UNIT – IV

General Equilibrium Theory – Interdependence – The Walrasian System – Graphical Treatment of the Two Factors, Two Commodities, and Two Consumer General Equilibrium System - General Equilibrium and Resource allocation.

GENERAL EQUILIBRIUM THEORY

General equilibrium theory, or Walrasian general equilibrium, attempts to explain the functioning of the macroeconomy as a whole, rather than as collections of individual market phenomena.

The theory was first developed by the French economist Leon Walras in the late 19th century. It stands in contrast with partial equilibrium theory, or Marshallian partial equilibrium, which only analyzes specific markets or sectors.

Key Takeaways

- **General equilibrium analyzes the economy as a whole, rather than analyzing single markets like with partial equilibrium analysis.**
- **General equilibrium shows how supply and demand interact and tend toward a balance in an economy of multiple markets working at once.**
- **The balance of competing levels of supply and demand in different markets ultimately creates a price equilibrium.**
- **French economist Leon Walras introduced and developed the theory in the late 19th century.**

Walras developed the general equilibrium theory to solve a much-debated problem in economics. Up to that point, most economic analyses only demonstrated partial equilibrium—that is, the price at which supply equals demand and markets clear—in individual markets. It was not yet shown that equilibrium could exist for all markets at the same time in aggregate.

General equilibrium theory tried to show how and why all free markets tend toward equilibrium in the long run. The important fact was that markets didn't necessarily reach equilibrium, only that they tended toward it. As Walras wrote in 1889, "The market is like a lake agitated by the wind, where the water is incessantly seeking its level without ever reaching it."

General equilibrium theory builds on the coordinating processes of a free market price system, first widely popularized by Adam Smith's "The Wealth of Nations" (1776). This system says traders, in a bidding process with other traders, create transactions by buying

and selling goods. Those transaction prices act as signals to other producers and consumers to realign their resources and activities along more profitable lines.

Walras, a talented mathematician, believed he proved that any individual market was necessarily in equilibrium if all other markets were also in equilibrium. This became known as Walras's Law.

The general equilibrium theory considers the economy as a network of interdependent markets and seeks to prove that all free markets eventually move towards general equilibrium.

INTERDEPENDENCE

The interdependence between individuals and markets requires that equilibrium for all product and factor markets as well as for all participants in each market must be determined simultaneously in order to secure a consistent set of prices.

THE WALRASIAN SYSTEM

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Understanding General Equilibrium Theory

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Special Considerations

There are many assumptions, realistic and unrealistic, inside the general equilibrium framework. Each economy has a finite number of goods in a finite number of agents. Each agent has a continuous and strictly concave utility function, along with possession of a single pre-existing good (the "production good"). To increase his utility, each agent must trade his production good for other goods to be consumed.

There is a specified and limited set of market prices for the goods in this theoretical economy. Each agent relies on these prices to maximize his utility, thereby creating supply and demand for various goods. Like most equilibrium models, markets lack uncertainty, imperfect knowledge, or innovation.

A Graphical Treatment Of The Two-Factor, Two-Commodity, Two-Consumer (2 X 2 X 2) General Equilibrium Model:

Now we use graphical analysis to show the general equilibrium of a simple economy in which there are two factors of production, two commodities (each produced by a firm) and two consumers. This is known as the 2 x 2 x 2 general equilibrium model. We will restrict our analysis to the perfectly competitive market system, since with free competition it has been proved that a general equilibrium solution exists (given some additional assumptions about the form of the production and demand functions). Furthermore we will be concerned with the static properties of general equilibrium and not with the dynamic

process of reaching the state of such an equilibrium, the latter having been sketched in the preceding section.

Assumptions of the 2 X 2 X 2 Model:

1. There are two factors of production, labour (L) and capital (K), whose quantities are given exogenously. These factors are homogeneous and perfectly divisible.

2. Only two commodities are produced, X and Y. Technology is given. The production functions of the two commodities are represented by two isoquant maps, with the usual properties. The isoquants are smooth and convex to the origin, implying diminishing marginal rate of factor (technical) substitution along any isoquant. Each production function exhibits constant returns to scale. Finally, it is assumed that the two production functions are independent: there are no external economies or diseconomies for the production activity of one product arising from the production of the other.

