microeconomics deals with the individual behavior of economic agents or variables. Macroeconomics, on the other hand, discusses overall behavior of agents or variables. Demand for or supply of a good, price of a good, income of a consumer or a producer are the examples of microeconomic concepts. The counterpart macroeconomic concepts are aggregate demand, aggregate supply, price level and national income respectively. Microeconomic theory provides the rationale behind the creation of demand through the attainment of utility. Cardinal and ordinal approaches of utility are the core topics covered in microeconomic analysis. Among many others, price elasticity of demand and supply, theory of production and cost, theory of firm, different types of market structures, factor pricing, general equilibrium and welfare economics are rigorously studied in microeconomics. Macroeconomics mainly discusses the composition and measurement of national income, theory of consumption, theory of investment, goods and money market equilibrium, fiscal and monetary policies, growth theory, international linkages, inflation-unemployment relationship etc. Techniques of stabilizing inflation and unemployment are carefully examined in macroeconomics. Since macroeconomics mostly addresses the policy concern, it may be termed as policy economics. Microeconomics does not deal with policy instruments or implementation, only examines individual behavior of economic units.

In microeconomic analysis, the concepts of opportunity cost and production possibility curve have wider use. These concepts have been briefly illustrated in sections 1.7 and 1.8.

1.7 Opportunity Cost

Opportunity cost is the next best alternative foregone to perform an economic activity. For example, if a producer gives up the production of 6 kg wheat in order to produce 5 kg rice, the opportunity cost of producing 5 kg rice is 6 kg wheat. Similarly, if an individual rejects some job offer to run a business then the opportunity cost of running that business is the amount of money that could have been earned from being employed. Opportunity cost is sometimes termed as implicit cost or invisible cost.

1.8 Production Possibility Curve

Production possibility curve (PPC) shows the combinations of two goods that can be produced under a given technology by efficiently utilizing all of the resources of an economy. Suppose the economy produces only two goods- food and cloth. Regular shape of a PPC has been shown below.

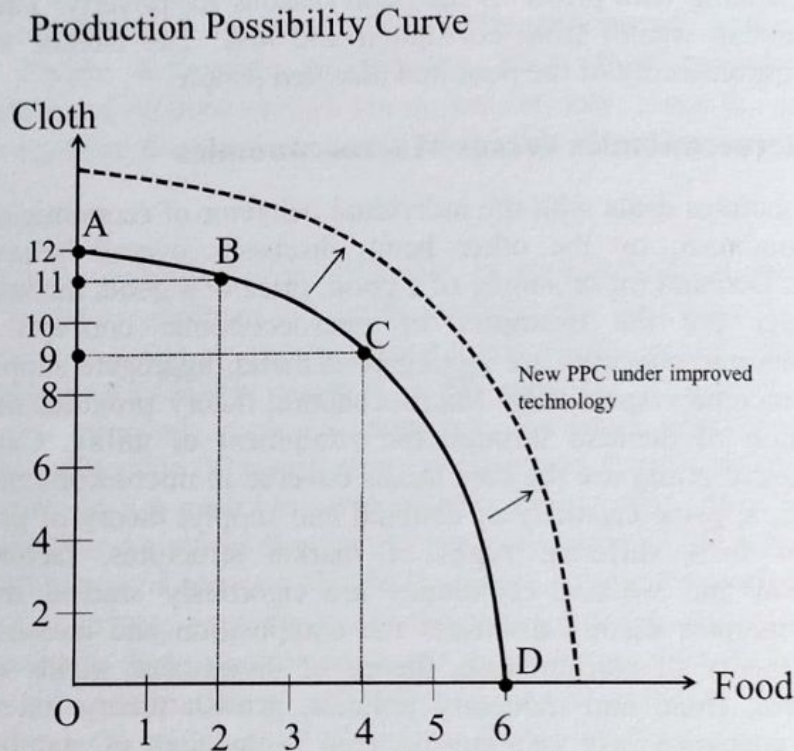


Figure 1.2

In Figure 1.2, point A shows that the economy produces 12 units of cloth by employing all of the resources. In this situation production of food is nil. The opposite occurs at point D where all resources produce 6 units of food alone. Points B and C show positive combinations of both food and cloth. By joining A, B, C and D production possibility curve (PPC) is drawn as a concave curve. If technology improves, PPC shifts outward. In Figure 1.2 the dashed PPC is the result of technological improvement.

