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1. Learning Outcomes

After studying this module, you shall be able to

- Know about the Benefit theory / Voluntary exchange model.
- Learn the two approaches of Voluntary exchange model i.e. Lindhal and Bowen's approach.
- Identify the advantages and limitations of these approaches.
- Analyse the feasibility of the two approaches.

2. Introduction

Theory of Public goods provides a rationale for the allocation function of Public policy. Public goods exhibit the features of non-excludability and non-rivalry. In the provision of Public goods, private market fails to utilize resources efficiently.

Public goods are also closely associated with the 'free-rider' problem, in which people do not pay for the good and may continue to access it which results in under-production, overconsumption and degraded goods and hence, government intervention is required.

The problem then is how the government should determine how much of such goods are to be produced and allocated.

The difficulty lies in deciding the type and quality of a public good that should be supplied and how much a particular consumer should be asked to pay.

In case of private goods, consumers pay for the benefits received, but the problem in case of public goods is how these benefits are valued. Individual consumers have no reason to reveal to the government how highly they value the public goods.

To serve as an effective mechanism of preference revelation, voting process on tax and expenditure decisions could be taken. Voters are confronted with a choice among budget proposals which carry a price tag in terms of their own tax contribution.

However, the political mechanism is imperfect and can only approximate what would be the optimal budget choice.

To explain preference revelation, there are two theories in Public Finance literature: the Ability theory and the Benefit theory (developed by Erik Lindahl). The Benefit theory

has a modern variety, which is known as the "Voluntary Exchange" theory. Moreover, the module is concluded with a brief overview to ability to pay approach.

3. Benefit Theory/Voluntary Exchange Theory

Most governments collect funds from various sources to provide public goods or to finance transfer payments. The supreme source of revenue in mixed economies is taxation.

Under the Voluntary exchange model, tax levels are determined automatically, because taxpayers pay proportionately for the government benefits they receive. Putting it another way, the individuals who benefit the most from public goods pay the most taxes.

For analyzing the Voluntary exchange or Benefit theory, 2 models have been discussed: the Lindahl model and the Bowen model.

3.1. Lindahl's model

Erik Lindahl (21 November 1891 – 6 January 1960) was a Swedish economist and a professor of economics at Uppsala University. He was also an advisor to the Government of Sweden and the central bank. Lindahl modelled the question of financing public goods in harmony with individual benefits. The quantity of the public good satisfies the requirement that the total marginal benefit equals the marginal cost of providing the good.

The necessary and sufficient condition for such an equilibrium being:

- (i) the sum of the declared willingness be greater than the cost of provision, and;
- (ii) the minimum willingness to pay is positive & non-zero.

Erik Lindahl was deeply influenced by his professor and mentor Knut Wicksell and proposed a method for financing public goods permissible to show that consensus politics is possible. As people are different in nature, their preferences are different, and consensus requires each individual to pay a somewhat different tax for every service, or good that he consumes. If each individual's tax price is set equivalent to the marginal benefits received, each individual is made better off by provision of the public good and may accordingly agree to have that service level provided.

A Lindahl tax is a system of taxation in which individuals pay for the provision of a public good in accordance to their marginal benefits. So each individual pays according to his/her marginal benefit derived from the public good. e.g. If A loves scenic beauty and likes to be close to nature he might be ready to pay 5 dollars per day for sitting in a park, whereas a college student who does not visit the park very often will not be ready to pay so much, but might agree to pay 1 dollar. So a person who values the good more pays more. In such cases, the problem of supply of the public good, at optimal levels arises. Lindahl taxation is a solution for this problem.