3. There are two consumers in the economy, A and B, whose preferences are represented by ordinal indifference curves, which are convex to the origin, exhibiting diminishing marginal rate of substitution between the two commodities. It is assumed that consumer choices are independent: the consumption patterns of A do not affect B's utility, and vice versa. Bandwagon, snob, Veblenesque and other 'external' effects are ruled out. Finally, it is assumed that the consumers are sovereign, in the sense that their choice is not influenced by advertising or other activities of the firms.

4. The goal of each consumer is the maximisation of his own satisfaction (utility), subject to his income constraint.

5. The goal of each firm is profit maximisation, subject to the technological constraint of the production function.

6. The factors of production are owned by the consumers.

7. There is full employment of the factors of production, and all incomes received by their owners (A and B) are spent.

8. There is perfect competition in the commodity and factor markets. Consumers and firms pursue their goals faced by the same set of prices (P_x, P_y, w, r).

In this model a general equilibrium is reached when the four markets (two commodity markets and two factor markets) are cleared at a set of equilibrium prices (P_x, P_y, w, r) and each participant economic agent (two firms and two consumers) is simultaneously in equilibrium.

The general equilibrium solution thus requires the determination of the values of the following variables:

The total quantities of the two commodities X and Y, which will be produced by firms and bought by the consumers.

The allocation of the given K and L to the production of each commodity (K_x, K_y, L_x, L_y).

The quantities of X and Y which will be bought by the two consumers (X_A, X_B, Y_A, Y_B).

The prices of commodities (P_x and P_y) and of the factors of production (wage w, and rental of capital r).

The distribution of factor ownership between the two consumers (K_A, K_B, L_A, L_B). The quantities of factors multiplied by their prices define the income distribution between A and B, and hence their budget constraint.

General equilibrium and the allocation of resources:

In figure 22.26 the general equilibrium solution is shown by points T (on the production possibility curve) and T (on the Edgeworth contract curve). These points define six of the 'unknowns' of the system, namely the quantities to be produced of the two commodities (X_e and Y_e), and their distribution among the two consumers ($X^A{}_e$, $X^B{}_e$, $Y^A{}_e$, $Y^B{}_e$). We examine the determination of the allocation of resources between X and Y. The determination of the remaining unknowns (prices of factors and commodities, and the distribution of income between the two consumers) is examined in two separate sections below.

Point T on the production transformation curve (figure 22.26) defines the equilibrium product mix Y_e and X_e. Recalling that the PPC is the locus of points of the Edgeworth contract curve of production mapped on the product space, point T corresponds to a given point on this contract curve, say T" in figure 22.28.

Thus T" defines the allocation of the given resource endowments in the production of the general equilibrium commodity mix. The production of X_e absorbs L_x of labour and K_x of capital, while Y_e employs the remaining quantities of factors of production; L_y and K_y. Thus four more 'unknowns' have been defined from the general equilibrium solution.

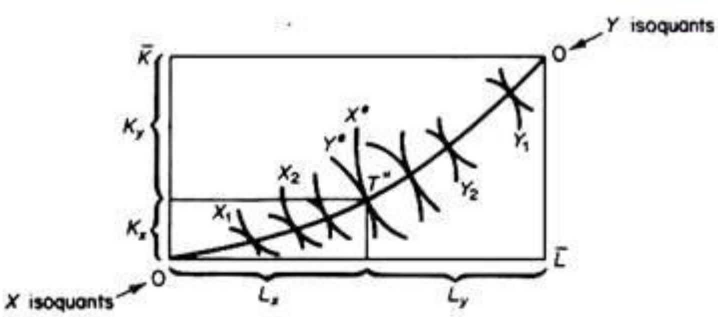

Figure 22.28 Allocation of resources to the production of X_e and Y_e

Prices of commodities and factors:

The next step in our analysis is to show the determination of prices in the general equilibrium model, under perfect competition.