Concavity of PPC reflects increasing opportunity cost. Production of food and cloth at point B are 2 and 11 units respectively. Movement from A to B implies an additional 2 units production of food at the cost of 1 unit cloth. That means, opportunity cost of producing 2 units foods is equal to 1 unit cloth. Movement from

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B to C represents another additional 2 units production of food at the cost of 2 units cloth. In this case opportunity cost of 2 units food equals to 2 units cloth. Movement from C to D reflects an opportunity cost of 9 units of cloth for 2 units of food. What is observed is that opportunity cost of first 2 units foods is equal to 1 unit cloth, opportunity cost of second 2 units foods is equal to 2 units cloths and opportunity cost of last 2 units foods is equal to 9 units cloths. This signifies the increasing nature of opportunity cost. Increasing nature of opportunity cost underlies the idea of efficient utilization of resources.

Suppose the economy has limited area of land that is used in food and cloth production. Efficient use of land would refer to using agricultural land in food production and urban land in cloth production. If all lands are however used in cloth production then the point would be A in the above diagram. Suppose the planner decides to produce 2 units foods hence releases a certain amount of land from cloth production. Of course, the land that is most fertile in food production would be released first. In our example, corresponding reduction in cloth production is 1 unit. If the planner again attempts to increase food production by another 2 units, he will not now find equally fertile land as before. As a result the amount of land to be released from cloth production should be higher, which causes 2 units reduction in cloth production. Earlier it required only 1 unit reduction in cloth production and now it requires 2 units reduction in cloth production for equal amount of food. Movement from C to D shows 9 units reduction in cloth production for the same amount of food. This proves increasing nature of opportunity cost. If all lands were equally productive in the production of food and cloth then opportunity cost would have been constant and production possibility curve straight-line.

Movement along a PPC exhibits the increase in output of one good and decrease in output of another good. The underlying concept is known as the marginal rate of product transformation. Marginal rate of product transformation is the decrease in production of one good due to one unit increase in production of another good or vice versa. Suppose a hypothetical economy produces only two goods- X and Y. Marginal rate of product transformation between X and Y ($MRPT_{XY}$) is defined as the change in production of Y due to one unit change in production of X when the amount of productive resource of the economy is fixed and technology remains unchanged.

Marginal Rate of Product Transformation

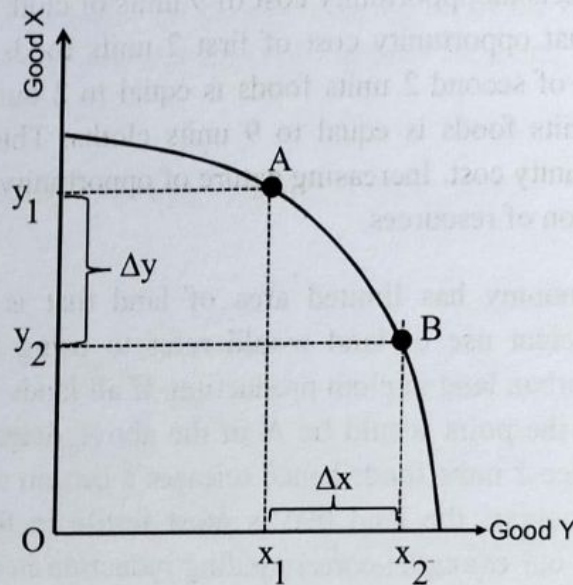


Figure 1.3

In Figure 1.3,

$\Delta x (= x_1 - x_2)$ unit increase in production of X requires $\Delta y (= y_1 - y_2)$ unit decrease in production of Y.

Therefore, 1 unit increase in production of X requires $\frac{\Delta y}{\Delta x} = \frac{y_1 - y_2}{x_1 - x_2}$ unit decrease in production of Y.

The definition follows, $MRPT_{xy} = \frac{\Delta y}{\Delta x} = \frac{y_1 - y_2}{x_1 - x_2}$

In Figure 1.4, at point A production of X is zero and production of Y is 6. At point B production of X is 2 and production of Y is 5.6.