Lindahl tries to solve the following 3 problems:

- Extent of state activity
- Allocation of the total expenditure among various goods & services
- Allocation of tax burden

Consider, the following figure 1:

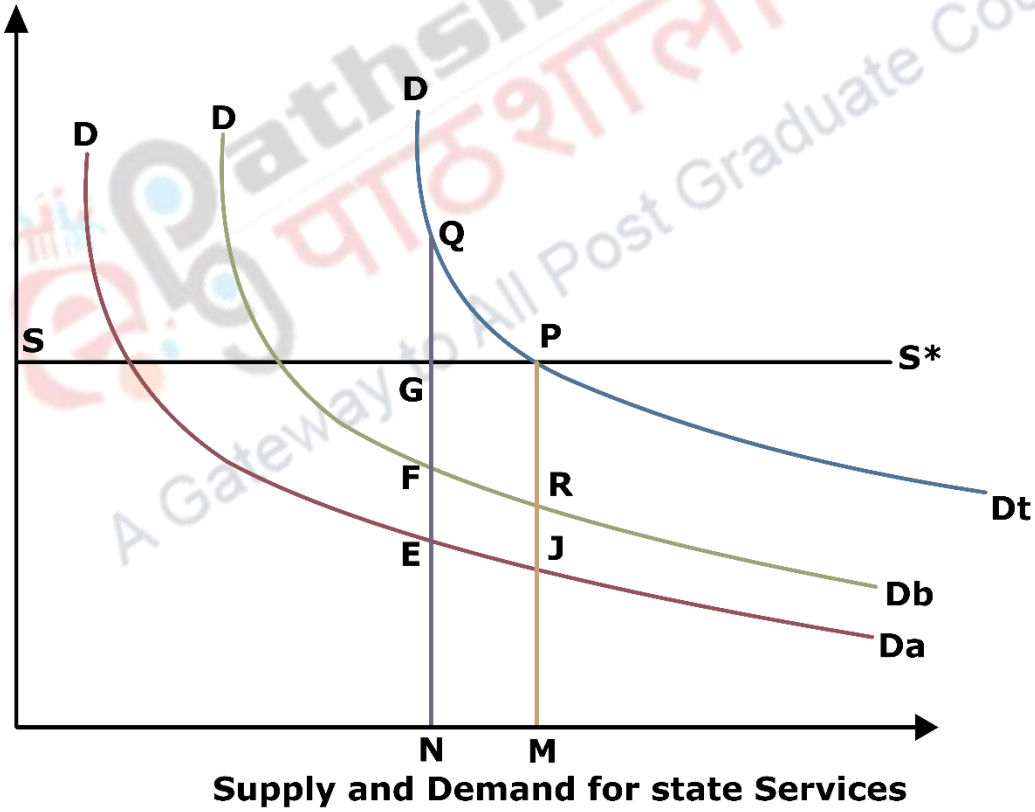


Figure 1: Supply and Demand for State Services/ Public Goods

In the Lindahl model, if SS is the supply curve of public goods it is assumed that production function of public/social goods is linear and homogenous. DD_a is the demand curve of taxpayer A, and DD_b is the demand curve of taxpayer B. The vertical summation of the 2 demand curves results in the community's total demand schedule for public goods. A and B pay different proportions of the cost of the services. When QN is the amount of public goods produced, A contributes NE and B contributes NF; the cost of supply is NG. Since the state is non-profit, it increases its supply to QM. At this level, A contributes MJ and B contributes MR (the total cost of supply). Equilibrium is reached at point P on a Voluntary-exchange basis.

3.1.1 Lindahl equilibrium

Lindahl taxes are also known as Benefit taxes. Lindahl equilibrium is a sort of economic equilibrium under such a tax. It is a method of finding the optimal level for the supply of public goods or services. The Lindahl equilibrium happens when the total per unit price paid by each individual equals the total per unit cost of the public good.

Lindahl equilibrium shows how efficiency can be sustained in an economy with personalized prices. Johansen (1963) gave the complete interpretation of the concept of "Lindahl equilibrium." The simple assumption of this concept is that every household's consumption decision is based on the share of the cost they must provide for the supply of the particular public good.