In the simple 2 x 2 x 2 model there are four prices to be determined, two commodity prices, P_x and P_y, and two factor prices, the wage rate w, and the rental of capital r. We thus need four independent equations. However, given the assumptions of the simple model, we can derive only three independent relations.

1. Profit maximisation by the individual firm implies least-cost production of the profit-maximising output. This requires that the producer adjusts his factor mix until the MRTS of labour for capital equals the w/r ratio

$$MRTS^{x}_{L,k} = w/r = MRTS^{y}_{L,K} \quad (5)$$

In other words the individual producer maximises his profit at points of tangency between the isoquants and isocost lines whose slope equals the factor price ratio.

2. In perfect factor and output markets the individual profit-maximising producer will employ each factor up to the point where its marginal physical product times the price of the output it produces just equals the price of the factor

$$w = (MPP_{L,X}).(P_X) = (MPP_{L,y}).(P_y) \quad (6)$$

$$r = (MPP_{K,x}) . (P_x) = (MPP_{k,y}) . (P_y) \quad (7)$$

3. The individual consumer maximises his utility by purchasing the output mix which puts him on the highest indifference curve, given his income constraint. In other words maximisation of utility if attained when the budget line, whose slope is equal to the ratio of commodity prices P_x/P_y, is tangent to the highest utility curve, whose slope is the marginal rate of substitution of the two commodities

$$MRS^{A}_{y,X} = P_y/P_x = MRS^{B}_{y,x} \quad (8)$$

Although we have four relations between the four prices, one of them is not independent. Because, dividing (6) and (7), we obtain

$$\frac{w}{r} = \frac{MPP_{L,x}}{MPP_{K,x}} = \frac{MPP_{L,y}}{MPP_{K,y}} = MRTS_{L,K}$$

Which is the same as expression (5). Thus we have three independent equations in four unknowns. Apparently the absolute values of w, r, P_x and P_y are not uniquely determined (although the general equilibrium solution is unique). Prices in the Walrasian system are determined only up to a ratio or a scale factor. We can express any three prices in terms of the fourth, which we choose arbitrarily as a numeraire or unit of account. For example assume that we choose P_x as the numeraire.

The remaining three prices can be determined in terms of P_x as follows:
From (5) we obtain

$$w = r(MRTS_{L,K}) \tag{9}$$

From the first part of expression (7) we have

$$r = (MPP_{K,x})P_x \tag{10}$$

Substituting (10) in (9) we obtain

$$w = (MRTS_{L,K})(MPP_{K,x})P_x \tag{11}$$

Finally from (8) we obtain

$$P_y = (MRS_{y,x})(P_x) \tag{12}$$

Equations (10), (11) and (12) give the *relative* prices w, r and P_y, that is, the prices relative to the *numéraire* P_x:

$$\frac{P_y}{P_x} = (MRS_{y,x}) \tag{13}$$

$$\frac{w}{P_x} = (MRTS_{L,K})(MPP_{K,x}) \tag{14}$$

$$\frac{r}{P_x} = (MPP_{K,x}) \tag{15}$$

The terms in brackets are known values, that is, values determined by the general equilibrium solution and the maximising behaviour of economic decision-makers with a given state of technology and given tastes.

Note that any good can serve as numeraire, and the change of numeraire leaves the relative prices unaffected. We can also assign any numerical value to the price of the numeraire. For convenience P_x is assigned the value of 1. But if, for example, we choose to set P_x = £b, then the price of y in £ will be

$P_y = b.\ P_y / P_x$ (pounds)

This, however, does not mean that the absolute level of the prices of the system is determined. It simply illustrates the fact that we can assign to the price of the numeraire any value we choose.

The reason that the prices are determined only up to a ratio is that money has not been introduced in the system as a commodity used for transactions or as a store of wealth. In a system with perfect certainty, where, for example, nobody would think of holding money, only relative prices matter. The three equations (13)—(15) establish the price ratios implied by the unique general equilibrium solution, and the absolute values of prices are of no importance.