Change in X, $\Delta x = 2$; and change in Y, $\Delta y = 6 - 5.6 = 0.4$. Therefore,

$$MRPT_{xy} = \frac{\Delta y}{\Delta x} = \frac{0.4}{2} = 0.2$$

At point C, production of X is 4 and production of Y is 4.5.

Movement from B to C associates, change in X, $\Delta x = 2$; and change in Y, $\Delta y = 5.6 - 4.5 = 1.1$.

$$\text{Therefore, } MRPT_{xy} = \frac{\Delta y}{\Delta x} = \frac{1.1}{2} = 0.55$$

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At point D, production of X is 6 and production of Y is nil.
Change in production of X, $\Delta x = 2$ and
change in production of Y, $\Delta y = 4.5 - 0 = 4.5$.

$$\text{Thus } MRPT_{xy} = \frac{\Delta y}{\Delta x} = \frac{4.5}{2} = 2.25.$$

Here MRPT gradually increases from 0.2 to 1.1 to 2.25. Indeed, increasing nature of marginal rate of product transformation makes the PPC concave.

Increasing Marginal Rate of Product Transformation

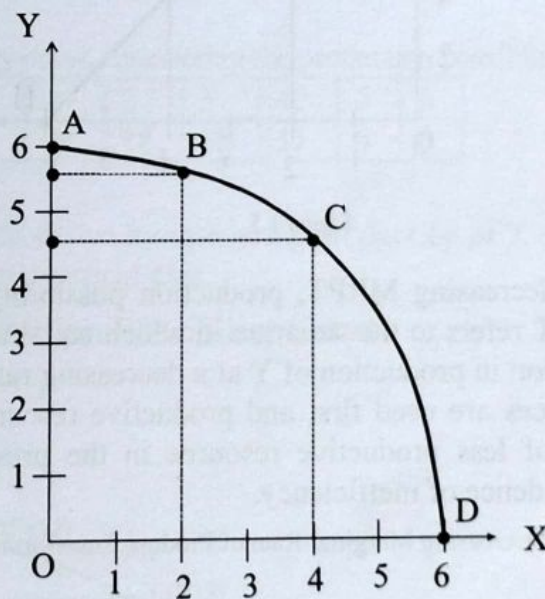


Figure 1.4

If MRPT remains constant, PPC becomes straight-line. Figure 1.5 represents the case of constant marginal rate of product transformation. At point E, production of X and Y are 0 and 12 respectively. At point F the corresponding productions are 2 and 8 respectively. Through the movement from E to F, change in X, $\Delta x = 2$ and change in Y, $\Delta y = 12 - 8 = 4$.

$$\text{Thus, } MRPT_{xy} = \frac{\Delta y}{\Delta x} = \frac{4}{2} = 2. \text{ Movement from F to G also results in } \Delta x = 4 - 2 = 2$$

and $\Delta y = 8 - 4 = 4$, leaving $MRPT_{xy}$ constant at 2. Movement from G to H yields the same $MRPT_{xy}$. If the resources of the economy are equally productive in producing X and Y then $MRPT_{xy}$ remains constant, PPC becomes straight-line.

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Constant Marginal Rate of Product Transformation

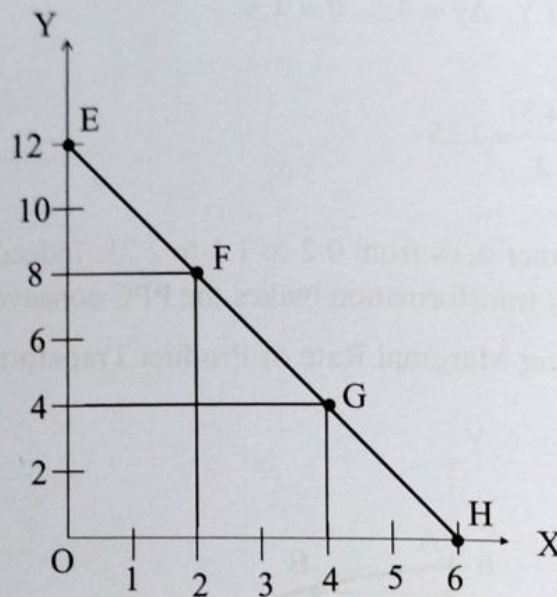


Figure 1.5

In the event of decreasing MRPT, production possibility curve becomes convex. Decreasing MRPT refers to the situation in which equal increment of production of X requires reduction in production of Y at a decreasing rate. This may happen if less productive resources are used first and productive resources come into production afterwards. Use of less productive resource in the presence of more productive resource is the evidence of inefficiency.