The importance of Lindahl equilibrium is that it fulfills the Samuelson rule and is therefore said to be Pareto efficient, despite the existence of public goods. It also establishes how efficiency can be reached in an economy with public goods by the use of personalized prices. The personalized prices equate the individual estimate for a public good to the cost of the public good.

Lindahl pricing and taxation requires the knowledge of the demand functions for each individual for all private and public goods. When information about marginal benefits is available only from the individuals themselves, they tend to under report their valuation for a particular good, this gives rise to a "preference revelation problem." Each individual can lower his tax cost by under reporting his benefits derived from the public good or service. This informational problem shows that survey-based Lindahl taxation is not incentive compatible. Incentives to understate or under report one's true benefits under Lindahl taxation resemble those of a Prisoner's dilemma, and people will be inclined to under report their demands for the public goods or service.

3.1.2 Lindahl tax and Pareto optimality

A very important question is that whether a Lindahl tax is Pareto Optimal equilibrium. A Pareto Optimal allocation happens with public goods when the total of the marginal rates

of substitution (MRS) equals the marginal rate of transformation (MRT). So if it can be shown that this holds true in Lindahl equilibrium, it can be conveniently said that it is Pareto Optimal. This can be shown by following the following steps, consider figure 2:

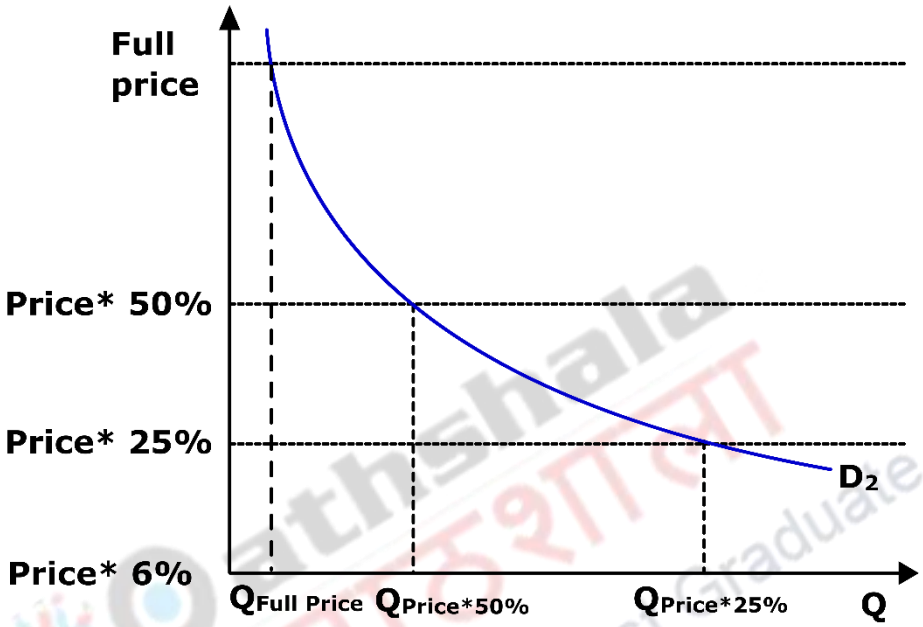


Figure 2: X's demand curve

We take a demand curve for a public good. X will want more good to consume when the price of the public good is less. Let the horizontal line (dashed) be the full price of the public good. Now here, the demand curve implies that X will demand very less. But what if instead of the price decreasing, the percentage of the price X has to pay decreases? Now X sees the price going down, so his demand for the good increases. Now let's consider the demand curve of another person, let's say Y. Y sees the vertical axis turned the other way around, with the full price on the bottom and percentage decreasing as you move upwards. Like X, Y will also demand more as his observed price goes down.