However, the general equilibrium model can be completed by adding one (or more) monetary equation. Then the absolute values of the four prices can be determined. Unless a market for money is explicitly introduced, the price side of the model depends on an endogenous numeraire.

Factor ownership and income distribution:

For the simultaneous equilibrium of production and consumption, consumers must earn the 'appropriate' incomes in order to be able to buy the quantities of the two commodities (X_A, X_B, Y_A, Y_B) implied by point T in figure 22.26.

Consumers' income depends on the distribution of factor ownership (quantities of factors which they own) and on factor prices. We saw in the preceding paragraph that the prices of factors are determined only up to a ratio. This, however, is adequate for the required income distribution, if the ownership of factors by A and B is determined. For this purpose we require four independent relations, given that we have four unknowns (K_A, K_B, L_A, L_B).

From the assumption of constant returns to scale we can make use of Euler's 'product exhaustion theorem'. This postulates that, with constant returns to scale, the total factor income is equal to the total value of the product of the economy (in perfect factor markets, where inputs are paid their marginal product)

Thus we have three independent equations in four unknowns (K_A, K_B, L_A, L_B), whose values cannot be uniquely determined. The general equilibrium solution does not give absolute values for the distribution of ownership of the factors and money incomes between consumers A and B.

This indeterminacy can be resolved only partly if one fixes arbitrarily the value of one of the four factor endowments, and then allocate the remaining three so as to make the individual incomes of A and B such as to lead them willingly to the consumption pattern implied by point T in figure 22.26. It should be clear that different distribution of resources among the two consumers can result in different product combinations, that is, different general equilibrium solutions.

The conclusion of this paragraph may be summarised as follows. The general equilibrium solution defines the total value of the product in the economy. With constant returns to scale this value is equal to the total income of the consumers. However, the individual incomes of A and B are not uniquely determined endogenously. One has to make a consistent assumption about the factor ownership distribution among the two consumers, so that their incomes are compatible with the purchasing pattern of X_e and Y_e implied by the general equilibrium solution (T and T in figure 22.26).

It should be stressed that the above result of factor and income distribution follows from the assumption of fixed amounts of L and K owned by the consumers and supplied to the firms irrespective of prices. The factor supplies did not depend (in this simple model) on the prices of factors and the prices of commodities. The model could be solved simultaneously for input allocations among X and Y, total output mix and commodity-distribution between the two consumers, and only subsequently could we superimpose on this solution the ownership of factors and money-income distribution problem.

GENERAL EQUILIBRIUM AND RESOURCE ALLOCATION

1. Resource Allocation under Partial Equilibrium:

In the long run, a perfectly competitive economy allocates its resources in the most efficient manner so as to maximise consumer satisfaction.

As such, perfect competition leads to socially optimal allocation of resources for the following reasons:

1. Every firm in the long run builds the least cost plant and operates it at its optimal level output so that the per unit cost (LAC) is the minimum.

2. Firms operate their plants at full capacity so that resources are allocated in the most efficient way within and between industries.

3. There are no substantial economies of scale within an industry.

4 Consumer preferences are fulfilled with the largest amount of goods at minimum prices.

5. Given the incomes and tastes of consumers, aggregate consumer satisfaction is maximised because goods are distributed among consumers according to their demands.

6. Resources are allocated optimally as a result of flexible product and factor prices. This leads to full employment of resources within the economy.

7. There is optimal allocation of resources because price equals the marginal cost of product,

8. Finns maximise their profits which means that they earn only normal profits.

This condition is assured by the equation:

LMC = P = AR = MR = LAC at its minimum.

Given the above conditions in a perfectly competitive industry, we explain below the optimal allocation of resources.

In a perfectly competitive market, firms are price-takers and quantity-adjusters. They accept the price which is determined by the total demand and supply of the industry. Such a situation for each firm and for the industry as a whole is depicted in Figure 1 (A) and (B). In Panel (A), the price OP is set by the industry which is accepted by each firm so that its demand curve (AR = MR) is a horizontal line as shown in Panel (B).