Decreasing Marginal Rate of Product Transformation

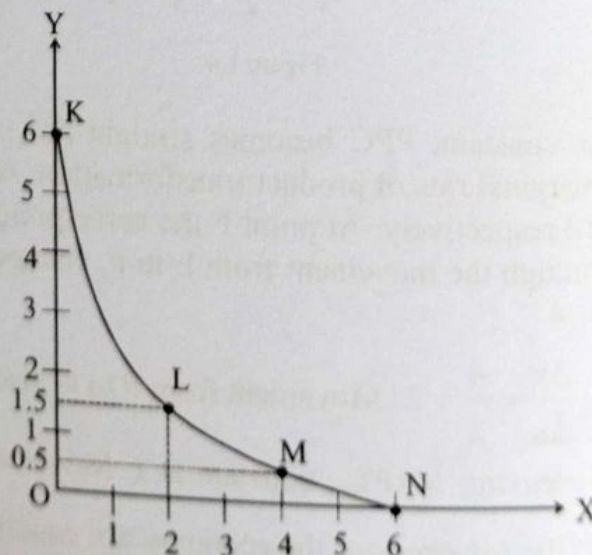


Figure 1.6

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Figure 1.6 represents decreasing marginal rate of product transformation. Movement from K to L associates $\Delta x = 2 - 0 = 2$ and $\Delta y = 6 - 1.5 = 4.5$.

$$\text{Therefore, } MRPT_{xy} = \frac{\Delta y}{\Delta x} = \frac{4.5}{2} = 2.25$$

Movement from L to M accounts for $MRPT_{xy} = \frac{\Delta y}{\Delta x} = \frac{1.5 - 0.5}{4 - 2} = \frac{1}{2} = 0.5$ and

movement from M to N yields $MRPT_{xy} = \frac{\Delta y}{\Delta x} = \frac{0.5 - 0}{6 - 4} = \frac{0.5}{2} = 0.25$.

MRPT gradually decreases from 2.25 to 0.5 to 0.25. Decreasing MRPT indicates that for additional productions of X, successively lesser quantities of Y are required to be sacrificed which is conflicting with economic efficiency.

Example 1.1

Draw the production possibility curve considering the production possibilities of X and Y.

Production of X	0	1	2	3	4	5	6
Production of Y	21	20	18	15	11	6	0

Solution

Production possibility curve is drawn by measuring production of X along horizontal axis and production of Y along vertical axis.

Production Possibility Curve

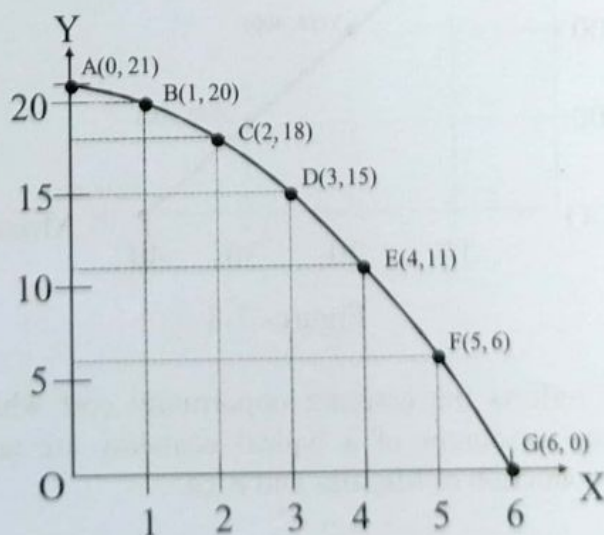


Figure- 1.7

Every 1 unit increase in production of X involves respectively 1, 2, 3, 4, 5 & 6 units decrease in production of Y.

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Example 1.2

Draw the production possibility curve (PPC) assuming the following table. What type of opportunity cost is reflected in the shape of PPC? How realistic is this?

Production of Rice	800	600	400	200	0
Production of Missiles	0	10	20	30	40

Solution

Figure 1.8 is the production possibility curve representing the given table. Production of Missiles has been measured along horizontal axis and Rice along vertical axis.