Consider figure 3:

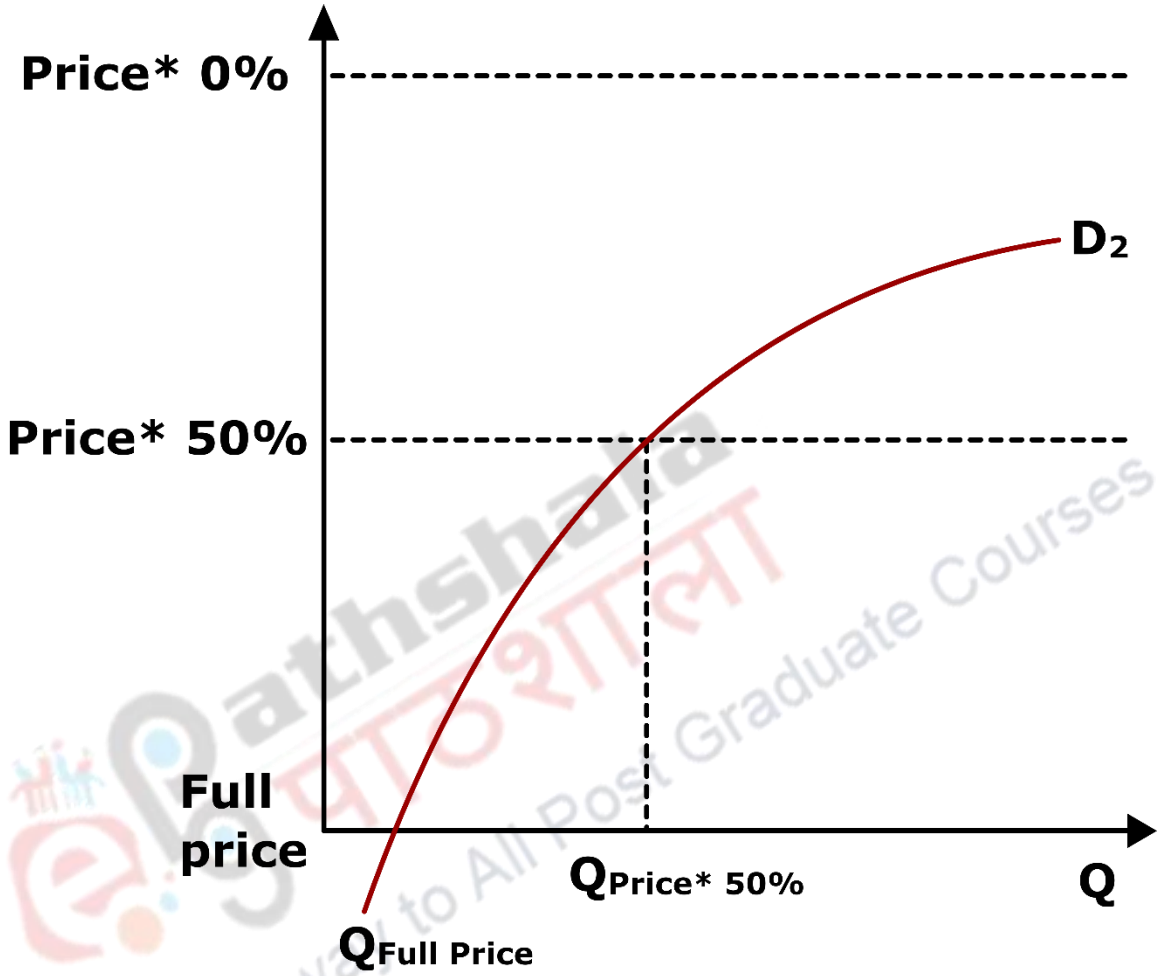


Figure 3: Y's demand curve

Now as Y observes the price going down it also means that we move further up the vertical axis. Equilibrium is when both X and Y demands the equal amount of the good. This is possible only when the demand curves of both X and Y intersects each other. If a line is drawn over the price axis from that point of intersection, we get the percentage share for each person that is required to get that price.