The firm's profit maximisation level of output is OM because it chooses to supply this quantity, as indicated by its marginal cost curve (LMC) which is also its supply curve. Thus the equality of price and marginal cost at point A satisfies the condition for an optimal allocation of resources by a perfectly competitive firm, i.e., LMC = P = AR = MR.

Another important condition for an optimal allocation of resources in a perfectly competitive market is that each firm must earn normal profits. Assuming that there are no substantial economies of scale, when price equals LMC, it must also equal LAC at its minimum level. This is shown in Panel (B) where the LMC curve cuts the price line P = AR = MR from below and also the LAC curve at its minimum point A, where the price line P is tangent to it.

Each firm produces the profit maximisation output OM, sells it at the given price OP and earns normal profits. This leads to an optimal allocation of resources because the full equilibrium condition is satisfied i.e., LMC – P = AR = MR = LAC at its minimum. If there were substantial economies of scale, the LAC curve would slope downwards and there would be no long-run equilibrium. Smaller firms with higher costs would be competed away out of the industry by larger firms with lower costs. Ultimately, this would lead to imperfect competition or even monopoly.

We may conclude that when each firm in a perfectly competitive industry produces at a point where P = LMC. There is an optimal allocation of resources. Further, when each firm produces at the minimum point of its LAC curve and earns only normal profits, and consumers get this commodity at the lowest price, there is again an optimal allocation of resources.

2. Resource Allocation under General Equilibrium:

Another way of explaining resource allocation under perfect competition is to assume that the economy produces only two goods and allocates them optimally at the point where an indifference curve is tangent to a production possibility or transformation curve.

This analysis is based on the following assumptions:

(1) There is perfect competition on the demand side of the market for finished goods.

(2) All goods are uniquely distributed in a society.

(3) Tastes and technology remain unchanged in a society.

(4) Every member of the society prefers more rather than less of each good.

(5) There is a given level of employment of resources. (6) There are no external effects in consumption and production.

(7) Community indifference curves do not intersect each other.

(8) The economy produces only two goods, say X and Y.

Given these assumptions, consider Figure 2 where the output of good X is measured along the horizontal axis and of good Y along the vertical axis. I, I_1 and $I_2$are the community indifference curves showing various possible combinations of-these goods available to the society.

The slope of an indifference curve at any point shows the marginal rate of substitution between the two goods X and Y (MRS_{xy}). TC is the production possibility curve showing various output combinations possible with the given resources and technology. The slope of the production possibility curve at any point measures the ratio of the marginal social cost (A/SC) of X to that of Y. The slope of the transformation curve in the marginal rate of transformation (MRT) between two goods X and Y. Thus $MRT_{xy}= MSC_X/MSC_Y$. PL is the price line whose slope shows P_x /P_y.

The society attains the optimal output position E where the transformation curve TC touches the highest possible community indifference curve I_1 .At this optimum level, the society produces and consumes OX_1 of good X and OY_1 of good Y. Any movement along the TC curve away from point E brings the community to a lower indifference curve, such as the curve I and to a level lower than the optimal.

This optimal output is, in fact, the competitive output. Since it is assumed that there is perfect competition and absence of external effects, prices of the two goods remain uniform throughout the market. Thus from the demand side, equilibrium is established at point E where the price line PL is tangent to the indifference curve I_1.

Thus at point E,

$MRS_{xy} = P_x/P_y$.

From the supply side, the competitive equilibrium requires that the slope of the price line must equal the slope of the transformation curve,

$P_x /P_y = MRT_{xy}$

In fact, MRT_{xy} is equal to the ratio of the marginal private cost of Y (MC_x) to that of Y (MC_y) in a perfect market. Since it is assumed that the external effects in production are absent, therefore, the marginal private cost equals the marginal social cost of production. Thus the slope of the transformation curve shows $MRT_{xy} = MC_x /MC_y = MSC_x /MSC_y$.

It follows from (1) and (2) that resources are optimally allocated under perfect competition at point E in Figure 2 where the transformation curve, the indifference curve and the price line are tangent to each other,

$MRT_{xy} = MRS_{xy} = P_x /P_y$.