Production Possibility Curve

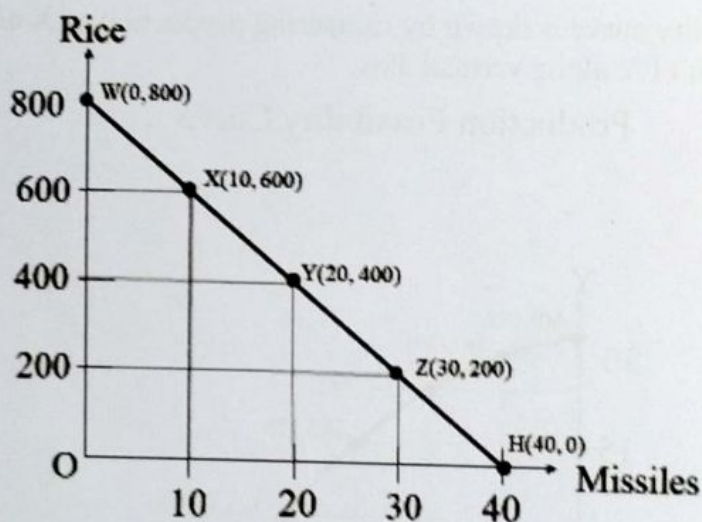


Figure- 1.8

Straight-line PPC reflects the constant opportunity cost which is not that much realistic because the resources of a typical economy are unlikely to be equally productive in the production of Missiles and Rice.

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Similarly $|A_2|$ is obtained by substituting the second column of A by constant column

$$|A_2| = \begin{vmatrix} 2 & 13 \\ 1 & -11 \end{vmatrix} = -22 - 13 = -35$$

Thus according to Cramer's rule, $x_1 = \frac{|A_1|}{|A|} = \frac{-28}{-7} = 4$ &

$$x_2 = \frac{|A_2|}{|A|} = \frac{-35}{-7} = 5$$

Exercise 1

1. Draw the production possibility curve from the information below. Comment on the nature of opportunity cost.

Production of Computer	0	2	4	6	8	10	12
Production of Tractor	30	25	20	15	10	5	0

2. Show that the shape of production possibility curve in the following case is concave. How realistic is this?

Production of Potato	0	1	2	3	4
Production of Cloth	100	90	70	40	0

3. Graph the following functions

a. $y = 12 - x^2$

b. $R = 100Q - Q^2$

c. $Q = \frac{400}{P}$

d. $y = 5^x$

e. $y = \ln x^2$

4. Show that $\sqrt[5]{x^7} = (\sqrt[5]{x})^7$

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5. Find $\frac{d}{dx} \left[\frac{(x^2 + 2x)(5 - x)}{(x^2 - 9)} \right]^5$
6. Given $y = (x^2 + e^{x^2})^{-5}$. Find $\frac{dy}{dx}$
7. Find f_K and f_L from $f(K, L) = K^{0.5} L^{0.6}$
8. Given $y = x^2 + 5xw + 2w^3$. Find total differential dy .
9. Evaluate
 - a) $2 \int a(ax + b)^7 dx$;
 - b) $\int_{-1}^1 (x^2 + 2x + 3) dx$
10. Given the marginal utility function: $MU = 100 - 2Q$. Find the amount of total utility from the consumption of 10 units of the commodity.
11. Find the determinant value of matrix $S = \begin{bmatrix} -5 & 3 & 2 \\ 7 & 0 & 3 \\ 10 & -6 & -4 \end{bmatrix}$
12. Find the inverse of $S = \begin{bmatrix} -5 & 13 & 2 \\ 7 & 0 & 3 \\ 11 & -6 & -4 \end{bmatrix}$. Check the validity of your answer.
13. Given the equation system

$$\begin{aligned} x + y + z &= 18 \\ x - y &= -1 \\ 2x + 3z &= 31 \end{aligned}$$
 Solve the equation system via Cramer's rule.
14. Solve the following market model using matrix inversion.

$$\begin{aligned} Q_d &= 25 - 3P \\ Q_s &= -2 + 5P \\ Q_d &= Q_s \end{aligned}$$
 Where Q_d , Q_s and P represent the quantity of demand, quantity of supply and price respectively.