In the Lindahl tax scheme it is essential that the system should provide for a Pareto optimal output of the public good. The other important condition is that the Lindahl tax scheme should connect the tax paid by an individual to the benefits he derives. This system promotes justice. If the individual's tax payment is equivalent to the benefits

received by him, and if this linkage is good enough then it leads to Pareto optimality. Consider the figure 4:

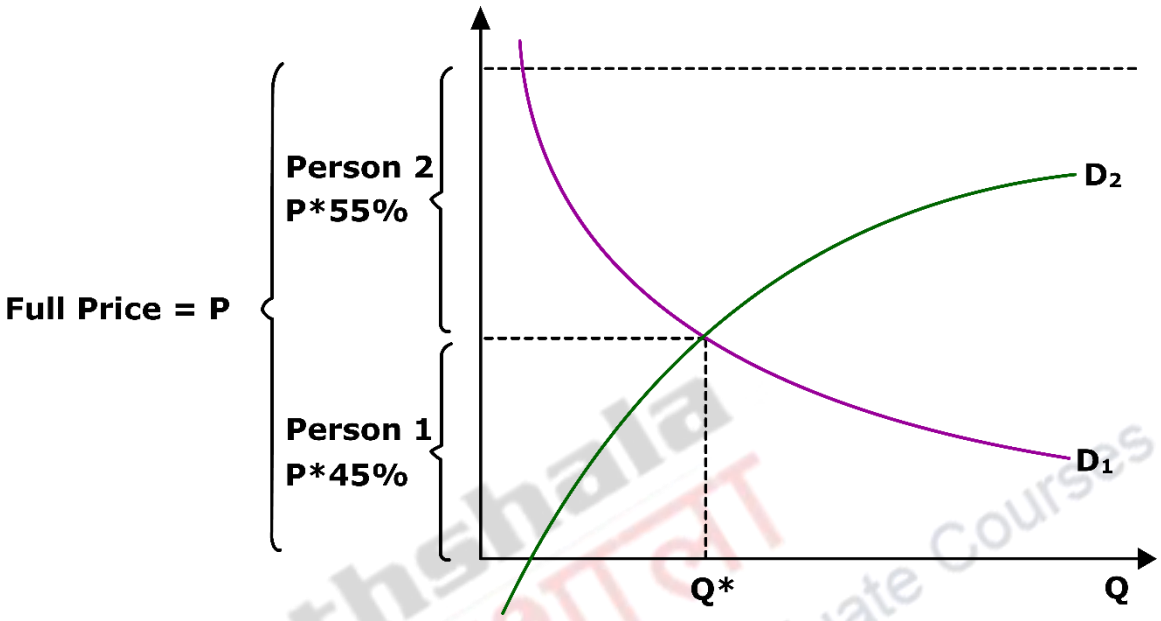


Figure 4: Lindahl Pricing

3.1.3 Lindahl Pricing

So it is observed that X is paying P*45% per unit, and Y is paying P*55% per unit, and the economy produces Q* units. This point is called the **Lindahl equilibrium**, and the corresponding prices are called **Lindahl prices**.

3.1.4 Mathematical representation

We assume that there are 2 goods in an economy: the first one is a "public good," and the second is "everything else." The price of the public good can be assumed to be P_{PUBLIC} and the price of everything else can be P_{ELSE}.

- $\alpha * P_{(PUBLIC)}/P_{(ELSE)} = MRS_{(PERSON1)}$

This is just the usual price ratio/marginal rate of substitution deal the only change is that we multiply P_{public} by α to allow for the price adjustment to the public good. Similarly, Person 2 will choose his bundle such that:

- $(1-\alpha) * P_{(PUBLIC)}/P_{(ELSE)} = MRS_{(PERSON2)}$

Now we have both individuals' utility maximizing. Moreover, in a competitive equilibrium, the marginal cost ratio (price ratio) should be equal to the marginal rate of transformation, i.e.:

- $MC_{(PUBLIC)}/MC_{(ELSE)}=[P_{(PUBLIC)}/P_{(ELSE)}]=MRT$

3.1.5 Limitations of Lindhal's model

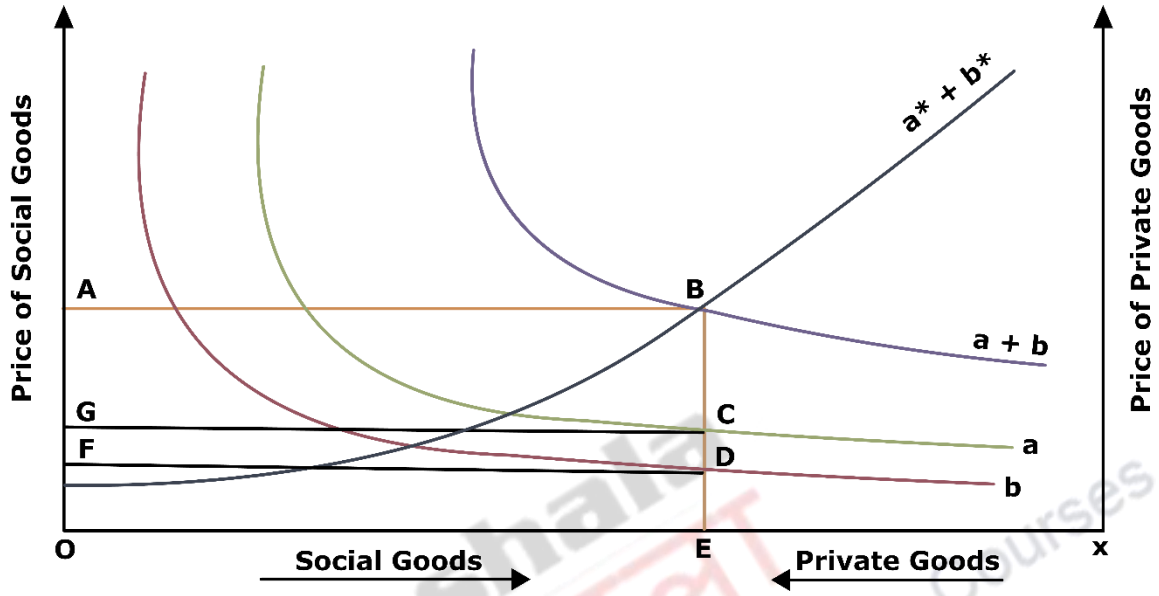
Lindahl prices do face some serious drawbacks. First, individual demand curves, and thus individual preferences, are not easily known. Due to the free-rider problem, people have the incentive to hide their true preferences and thus their marginal valuation (However, mechanism design of Groves, which is strongly individually incentive compatible, and Vickrey auctions could be used to overcome this problem).

Another drawback is that Lindahl prices may be unfair. Consider a television broadcast antenna that is discretionarily placed in an area. Those living near the antenna will receive a clear signal while those living farther away will not receive clear signal. Those living close to the antenna will have a relatively low marginal value for additional wattage (thus paying a lower Lindahl price) compared to those living farther away (thus paying a higher Lindahl price).

3.2 Bowen's model

Bowen's model has more functioning significance, since it establishes that when public/social goods are produced under conditions of increasing costs, the opportunity cost of private goods is foregone.

Consider figure 5:



For example, if there is one public good and two taxpayers (A and B), their demand for public goods is represented by a and b; therefore, a+b is the total demand for public goods. The supply curve is shown by a'+b', indicating that goods are produced under conditions of increasing cost. The production cost of public goods is the value of foregone private goods; this means that a+b is also the demand curve of private goods. The intersection of the cost and demand curves at B determines how a given national income should (according to taxpayers' desires) be divided between social and private goods; hence, there should be OE public goods and EX private goods.

Simultaneously, the tax shares of A and B are determined by their individual demand schedules. The total tax requirement is the area (ABEO) out of which A is willing to pay GCEO and B is willing to pay FDEO.

3.2.1 Advantages and limitations of Bowen's model

Advantages

The advantage of the Bowen's model (Voluntary exchange model) is that it takes into consideration the direct correlation between revenue and expenditure in a budget. It explains the role of market in the allocation procedures of the public sector.

Limitations

Although simple in its application, the model has difficulties:

- It limits the scope of government activities.
- Govt can neither upkeep the poor nor take steps to stabilize the economy.
- It is applicable only when beneficiaries can be observed directly (impossible for most public goods).
- Taxation in accordance with the benefit principle would leave distribution of real incomes unchanged.

3.3 Application of Benefit Principle

The benefit principle may be applied as a guide to tax-structure design in the following ways -

- **A General Benefit Tax –** Under benefit taxation, each taxpayer would be taxed in line with his or her demand for public goods. Since preferences differ, no general tax formula could be applied to all people.

  Government can ask how much various consumers are willing to pay for the same amount. Suppose that taxpayers have the same structure of tastes so that persons with the same income value same amount equally.

  Then people with incomes of Rs 10,000 value a given level of public goods at suppose Rs 1000. With 1000 units supplied, they would be willing to pay Rs1 per unit. With incomes Rs 20,000 they would be willing to pay a higher price Rs 2.

  The appropriate tax formula then depends on the income and price elasticity of demand for public goods. If income elasticity is high, the appropriate tax prices will rise rapidly with income; but if price elasticity is high, the increase will be dampened.

- **Specific Benefit taxes -** In this case, particular services are provided on a benefit basis and consumers are asked to pay fees, user charges or tolls.
- **Taxes in lieu of Charges –** At times when impositions of direct charges are costly a tax on a complimentary product may be used in lieu of charges. For e.g. automobiles taxes may be used in lieu of tolls.
- **Earmarking –** It means allocating revenue collected from taxes.

4. Ability to Pay Approach

The ability-to-pay approach treats government revenue and expenditures separately. Taxes are based on taxpayers' ability to pay; there is no *quid pro quo*. Taxes paid by the

taxpayers are seen as a sacrifice, which raises the issues of how much the sacrifice of each taxpayer ought to be and how it should be measured:

- *Equal sacrifice:* The total loss of utility because taxation ought to be equal for all taxpayers (the rich will be taxed more heavily than the poor).
- *Equal proportional sacrifice:* The proportional loss of utility because taxation ought to be equal for all taxpayers.
- *Equal marginal sacrifice:* The instantaneous loss of utility (as measured by the derivative of the utility function) because taxation should be equal for all taxpayers. This will involve the least aggregate sacrifice (the total sacrifice will be the least).

5. Summary

Economists have displayed a growing interest in the problems identified to an appropriate allocation of public goods. The fact that public budgets has grown considerably during the period had added to the attractiveness of the problem.

Individuals in a society have different preferences based on their nature, personal choice etc. An individual's willingness to pay for a public good is a function of many factors, like income, preference etc. So in such cases the problem of supply of the public good, at optimal levels arises. Lindahl taxation is a solution for this problem.

Lindhal's voluntary exchange model has proposed a solution to the problem of simultaneous determination of the extent of public activity and distribution of the corresponding tax burden.

Lindahl tax is an individual share of the collective tax burden of an economy. The optimal level of a public good is that quantity at which the willingness to pay for one more unit of the good, taken in entirety for all the individuals is equal to the marginal cost of supplying that good. Lindahl tax is the optimum quantity times the willingness to pay for one more unit of that good at this quantity.

In spite of the shortcomings of Lindhal's model, it has proven to be an important impetus for the development of the theory of public goods.

The ability-to-pay approach gives govt revenue and expenditures separately. Taxes are created on taxpayers' ability to pay; there is no *quid pro quo*. It is measured by Equal sacrifice, Equal proportional sacrifice & Equal marginal sacrifice.